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ELECTRONICS TODAY INTERNATIONAL

SPECIAL HDTV ISSUE:

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WHAT'S BEST FOR AUSTRALIA?

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WIN! PIONEER AVANTE A-V SYSTEM WORTH $7000

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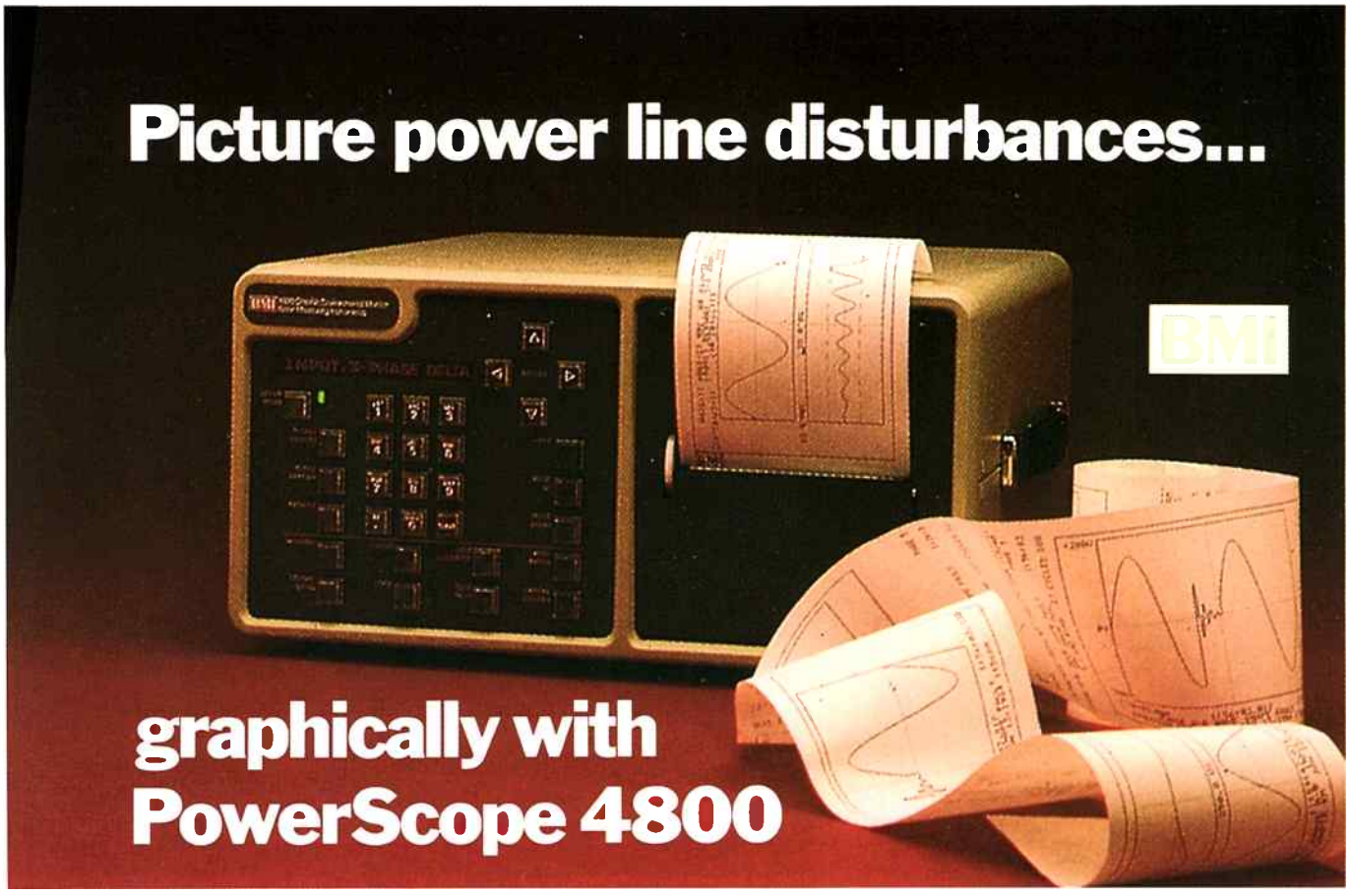
Picture power line disturbances...



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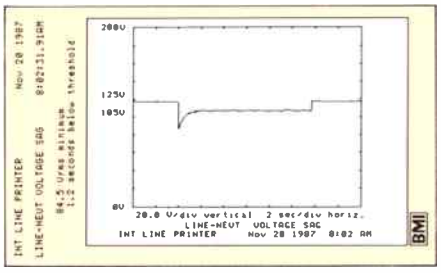
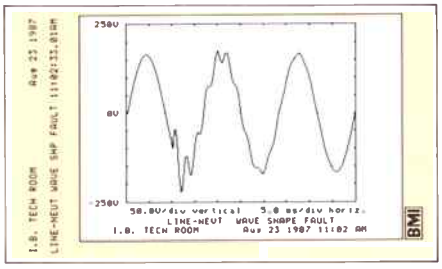
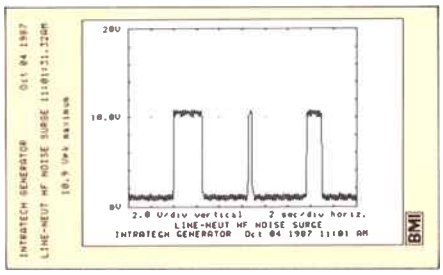


- impuse irregularities
- frequency disturbances
- current wavelength irregularities
- wave shape faults
- high frequency noise





- frequency spectrum irregularities
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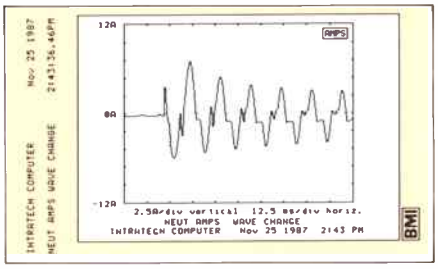

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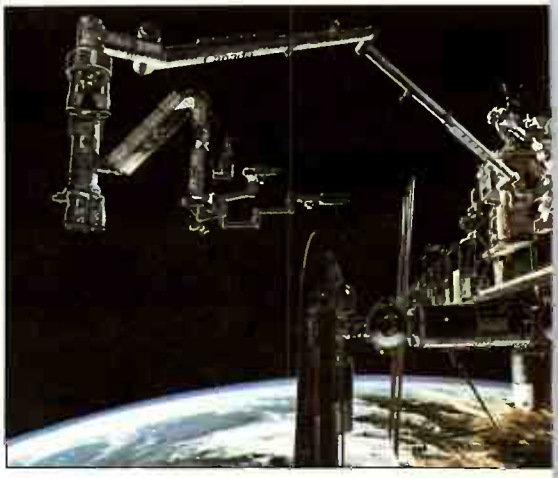

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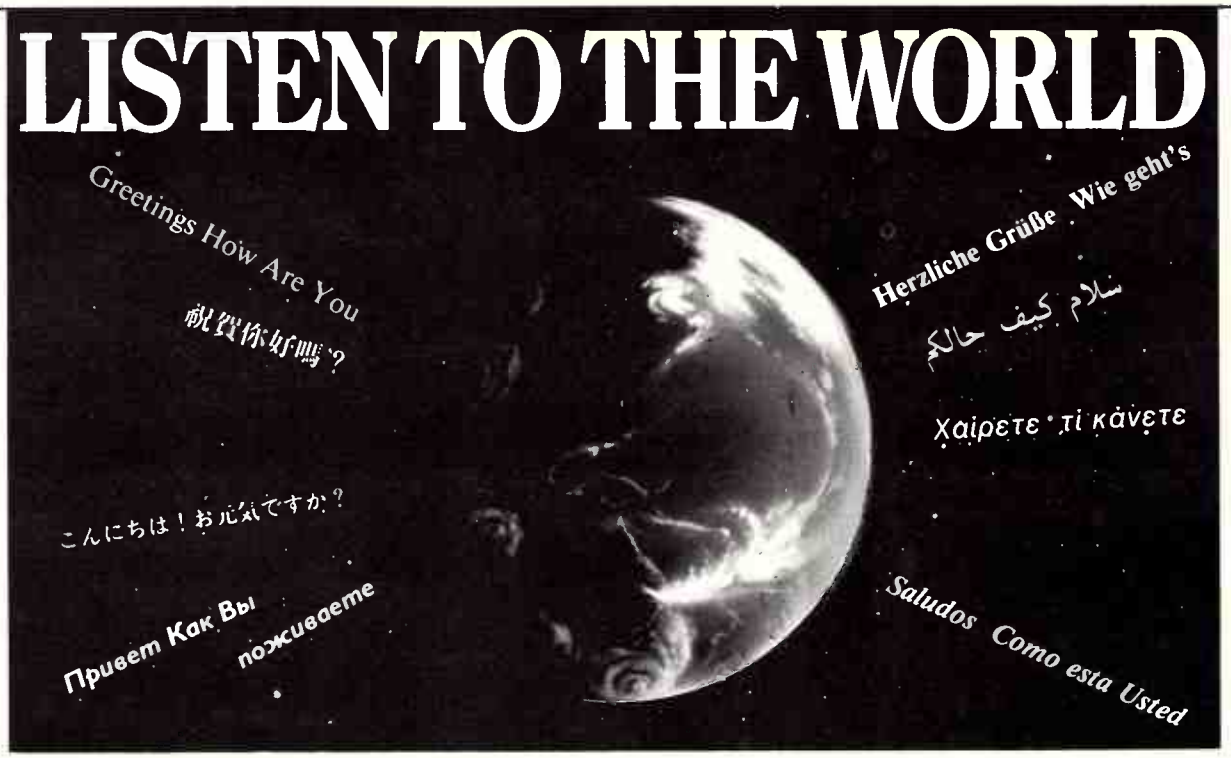
LISTEN TO THE WORLD



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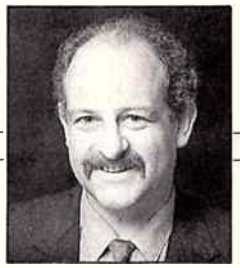

KIM BUCKNOLE

Eureka — the Darwinian approach to HDTV

On mid-November last year, the Southern Cross flag was metaphorically raised over Sydney's Opera House, as the Eureka HDTV Group set up its stall at the Australian Broadcasting Tribunal's conference, themed "Television 2000 – Choices and Changes".

Australians could have been forgiven for wondering what was going on. Eureka in Australia conjures up a particular image. Few of us would immediately recall Archimedes and his bathtub. Fewer would think of a European TV consortium. And then, as if to compound the confusion, a gentleman of Irish extraction, surnamed Lalor, addressed the media espousing the cause of Eureka.

Eamon Lalor, director of the European Communities' HDTV directorate in Brussells, claims Peter Lalor as a possible relative (his ancestors and Peter having come from the same spot in Ireland).

One can interpret Peter Lalor's Eureka as an attempt at genuine revolution, inspired by the then current republican revolutionary sentiment in America, France and Ireland. Eamon Lalor's Eureka, on the other hand, can be seen as a rejection of revolution in favour of compatibility and evolution.

Lalor, the eurocrat, was here to support the European Eureka D2MAC standard approach to HDTV. His argument was that Eureka builds on existing systems and standards (PAL and MAC). Wrapping himself in the flag of consumerism, he asserted that Eureka keeps faith with the common man since there are millions of PAL TV sets in use around the world. Evoking his (possible) ancestor, he believed that Peter would have approved Eureka's goal of ensuring that technological change does not disenfranchise the PAL viewer (in his millions).

Now, all this is good PR – it offers an attractive grab for the media – Lalor², Eureka, Australia, consumer advocacy – irresistible. At least, I couldn't resist it. But behind the PR, what's it all about?

Well, it's not a battle for hearts and minds. Rather, it's a battle about dollars, employment, overseas earnings, protectionism and good old capitalistic imperialism. The other protagonists are, inevitably, Japan and the USA. My experience of the USA tells me that, at times, its manufacturers are careless of the world at large – their domestic market is big enough for them to plough their own furrow.

There are about 140 million TV sets in the USA, but only one remaining domestic manufacturer – Zenith. The US Federal Communications Commission (FCC)'s guidelines require that US viewers should not have to buy new TVs to receive HDTV broadcasts. This makes life tough for the Japanese, their standard specifying a 30MHz bandwidth signal incompatible with existing systems.

The Japanese have long been in export or die mode, and it seems to be a matter of honour and government policy that Japanese consumers should acquire the latest and greatest from their electronics and automotive giants. Protection of their domestic markets is ensured by myriad and subtle systems and conventions.

And now, the Europeans have begun to flex the muscle inherent in the EEC body into which they have conformed themselves. Up go the barriers, in go the systems and regulations. Europe has the collective clout to win virtually any battle it enters, but usually nationalism, self-interest, quirkiness (often French) or some other factor has prevented concerted action.

PW Bogels, International director of NV Philips, Consumer Electronics Division, and president of the Eureka EU95 HDTV project, predicted more than a year ago that the compatible Eureka system, taken with the FCC guidelines, would force Japan to change its standards for both domestic and export markets. Otherwise, they would need to make three systems to cover the Japanese domestic, US and European markets.

Eureka claims to have surpassed Japan's technology, and, using the latest digital VLSI processing technology, says it can produce a complete television system visually superior to all other HDTV.

What's in Eureka for Australia? According to Willem MacLaine Pont, chairman and MD of Philips Australia, opportunities will emerge for our film and TV production industries to help supply the new MAC TV satellite channels (more than 100) in Europe. And, since MAC is an open system, local industry will be able to participate in the development and manufacture of the associated hardware.

The Europeans vetoed Japanese HDTV proposals at the CCIR Plenary meeting in Dubrovnik in May 1986, and that July launched the Eureka 95 project. In November 1987, Japan took steps to protect its domestic HDTV market. In September 1988, the FCC set down its guidelines for the USA. No free-trade, no let-the-market-decide, just "you can't play YOUR game in MY arena". The players have made their opening gambits and one after another have "castled". One might think that Australia has only to decide whether it is a black pawn or a white pawn to join the game. Or, perhaps the game isn't chess, perhaps it's a choice between two games – "Go" with the Japanese or "Gaelic football" with Eamon Lalor. Or is there another alternative – a middle way or a uniquely Australian approach? In this month's HUB, Gerry Moriarty, assistant managing director (Resources) at the ABC, comments on the Australian broadcaster's view of the HDTV shenanigans, and discusses the Australian proposal for a common image format.

And in Sound Insights, Barrie Smith writes about TV, film to video and film and HDTV.

As they used to advise, don't sit too close to the set.

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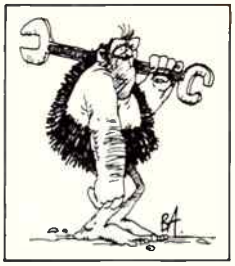


TECHNOLOGY

MAINS CONDITIONING

Electronic and computer equipment can be severely affected by problems on the mains supply. Roger Harrison investigates the effects, the causes and the cures.

The 240 Vac mains supply is by no means a 'pure' supply source, being plagued by problems that go under a variety of curious names, such as 'spikes', 'hash', 'surges', 'sags', 'brownouts' and the like. Where do they arise and how do you cure them?

The supply parameters

What are the basic parameters of the mains? The state supply authorities, and their local distributors, while providing no guarantees, undertake to provide a supply at your power point of nominally 240 V, 50 Hz ac within certain tolerance limits.

The Electricity Commission (Elcom) in New South Wales, for example, has a statutory requirement to maintain the supply voltage to the local councils (who actually distribute to consumers) within +/−6 per cent, according to an Elcom spokesman I consulted. Generally, he says, they manage to maintain the supply within +/−2 per cent. Local distribution involves a series of substations located at selected sites. But the supply at a consumer's premises may vary from the nominal 240 volts by as much as +/−10 per cent owing to a variety of factors, like distance from the substation, nature of the load etc. Generally, the distributor tries to err on the minus side (under voltage), rather than the plus side (over voltage), for reasons which will become apparent later.

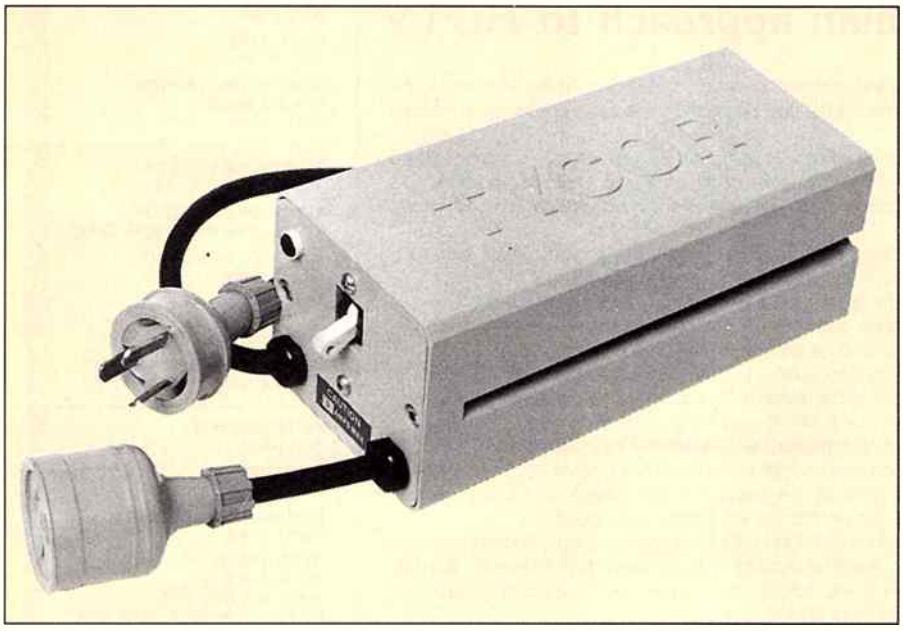
The upshot is that, at your power point, the nominal supply voltage may lie somewhere in the range from 216 to 264 volts, even though the distributors attempt to maintain the supply within 220 to 255 volts (i.e: about +6 per cent, −8 per cent). In addition, whatever your nominal supply voltage happens to be, the typical variation on that may be some +/−2 per cent.

The supply voltage will normally vary somewhat throughout the day and from day to day during the week, depending on the typical pattern of load demand. Although the tolerance variations at each stage of the supply distribution are not necessarily additive, at your power point the voltage may "sink" as low as 210-215 volts, or rise to as much as 260-265 volts; but these should be considered extremes.

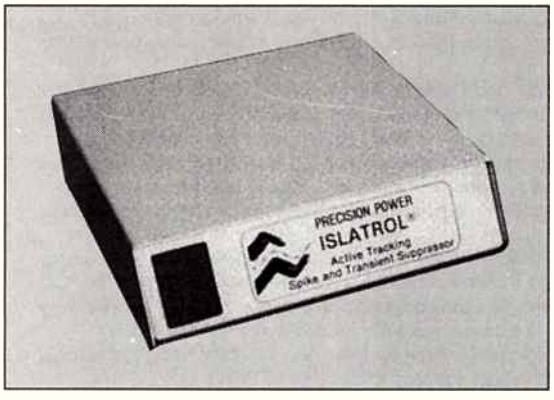
The tolerance specifications on the mains frequency are quite stringent as the mains is widely used as a timing reference for clocks (particularly "bundy" clocks in factories) and legions of automated or semi-automated time controlled equipment, ranging from domestic power point timers to industrial equipment control mechanisms.

The mains frequency is nominally maintained within +/− one-tenth of a Hertz, according to Elcom. Infrequent disturbances, such as loss of a generator and the necessary bringing on-line of a backup, may cause the frequency to drop as low as 49.3 or 49.4 Hz, I was told. In such circumstances, the generator operators will follow with an over-frequency correction for a period as a 'speed-up' for time controlled equipment, to bring the clocks back on time. Elcom maintains clocks within two seconds a month, my source said.

Well, that sets out the basic parameters of the mains supply. From your end, what do



Above: this Tycor product is an in-line active tracking type of filter and spike suppressor. Distributed by Electromark.



Precision Power Products distributes the Islatrol range of active tracking filter/spike suppressors. This is their ATS desk-top unit, obtainable in ratings ranging from 240 VA to 1800 VA.

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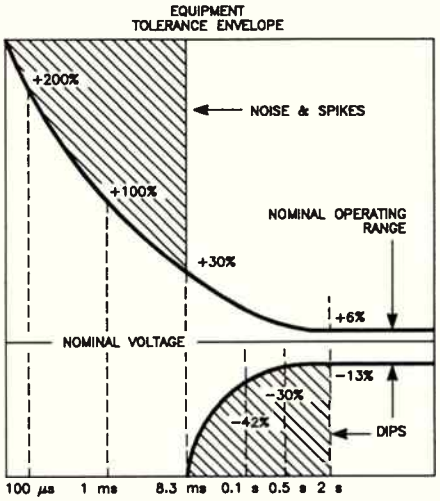

Figure 1. This 'equipment tolerance envelope' shows the period and amplitude of variations which may affect equipment operation.

you see? Let's work our way from the longer-term variations through to the short-term transients.

Overview of the problems

Figure 1 here graphs the various short term and long term voltage variations experienced on the mains supply with reference to an "equipment tolerance envelope". Knowing the general tolerance limits of the nominal mains supply, the designers of electronic and computer equipment generally make allowances for them, so that the equipment functions within its specifications despite such variations. It's when variations outside those parameters occur that problems with the equipment's operation arises.

As you can see from Figure 1, long term variations, which may last from seconds to days (or more) will affect the operating reliability of equipment if the variations exceed limits of around +6 per cent to −13 per cent. The envelope 'widens' as the period of the variations get shorter.

High frequency disturbances, ranging from 10 kHz to 120 Hz or so (periods from 100 us to 8.3 ms) are variously termed hash or noise; single transients in this range are known as 'spikes'.

Disturbances with periods ranging from about 10 ms to a couple of seconds are variously termed 'dips', 'sags' and 'dropouts' for those on the minus side of the nominal mains voltage variation, while the opposite is known as a 'surge'.

Every audio engineer and sound technician, communications engineer and operator, computer maintenance engineer and personal computer user is aware of, or has experienced, some or all of these mains-borne problems at one time or another.

With personal computers in particular, mains variations of whatever form or type can manifest themselves in subtle, but devastating, ways: these may range from a spontaneous re-boot (re-start) of the computer, to the corruption of files on floppy disks or hard disks, rendering them inaccessible – a true disaster!

In electronics, automated test and measurement systems can be seriously affected, giving erroneous results which may not be picked up at once. In medical electronics, mains interference or other problems can render pathology test results useless, requiring costly test re-runs, or equipment malfunctions which may have serious consequences for a patient.

Let us now have a look at each variation in detail.

Undervoltage

This occurs when the mains voltage drops substantially so that it falls below the lower limit of the mains tolerance for an extended period. This may last for from some minutes to a few hours. The condition is often called a 'brownout'; not quite a blackout! Here, a substantial drop may mean some 20 per cent below the nominal 240 volts. You could hardly regard 190 V (about −21 per cent) as adequate supply.

This can cause power supplies to mis-function – regulators fail to do their job in linear supplies, for example, and the supply rails within the equipment will show a ripple component that may affect the equipment's operation – showing up as hum or buzz in an audio system, "shrunken" pictures on TV sets, video monitors, etc.

A computer system with inadequate supply rail in these circumstances may simply fail altogether – and crash. Fortunately, many computers these days incorporate switched-mode power supplies, which happily operate over a very wide range of input voltage, and brownouts don't seem to be the trouble they once were. A lot more electronics equipment employs switch-mode power supplies these days, too, and such equipment is much more tolerant of mains undervoltage.

Overvoltage

Clearly, this is the opposite situation, where the supply may rise a substantial amount (again, say, 20 per cent) from the nominal 240 volts, and sit above the upper limit for a period of some minutes to several hours. This can cause considerable stress for power supplies which must dissipate the unwanted extra energy, with overheating and subsequent failure the result. Electrolytic filter/reservoir capacitors have been known to explode in such circumstances, showering adjacent components with corrosive liquid electrolyte! Fortunately, this situation is much less frequently met than undervoltage as the supply distributors have a policy of 'erring' on the low voltage side.

Both undervoltage and overvoltage conditions are readily detected with a good multimeter, either analogue or digital – but it's not a safe idea to stick the meter probes

Hobart-based Critec Corporation has recently acquired sole Australian distributorship for International Power Machines (IPM) Corporation of Texas, claimed to be leaders in Uninterruptible Power Supply (UPS) systems for the last twenty years. UPS systems provide power supply protection for large, sophisticated computers and other high technology equipment that requires constant, unadulterated power for reliable performance. They filter and condition inconsistent mains electricity to feed delicate equipment with precision quality power and feature battery backup which automatically intervenes to maintain power supply during mains failures.

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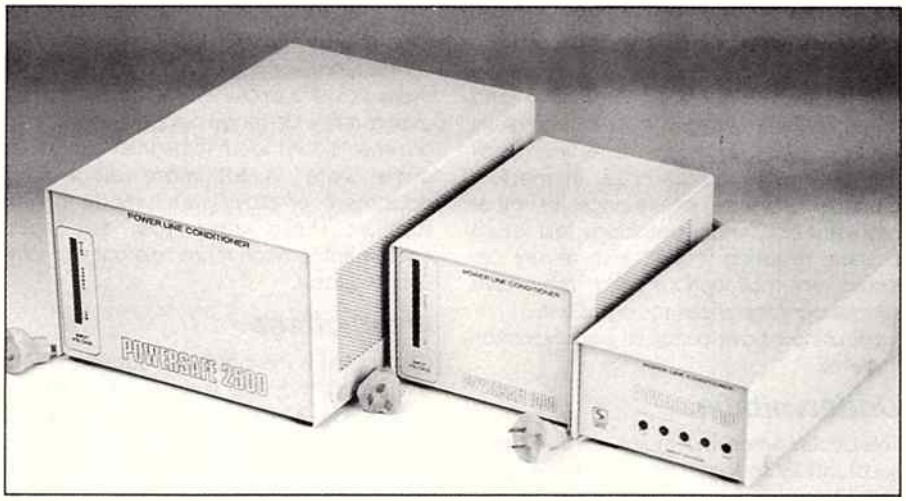


A range of line conditioners made in Australia by Critec. These range in rating from 2500 VA (at left) to 500 VA (right).

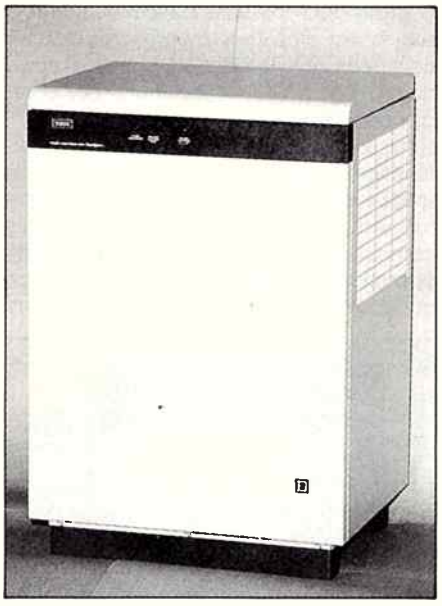
in a power socket! If ever you need to check the mains voltage, it should always be done by attaching the multimeter at the input to the power supply of the equipment, with the mains cord unplugged, and using insulated, safety type clip-on connectors.

For persistent problems that may be attributed to undervoltage and overvoltage conditions, specialised mains checking and recording instruments have been produced.

Sags

A drop of at least 20 per cent from the nominal supply voltage, lasting one or more cycles (20 to 200 ms) up to a few seconds duration, is termed a 'sag'. This sort of disturbance often results from a heavy load being turned on – such as an air conditioner compressor, electric heater, etc. The load may be nearby, within your premises and connected to your mains circuit, or it may be external to your premises.

The consequences of a sag in the mains voltage are much the same as for undervoltage, but of much briefer duration.



A large, 10 kVA floor-standing line conditioner, made by Topaz. Distributed by Online Control.

Surges

As explained earlier, a brief overvoltage condition is called a surge. Like a sag, it lasts from perhaps a few cycles up to several seconds. Generally, surges occur immediately following a heavy load being switched *off*. Surges may also be caused by load switching on the distribution network and lightning strikes some distance away affecting the distribution network.

Massive surges, lasting one or two cycles, do occur, though rarely. They can range from tens of volts to hundreds of volts and will result in some destructive effects at worst, or cause 'glitches' in electronic equipment, particularly computing equipment.

Sags and surges cannot be detected with an ordinary general purpose multimeter. A digital multimeter featuring a "peak hold" facility, however, may be used to detect them. In general, special monitoring equipment that detects and records such events, as referred to above, is required to single out or identify problems arising from this source.

Dips and dropouts

A dip or dropout occurs when the mains voltage drops right to zero for a period lasting from something less than half a cycle (10 ms) to a full cycle or so (20-100 ms). Such events are rarely evident on video/TV or computer screens, nor do they affect lighting, but a power supply running at or near maximum load may experience a short duration voltage-drop pulse on the dc output rail(s).

Such pulses can really play havoc with logic circuitry, particularly microprocessor equipment, depending on the time relationship between the dropout and internal circuit operations. Have you ever experienced a spontaneous reset on a personal computer? The result can range from minor irritations like loss of a small amount of work in progress, through to destruction of the directory or system tracks on a disk – which can spell disaster! On a compact disc player, for example, it may result in track skipping or restarting play from track one; which is irritating at the least.

Hash

Hash comprises high frequency signals, with components ranging from as low as 100 Hz right up to tens of kHz, that may be repetitive or seemingly random in form (more like noise). Such signals may be of short duration, a burst of a second or two, bursts of varying duration following in a repetitive sequence, or long bursts of minutes to tens of minutes duration.

The brief "bzzzt" you hear from your stereo or your TV for a moment when a faulty light or power switch is operated; the harsh, annoying "bbffaaaartt" that emanates from them (accompanied by flickering lines across the screen) when the Bamix is being used in the kitchen, or when the electric drill is being used next door – that's hash!

Electric motors of the commutator type (so-called 'universal' motors) – as in the examples of the electric drill and Bamix, generate hash. It arises from the switching action of the commutator, where current is switched to successive coils in the rotor of the motor as it spins; the commutator is merely a rotary switch. It is the switching action and the resultant tiny arcs that generate the hash signal. The noise voltage generated may range from a volt or so, to tens of volts – and it's superimposed on the mains, propagating back down the line to which the appliance is connected.

Hash is a very common, perhaps the most common, component of the mains supply.

Transients

Strictly speaking, a transient is any momentary, non-repetitive event. Thus, dropouts, surges and sags could really be included as transients. However, if we accept transients as short term (lasting half a cycle or less), more or less one-off events, even if such events recur over short, but randomly spaced, intervals, then surges and sags etc do not come under the category of transients.

Transient voltage pulses may be variously termed "spikes", "glitches" or "impulses". They may be a single, narrow pulse or a rapidly decaying oscillation. Their duration may be as short as a few nanoseconds, ranging up to as much as 10 ms – that is, half a cycle. Amplitudes may range from tens of volts to hundreds of volts. If the pulse is positive-going and occurs at or near the peak of the

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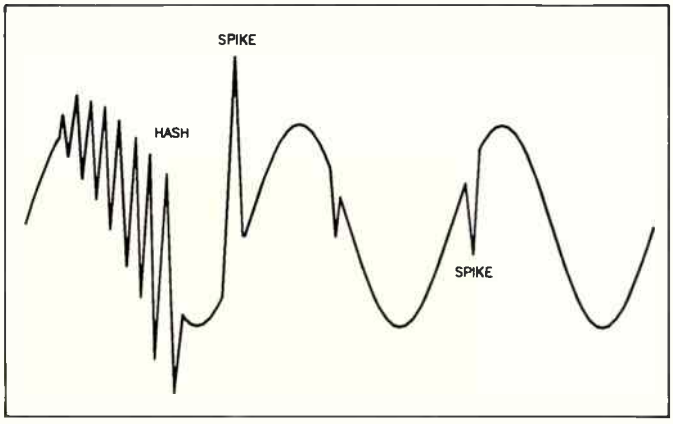


Figure 2. How high frequency variations are manifested on the mains.

positive half-cycle of the mains, then a tremendously high – and potentially very destructive – voltage peak is generated.

Although the amount of energy contained in such peaks may be relatively low, it is often responsible for causing *punch-through* in the dielectric of capacitors used in linear and switched-mode power supplies. While this may not be destructive in itself, as modern metallised capacitors have the ability to absorb the transient at the punch-through point by vaporising the surrounding metallisation, some erosion occurs with the effects from repeated transients and the capacitor eventually fails.

In a similar way, such transients can cause punch-through of the dielectric in mains transformers, causing or contributing to ultimate failure of the component. Transients can destroy rectifier diodes and regulators in power supplies, disturb logic circuitry and microcomputers in much the same way as dropouts, etc.

Like hash, transients are a frequent occurrence on the mains.

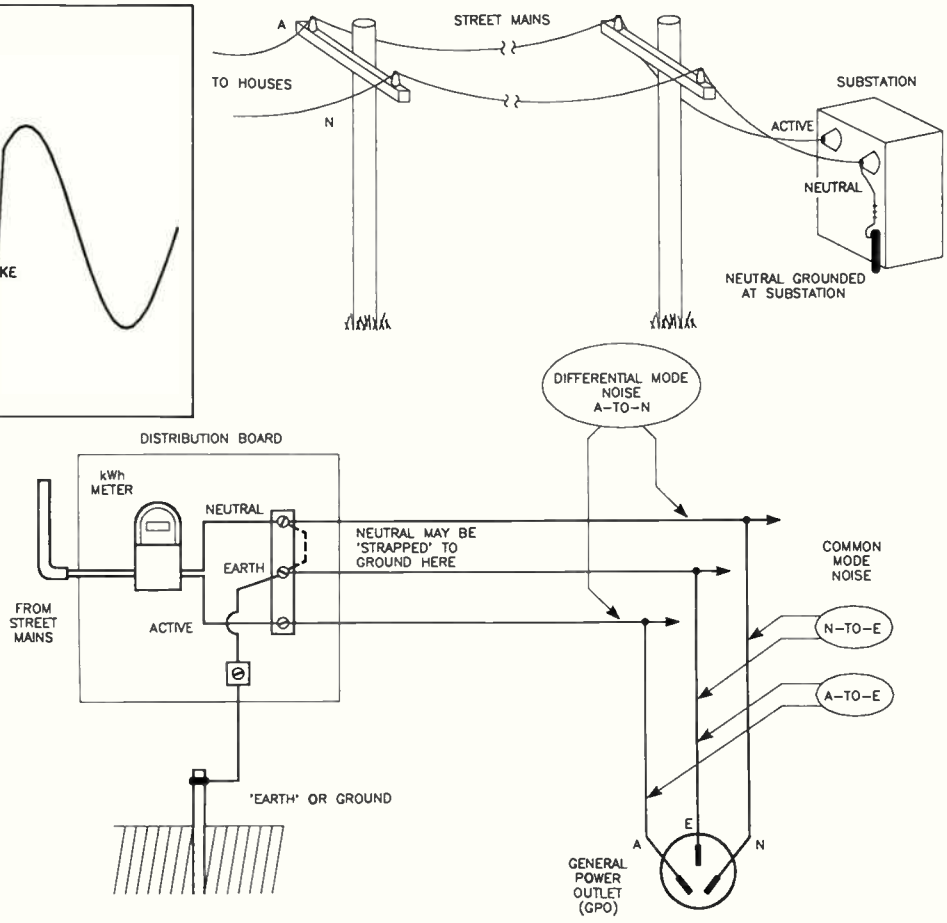


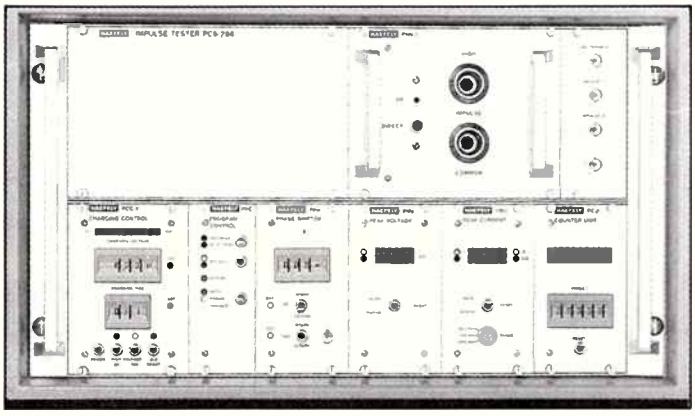
Figure 3. The general details of the mains distribution system and how noise is conducted to a GPO.

Power failure

Lastly, there's total supply failure! There may be no power for an unspecified period, ranging from minutes to many hours. The effects are quite predictable – just turn off your equipment sometime and see what happens!

The 'how' of it

While you can readily see how the longer-term effects – surges and sags, under and over voltage – all affect equipment, just how are hash, spikes and other transients, conducted by the mains, and how do such signals or events enter a piece of equipment? If you monitor the mains voltage with an oscilloscope (via a special isolating connection), you will see events as depicted in Figure 2 (idealised here, for the sake of



The Haefely impulse tester PC6-288 is used to test the electro-magnetic compatibility (EMC) of electronic equipment and systems, industrial process measurement and control installations and avionics as well as the functioning and efficacy of protective elements and complex protection circuits. EMC testing with this impulse tester provides information on a system's immunity to interference and determines the immunity level with respect to high energy transients on supply, signal and control lines.

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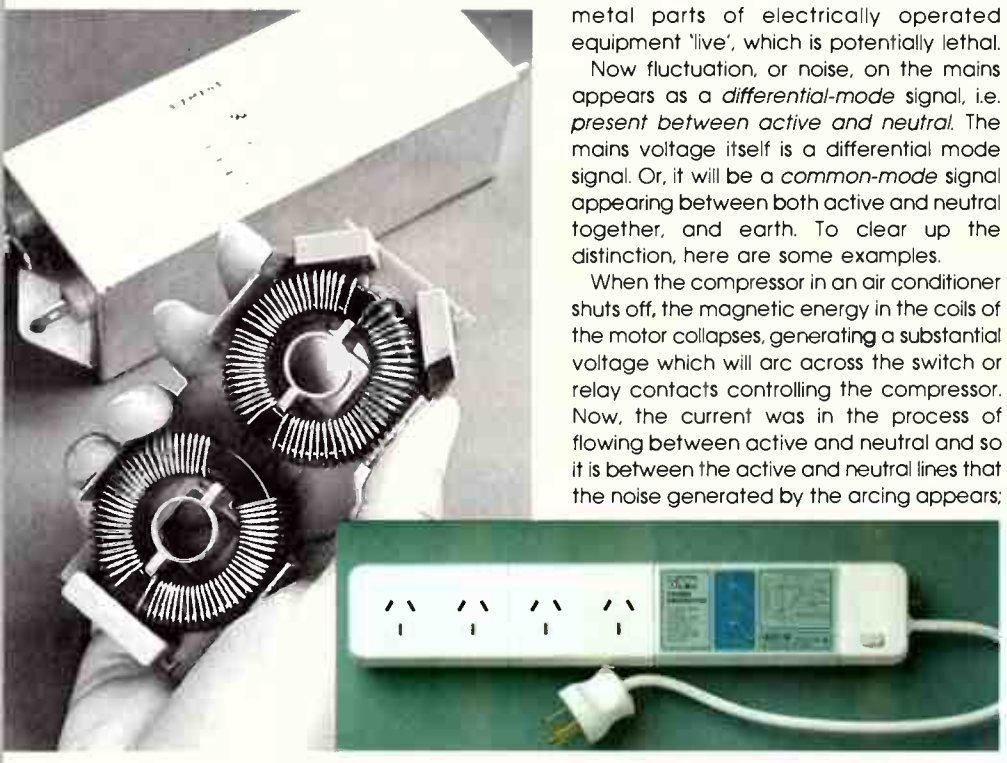

Figure 4. Top: this Siemens SIFE-E mains filter is a board-level product featuring a two-stage filter that the company claims provides up to 30 dB of rejection to common mode and differential mode interference at less than 50 kHz. Clipping is not included. Bottom: the HPM Power Protector is an in-line filter/clipper product that provides protection against both common mode and differential mode noise. It features a warning when the surge clipper has been overstressed, so the user can return it for service.

clarity). Hash may appear over part only of a cycle, or last for many cycles.

Figure 3 shows the general details of the mains distribution system. A pair of wires enters your house from the street (in the case of a single phase supply, for argument's sake) which come from the output of a transformer at your local substation. The power is delivered between the 'active' line and the 'neutral' line, entering your premises via a consumption, or kilowatt-hour (kWh) meter.

The third connection on your power outlets is 'earth', which is there as a safety measure. Ideally, earth and neutral are the same, but ideal situations rarely exist. The earth connection is usually made to neutral at the local substation. The earth line on your distribution board may go to an earth connection at your premises (either a water pipe or a rod hammered into the ground at the house) and/or be strapped to the neutral line at the tiepoint on your distribution board. The earth is there so that faults do not render the metal casing or any exposed metal parts of electrically operated equipment 'live', which is potentially lethal.

Now fluctuation, or noise, on the mains appears as a *differential-mode* signal, i.e. *present between active and neutral.* The mains voltage itself is a differential mode signal. Or, it will be a *common-mode* signal appearing between both active and neutral together, and earth. To clear up the distinction, here are some examples.

When the compressor in an air conditioner shuts off, the magnetic energy in the coils of the motor collapses, generating a substantial voltage which will arc across the switch or relay contacts controlling the compressor. Now, the current was in the process of flowing between active and neutral and so it is between the active and neutral lines that the noise generated by the arcing appears; hence, this will appear as a differential-mode noise signal.

Sags and surges are differential-mode signals, just as dropouts and brownouts are.

When hot, dry winds blow in the summer months, they often carry charged particles. Blowing past the distribution lines reticulating the power throughout your neighbourhood, these particles will dissipate their charge via the power lines, generating a noise voltage acting between active/neutral and ground.

Likewise, during electrical storms, atmospheric discharges involving the power lines will likely dissipate via the active and neutral lines together as these lines travel together. So a lightning-induced pulse on the mains supply is typically a common-mode signal. In addition, the earth line may also be a culprit because stray capacitance between it and the other two lines will induce noise currents in the earth line, which has a finite impedance, and noise signals will appear on the mains earth line.

Attacking the problems

All the above-described problems vary widely in characteristics. Hence, it requires different techniques to minimise or remove them before they can affect an item of equipment. In addition, it must be understood that some problems can be tolerated, whereas others have a major effect. Such tolerance varies depending on the type of equipment, and may even vary from unit to unit of the same type and make of equipment.

For example, the occasional click – caused by a transient – emanating from a TV or stereo sound system is tolerable, but where such a transient causes re-boots in a computer system, it's cause for concern. Again, the occasional sag in the mains will only have a passing and quite tolerable effect on a TV set (a momentary picture shrink), but it may cause a computer system to cease operating entirely – a crash!

The frustration and time delay occasioned by 'down time' of a computer following a system crash, even if relatively infrequent, can be avoided.

One method employed to escape the unwanted effects generated by other equipment connected to the same power circuit is to install a 'dedicated line'. This is a line run from the distribution board to the equipment, from which no other equipment is powered. Thus, problems produced by air conditioners, motors and such like – which tend to affect only the mains circuit to which they are connected, can be eliminated from the line. Such lines cannot, of course, prevent mains variations which arise externally to your premises from affecting the attached equipment.

Special 'isolation' transformers are sometimes employed, generally built in to an item of equipment, but occasionally as an in-line unit. They are specially constructed transformers which incorporate 'Faraday shielding' between the primary and secondary. This is a layer of foil or copper sheet that virtually eliminates capacitive coupling between the windings.

Such transformers can be very effective in reducing common-mode noise, but have several drawbacks. They have poor output regulation, and in the presence of spikes, the output transient can be larger than the input!

Apart from these methods, there are six approaches to tackling the minimisation or elimination of mains variations. These are:

- Filters
- Clippers
- 'Active tracking' devices
- Constant voltage transformers (CVTs)
- Line conditioners, and
- Uninterruptible power supplies (UPSs)

Filters

By far the most common mains variations encountered are spikes and hash, and the widest employed method of dealing with these is the use of filters to attenuate their effects.

Why can't you just have a filter to get rid of all differential-mode signals above 50 Hz? Well, you could, but such a filter would be impractical from a cost and constructional viewpoint. Capacitor and inductor values would be huge, making their physical size cost prohibitive. In addition, a filter cannot affect the slow variations, such as surges, sags and brownouts.

It is fortunate that most noise signals that appear on the mains have a spectrum that starts fairly high in the kilohertz region, which allows components of a more reasonable

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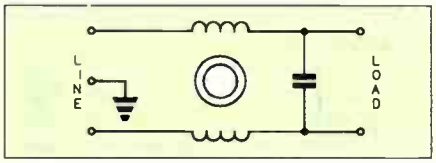

Figure 5. Circuit of the simplest mains filter.

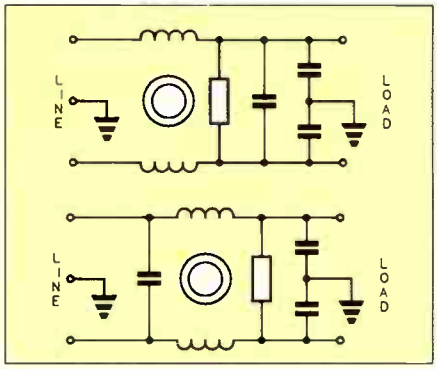

Figure 6. Variations of the simplest filter circuit may include additional capacitors to filter common-mode signals. The resistor here is to discharge the capacitors after switch-off if no other discharge path is available (for example through a mains transformer primary).

value, and thus of more practical size and cost.

Filters may be of the in-line type, incorporated in a box with a line cord and plug input and one or more sockets on the output. Or they may be a component to be built in to equipment, available in a variety of forms – pc board mounting, in shield 'cans' for chassis mounting, and such like. See Figure 4.

The circuit of one of the simplest types of filters encountered is shown in Figure 5. It is simply an inductor in each line followed by a capacitor between the lines. It looks like a low pass filter, but the components act separately. The two inductors are wound on the same core and connected such that the magnetic field set up by the line current in the coil in the active line is opposite to – and thus cancels – the magnetic field set up by the coil in the neutral line. This ensures that the core on which the inductors are wound will not saturate and thus it is possible to obtain a relatively high inductance in a small space. The inductors are usually wound on a toroid, each winding on one half of the toroid which ensures maximum mutual coupling while keeping the windings physically separate.

As the mains is a differential-mode signal, the fields produced by the two coils from any other differential-mode signals will also cancel, passing the signal straight through. Thus the coils are only effective on common-mode signals. The capacitor provides some 'shunting' of differential-mode signals, but as the value is usually limited by other concerns, its effect is limited to frequencies well into the 100s of kHz region. It is thus fundamentally an RF bypass.

Variations on this basic filter scheme are illustrated in Figure 6. Filters such as this may also be cascaded – where one filter follows another in the line, or they may be followed by a straightforward LC filter employing separate inductors, as illustrated in Figure 7. The separate inductors, for practical reasons, will not have very high values and so they only act on relatively high frequency signals.

Filters can be quite effective in dealing with shorter period, high frequency mains disturbances, but will have no influence on such problems as dips and surges. Much electronic equipment these days incorporates a filter at the mains input, often just to prevent noise getting from the equipment *back* onto the mains, as well as vice versa.

Spike clippers

Large amplitude spikes, if they occur at or near the peak of the mains voltage cycle, can wreak considerable havoc, as explained earlier. To combat the effect of such spikes, a device called a 'Varistor' may be used. Electrically, it looks like two hefty zener diodes connected back-to-back. The Varistor normally appears as a rather high impedance, but when its voltage threshold is exceeded, it draws current very rapidly and 'clamps', or 'clips', the voltage at a fixed level.

Varistors are very fast-acting and capable of dissipating enormous amounts of energy for a brief period. Those rated for mains operation typically act at around 400 V, which is somewhat above the mains peak voltage (340 V for nominal 240 V mains). A Varistor is generally connected at the *output* of a filter, across the active and neutral lines, thus clipping differential mode spikes. Sometimes, additional Varistors are placed from active to earth and neutral to earth, to clip common-mode spikes.

Varistors are made in disc form by General Electric and Siemens and in typical semiconductor packages by Thomson-CSF, known as 'Transil' transient suppressors.

While these devices clip any spikes that exceed the peak of the mains cycle, they will not affect substantial spikes that may occur near the zero crossing point. Such pulses can then be passed on to equipment, incurring problems.

A more effective device, generally known as an 'active tracking filter' deals with

Many years ago, Melbourne company Thycom became the first Australian company to establish an R&D department committed to producing a locally-made, world class range of Uninterruptible Power Supplies (UPS). Thycom has now released the MPU series of Mid Range Power Units. The new units range from 10kVA to 120 kVA and are especially designed for ease of installation and servicing. Features such as front access, maintenance-free battery storage, microprocessor controls and minimal noise levels ensure these units will be compatible with any modern office environment. The systems are designed to exacting specifications and locally-manufactured to meet the most stringent standards, says Thycom.

The ultimate protection is provided by an uninterruptible power supply, or UPS. Shown here are two models of a 1000 VA UPS from Densei.

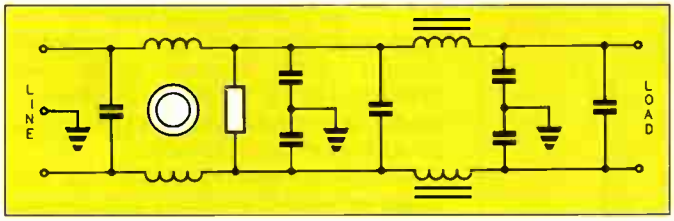

Figure 7. Two-stage filters provide effective attenuation of common-mode and differential-mode noise.

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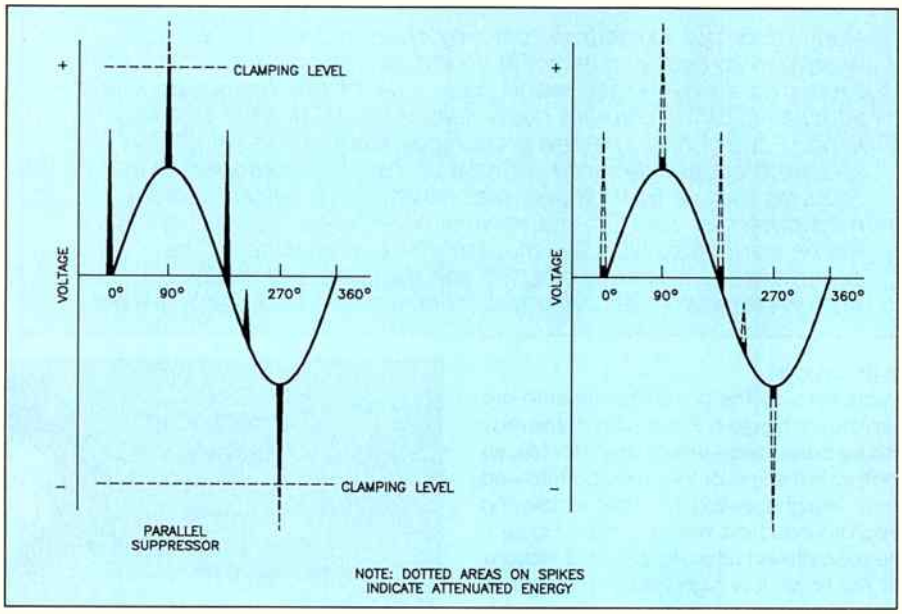

Figure 8. Comparison between the actions of a spike clipper type circuit and an 'active tracking filter'.

transients, no matter where on the voltage cycle they occur. The action of an active tracking filter is compared to a Varistor clamp or clipper in Figure 8.

Canadian filter manufacturer, Tycor, has developed such a device, distributed here through the Sydney-based company Electromark. Brisbane-based Precision Power Products manufactures and distributes an active tracking filter under the name of "Isiatrol", under license to Control Concepts.

These are in-line devices and models are available for single-phase and three-phase use at typical power ratings from 240 VA through to 24 kVA in single-phase, and from 12.5 kVA to 10000 kVA in three-phase.

Constant voltage transformers

Generally called CVTs, these have been used since the 1930s to deal with sags, surges and dropouts. There are two forms. One consists of a transformer in which the primary coil operates at full saturation. The output is very nearly square wave, being a heavily clipped version of the sine wave input. The other type, termed a ferro-resonant transformer, also operates with a fully saturated primary, but the secondary consists of three or four windings with a special capacitor connected to 'tune' the transformer. These have a sine wave output. Figure 9 shows the general circuit of a CVT.

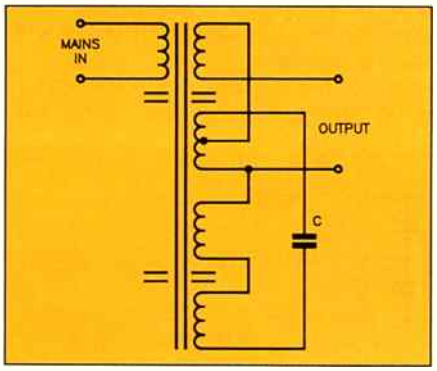

Figure 9. General circuit of a constant voltage transformer, the heart of a line conditioner.

Both types provide protection against differential-mode disturbances, but offer no protection against common-mode noise. The simple saturating type offers little protection against dropouts, but the resonant type does because the resonating circuit is able to 'fill in' the small gap of a dropout. The square wave output of the simple saturating CVT is not tolerated by the power supplies of some equipment.

Typically, the CVTs will typically maintain the output within + / – 3 per cent or as close as + / – 1 per cent, for an input variation of + / – 15 per cent. The CVT doesn't 'stop' outside this range, but the maximum swing is practically limited to + / – 25 per cent. They are designed to operate over a given load range, so must be selected for the equipment with which they are to be used. They are made in ratings ranging from a low 15 VA (that is, watts where the load is resistive) up to 10 kVA.

One variant of the resonant type combines the features of an isolation transformer, and these can give quite good protection against both common-mode and differential-mode fluctuations. However, should the load fall below 75 per cent of the rating, they offer no protection.

Considerable heat and audible noise can be generated by CVTs during operation and this must be taken into account when considering their use. So-called 'line conditioners' generally consist of a ferro-resonant transformer combined with filtering and spike suppression.

An important drawback of CVTs is their current limiting characteristics and high leakage inductance. These can cause real problems in computer installations where several machines are fed from the same line conditioner/CVT. When a machine is turned on, sometimes – depending on the actual phase angle at the instant of turn-on – a brief but very high in-rush current will occur. This results in a corresponding voltage drop-out, with frequently disastrous effects on attached computer equipment.

The solution to this dilemma is to (a) have only one item of equipment per line conditioner, (b) ensure that all equipment connected to the line conditioner is kept switched on, (c) if auxilliary equipment must be connected or turned on then it is only done when no critical operations are taking place, or (d) connect a suitable switch-on current surge-limiting thermistor in circuit.

Uninterruptible supplies

As the name states, these will maintain a continuous ac output when the ac mains supply is interrupted for a period. They compromise a battery-operated inverter, the battery charge being maintained while the ac, mains is present, but the equipment always draws its supply from the battery. Clearly, this provides virtual total isolation from the mains.

An uninterruptible power supply (or UP) represents the ultimate in protection from mains-borne interference. A UPS will provide a well-regulated sine wave output and will maintain supply in the absence of the mains for periods ranging from five minutes to an hour. Generally, overload protection is also provided.

They can be used over a wide range of loads, up to their design rating, and units intended to power one or two personal computers may be more economical than a line conditioner.

Uninterruptible supplies are made with ratings ranging from 150 VA (that is, watts when the load is resistive) right up to 250 kVA!

Conclusion

Clearly, when it comes to dealing with mains-borne interference, it's a matter of 'horses for courses' when looking for a solution. Cost and effectiveness must be weighed against the effects of occasional, but nonetheless existent, problems. With careful investigation and consideration, you'll find a solution. eti

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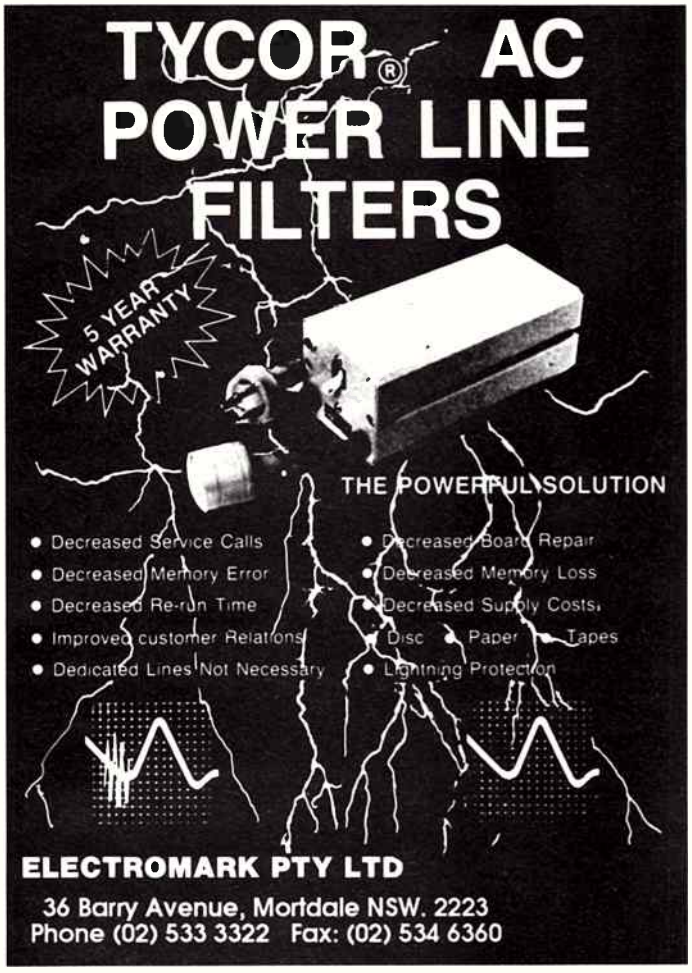

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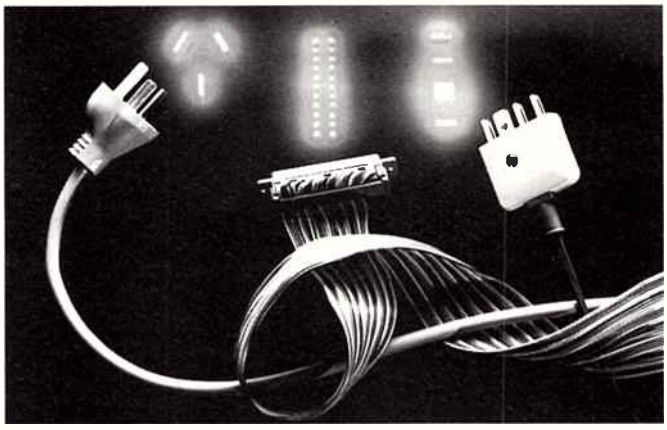

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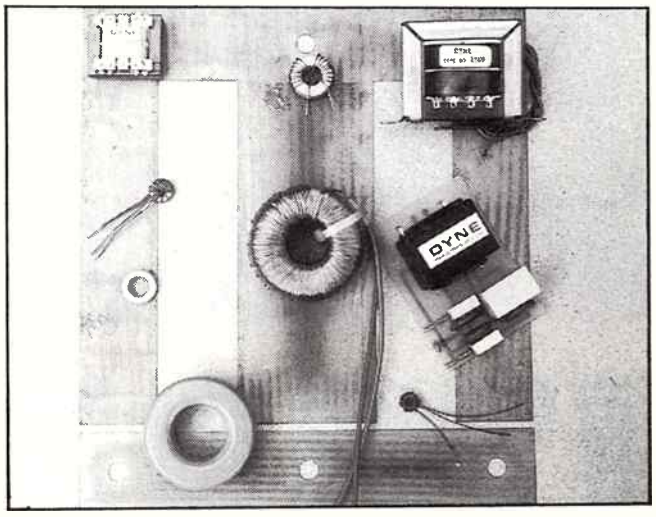

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TECHNOLOGY

THE FUTURE

If the USA's planned Space Station, Freedom, is NASA's 'next logical step', why is its future so undecided? Kathryn Doolan investigates.

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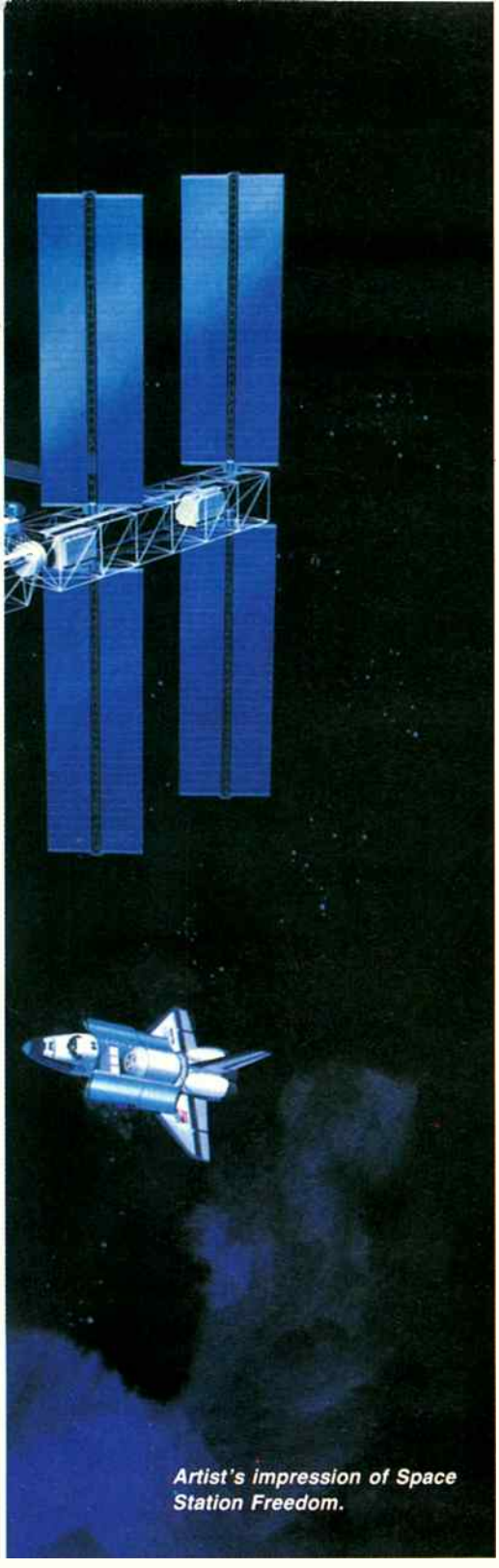

Artist's impression of Space Station Freedom.

OF FREEDOM

February 5th, 1987 was an historical day. It was the beginning of over two years of continuous living and working in space by Soviet cosmonauts on their Space Station Mir. It was only in April last year that the Soviets left the station unmanned and, at the time of writing, it remains empty.

Considering the fuss that was made in the late fifties and sixties when the Soviets were continuously upstaging the USA with space (and propaganda) triumphs – including the first satellite, Sputnik, and the first man in space, Yuri Gagarin – the success of the Soviet's Mir has been met with resounding silence by the USA. In the last three years, all the US manned space program has concentrated on has been getting the much maligned Space Shuttle back into space. Little mention has been made of the proposed US and international Space Station.

The Next Logical Step is the title that NASA has given to its planned Space Station, Freedom, meant to be operational by 1994. Due to the Shuttle program being grounded, and financial woes, Freedom will be lucky to be alive and operational by the year 1998. Currently, the future of Freedom is still very much undecided.

The United States has already had experience in the space station field. In the early seventies, using left over equipment from the Apollo program, Skylab was sent into orbit and manned for a total of 175 days by three crews of astronauts. The success of Skylab was in the fact that the three crews were able to live in space and participate in a variety of experiments that exceeded NASA's expectations. It proved that there were no major medical obstacles to living in space for extended periods of time. Apart from spacecraft problems, which were minor, and a "mutiny" by the third crew (who thought that they were working too hard) Skylab was a stunning success. Before the Shuttle could get into space to send Skylab to a higher orbit, Skylab re-entered the Earth's atmosphere in July 1979, showering the West Australian outback with debris.

As with many recent space projects, NASA had to initiate studies and then fight for funding from the Congress and the White House. In 1982, the then Administrator, James Beggs, created the Space Station Task Force to study and identify the requirements for, and the design of, the initial Space Station. As well, the Task Force co-ordinated efforts with the NASA field centres and aerospace contractors who were interested in having a Space Station.

Later in the same year, NASA granted contracts to eight aerospace companies to determine what activities would take place on the station. At the same time, the governments of Canada, Japan and Europe conducted similar studies at their own expense, to see what sort of role they would have in the Space Station. After hearing of foreign interest in the Space Station, NASA actively began to lobby Congress and the White House for approval; but, still, a lot of work needed to be done before approval could be granted. The Reagan administration had started its massive defence buildup and the Pentagon was cautious of any other major competition for funding.

In April 1983, the White House directed the Senior Interagency Group for Space to study NASA's findings on the Space Station concept. From these discussions, an understanding of the advantages of having a Space Station came to the fore, and it became easier for NASA to gain the President's support for the station.

Killed off

There was one snag, however. David Stockman, the Director of the Office of Management and Budget (OMB), had, in the previous two years, all but killed off the planned space science programs that NASA had planned. Stockman was against the Space Station, as he thought it was an expensive waste of time and would be of little use to the American public. Stockman reminded President Reagan that with a massive defence buildup, some programs would need to be cut, especially an expensive 'boondoggle' like the Space Station.

NASA's 25th anniversary took place in October 1983, and, at a high profile dinner, there was hope that President Reagan would announce approval for the station. By this time, NASA felt that they had won the Station argument and it was just a waiting game for official approval. But in his speech no mention was made of it.

Approval eventually came on 25th January, 1984, during the President's State of the Union speech. Reagan directed NASA to start building a Space Station and to do it within a decade. Many journalists compared the Reagan speech of 1984 with the speech

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given by John F Kennedy in May 1961 in committing the USA to a manned lunar landing by the end of the sixties. But, as it was pointed out, there were many differences – the main ones being national commitment and the steady intrusion by the Pentagon in to the shuttle program.

Now that the Station had White House approval, it was time for the Congressional fight to gain funding. The White House had announced a tentative cost of eight billion dollars, but it was expected that by the Station's completion in 1994, sixteen billion dollars would be a more realistic figure. In an unexpectedly easy fight, NASA was able to gain approval from Congress without the bloodletting that had taken place in other programs (Galileo and Hubble Space Telescope) and received the amount of money requested.

In April 1984, the Space Station Program Office (SSPO) was established and began to undertake the detailed planning for the station. The NASA program objectives for the Station are to:

- Establish a capability to live and work in space.
- Promote substantial international co-operation and participation in space.
- Stimulate technologies of national importance, especially in the fields of automation and robotics, and to use them to provide Space Station capabilities.
- Create and provide opportunities for private sector activity in space.
- Provide the USA with a capability to meet future space needs and challenges.
- Establish a permanently manned Space Station in Earth Orbit by 2000.

One of the most important studies that NASA undertook was the design. NASA awarded several contracts to aerospace firms and requested they design a Station based on the NASA guidelines that had been developed in the early 1980s. The most favoured design was referred to as 'The Power Tower'. A 125 metre trusswork tower was the central element of this concept, with massive solar panels providing power grouped at one end of a giant crossbeam measuring 92 metres. The other components, including the living and working modules, the manipulator arm, radar dishes and docking modules were attached to the central power structure on the crossbeam. NASA had emphasised that the station had to be customer friendly and the Power Tower was open and accessible from all points in space. One of the tower's most important advantages was its size, which meant it would be more stable in orbit and, with thrusters, it could be boosted into a higher orbit on request, or change its position to Earth.

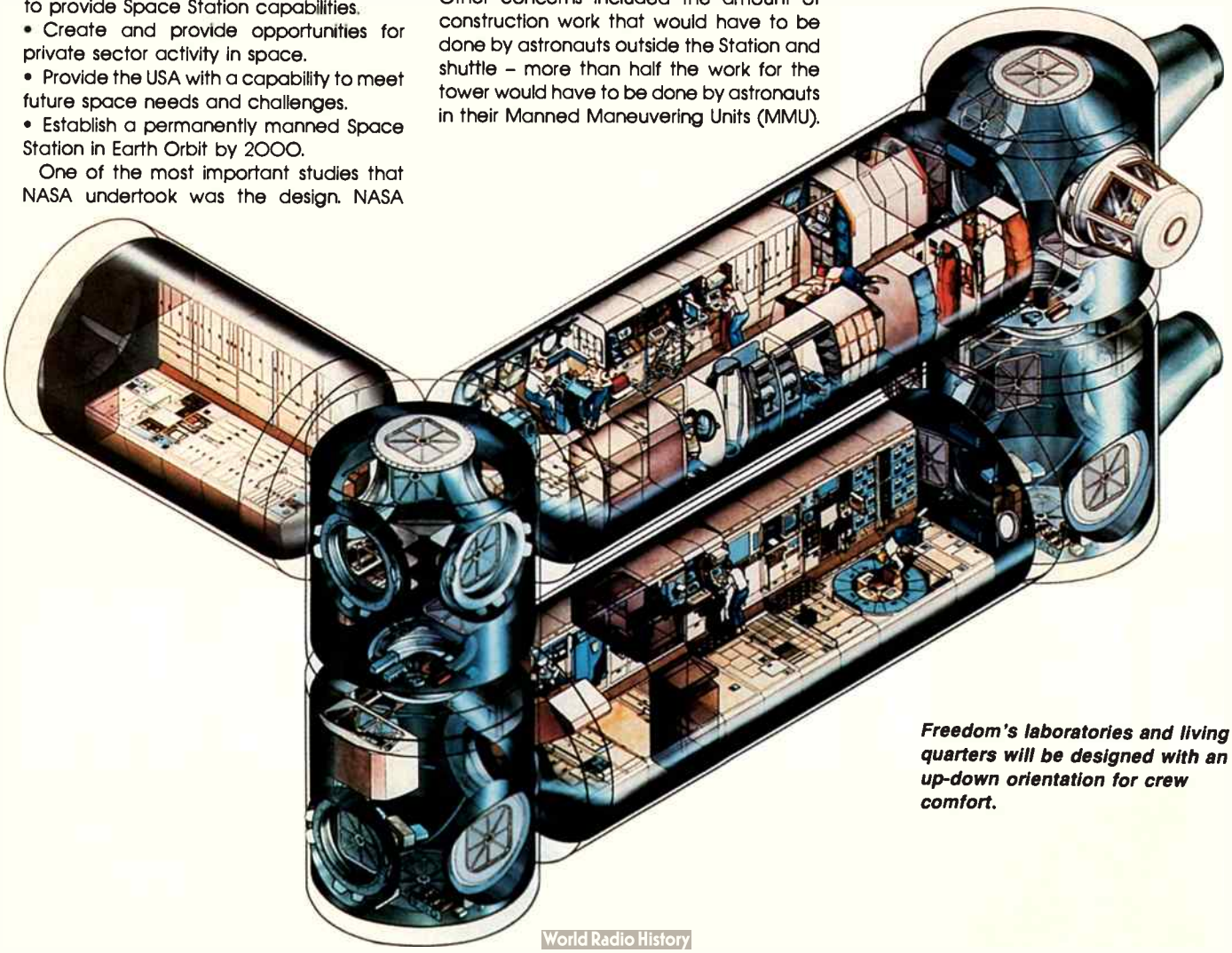
Safety conscious

After the Challenger tragedy in 1986, NASA became more safety conscious and there were some serious questions raised about the tower design. One of the main problems seemed to be with the modules, which were connected together and could not be closed off individually in an emergency. Other concerns included the amount of construction work that would have to be done by astronauts outside the Station and shuttle – more than half the work for the tower would have to be done by astronauts in their Manned Maneuvering Units (MMU). This was considered to be a bad idea, based on previous spacewalks when only one astronaut at a time was allowed to use the MMU for safety purposes.

Engineers at two of the aerospace firms working on NASA contracts in early 1986 – Lockheed and McDonnell Douglas – came up with the idea of having a differently designed Station know as the 'Dual Keel' or, in jest, the 'box kite'. This is the current design for the station and, barring a change of mind by NASA, will be the design used.

The Dual Keel has two major structural beams which are 110 metres in length and parallel to each other. Unlike the Power Tower, the living, working and laboratory modules are mounted in the middle of the structure. They are completely separate and can be closed off in case of emergency. The centre position of the modules reduces the microgravity loads that the Materials Processing Facility would have and this was one of the main reasons why there was such a drastic change. Other highlights of the Dual Keel include the solar panels, which will provide 75 kW (all the power), docking modules for the shuttle and Hermes, room for astronomical telescopes and possibly an area for a space debris radar to track both large and small pieces of space debris.

The first of the construction flights will start in January, 1995. A series of twenty shuttle



Freedom's laboratories and living quarters will be designed with an up-down orientation for crew comfort.

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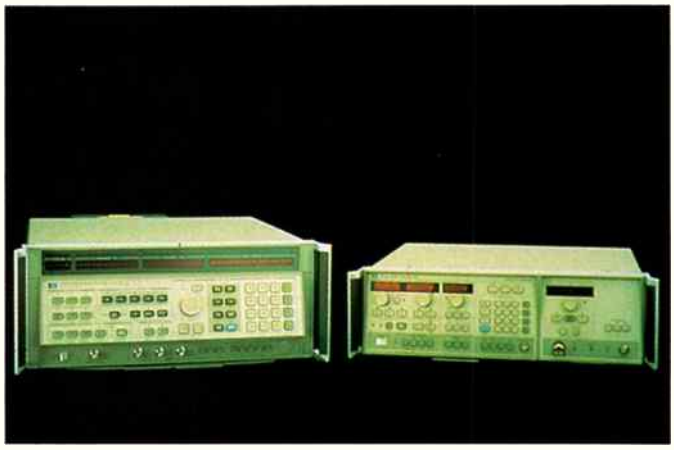
HP's 8720B Vector Network Analyser.



The 8341B Synthesised Sweeper.

vibration testing – simulating the launch environment – subjects the component to up to eleven 'g' forces. Thermal vacuum testing simulates the orbital environment.

Thermal cycling, taking the units through temperature variations from minus 30 to plus 70 degrees Celsius, simulates time spent in full sun and shadow during each 24-hour orbit."

Mr Jacob said the detailed analysis of the reliability of each and every component would ensure that they lasted the life of the satellite. "In fact, the time in orbit is determined by the life of the satellite itself," he said. "The electrical components will actually outlive the spacecraft themselves." The Subdivision's engineering manager, Mr Djin Siauw, said the test and measurement contract had been awarded to Hewlett-Packard because of the joint requirements for 'precise, 'state-of-the-art' test and measurement equipment and for a high level of local support for the equipment.

"It is the first time some of this equipment has ever been used at NEC and the HP contract included training and a pledge of support for the life of the project." In fact, Jacob and Siauw said, when the Aussat B project was awarded to Hughes Corporation, Hughes had felt confident in taking NEC on board as the supplier of the communications platform and both had been happy to have HP as the major test and measurement equipment vendor.

Milestone

For HP Australia, the contract, which is possibly the company's largest single test and measurement equipment buy, is seen as an important milestone in the company's fiftieth year. The company's NEC account manager, Mr Ron Wilkinson, who is HP's senior field engineer in the area of Telecommunications, Radio Frequency and Microwave Systems, said the company had won 100 per cent of what it had bid for the project.

"It was the right match for NEC," he said. "In fact, Hughes Corporation defined HP's high technology offerings as being the only test and measurement equipment capable of making measurements to the extremely tight specifications demanded for this project."

The NEC buyers agreed that the equipment enabled them to be absolutely confident that the measurements they were making did meet exact test specifications. NEC has formed a Space Communication Subdivision, and parts of its Mulgrave manufacturing operation have been remodelled to include a dust controlled climate, or "clean room", and an environmental room.

A team of around 65 technicians has been assembled and trained and three shifts will work around the clock at Mulgrave to meet the delivery deadline of September this year. Key members of the project team, including design and production engineers, quality assurance and testing personnel, have undergone rigorous training, both in Australia and overseas.

The HP 8757 Scalar Network Analyser System.

Significant link

For Hewlett Packard, the NEC link is the most significant, but not the only, link with the Aussat B project. The company's high performance test and measurement equipment is also used in production testing and in the specialised research and development area. Typical customers include Telecom Australia, Aussat itself, for the monitoring of satellite performance, the Defence Department and research institutions. eti

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INSTRUMENTATION

HP MEASURES UP TO AUSSAT B

HP's Gordon Williams discusses the company's involvement in Australia's satellite communications and NEC's export expectations.

HP Australia has installed $2.15m worth of equipment in the Space Communications Subdivision of NEC Australia in Melbourne, where transponders, or microwave radio repeaters, are being built for the communications platforms of the next generation of Aussat satellites – the Aussat B series.

With testing making up 70 per cent of the production time of electrical components that have to function perfectly for 15 years in orbit around the Earth, the contract is seen as vital to the overall project.

NEC Australia is the major Australian-based sub-contractor for the Aussat B satellites, the first of which will be launched by China's Long March rocket in 1991. It is the first time NEC – which has operated in Australia for 20 years – has produced high technology space communications equipment outside Japan.

Exports

According to NEC Australia management, the company expects to export Australian-made transponders for use on other international communications spacecraft, including future European IntelSat satellites.

"When Hewlett Packard first sold test and measurement equipment to Walt Disney 50 years ago, to test the sound system for the movie 'Fantasia', satellite technology would have been seen as just another fantasy," said Frank Freschi, test & measurement manager for HP Australia. "But now, in the company's fiftieth anniversary year, its latest high technology test and measurement offerings are being used to keep tabs on the manufacture of Australian satellite components."

NEC's production test and inspection manager, Space Communications Subdivision, Mr John Jacob, said each of the hundreds of individual electronic components in the modules making up the transponders had to be subjected to rigorous testing, to specifications laid down by Hughes Corporation, which has the Aussat contract. Each element was effectively triple-tested, as the exacting manufacturing process of each component was carried out in three stages.

> *"It is the first time NEC has produced high technology space communications equipment outside Japan"*

"We first assemble development models, which are then subjected to rigorous testing on HP equipment," Mr Jacob said, "then based on test results, the design of each unit is accepted. The next stage is evaluation models, also subject to strenuous testing, then the final flight models. Under the specifications, each unit has to be tested for at least 100 hours before shipment."

Mr Jacob said the testing was also carried out in several stages. All the models were tested using the sophisticated equipment supplied by Hewlett Packard, which included microwave network analysers and high performance signal generators, microwave spectrum analysers and amplifiers, plus test equipment controllers and a range of general purpose test and measurement instrumentation.

"The units are then put through environmental testing, comprising vibration, thermal vacuum and thermal cycling tests, duplicating the conditions to be encountered at launch and during orbit. The

Testing of components being carried out by an NEC technician on HP equipment.

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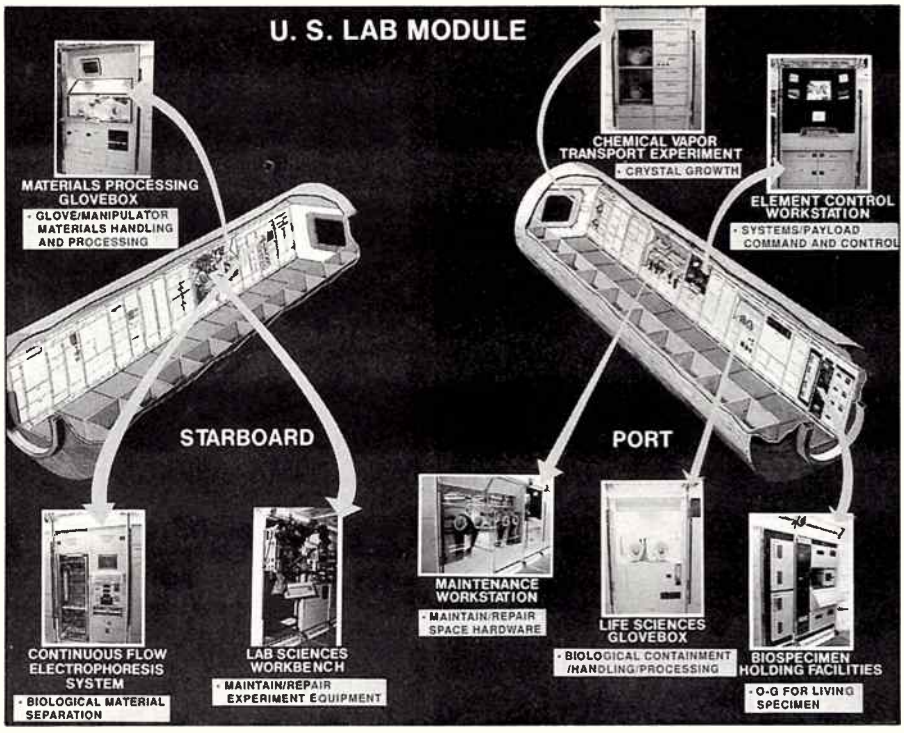

Some features of the proposed US lab module.

small crystals which prevent study by X-ray techniques. The crystals grown in space will be large enough to be studied and, once their molecular structure has been determined, new products may be synthesised on Earth through bioengineering techniques, which may lead to the altering, enhancing or elimination of protein effects in the human body. Fields that this will be useful in will include the treatment of diseases and disorders and organ transplants and implants.

In the field of metallurgy, zero gravity provides a boon as metals behave differently in a space environment. In conjunction with containless processing, a vacuum system offers opportunities to study metal purification and the basic properties of corrosive materials. When a metal is created in space, it quickly becomes solid and this can sometimes make it stronger and weigh less than the same metal being created on Earth.

The understanding of the behaviour of fluids in space is essential as nearly all industrial processes are carried out in a fluid state. Specific experiments could examine processes and phenomena relating to droplet and bubble dynamics, capillary processes and phase transitions. This could be useful in a wide range of applications including liquid propellant storage, meteorology and the study of planetary interiors.

One important aspect to the eventual approval and success of the Station is iinternational co-operation with Europe, Canada and Japan. Agreements have already been signed and work by those countries is steadily progressing. Each of the partners has agreed on monetary shares, with the USA paying the most, followed by Europe, Japan and Canada.

Europe has been active in space for the last twenty six years under the auspices of the European Space Agency. The fourteen member states each contribute money for the running of the Agency with West Germany and France contributing the largest shares.

One of the ESA's biggest success stories has been Spacelab – a manned laboratory that has flown on several shuttle flights. It is this format that will be the main European contribution to Freedom. The ESA module will be one of the main working areas on Freedom, and will be based on Spacelab.

The module will consist of four cylindrical segments forming a pressurised compartment in which ESA astronauts will conduct research in fluids, material sciences and life sciences.

Another ESA contribution will be a self-contained automatic laboratory operating independent of the Station. Known as the Man Tended Free Flyer (MTTF) it will be made up of two Spacelab segments and a resource module that will store supplies. As a self contained laboratory, the MTTF will produce space grown crystals and other material in an undisturbed environment.

ESA will also send a polar platform into orbit aboard an Ariane rocket in the mid 1990s. Along with the US polar platform, the ESA platform will continuously orbit the Earth from the North Pole to the South Pole and will make studies of the oceans, our atmosphere and solar phenomena (aurorae).

JEM

The Japanese contribution to freedom will be a module known as the Japanese Experimental Module (JEM), which will arrive once the Station is fully staffed. The JEM will accommodate technological and scientific development research with an emphasis on microgravity research. One part of the deck will be exposed to space and will hold a variety of experiments which can be reached by a manipulator arm.

Another contribution will be a detachable experimental logistics module that will store consumable goods, experimental specimens and gases for the JEM. This module will be sent into orbit either by the shuttle or a Japanese expendable launch vehicle.

The Canadian contribution to the Station will be the highly successful Remote Manipulator System (RMS) which has been one of the Space Shuttle's few unqualified successes. For the Station a similar system has been designed, but on a much bigger scale. Known as the Mobile Servicing System (MSS), it will play a leading role in the assembly and maintenance of the Station. It will be able to move equipment and supplies, support astronauts in the servicing and repair of satellites and in their work around the Station and will also be used for the loading and unloading of materials.

With all the wonderful technology being designed for the Station, the present question on everyone's lips is, "Is there going to be a Space Station?" At the time of writing, everything is still undecided and it is unclear whether Freedom will gain the financial support it needs to continue. President George Bush has stated the USA *will* get a Space Station but, so far, his support has been lukewarm.

One of the big surprises, space wise, has been the National Space Council. Recently reinstated under the leadership of Vice President Dan Quayle, the members have been constantly reminding everyone of the need for the Station before long term exploration of the Moon and Mars start. Quayle has been actively lobbying for the Station but it appears that if Freedom is to survive, a massive cash infusion is needed. Congressional committees, when slicing NASA's budgets, have always targeted the Station first and in the last couple of years funding has been slashed to the bone.

Readers of US space magazines have been bombarded with advertisements from aerospace firms telling of the need for the Station, and an active letter writing campaign has started.

But, at present, Freedom is just a dream and will remain so until either NASA or the White House decides to act on its future.

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flights over the next three years will send all the material up into space, where, using Remote Manipulator Systems provided by the Canadians, crews of astronauts will construct the station. It is expected that the Station will be permanently manned by late 1996 and, by the time construction is finished, eight people will be able to live there for periods of up to two years at a time. The shuttle will then return them to Earth and send a new crew up.

The living quarters on the station are the most important areas to be designed and NASA and its contractors are going all out to design a "real" home in space. Unlike the primitive Skylab, Freedom will be a luxurious place to live and there are some wonderful things being invented for use in the Station.

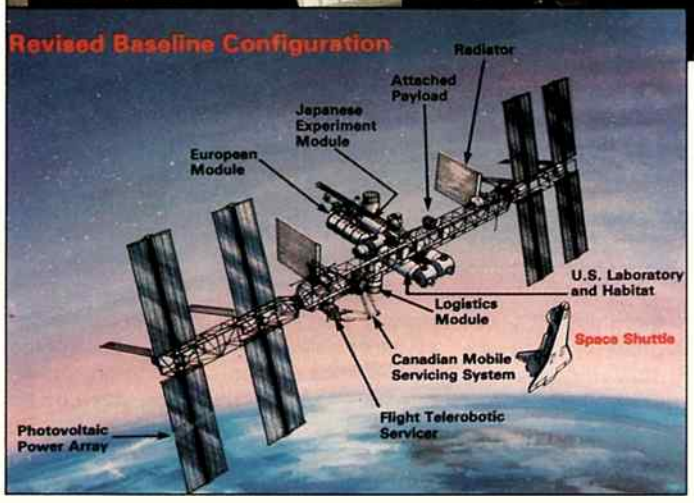
Each crew member will have his own soundproof compartment measuring approximately 4.2 metres, which he can design to his own taste. In this area, there will be a television set, video recorder, stereo system and telephone and video links which will permit private conversations with families and friends on Earth. The compartment will also include a personal computer to be used for either work or entertainment. A sleeping bag hung on the wall will contain elastic bands to give the sleeping crew member the feeling that he is lying horizontally.

Toothpaste tubes

The food on the Station will be a far cry from the days of food from toothpaste tubes. On board the Station's galley will be a fridge, freezer and both microwave and conventional oven. There will be an expanded menu which will include entrees, main meals and desserts. NASA dieticians proudly boast that if crew members want to, they can whip up treats such as birthday cakes or, with their international guests, produce a gourmet dinner with dishes from all over the world.

On the personal hygiene side, there will be a toilet and bathroom with a specially designed shower in which the crew member will be washed by a combination of flowing air and warm water. A washing machine and dryer will also be on board, to cut down on storage space for clothing.

Probably the most important aspect of living in space is keeping the crew healthy and adjusted to zero gravity. Some problem areas are the heart, muscles and motion sickness. In zero gravity, the heart is no longer required to pump blood against the pull of gravity. As a result, it grows lazy and red blood cells in flights lasting longer than one month are destroyed. Muscles (especially in the leg area), because they are not used, tend to atrophy and become useless. Another problem is temporary and uncomfortable motion sickness, which tends to strike fifty per cent of all space travellers for up to the first five to seven days of a spaceflight. As yet, there has been no explanation for this illness.



Once the Station is complete, the crew of eight will work in teams in nine hour shifts, five days a week.

To keep healthy, crew members will exercise for two 45 minute periods each day, using the treadmills and exercise bicycles on board. These exercise periods are based on the experience of Skylab and will be strictly enforced. It was found from Skylab that if an astronaut exercised on a daily basis, he returned to Earth in better shape than if he did not.

In case of any major medical emergencies on board, there will be a complete medical facility available. Crew members will be trained for emergencies and there will be a doctor on board for most long duration flights. To save space in storing medical books, a computer is currently being designed which will allow the doctor to access information by pushing a button. Minor surgery and dental procedures will be able to be carried out on board, but if there is a life threatening emergency the ill crew member will be returned to Earth.

With safety taking a higher profile at NASA these days, several escape systems are being designed for the Station. NASA is currently studying the use of Crew Emergency Return Vehicles (CERV). The theory behind having a CERV is that one would always be aboard the Station and, at a moment's notice, could be used to return crew members back to earth. Other alternatives include keeping a shuttle or some other vehicle on permanent standby.

Apart from living in space, the other goal of the station is to work in a zero gravity environment. Once the Station is complete, the crew of eight will work in teams in nine hour shifts, five days a week. Outfitted with a diverse range of sophisticated hardware, Freedom will be an international research base for conducting research in physics, life sciences, chemistry, environmental science, materials processing and future technologies. In the shirtsleeves environment of the Station complex experiments will take place in all the above fields and it is hoped that the knowledge gained can be put to use back on Earth.

Important experiments

Because of the zero gravity environment in Freedom, several important experiments will take place, including Protein Crystal Growth, experiments with metallurgy and research in fluids. The Protein Crystal Growth experiment is one that is unique to a zero gravity environment. Previous experiments have demonstrated the feasibility of growing large protein crystals without the formation of mutiple seeds. Multiple seeds produce

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LUST AND THE LISTENER'S DREAM

Icom's new top-of-the-line communications receiver, model IC-R9000, covers the spectrum from 'dc to daylight', as they say. And it does a whole heap of other things, too, making it more than just a receiver. Roger Harrison reports.

No doubt most shortwave listeners and radio amateurs recognise that, over the years, there has always been one certain type of general coverage receiver that everyone of like interests has desired (nay, lusted after) but of which few have gained possession. Post WWII it was the AR88; in the 50s, the Collins 51J4 (or *any* Collins); in the 60s, Racal's RA-series Wadley-loop technology-receivers were the pinnacle. In the 70s, the field became a little more crowded, as Japanese companies such as Yaesu and Icom gained considerable footholds, with well-engineered, well-packaged and well-priced equipment. In the 80s, it was Icom which claimed the pinnacle.

In the 90s, I'll wager, Icom's IC-R9000 will hold that pinnacle of the listener's dream – that one product which we all lust after. Whether or not it will be more obtainable is a moot point.

The top receivers of past eras were basically all variations on a theme – superhets in one form or another, boasting ever-better performance than their predecessors, but nevertheless having similar basic features and functions.

But the R9000 is so different to all that have come before, that it's hard to see exactly what the next step will be – or who will make it.

Features and functions

The R9000 is truly a general coverage communications receiver, boasting coverage of the entire frequency range from 10 kHz to just under 2 GHz, that is, from VLF through the MF, HF, VHF and UHF to SHF regions. That's pretty general!

Apart from the extremely wide frequency coverage, the R9000 has two other major features that set it apart: the number and variety of reception modes provided and the VDU-type display.

The R9000 provides detection of sound signals transmitted by AM, FM (narrow and wide) and SSB modes, plus such digital modes as radio facsimile and radio teletype (RTTY), which use frequency-shift keying (FSK). And there's one other plus – it will demodulate and display TV signals (PAL, too!). It could truly be described as an "all mode" receiver.

The CRT display dominates the receiver's front panel, as you can see from the photograph. Eight display screens are provided, including a unique "spectrum scope" display. This is akin to a spectrum analyser display, allowing you to observe the signal spectrum over +/– 25, 50 or 100 kHz from the set receive frequency. More on the display after I've covered the rest of the receiver's features and functions.

Tuning steps of 10 Hz, 100 Hz, 5 kHz, 9 kHz, 10 kHz, 12.5 kHz, 20 kHz and 100 kHz steps are provided. The main tuning is via a large knob. A pair of up-down keys provide jumps of 1 MHz. Frequencies may be changed or received in 1 MHz steps, and there is an automatic detent function on the knob control when using steps of more than 5 kHz.

Frequency stability is given as +/- 0.25 ppm in ranges over 30 MHz and +/- 25 Hz in ranges under 30 MHz. Receive frequencies and memory channels can be selected by keyboard, and a total of 1000 memory channels are grouped in 10 memory banks for storing frequencies, modes, filter widths and tuning steps.

Three pushbutton selectable receiver IF bandwidths (wide, middle and narrow) are provided, plus a variable notch filter which is very useful in AM, SSB and FSK reception on the HF bands.

There is a 24-hour system of dual clocks, with two kinds of sleep timers and six different daily timers. Settings can be set up on the CRT display. The R9000 has many scan functions for searching desired stations (13 a second) in wide frequency bands, and can also scan between two programmed frequencies or band edges. A total of 10 groups of scan ranges can be specified. You can also do a 'delta-F' scan, searching repeatedly across +/- 2.5, 5, 10, 20 or 50 kHz from a preselected frequency. A Priority Scan mode monitors desired memory channels for activity while you listen on another channel. Your most-required memory channel can be programmed as a priority channel for each memory bank.

The Selected Number Memory scan searches only memory channels containing a specified group number. Auto Memory Write scans between two programmed edges, writing the frequency, received time and date of signals sequentially in memory channels 900-999.

When the Voice Scan Control feature is invoked, scanning will not pause for signals which do not include voice modulation, and Icom claims the VSC feature ignores beat signals and noise.

Many control functions like frequency and memory channel selection can be selected using a PC equipped with an RS-232C port, linked to the R9000. This is allowed by an improved CI-V system for computer control, according to Icom.

The Icom all-mode S-meter squelch is built-in for receiving only signals stronger than the pre-set squelch control level.

The receiver also boasts an IF Shift control which shifts the centre frequency of the IF passband, a feature that provides effective rejection of nearby interfering signals in SSB,

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CW, FSK and AM reception modes.

The AGC circuit has selectable decay times of fast (less than a second) and slow (three to four seconds). It can also be turned off. A variable squelch control quiets the receiver output when no signal is present, or signals are below the pre-set level, only allowing reception of signals stronger than that.

The receiver's noise blanker is designed to provide clear reception in the presence of impulse noise. A threshold adjustment and a pulse width allow you to cope with widely varying circumstances.

Icom claims the R9000 has a dynamic range of 103.5 dB (on 14 MHz), which ensures pretty good freedom from crossmodulation and intermodulation effects from nearby transmitters or otherwise strong signals. Sensitivity is quoted as 0.16 uV for 10 dB S/N (SSB, CW, FSK) between 8 MHZ and 30 MHz, and less than 0.5 uV for 12 dB SINAD (FM) from 30 MHz to 1 GHz.

An AFC function provides for rapid acquisition of an FM signal during tuning and also compensates for Doppler shift when receiving satellite signals in the VHF or UHF bands.

Two pushbutton selectable RF attenuators are provided, one of 10 dB and one of 20 dB, allowing for attenuation at the input of 10, 20 or 30 dB. These can be used to prevent saturation of the receiver's input from very strong signals.

The S-meter provides both the traditional signal strength indication as well as centre frequency indication for tuning FM signals. The function is pushbutton selectable.

No less than four antenna connectors are provided on the rear: an RCA socket and SO239 for VLF to HF, and two Type-N sockets for 30-1000 MHz and 1-2 GHz.

Getting back to the CRT display, you can list the various memory functions, showing 10 at a time. Memory channels may be scrolled for viewing. You can also edit memory functions on-screen and display the scan conditions. The display also has a terminal monitor mode which allows monitoring of RTTY, fax or packet radio, and ASCII (RS-232C level) code data, putting the text on-screen. However, an external decoder or terminal unit, or packet terminal node controller (TNC) is required.

Appearances

The R9000 has a well laid-out front panel that is quite "full" of controls and pushbuttons, but somehow remains uncrowded. The CRT display dominates. To its left, at the top, is the S-meter, surrounded by associated function buttons. In the lower part of this side of the panel are the audio and RF gain controls, noise blanker, tone and scan controls and associated pushbuttons.

Beneath the display there are two rows of display function keys, and right along the bottom another series, which invokes such functions as remote operation, AFC, antenna selection, display selection and the two RF attenuators.

The right hand side of the front panel is divided vertically into two areas. At the top, immediately adjacent to the CRT, there's a numeric keypad, for entering frequencies and numeric data for other functions. To the left of this is a column of six keys for selecting the reception mode. Beneath the keypad are two keys for setting the tuning step. The tuning knob is at the bottom of this panel.

The far right hand side features filter and notch selection keys, IF Shift and Notch tuning controls, memory bank selection and function keys and, right at the bottom, the two 1 MHz up-down keys.

The rear panel contains all the connectors, including a standard DIN 240 Vac line socket, dc (13.5-15 V) input socket (yes, you can power it from a car battery) and the four antenna inputs. A large wing nut and bolt provide a good grounding connection, if needed.

On the air

The R9000 is, indeed, everything I have ever lusted after in a receiver. It covers not just those regions of the spectrum that interest me now, but many other regions which I had either ignored, or considered beyond my current resources to take an interest in.

To give the R9000 a decent workout, before it was delivered I built and installed for myself a series of antennas to pretty well cover the spectrum that it covers.

Upon arrival, I eagerly unpacked the beast and set about learning how to "drive" it. Fortunately, like most Icom gear, the front panel is sensibly designed and arranged, and I soon had most of the functions and modes down pat. One thing had me fooled for a long time, though. Duncan Baxter, of Icom, had made passing mention of receiving 'TV pictures'. For the life of me, I couldn't see how to set it up to do this.

I could dial up the sound (sub) carrier or the vision carrier of a TV station, but no way could I get the CRT display to show a picture, even though the receiver's "video out" and "video in" sockets were linked. Finally, Duncan told me the secret: dial up the sound carrier and hit the display button beneath the screen – voila, pictures! For TV DX enthusiasts – what more could you want? (I know, I know, NTSC and SECAM demodulators too!)

I started my investigation of the R9000 on the HF bands, using my newly-erected long wire antenna. Curiously, results were not what I expected. I could hear lots of "crud"; VNG was audible on 5 MHz (groundwave from Llandillo to Balmain), a very few weak and fading shortwave broadcasters, and little else. Hmmm. Must be a break in the antenna, I thought. A little investigation showed I was trying to receive on about a

metre of lead-in wire!

So, I quickly fixed that and tried again. This time I got louder crud, but much the same results! Very puzzling. Maybe there was something wrong with the receiver? Signals on the MF broadcast band were predictably strong, and didn't tell me very much. A quick check with a signal generator told me the R9000 was OK. Scratch my head. Put the problem aside and see what's happening on VHF/UHF.

The region above 30 MHz has lots to fascinate one. I had erected a discone broadband antenna, and a 136-138 MHz turnstile for the APT weather satellite band (manufactured by ZZV Antenna Farm, Newcastle NSW). So, for a start, I set the R9000 to monitor one of the APT weather satellite transmission channels on 137 MHz (FM), with the AFC on and the squelch set at its most sensitive. In due course, one of the satellites made its appearance, and the characteristic AFSK "burble" could be heard. The AFC kept the signal in tune for the duration of the satellite's pass.

I thought I might listen to the aircraft channels, as Kingsford Smith airport is but a few kilometers from my location. As the pilot's dispute was in full swing at the time, I got little cheer there. Switch to monitoring Bankstown light aircraft aerodrome. Much better!

A number of the amateur VHF repeater outputs were already pre-programmed (the memory is battery-backed) into memory I found, so I set about scanning various amateur band repeaters, and calling channels on VHF. The R9000 clearly has excellent sensitivity, as I got good reception from signals up to 100 km or so distant – just using the discone antenna, too.

I also gave the R9000 a workout on the FM broadcast band, and it acquitted itself very well indeed. Icom has provided tone controls (bass and treble), which are clearly meant for broadcast reception. A nice touch. A larger (or even a hi-fi) speaker gives good audio. Stereo decoding is not provided on either the FM or AM broadcast bands, I note. I guess decoders could be added, because an "IF OUT" RCA socket is provided on the receiver's rear skirt.

So, back to the problem on HF, a few days later. Lo and behold – problem gone! What had happened? Well, it turns out that I was caught by a "shortwave fadeout", the

World Radio History

product of a solar flare. I should have twigged, having worked in the area of HF propagation. The Sun's nearing the peak of its 11-year cycle and very active at present.

With the HF bands recovered from Old Sol's assault, the R9000 turned in a sterling performance. I deliberately picked a number of crowded band segments to try out the IF Shift and Notch Filter facilities. Either the IF Shift or the Notch Filter on their own can assist greatly in reducing adjacent channel interference, in any of the reception modes common on HF. Together, they're a formidable tool, rendering an otherwise unintelligible signal tolerably readable – or completely so! Their use requires a little skill, but that's something you soon acquire, I found out.

The spectrum scope screen on the CRT is a real boon when you're looking out for activity in the immediate vicinity of the band you're tuned to. I was quickly able to identify new SSB and FSK signals appearing amongst the general background on the 14 MHz amateur band – for example, when the band was live with DX. On the VHF bands, the spectrum display could usefully do with more spread than the maximum +/– 100 kHz provided. I guess the designers had to stop somewhere.

One thing I did notice about the spectrum display was that it needs a warm-up time of about half-an-hour before the display shows the peak for the signal being received on the display's centre cursor.

The spectrum display on its narrowest scan is a bit dotty – rather reminiscent of a digital storage scope display. This is an artifact of the CRT scanning, but it's quite illuminating, nonetheless.

You can graphically see the modulation characteristics of a signal being received – AM, SSB, FM or FSK. It's curious to watch slow speed FSK signals on the spectrum scope, and Morse (CW), too.

The noise blanker is remarkably effective on thunderstorm crashes, vehicle ignition and similar impulse noise. Adjustment I found non-critical and it does not appear to affect the receiver's crossmodulation performance.

At night, I had a good look around the MF broadcast band. Boy, what a revelation! Signals poured in from all around the Pacific region. I had no difficulty separating a weak, distant station that was as close as 15 kHz from a strong local station. Not bad, Icom! The 9 kHz step tuning rate is great for tuning for Australasian region broadcast stations.

The scanning functions provided are nothing if not comprehensive. Front panel controls let you set channel-to-channel scan rate and the period for which the receiver is to pause on an occupied channel. Things like VSC scanning, and all those functions used in conjunction with the CRT display, make the R9000 very versatile indeed.

In each memory, you can program channel frequency, mode, filter width and tuning step. Each memory channel can have quite different mode/filter and tuning step settings, not just a different frequency. And you can write yourself a note of up to eight characters for display on the CRT.

As far as I can count, there is a total of 20 display screens, accessed through two menu screens. I just don't have room to go into everything the display functions provide on the R9000.

Provision is made for you to take recordings, using a cassette recorder, and this includes a link to the recorder's remote jack so that recording can be made only when there's valid sound output. Good one, Icom.

An RCA socket on the receiver's rear provides for connection to an external video monitor when receiving TV signals, and a DIN socket allows you to display the CRT data on an external monitor. An accessory socket permits linking the R9000 to a suitable transmitter or transceiver. As mentioned before, the R9000 can also be linked to a personal computer via an Icom model CT-17 CI-V interface unit. I was unable to give this a try, however.

Summary

Sadly, I'll have to wrap up the review of this point – for more details, get yourself a brochure, or, better still, get your hands on a unit!

I found the R9000 a positive delight to use. All the sorts of features I'd ever wanted in a receiver and/or scanner have been included – and a lot of others besides!

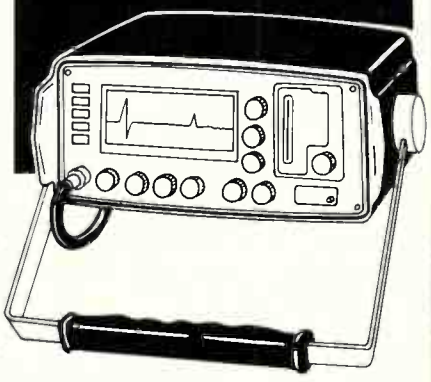
The R9000 is more an "instrument" than just a receiver, having all the attributes of a top-line general coverage HF communications receiver, VHF-UHF scanner, spectrum scope (once known as a "panadaptor") and specialised VDU all rolled into one. At a price of $6650, it will certainly remain but an object of lust for many, and will become the proud possession of only a lucky few. Now let me see ... I could sell the hi-fi gear, auction those old Norman Lindsay etchings, put the kids in hock ... maybe, just maybe. eti

Contributed by The Apogee Group

Review unit kindly loaned by the importer/distributor, Icom (Australia), 7 Duke Street, Windsor, Vic 3181. ☎ (03)529-7582.

World Radio History

Searching for that elusive cable break?



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BOOK REVIEW

FORREST MIMS' CIRCUIT SCRAPBOOK II

For every dyed-in-the-wool experimenter or electronics enthusiast, this book is a *must*. The title is very descriptive; it's a collection of experimental circuits, circuit experiments and construction techniques ranging across such things as a simple two-transistor metronome to experiments with piezo-electronics, lightwave communications to active filters, radio controlled aerial photography from kites and balloons to experiments with a solid-state heat pump.

Forest M. Mims III is a prolific US author, often seen in US electronics publications over the years. He has published a variety of books for electronics and computing enthusiasts. This book, published by the Howard W. Sams Company, was originally published in 1987 and reprinted in 1988. It is a compilation of Mims' columns that were originally published in *Popular Electronics, Computers & Electronics* and *Modern Electronics*.

The book's nine chapters tell what it's all about: Transistor and MOSFET Circuits; Analogue Circuits; Digital Circuits; LEDs, Laser Diodes and Optoelectronics; Lightwave Communications; Control and Telemetry; Radio Control and Remotely Triggered Cameras; Sensors and Sensing Systems; Piezoelectronics; Thermo-electronics and Experimental Circuits; and Circuit Assembly Tips.

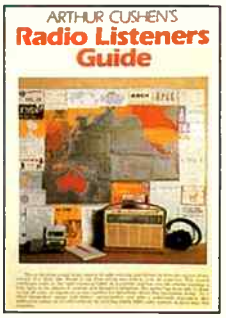
While many of the active devices specified are US in origin, local equivalents can be found e.g: many circuits call for 2N2222 (NPN) and 2N2907 (PNP) transistors. These are general purpose types for which the locally available equivalents are the PN100 (NPN) and PN200 (PNP). Mims makes much use of the common 741 op-amp and the 555 timer. A few devices shown are not available here – but it is possible to mail order from the USA, without too many hassles.

This book is chock-a-block full of practical ideas – and some not-so-practical ideas – but you'll soon learn why when you try them. Quite a few circuits are simply variations on the one basic circuit 'block' – like the two-transistor metronome (just six components!) and the 555 astable; but that's not a criticism. If you aim to learn something by experimenting with electronics, then learning to recognise variations on a theme is a very useful skill to acquire.

It is written in a simple, down-to-earth style without high falutin' jargon and convoluted language. Many parts of the book should be readily understood by the newcomer to electronics who should find plenty of interesting things to tackle. But that doesn't mean to say there's little 'meat' for the more experienced experimenter. I whole-heartedly recommend this book as a worthy inclusion on your bookshelf. You'll find it will be a source of circuits, circuit ideas and interesting activities for years to come. Money well-spent.

R.H.

Forest Mims' Circuit Scrapbook II is published by the Howard W. Sams Company; 255 pages, soft-bound, 280 x 213 mm. Review copy from the importers, Stewart Electronic Components, P.O. Box 281 Oakleigh 3166 ☎ (03)543-3733. Cost: $33.90 inc. post within Australia. Stock No. BX22552.



ARTHUR CUSHEN'S RADIO LISTENERS GUIDE

For a succinct description of this book, I can do no better than quote the author's front cover description: "This publication covers many aspects of radio listening and follows on from the success of the writer's first book *The World In My Ears* which was sold in over 70 countries. This second publication looks at the radio listening hobby as a pastime and has over 60 articles covering a wide span of the subject of medium and shortwave reception."

Arthur Cushen is ETI's *Kilohertz Comment* correspondent. He's had 50 years' experience as a listener, correspondent and consultant in international broadcasting. He's known throughout the world and over the years as a listener and has verified nearly 9000 radio stations in more than 300 countries. No mean achievement for a blind person!

The book is a compilation of articles relevant to the field of medium and shortwave listening. Some one-third of the book comprises a series titled "Starting DX", written for ETI and published over 1984-85. The balance has been specially written, contributed or culled from other sources – including an article on antennas from your reviewer, originally published in *Australian Electronics Monthly* in 1985.

The contents is divided into eight categories: Shortwave; Mediumwave; Equipment; The Radio Listening Hobby; Program Listening; The DX Club; Conferences and Conventions; Profile - The Author. The contents in each category is quite comprehensive. Some material covers the same or similar ground to other material, but in general it's not repetitious.

The text is supported by numerous pictures and diagrams. There are lists of stations, frequencies and programs. There are historical items and practical items. With the exception of about three articles, it is entirely non-technical. Even the technical articles should be readily understood by most listening enthusiasts with a high school education.

Arthur Cushen writes in a friendly, personal style, and his wealth of experience shows through, but not in an "I'm smarter than you" fashion as is evident of some authors in specialist fields. It should appeal to newcomer and old hand alike. It's 108 pages contains an absolute wealth of information. It's not a book for reading from start to finish, although I don't doubt that it will be read from cover to cover. It *is* a book for dipping in to.

R.H.

Arthur Cushen's Radio Listeners Guide is published and distributed by Arthur Cushen Publications, 212 Earn St, Invercargill, New Zealand; 108 pages, soft-bound, 300 x 210 mm. Review copy from the publishers. In Australia, it may be purchased from: Technical Book & Magazine Company, 289-299 Swanston St, Melbourne Vic 3000. Cost: $22.00.

World Radio History

eti PROJECTS

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

This month we include:

- ***ETI-753 — 1:1 HF Antenna Balun***
- ***ETI-1548 — Dual Rail Power Supply Module***
- ***ETI-1202 — Projects using Musical Xmas Cards***

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The following services are available direct from ETI.

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Back issues, if available: $4.

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

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

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

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Circuit boards and some front panels are available from the following:
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Part 7

BUILDING BLOCKS OF ELECTRONICS

Audio filters, RF/IF amps

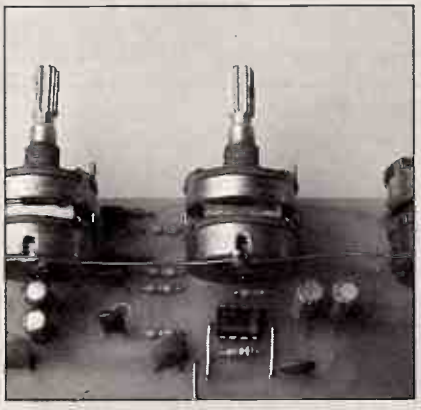
Having covered plain and simple amplifier stages, we now move on to audio filters, tone controls and equalisers, then RF/IF amplifiers. By Jack Middlehurst.

A filter can be defined as any circuit block that does not have a flat frequency response in the frequency range of interest. The reason for the last six words is that without them, all circuit blocks would be filters, since every circuit has a cutoff frequency somewhere. Apart from loudspeaker crossovers, the three audio filters that you are most likely to meet are the RIAA filter, the tone control, and the graphic equaliser.

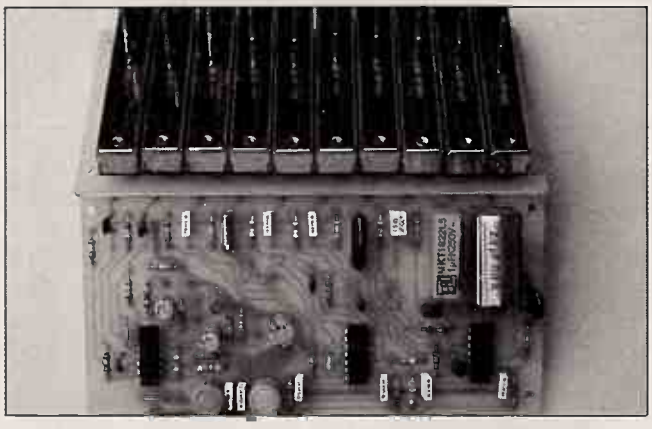
The RIAA filter

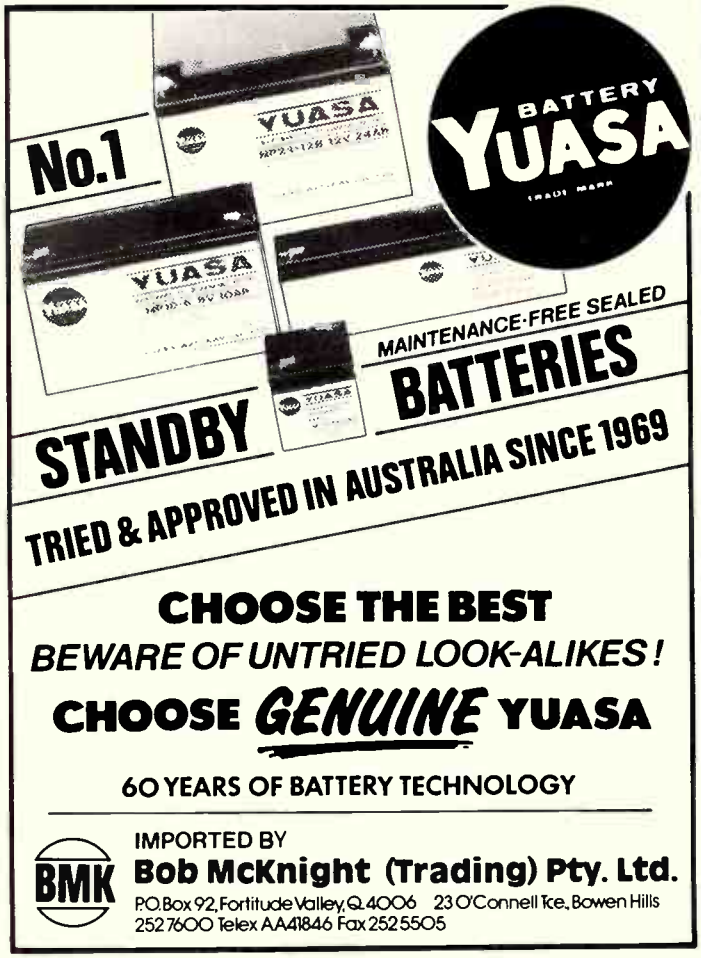
The RIAA (Record Industry Association of America) filter is found in all phono pickup preamplifiers. Its purpose is to optimise the

View of a tone control stage from a stereo preamp. High performance LM833 dual op-amps are used in this circuit.



Below: Example of a 10-band graphic equaliser. This unit employs gyrator circuitry in each stage, at half-octave intervals. The slider controls provide boost and cut above and below centre position, respectively. The ICs are quad op-amp packages, type LF347N.





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ROD IRVING ELECTRONICS

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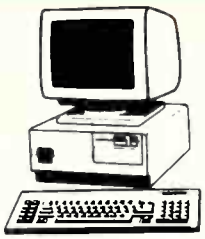

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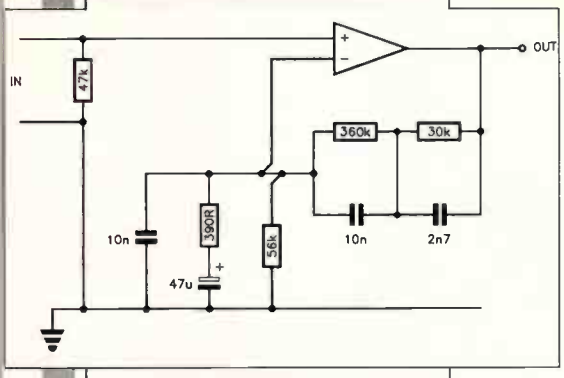


Figure 7.1. Amplifier with RIAA filter.

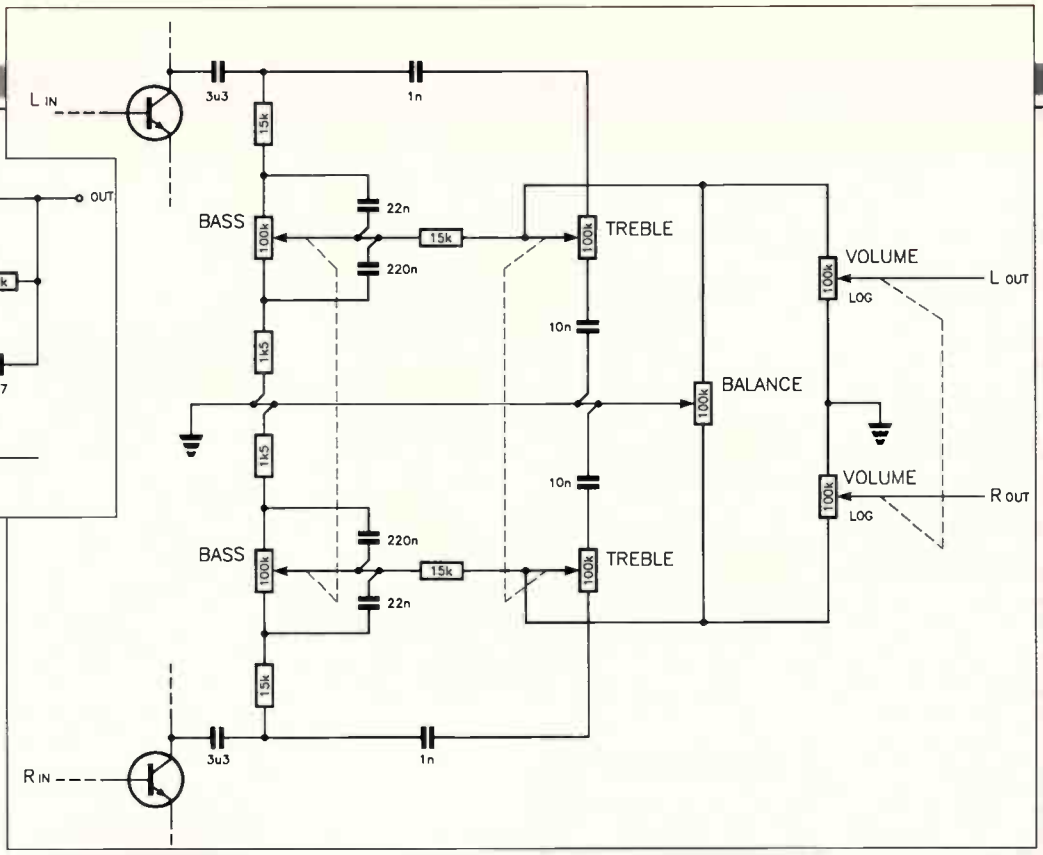


Figure 7.2. Passive stereo tone control.

signal-to-noise ratio of the sound produced from signals recorded on (vinyl) discs. In cutting the discs, the high frequencies are emphasised and the low frequencies are reduced. To get an overall flat frequency response, the RIAA filter performs the reverse of these filtering operations in the playback equipment, boosting the bass and cutting the treble. The more precise the filter, the flatter the overall response.

Figure 7.1 shows a typical preamplifier using an RIAA filter. For best results, all components in the filter network need to be within 1% of their design value and, indeed, better quality equipment uses components of 1% tolerance. It is common to find that standard capacitor values are used, leading to the need for non-standard resistor values, since it takes less space to parallel resistors than capacitors in order to make up the odd values required.

The most likely component to give trouble in this circuit is the 47 uF polarised capacitor. Since this controls the cutoff frequency below 20 Hz, an increase in capacitance will increase the amplification of any turntable rumble, and a low value will reduce the low frequency response. In either case the capacitor has to be replaced. There are several forms of the RIAA circuit used in the highest quality equipment that avoid having a large capacitor (see "An 'Ultra-Fidelity' Preamplifier", in *Australian Electronics Monthly, Oct. and Nov. 1985).*

Tone controls

The tone control in early radios is simply a capacitor (usually 0.05 uF) in series with a variable resistor (10 or 20 k), the combination being connected across the primary of the output transformer. This can only give treble cut. More recently, the passive tone control has been developed to the stage where it can give boost and cut at both bass and treble frequencies. A stereo circuit to do this is shown in Figure 7.2, which also includes a stereo balance control.

The most popular active tone control before multi-channel equalisers came onto the scene was the bridge circuit of Baxandall, shown in Figure 7.3. Each control can give 20 dB of cut or boost with a distortion level that is less than 0.1%, depending on the amplifier. The amplifier can be a single pentode, a transistor such as a member of the BC109/BC549 series, or it can be an IC such as the 5534AN. The circuit components shown are for use with a FET-input amplifier, such as the LF353 or a pentode, such as the 6AK5.

Figure 7.4 shows how the bass part of this circuit works. At (a) is the circuit with the bass control at maximum. The gain of the amplifier is Zfbk/R1. At very low frequencies, the

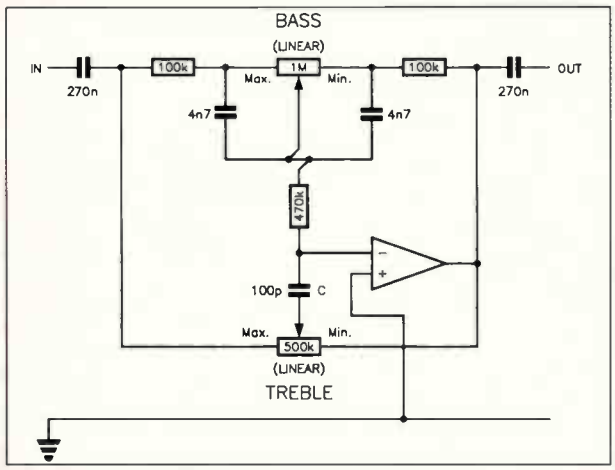


Figure 7.3. Baxandall tone control.

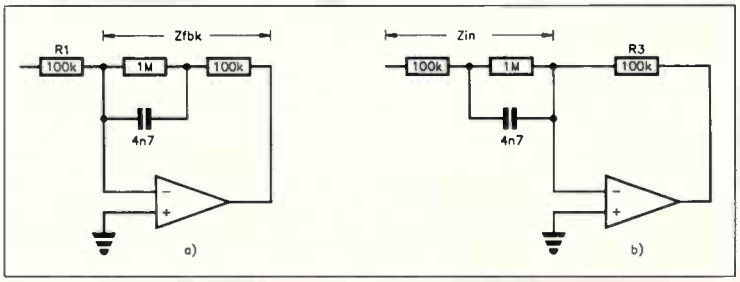


Figure 7.4. Principle of operation of Baxandall tone control: a) control in maximum bass boost position, b) control in maximum bass cut position.

World Radio History

capacitor behaves as an open circuit, so the gain is 1.1M/100k = 11. At high frequencies, where the capacitor behaves as a short circuit, the gain is 100k/100k = 1. At the frequency where the impedance of C is equal to 100k, the gain is approximately two.

So by choosing C as 4n7, this frequency is about 350 Hz and the bass is boosted smoothly from about 1 kHz down. With the control set for minimum bass, the circuit appears as in Figure 7.4(b). Now the gain is R3/Zin which, at low frequencies, is 100k/1.1M = 1/11. At 350 Hz, the gain is about 0.5, and

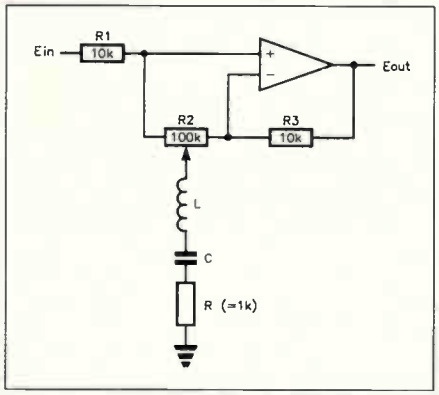


Figure 7.5. Circuit showing the principle of operation of a graphic equaliser.

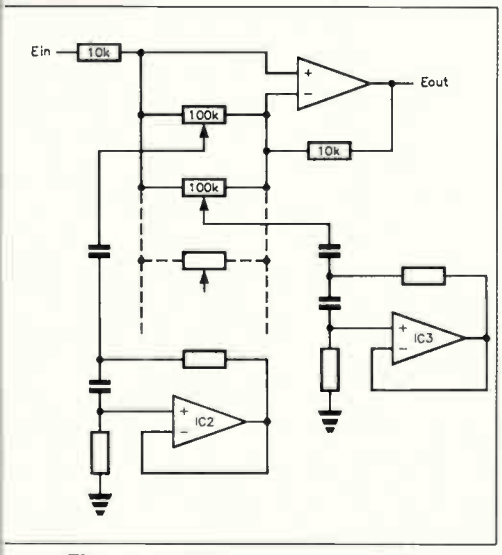


Figure 7.6. Graphic equaliser using gyrators to simulate inductors.

for frequencies above about 1 kHz, the gain is one. With the control set in the centre, the circuit is exactly balanced and the gain is one (or, unity) at all frequencies.

The treble control acts in a similar manner, with the high frequencies being selected by the small capacitor C, and then added to or subtracted from the incoming signal depending on the position of the treble control.

Graphic equalisers

Graphic equalisers use similar principles to the bridge system of the Baxandall control. The general circuit is shown in Figure 7.5. Assume for the moment that the tuned circuit is tuned to resonance, so it behaves as a simple resistor of value R = 1k. When the control is in the centre position, the signal into the non-inverting input is:

Ein × (R + R2/2)/(R + R2/2 + R1)
= Ein × 6/7.

The gain of the amplifier is set by the negative feedback loop and is given by:

(R + R2/2 + R3)/(R + R2/2)
= 7/6.

So, Eout = Ein × 6/7 × 7/6 = Ein.

i.e. the overall gain is one, independent of the value of R. If the control is moved to the left, such that R2 is divided into 20k + 80k, the signal into the non-inverting input becomes Ein x 21/31, and the gain is 91/81, so the overall gain is (21/31) x (91/81), or 0.76.

Similarly, moving the control to the right by the same amount changes the overall gain to (81/91) × (31/21) = 1.3. In this way, the gain of the system at resonance can be changed at will. Away from resonance, the impedance of the tuned circuit is high, and the overall gain is one, independent of the setting of the control. As many as 20 such controls, each with its own tuned circuit, can be connected across the input terminals of the amplifier.

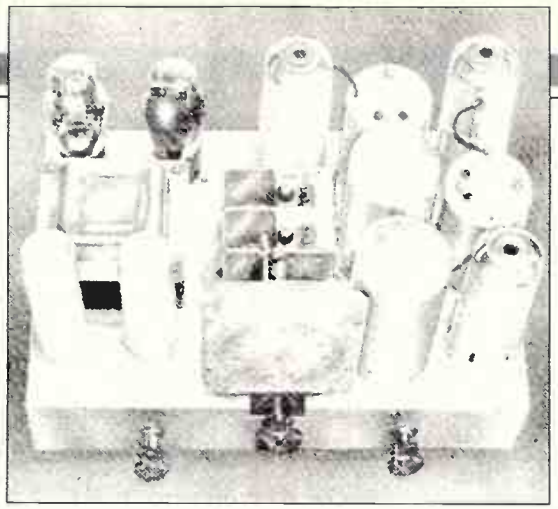
Some equalisers use ferrite cored inductors in the tuned circuits, but many use a 'virtual inductor' generated by a special circuit called a *gyrator*. The circuit of such an equaliser is shown in Figure 7.6, where IC2 and IC3 form two of the gyrators.

Trouble-shooting any of the active tone control circuits is the same as for any audio voltage amplifier.

Valve IF and RF voltage amplifiers

Figure 7.7 shows the general circuit used for both IF and RF amplifiers. Because of the inherent feedback within triodes, they are not used at these frequencies. Pentodes, with grid-to-plate capacitances of 1/100th of those of triodes, are widely used in both tuned and untuned forms. Typical would be the variable mu pentodes 1T4, 6K7, 6BA6, 6BJ6, and EF85 for circuits with automatic gain control, and the linear pentodes 6AC7, 6AU6, 6AK5, 6CH6 and EF91 for circuits without.

The bypassing in these circuits is critical, so if such a circuit is found to be oscillating, the safest procedure is to replace *all* the bypass capacitors. In some circuits, one or both sides of the transformers may not be tuned. Tuning may be by way of a variable capacitor, often seen in IF transformers in older equipment, or by having variable inductance achieved by means of a screw-in slug of iron powder; the further the slug is screwed into the coil winding, the greater the inductance, and vice versa. In VHF stages, a brass slug may be used which has the opposite effect to an iron powder slug – you get less inductance the further you screw it into the



View of a valve superhet receiver chassis. The IF transformers are seen towards the rear right hand corner, either side of the valve located right in the corner — the little "eyes" are access holes for the tuning capacitor trimmers. Picture courtesy of Stewart Day of Stewart Electronic Components, Melbourne. The valves, pictured in Part 6, were supplied courtesy of Andrew Kay of The Vintage Wireless Radio Co., Annandale, NSW.

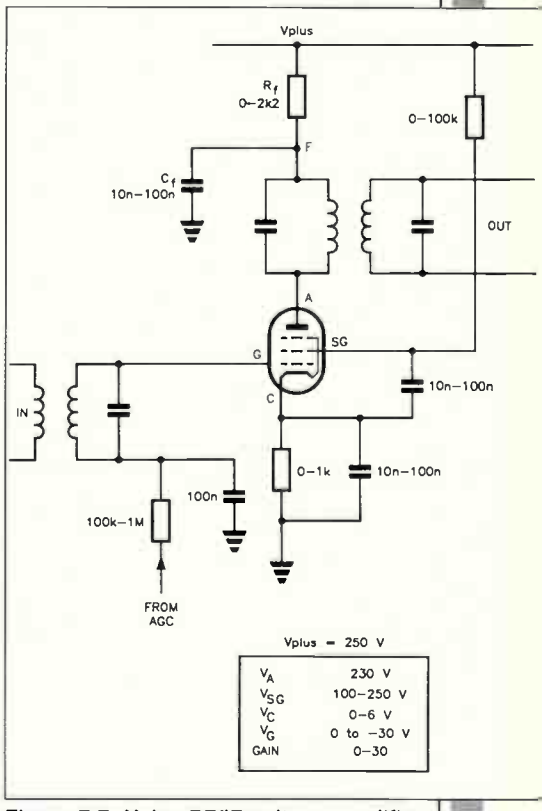


Figure 7.7. Valve RF/IF voltage amplifier.

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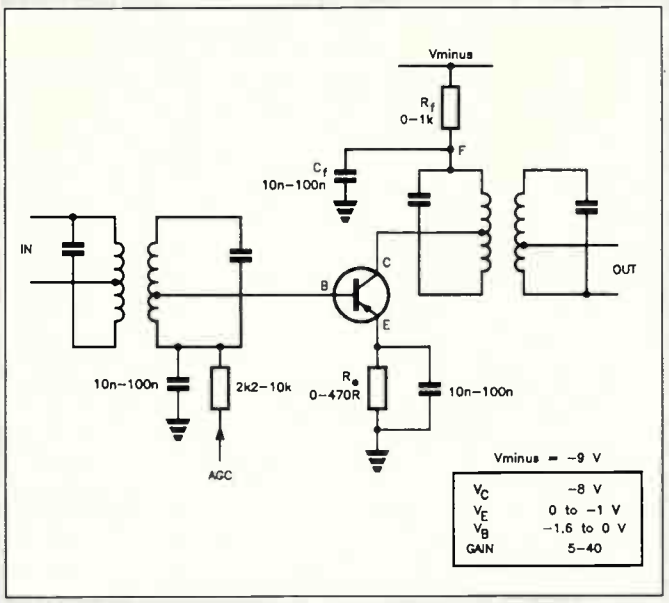


Figure 7.8. PNP transistor RF/IF voltage amplifier.

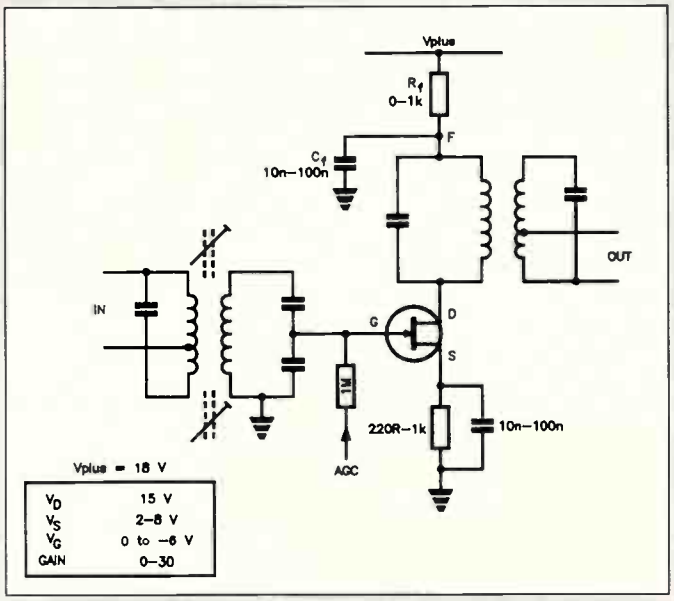


Figure 7.9. FET RF/IF voltage amplifier.

coil winding.

The procedure for dc voltage testing of these circuits is similar to that used with AF amplifiers. Since the resistance of the IF/RF transformer is only a few Ohms, Va will be only a little lower than Vf.

Most IF and many RF amplifiers use automatic gain control (AGC) in the form of a negative voltage, proportional to the signal at the output of a diode detector, applied to the grid resistor of the amplifier.

To test such an amplifier, it is necessary to replace this voltage with a fixed negative voltage, usually −1.5 V or −3 V from a battery; a variable power supply is ideal if you have one that can deliver voltages as low as −1.5 V. Once the grid voltage is fixed, the circuit can be tested in the same way as for an ordinary audio frequency pentode.

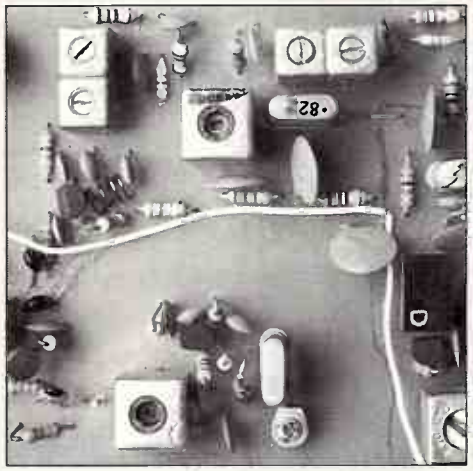
The best way to test the performance of these amplifiers is with a signal generator tuned to the correct frequency. Lacking that, you can use the squarewave output of the ETI-195 Signal Injector, injecting directly into the grid of the amplifier. With a 100 mV p-p (25 mV RMS) signal being injected, the Tracer should read 100 mV or more at the output.

Unfortunately, it is not possible to tune the RF and IF transformers of a broadcast receiver using this setup. Once you are convinced that the amplifier is working, the transformers can be tuned for maximum AGC voltage, first using an aerial and with the radio tuned to the signal from a strong radio station. Once tuned in this fashion, find a much weaker station and 'touch up' the tuning, again adjusting for maximum AGC voltage.

The whole subject of tuning – or, more properly, aligning – RF and IF stages in a receiver is a subject in itself, beyond the scope of this article, I'm afraid.

Transistor IF and RF voltage amplifiers

Mainly for historical reasons, and a slight margin in price, transistor radios usually use PNP rather than NPN transistors in the RF and IF stages. The design is similar to that of a pentode stage except for the biasing and AGC arrangements. Figure 7.8 shows a typical circuit. Transistors have low input impedance and comparatively low output impedance at these frequencies. So, to



A transistor radio, showing the IF and RF stages. Note the adjustable 'slug' cores in the tiny shielded coils.

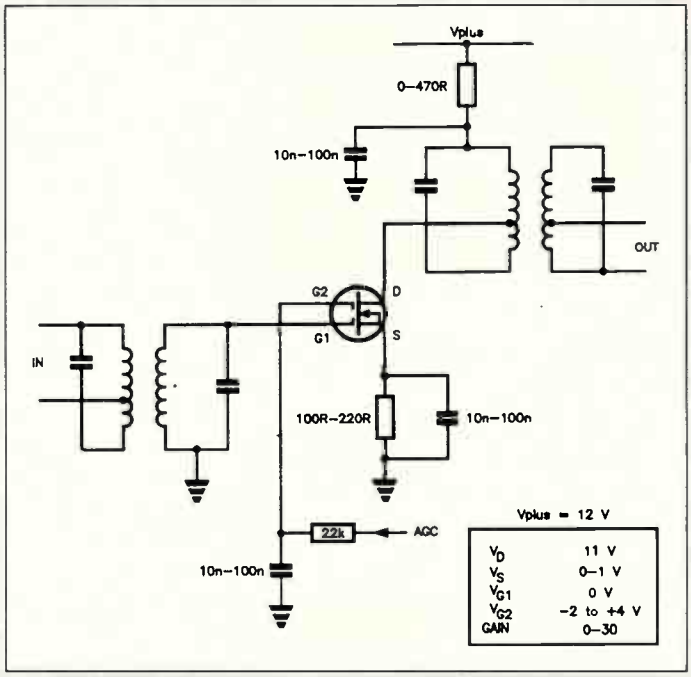


Figure 7.10. MOSFET RF/IF voltage amplifier.

World Radio History

maintain high Qs in the transformers, the transistors are connected to tappings rather than directly across the coils. The circuit has minimum gain when the AGC is generating maximum (positive) voltage and maximum gain when the AGC voltage is zero.

As with valve RF/IF amplifiers, Vc is a fraction of a volt less than Vf. If Vc = Vminus then there is no current flowing in the transistor. This usually means trouble in the AGC system, otherwise Rf, Re, one of the coils, or the transistor is open circuit. If Vc is close to zero, the AGC voltage is much too high or the transistor is faulty.

The NPN circuit equivalent to Figure 7.8 simply has an NPN transistor and uses Vplus instead of Vminus and the signs of the voltages in the table of the figure are positive instead of negative. The ac testing of these circuits is the same as for valve RF/IF amplifiers.

FET IF and RF voltage amplifiers

Because of their high input and output impedance, FETs make excellent RF/IF amplifiers. Unfortunately, they cost a good deal more than transistors so their use is restricted to better quality equipment or to very high frequencies where FETs offer superior performance. Either junction FETs or MOSFETs may be used, depending on the designer's preference.

Figure 7.9 shows the circuit of an RF/IF amplifier using a FET. The gain is maximum when the AGC voltage is zero and reduces for negative AGC voltages. Because of the high input impedance it is possible to use a capacitive divider on the input transformer rather than use a tapping on the coil. With this form of 'tapping', the inductance of the coil is changed to tune the transformer.

Figure 7.10 shows the way in which a dual-gate MOSFET can have AGC applied to the second gate. The AGC voltage in this case has to vary over the range from about +4 V (maximum gain) to about −2 V. The great advantages of the dual-gate MOSFET are that the AGC control characteristics make for smooth control with a minimum of intermodulation and cross-modulation difficulties, and the control voltage and the RF or IF signal paths are completely separate so there so little chance of feedback between the stages that are having their gains controlled.

The dc and ac testing procedures for these circuits are the same as for the pentode, except that typical voltages are those given in the table accompanying Figure 7.10.

IC IF and RF voltage amplifiers

ICs are used as RF/IF amplifiers in some high quality broadcast band receivers, but their main use is in FM and TV receivers. Special amplifiers such as the CA3028A and MC1590G that permit the use of AGC were developed for this. ICs such as the LM3011 are designed for limiter stages in FM receivers so they have no provision for AGC.

A typical circuit for a CA3028A is shown in Figure 7.11 and the dc voltages are given in the table. If these voltages are correct, the block should function, giving maximum gain for an AGC voltage of +9 V. If there is IF signal going in and nothing coming out, and the dc voltages are correct, the most likely faults are in the tuned circuits and the load on the output tuned circuit.

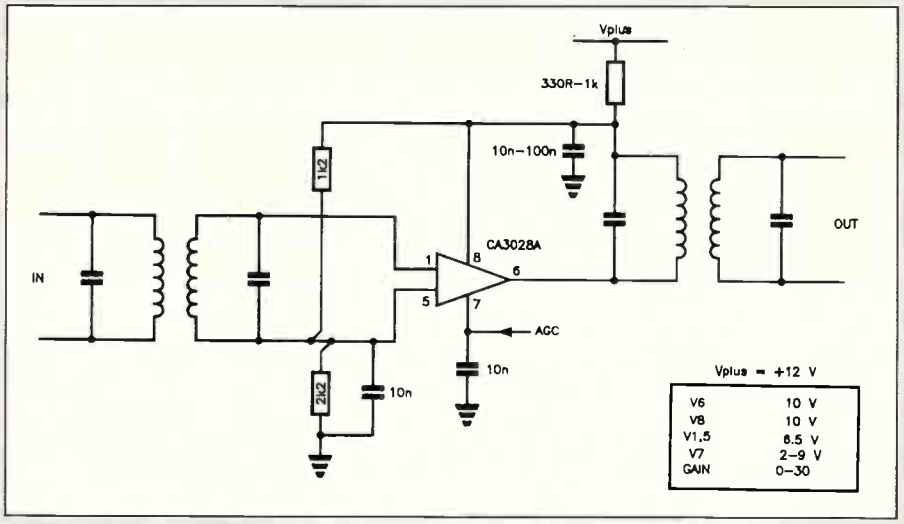


Figure 7.11. IC RF/IF voltage amplifier with provision for AGC.

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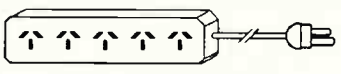

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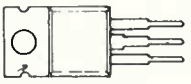

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World Radio History

ARTHUR CUSHEN

RADIO MOSCOW SERVES A GLOBAL AUDIENCE

Radio Moscow recently celebrated 60 years of broadcasting. It operates in 77 languages and broadcasts to all parts of the globe; it has the world's largest shortwave operation.

The network of stations operated by Radio Moscow is extremely complex, according to Jonathan Marks of Radio Nederland, who spent some time in the Russian capital recently.

The stations, spread across the Soviet Union, require schedule changes as often as six times a year. Many of the transmitters are used for 24 hour-a-day schedules, while others are used for lesser periods and several carry other services. The transmitters are linked by satellite and in some cases, a shortwave link, and power is usually 250-500kW. All broadcasts originate from Radio Moscow buildings in the Soviet capital and reception of their signals creates no problem, mainly because of the large number of frequencies used (with anything up to 20 carrying the one program).

The Russians are convinced that this high number of frequencies is necessary (particularly with broadcasts to Latin America) because of the wide area being served. The antenna systems used are modern, and enable the takeoff angle of the signals to be altered within a few seconds. The beam width of the signal is narrow so that energy can be concentrated and the beam moved up to eight degrees either side of its main signal path. Radio Moscow not only has transmitter sites in its 15 Republics but is also relayed by Radio Sofia, Bulgaria and Radio Havana, Cuba. Both of these countries have signed agreements with the USSR for use of their facilities, while plans to have the programs relayed from Africa Number One in Gabon are being considered.

A selection of verification cards issued by Radio Moscow; they date back to the 1930s.

Program services

On the fourth floor of the Radio Moscow studio buildings, the programs are scripted, then taped and taken to the studios to be broadcast. Most material is taped before transmission, with no live broadcasting except when there is a major news item.

While Radio Moscow is the official international voice of the Soviet broadcasting system, Radio Peace and Progress is the voice of Soviet public opinion, trade unions, social organisations, friendship committees and the like. It often deals with subjects which are off limit to Radio Moscow. Peace and Progress used to have its offices in the Radio Moscow building, but recently, when the Soviet authorities stopped jamming Western broadcasts, many of the buildings used for co-ordinating and jamming were left vacant and Peace and Progress has moved into one of these.

In Moscow there are four national programs on medium-wave, longwave and FM, while in recent months, the transmitters which were used for jamming have been put back into service to relay programs from the Soviet Republics for reception in the Moscow area.

Radio Moscow World Service broadcasts to Australia: 0000-0100 7135, 11985, 15420, 17570, 17655, 21790kHz; 0100-0200 7135, 11985, 15420, 17570, 17655, 17825, 21790; 0200-0800 7135, 15420, 17570, 17655, 17825, 21790; 0800-0900 7135, 15420, 17570, 17655, 17765, 21790; 0900-1000 17570, 17645, 17765; 1000-1100 17570, 17645, 17655, 17765; 1100-1300 17570, 17645, 17655' 2000-2100 5905, 9780, 17570; 2100-2200 5905, 11985, 15130, 17570, 17655; 2200-2300 11985, 15130, 17570, 17655; 2300-0000 7135, 11985, 15130, 15420, 17570, 17655, 21790.

News is broadcast on the hour every hour and there is a special program for our area, "Focus on Asia and the Pacific", which is heard after the news at 0100, 0700, 1000, 1130, 1300, 1500UTC.

New Saipan station

THE operation over several months of KYOI, broadcasting popular music to Japan, did not prove to be a commercial success, and last year the transmitter was purchased by Christian Science Monitor.

Station KHBI Saipan has taken over some of the old frequencies of KYOI and continues to broadcast to Australia 0800-1000UTC on 17855kHz. Other transmissions include: 1400-1600 on 9530, 15385; 2000-2200 9455, 17770; 2200-2400 15275, 15405kHz. Meanwhile, transmissions from the Boston Studios are 0000-0200 7400; 0200-0400 0455; 0200-1400 6150; 1400-1600 13760; 2200-2400 9465, 15610kHz. Two transmitters are used, WCSN Scotts Gap, Maine, and WSHB Cypress Creek, South Carolina, both 500kW. The mailing address is, P.O. Box 860, Boston, MA USA 02123.

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

World Radio History

ELECTRONICS

ETI PROJECT BUYERS' GUIDE

Shoparound lets you know which firms are stocking kits for current projects published in the magazine, those firms stocking printed circuit boards, and companies that carry components used in projects we've published, along with news about products and services of interest to electronics enthusiasts.

Electronics retailers and other suppliers are circulated with information on projects to be published in ETI some three months in advance of publication, but there is still a time lag of around six weeks before the magazine appears and many things can transpire in that time that may affect the availability of a particular component and thus the availability of a kit. The information supplied in this column is as accurate as we can ascertain at the time of writing, so please understand if the situation is different by the time you check with suppliers.

ETI-753 Balun

Suitable toroids for this project are obtainable from:

Stewart Electronic Components 44 Stafford St HUNTINGDALE Vic 3166 (PO Box 281, Oakleigh 3166) ☎ (03)543-3733.

Note that Stewarts stock the *complete* range of Amidon toroids. R.J. & U.S. Imports also sell Amidon cores. Their address is PO Box 157, Mortdale NSW 2223. Retail stockists include Geoff Wood Electronics in Sydney, Webb Electronics in Albury, Electronic Components in the ACT, Truscott Electronics in Melbourne, Willis Trading in Perth and Associated TV Services in Hobart.

The Clipsal three-way, round junction box is available through hardware stores, as is the dowel, the clothesline and the eye hooks. The egg insulators were obtained from Dick Smith Electronics. The coax connectors are widely stocked by electronics retailers, as is the winding wire.

Membrane keypad

If you're looking for a 4 × 4, or 16-key, keypad for a combination lock or other digital project that calls for a keypad of this type, then All Electronic Components in Melbourne is the place to go.

They stock keenly-priced membrane-type keypads in both 4 × 4 and 3 × 4 styles, which you can configure to suit your application. So, if you're after a keypad, give 'em a call:

All Electronic Components 118-122 Lonsdale St MELBOURNE Vic 3000 ☎ (03)662-1381.

ETI-1202 Projects from Musical Greeting Cards

Having obtained your "musical modules", any other components you need for these projects are all readily available from electronics retailers. The CMOS 'triple-5' timer is variously known as a '7555', 'LM7555' or 'TLC555CP', depending on the manufacturer. Printed circuit boards are obtainable from the suppliers listed below.

ETI-1548 Power Supply Board

A handy module for all sorts of purposes! The 1N5404/1N5408 diodes used in this project are widely stocked by electronics retailers. For the capacitors you need, a little shopping around may prove a money-saver. Prices vary widely from store to store.

As mentioned in the article, 5600u/40 V types were generally the most expensive. But, as "bigger is better" when it comes to audio amps, 6800u or 10,000u types may be readily substituted where 5600u might be called for.

Printed circuit boards are obtainable from the suppliers listed at the end of this column.

PCBs — general

Printed circuit boards for ETI projects are generally obtainable from three suppliers:

All Electronic Components 118-122 Lonsdale St MELBOURNE Vic 3000 ☎ (03)662-1381.

Acetronics 112 Robertson Rd BASS HILL NSW 2197 ☎ (02)645-1241.

RCS Radio 651 Forest Rd BEXLEY NSW 2207 ☎ (02)587-3491.

However, these firms are not able to supply boards for projects where the pc board copyright is retained by the author or kit supplier. Check the details in the article first or, if they're not to hand, check with one of the suppliers above to see if they do stock it and that they have stocks on hand.

Don't forget that Scotchcals, or Dynamark labels, of front panels and meter scales, etc can also be supplied, where available, by the above firms. eti

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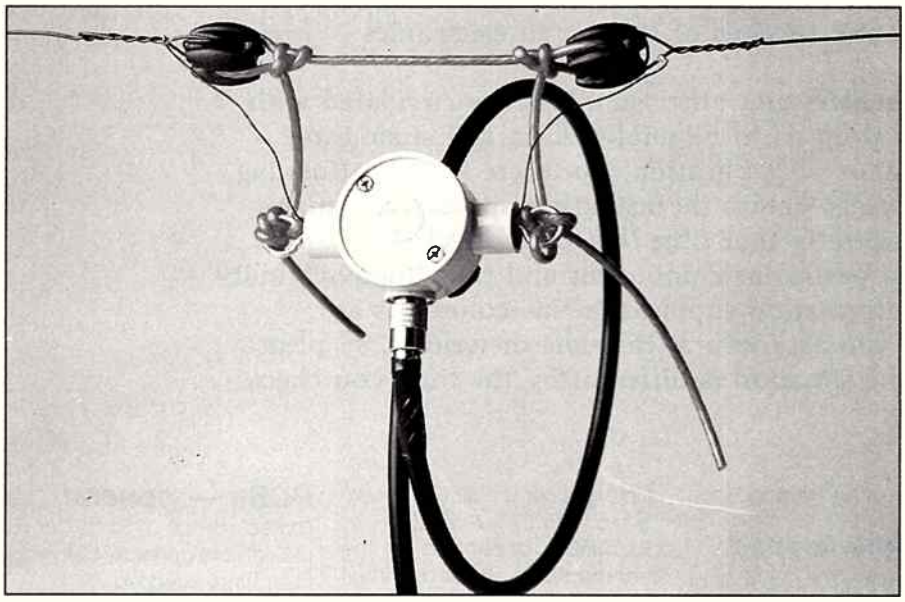
World Radio History

A WIDEBAND 1:1 BALUN FOR HF ANTENNAS

ELECTRONICS
E T I - 7 5 3

While coaxial cable is widely used for antenna feedlines for many good reasons, centre-fed antennas like the dipole have a balanced feedpoint. To interface the two, you need a balun. By Roger Harrison VK2ZTB.



The balun project, slung at the feedpoint of a wire dipole.

All the "good books" on antenna construction recommend you install a balanced-to-unbalanced transformer, or balun, at the feedpoint of a dipole or any other centre-fed, balanced antenna, if it's to be connected to your transmitter (or receiver) via coaxial cable.

When a balanced antenna is fed at the centre with a balanced feedline, the balance is maintained throughout the antenna-feedline system because currents of equal value, but of opposite phase, are flowing in each half of the system at any given instant. The current in one conductor of the feedline sets up a field which is cancelled by the field set up by the other conductor.

When a coaxial cable is connected directly to a balanced antenna feedpoint, the system's balance is upset because one side of the antenna is connected to the inner conductor, while the other is connected to the shield. Normally, in a coaxial cable, the current flowing in the cable sets up a field between the inner conductor and the *inside* surface of the shield. The currents in each conductor of the coax are of opposite phase and, again, if all is well, of equal magnitude. Hence, inside the coax, the fields cancel. No current flows on the outside of the shield.

When the coax is connected directly to a balanced antenna, a current is induced on the outside surface of the shield, as well as inside. Thus, the field set up inside the cable by the inner conductor, and that portion of current flowing on the inside surface of the shield, cannot cancel, and hence the current flowing on the outside of the shield will be responsible for radiation. The effect is particularly noted at higher operating frequencies.

Radiation from the line distorts the radiation pattern of the antenna, and conducts RF into the shack where it tends to create havoc with audio circuits and other electronic equipment in the vicinity.

Such problems can be prevented by changing a balanced connection, at the antenna feedpoint, to an unbalanced connection at the end of the coax which is to be connected to the antenna, while maintaining the impedance.

Principle of the balun

The circuit diagram of a balun is shown in Figure 1. The balun consists of three closely-coupled coils, one of which is connected in opposite phase to the others, as indicated by the dot adjacent to one end of each coil. This winding effectively ensures that phase-cancellation of the fields set up by the currents in windings a-aa and c-cc occurs, the junction of b and aa being grounded to the coax shield.

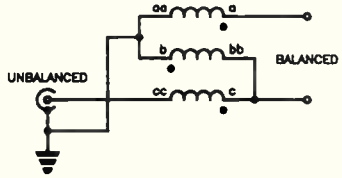


Figure 1. Circuit diagram of a balun, which transforms a balanced connection to an unbalanced connection, while maintaining the impedance. The dots at one end of each coil show the phase of the coil connections. Note that the b-bb winding is connected in phase opposition to the other two.

The coils are really all connected in series, if you rearrange the circuit as per Figure 2.

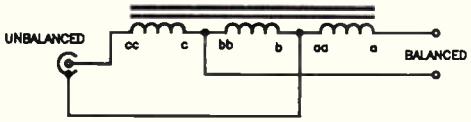


Figure 2. A rearrangement of Figure 1. The coils are all connected in series, as you can see. The balanced connection is made across the a-aa and b-bb windings, while the unbalanced connection is made across the b-bb and c-cc windings. Thus, currents of opposite phase are 'commoned' in the b-bb winding, and cancel.

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The three wires being wound closely together means they act, in effect, as a short length of transmission line themselves. It will have a very broad bandwidth if the length of the transmission line is less than one-tenth of a wavelength at the highest operating frequency. The lower frequency cutoff is determined by the inductance of the coils. By winding the balun on a suitable ferrite or iron powder core, the bandwidth of this sort of balun can extend over many decades. Typically, the lower frequency cutoff may be well below 3 MHz, in the one to two megahertz region, while the upper frequency may extend to 30 MHz, or even beyond 50 MHz.

The balun's core may be any convenient shape, rods and toroids being popular. However, the core must exhibit low loss in order to maintain the balun's high efficiency.

A suitable core

While a short length of rod makes an easy former on which to wind the balun coils, toroids have other advantages which make them popular for this purpose. First, they make for compact assembly. Secondly, they provide a better low frequency response. Toroids of powdered iron are better in high power applications compared to ferrite types. Ferrite cores used in balun applications are known to contribute to distortion of the transmitted signal.

So, having decided to use a powdered iron toroid, it came down to a matter of "which to choose?" So, I consulted product data published by Stewart Electronic Components, which stocks the full line of ferromagnetic products from Amidon Associates of the USA.

I needed a core that could handle up to 400 watts and was of a manageable size – not too big, physically, which would make for an unwieldy balun assembly, and not too small, which would make it difficult to wind coils of heavy gauge wire on to it.

Amidon's iron powder toroid products range in size from a teensy 3 mm outside diameter right up to 100 mm o.d. monsters! "Pick something in the middle," I thought. At the end of this article I have reproduced the Stewart Electronic Components data sheet on the Amidon toroidal cores. I consulted John Day VK3ZJF, technical director of Stewarts, who indicated that type T80 and T106 cores have been used in low impedance applications at power levels of up to 1000 watts.

Looking at the table of Physical Dimensions in the accompanying data sheet, the T80 core measures 20.20 mm o.d. by 12.60 mm i.d. by 6.35 mm thick; the T106 core measures 26.90 mm o.d. by 14.50 mm i.d. by 11.1 mm thick. In between these two is the T94 core, measuring 23.90 mm o.d. by 14.20 mm i.d. by 7.92 mm thick. This all looked promising. In the end, I selected the T94 core for mechanical reasons, which shall become clear shortly.

Iron-Powder Toroidal Cores

AMIDON Iron-Powder Toroidal Cores

AMIDON Associates, INC.

Physical Dimensions — Iron-Power Toroidal Cores

CORE SIZE	Outer Diam. (mm)	Inner Diam. (mm)	Height (mm)	Mean Path L (cm)	Cross Sect. A (cm²)	Volume V (cm³)
T12	3.18	1.57	1.27	0.76	0.01	0.0075
T16	4.06	1.96	1.52	0.95	0.018	0.016
T20	5.08	2.34	1.78	1.15	0.025	0.029
T25	6.48	3.05	2.44	1.50	0.042	0.063
T30	7.98	3.84	3.25	1.83	0.065	0.119
T37	9.53	5.21	3.25	2.32	0.07	0.163
T44	11.20	6.02	4.04	2.67	0.107	0.284
T50	12.7	7.70	4.83	3.20	0.121	0.374
T68	17.50	9.40	4.83	4.24	0.193	0.803
T80	20.20	12.60	6.35	5.15	0.242	1.25
T94	23.90	14.20	7.92	6.00	0.385	2.27
T106	26.90	14.50	11.10	6.50	0.69	4.50
T130	33.00	19.00	11.10	8.20	0.733	6.00
T157	34.90	24.10	14.50	10.00	1.14	11.30
T184	46.70	24.10	18.00	11.12	2.04	21.00
T200	50.80	31.80	14.00	12.07	1.53	17.30
T200A	50.80	31.80	25.40	12.07	2.42	31.40
T225	57.20	35.80	14.00	14.50	1.50	21.00
T225A	57.20	35.60	25.40	14.59	2.73	39.80
T300	77.20	48.00	12.70	18.82	1.79	36.50
T300A	77.20	48.00	25.40	18.82	3.58	71.00
T400	102.00	57.20	19.50	24.94	3.66	91.30
T400A	102.00	57.20	33.00	24.94	7.32	183.00

Number of Turns vs. Wire Size and Core Size

Approximate maximum number of turns-single layer wound-enamelled wire

Wire Size AWG	Core Size T200	T130	T105	T94	T80	T68	T50	T37	T25	T12
10	33	20	12	12	10	6	4	1	—	—
12	43	25	16	16	14	8	6	2	—	—
14	54	32	21	21	18	12	9	5	1	—
16	68	41	28	28	24	17	13	7	2	—
18	86	53	37	37	32	23	18	10	4	1
20	111	67	47	47	41	29	23	14	6	1
22	140	86	60	60	53	36	30	18	9	2
24	177	109	77	77	67	48	39	25	13	4
26	223	137	97	97	85	63	50	33	17	7
28	281	173	123	123	108	80	6	42	23	9
30	357	217	154	154	136	101	81	54	29	13
32	439	272	194	194	171	127	103	68	38	17
34	557	348	247	247	218	162	132	88	49	23
36	683	424	304	304	268	199	162	108	62	30
38	875	544	389	389	344	256	209	140	80	39
40	1103	687	492	492	434	324	264	178	102	51

HOW TO ORDER —:

Core Size	26-mix yl/wh μ = 75 0 -1.0 MHz	3-mix grey μ = 35 .05 - 0.5 MHz	15-mix rd/wh μ = 25 0.1 - 2 MHz	1-mix blue μ = 20 0.5 - 5 MHz	2-mix red μ = 10 1 - 30 MHz	6-mix yellow μ = 8 2 - 50 MHz	10-mix black μ = 6 10 - 100 MHz	12-mix gr/wh μ = 3 20 - 200 MHz	0-mix tan μ = 1 50 - 300 MHz
T400A—	FC— AI 2600				FC301 AI 360				
T400—	FC302 AI 1320				FC303 AI 185				
T300A—	FC304 AI 1600				FC305 AI 228				
T300—	FC306 AI 825				FC307 AI 115				
T225A—	FC308 AI 1600				FC309 AI 215				
T225—	FC310 AI 950	FC311 AI 425			FC312 AI 120	FC313 AI 100			
T200A—	FC314 AI 1550	FC315 AI 460		FC316 AI 455	FC317 AI 218	FC318 AI 180			
T200—	FC319 AI 825	FC320 AI 425		FC321 AI 250	FC322 AI120	FC323 AI100			
T184—	FC324 AI 1840	FC325 AI 720		FC326 AI 500	FC327 AI 240	FC328 AI 195			
T157—	FC329 AI 970	FC330 AI 420	FC331 AI 300	FC332 AI 320	FC333 AI 140	FC334 AI 115			
T130—	FC335 AI 785	FC336 AI 350	FC337 AI 250	FC338 AI 200	FC339 AI 110	FC340 AI 96			FC839 AI 15
T106—	FC341 AI 900	FC342 AI 450	FC343 AI 345	FC344 AI 325	FC345 AI 135	FC346 AI 116			FC346 AI 19
T94—	FC347 AI 590	FC348 AI 248	FC349 AI 200	FC350 AI 150	FC351 AI 84	FC352 AI 70	FC353 AI 58	FC354 AI 32	FC355 AI 10.6
T80—	FC356 AI 450	FC357 AI 180	FC358 AI 170	FC359 AI 115	FC360 AI 55	FC361 AI 45	FC362 AI 32	FC363 AI 22	FC364 AI 8.5
T68—	FC365 AI 420	FC366 AI 195	FC367 AI 180	FC368 AI 115	FC369 AI 57	FC370 AI 47	FC371 AI 32	FC372 AI 21	FC373 AI 7.5
T50—	FC374 AI 320	FC375 AI 175	FC376 AI 135	FC377 AI 100	FC378 AI 49	FC379 AI 40	FC380 AI 31	FC381 AI 18	FC382 AI 6.4
T44—	FC383 AI 360	FC384 AI 180	FC385 AI 160	FC386 AI 105	FC387 AI 52	FC388 AI 42	FC389 AI 33	FC390 AI 19	FC391 AI 6.5
T37—	FC392 AI 275	FC393 AI 120	FC394 AI 90	FC395 AI 80	FC396 AI 40	FC397 AI 30	FC398 AI 25	FC399 AI 15	FC400 AI 4.9
T30—	FC401 AI 325	FC402 AI 140	FC403 AI 93	FC404 AI 85	FC405 AI 43	FC406 AI 36	FC407 AI 25	FC408 AI 16	FC409 AI 6.0
T25—		FC410 AI 100	FC411 AI 100	FC412 AI 70	FC413 AI 34	FC414 AI 27	FC415 AI 19	FC416 AI 12	FC417 AI 4.5
T20—		FC418 AI 80	FC419 AI 65	FC420 AI 52	FC421 AI 27	FC422 AI 22	FC423 AI 15	FC424 AI 10	FC425 AI 3.5
T16—		FC426 AI 61	FC427 AI 55	FC428 AI 44	FC429 AI 22	FC430 AI 19	FC431 AI 13	FC432 AI 8	FC433 AI 3.0
T12—		FC434 AI 60	FC435 AI 50	FC436 AI 48	FC437 AI 20	FC438 AI 17	FC439 AI 12	FC440 AI 7	FC441 AI 3.0

Number shown in [reverse] STEWART stock number. —always order by this number only—
To obtain AMIDONpart number add mix number to core size i.e. T400A-26
AI value shown under stock number (μH / 100 turns)

Turns = 100 √(desired L (uh) / AL (uh/100t))

Iron-Powder Toroidal Cores

AMIDON Iron-Powder Toroidal Cores Con't

MATERIALS

Mix 3 (35 permeability) A carbonyl 'HP' iron-powder material having excellent stability and good 'Q' for the lower frequencies from 50 KHz

Mix 15 (25 permeability) A carbonyl 'GS6' iron-powder material offering good stability for commercial broadcast frequencies where good 'Q' and high order of permeability must be maintained

Mix 1 (20 permeability) A carbonyl 'C' iron-powder material very similar to the **mix 3** material, but has a higher volume resistivity and offers beter stability than the **mix 3** material

Mix 2 (10 permeability) A carbonyl 'E' iron-powder material having high volume resistivity and offers high 'Q' for the 1 MHz to 30 MHz frequency band. Most widely used of all iron-powder materials

Mix 6 (8 permeability) A carbonyl 'SF' iron-powder material very similar to the **mix 2** material but has an improved 'Q' for the higher frequencies to 50 MHz. Higher cost than **mix 2** material

Mix 10 (6 permeability) A carbonyl material offering high 'Q' for frequencies to 100 MHZ

17-Mix (3 permeability) A synthetic oxide material (Trn 8) having moderate 'Q' above 100 MHz

Mix 0 (1 permeability) This material has a permeability of 1. Most commonly used for frequencies above 200 MHz

Mix 26 (75 permeability) A hydrogen reduced material very similar to **mix 43** material, but offers extended frequency range

Iron-Powder toroidal cores are available in numerous sizes rangeing from 0.05" to more than 5" in outer diameter. There are two basic material groups -

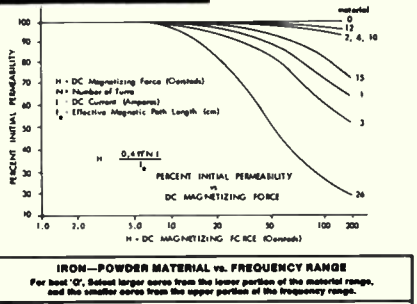
The Carbonyl Irons and the Hydrogen Reduced Irons. The Carbonyl types are especially noted for there excellent stability over a wide range of temperatures and flux levels. Their permeability range is from less than 3mu to 35 mu and can offer excellent 'Q' factors for the 50 KHz to 200 MHz frequency range. They are ideally suited for a variety of RF applications.

The frequency range specified for each material mix is especially important for tuned circuits where high 'Q' is essential. These same materials can also be used in broad-band applications where 'Q' is no longer a primary concern therefore be useful to considerably higher frequencies.

The Hydrogen Reduced Irons have permeabilities ranging from 35 mu to 90 mu. Some-what lower 'Q' values should be expected from this group of cores. They are mainly used for EMI filters and low frequency chokes. In recent years they have been very much in demand for use in both input and output filters for switch-mode power supplies.

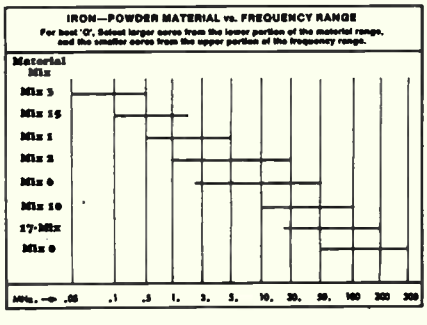
Toroidal cores, in general, are the most efficient of any core configuration. They are highly self-shielding since most of the flux lines are contained within the toroidal form. The flux lines are essentially uniform over the entire magnetic path length and consequently stay magnetic fields will have very little effect on a toroidal inductor. It is seldom necessary to shield or isolate a toroidal inductor to prevent feedback or cross-talk. Toroidal inductors simply do not like to talk to each other.

The number of turns required for a specific inductance may be calculated by using the AI value for the selected core and the formula at the botom of the HOW TO ORDER chart.



IRON—POWDER MATERIAL vs. FREQUENCY RANGE

For best 'Q', Select larger cores from the lower portion of the material range, and the smaller cores from the upper portion of the frequency range.



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You can make your own decision when it comes to choosing the core's permeability, which affects the balun's final frequency range. A '2-mix' will provide operation over the 1-30 MHz range, while a '6-mix' will provide coverage over the 2-50 MHz range. For myself, I chose a 6-mix core. The 'mix' number is added to the core size designation to come up with Amidon's part number, i.e. I used a T94-6 toroid. From the data sheet, this is Stewart Electronic Components' part number FC352. A T94-2 is Stewart part number FC351.

The toroids are painted a dull green or grey colour and then a colour code painted over this, generally on one side only, but sometimes covering the whole core. 2-mix toroids are colour coded red, while 6-mix cores are coded yellow.

A T80 core is ideal at lower transmitting powers and for receiving applications; it is easily wound using 20 gauge (0.8 mm) enamelled wire.

The housing problem

How to house the balun was the next question I tackled. The balun would have to be able to be conveniently mounted at the centre feedpoint in a wire dipole, or at the feedpoint of the driven element of a parasitic beam, such as a Yagi or quad. Hence, I needed a lightweight housing that would accommodate the toroidal core, provide for a suitable coax connector and be capable of being sealed against the weather.

I could find nothing to suit in the inventories of electronics retailers. But, one Saturday, while browsing in my local hardware store, I noticed a small, round, low-cost plastic electrical junction box. It proved to be just the ticket! The one I used is manufactured by Clipsal. It measures 65 mm diameter by 35 mm deep. It has two diagonally opposite ports, and a third port at right angles to these two. Upon close examination, it would accommodate any of the three toroids mentioned above.

A means of suspending the housing at the centre of a wire dipole immediately suggested itself. If an eye hook of appropriate size could be affixed in each of the diagonally opposite ports, the dipole could be tied off to the eye hooks at the feedpoint. A length of wooden dowel through these two ports would secure the eye hooks and thus suspend the housing at the dipole feedpoint. 18 mm diameter dowel proved a tight fit. Bingo!

And with a little further investigation, I found I could fit a single-mount SO239 coax socket in the other port. So, all the required elements of the housing were satisfied.

With the dowel running through the guts of the junction box, not a lot of room was left to accommodate a toroid wound with heavy gauge wire. Playing with a few sample toroids, the T94 proved to be just the thing.

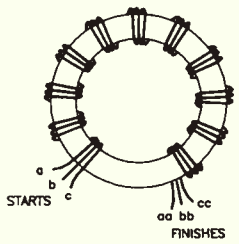


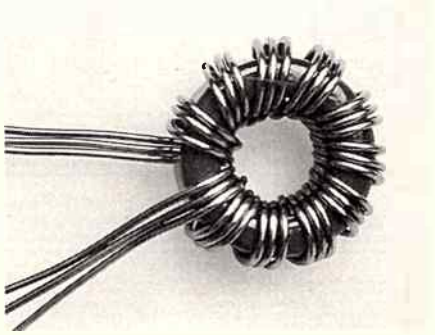
Figure 3. General arrangement balun winding. This is not to scale. On the T94 core, using 18 gauge wire, some 11 trifilar turns will fit around the toroid's circumference.

The accompanying photographs illustrate just how the balun assembly was accomplished.

Balun construction

Wind the coils on the toroid first. It is 'trifilar' wound, the three separate coils being wound with the wire laid together. Cut three lengths of the 18 gauge enamelled winding wire, each 700 mm long. The general arrangement is shown in Figure 3.

Lightly tape the ends of the three wires together. Pass this through the centre of the toroid so that equal lengths protrude each side, then wind the wires round the core, from the middle outwards. This makes winding easier. Make sure you keep the wires flat as you lay the winding round the core, so that you end up with the wires side by side, as can be seen in the accompanying photograph



The toroid after it has been wound. The three wires are laid close together, side by side during winding. A 'turn' on a toroid is defined as one pass of the wire through the centre. A total of 10 or 11 turns of the trifilar winding will fit on the T94 toroid.

of the wound toroid. Note that the lead out wires at start and finish are quite long. This is deliberate, as you shall see later.

These iron powder toroids are conductive. However, they have rounded edges, which avoids scraping of the insulation of the winding wire, and affords the paint further protection. The enamel insulation on winding wire is fortunately quite tough, so no additional precautions against shorts to the core need be taken.

Having wound your toroid, bare the ends of each wire and use a multimeter to identify the individual windings. Slip markers on each end using sticky tape and small pieces of

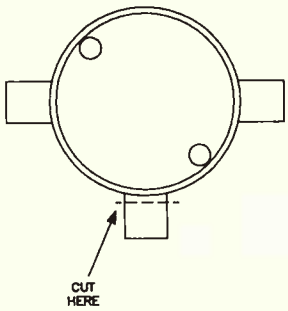
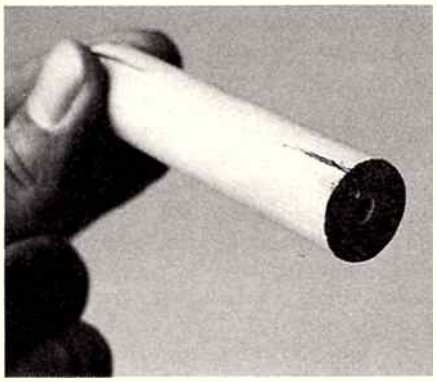


Figure 4. The third port of the junction box is cut off, approximately 2 mm away from the body.

paper with the identifying letters written on them. Now put this aside and tackle the mechanical preparations.

Prepare the short length of 18 mm dowel first. Drill pilot holes for the eye hooks in each end and then saw slits down the shank at each end, as seen in the photograph here. These slits will allow you to pass the wires from



The wooden dowel is prepared by drilling pilot holes in each end for the eye hooks and cutting a slit down each end to pass the balun's connections out to the antenna feedpoint.

the balun out to the dipole feedpoint connections. I used a hacksaw to do this and the slits proved just the right width for the 18 gauge wire.

Next, cut off the third port on the junction box, as shown in Figure 4. The SO239 socket is fitted into this hole. The single-mount socket comes with a spring washer and a solder lug, held beneath the securing nut. Discard the spring washer. You'll find you will need to pare out the inside of the port hole. I used a sharp, narrow-bladed hobby knife to do this. Pare a little, then do a trial fit. Pare a little more and fit again. Keep going until you get the socket to fit comfortably. Put the solder lug beneath the nut and secure the socket.

The coax feedline needs to be

Continued on page 95

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FEBRUARY 1990

HUB

INFORMATION TECHNOLOGY MAGAZINE

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SPECIAL FEATURE: SMART CARDS — THE MICRO MICRO COMPUTERS OF TODAY

DATABASES ON DISC

LAYPERSON'S GUIDE TO LANS PART 1

THE PHARMACEUTICAL INDUSTRY ADOPTS EDI

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KEEPING TABS

While Australia's regulatory authority, Austel, reviews existing arrangements for the cellular mobile telephone service and introductory arrangements for cordless telephony, manufacturers and telecommunications carriers are looking ahead to the era of personal communications networks or PCNs. (The UK has already received licence applications for its proposed PCN: and in Europe 21 companies are cooperating on the development of a system that will service Europe).

The vision implies that each individual will be immediately contactable via a single telephone number which, when rung, will find you either at your home, your office, in your car, or will page you if you are at none of these. Coming of age in the future could mean being allocated a life-long telephone number rather than being given the key to the door of the local pub.

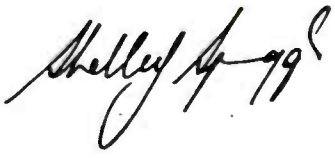
As Stuart Corner writes, the intelligent network that will deliver such a service will comprise huge computer databanks which will track each user, knowing how and when they can be contacted at any time. In his article he reviews the technologies that will form the hybrid system and traces the path to introduction from where we now stand.

Looking to the individual for ultimate responsibility is also evident in the development of the quintessential personal portable micro computer — the integrated circuit card or smart card. One single card no larger than the standard credit/debit card has the potential to become both a debit and credit card, security card for both computer and site access and an indisputable ID card carrying, amongst other things, hand prints.

But beyond the gee-whizzedness of these new technologies, there are some critical privacy and political implications. Those huge computer banks will store a wealth of information on individuals, their associates and interests.

Similarly, it is conceivable that smart ID or access cards will leave a trail of where you have been, what you have been doing and what information you have access to. There is also the prospect of pre-programming cards to prevent spending on some items or to bar access to information or places.

Also in this issue we look at the data storage capacity on CD-ROM and, in particular, the valuable cross-referencing and categorising capabilities of DTMS (Desk Top Marketing System). A quick demo of manipulating the information contained in that database demonstrates its value as a marketing tool; and gives cause to wonder just how innocuous your White or Yellow Pages listings are . . . how many Sydney fish wholesalers have substantial interests in Friendly Societies?



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Cover: D Sarraute/The Image Bank

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Large screen high definition television is set to turn the TV set — the highest selling consumer electronics gadget of all — into a high-tech marvel. But its progress is marred by a three-way standards debate as Europe, Japan and US electronics companies scramble for dominance in a worldwide market estimated to reach $US300b by 2000. As the ABC's **Gerald Moriarty**, Assistant MD (Resources) writes, these disparate approaches will prove to be a headache for Australia as a major program producer and buyer of TV product.

HIGH DEFINITION TELEVISION

NOT JUST A BROADCASTING ISSUE

For most of this decade, debate has raged over the choice of a system which would allow the introduction and mass marketing of the future world of bigger, brighter, better pictures in the home — high definition television.

Dominating the debate — still far from ended — have been the business and national interests of manufacturers, governments and technologists. Although the issue will obviously determine the future of broadcasters and the film and video production companies, it has the potential to influence a much wider industry. The establishment of HDTV standards, and the manufacture of equipment, will potentially affect all forms of video application: computer terminals, graphics screens, electronic publishing, home video games, and specialist forms of video imaging, for example in the medical profession.

Competing HDTV production systems

The Japanese led the development of HDTV for almost a decade, with a system which originated in the research department of NHK (Japan's public broadcaster). This system is based on the Japanese and North American 60Hz television system and is for program production. The new system increases the resolution of the picture by increasing the number of lines on the TV screen from 525 (in the current Japanese and North American systems) to 1125. It also increases the picture width by changing the aspect ratio from 4:3 to 16:9.

The television industry presently uses the versatile medium of film for quality productions. Most productions made primarily for television are made in 16mm format, with some high budget productions, destined for international sales, shot on 35mm.

Australia has proposed through the International Standards Committee a "bridge of maximum commonality". Like most good ideas, the concept is simple.

HDTV production equipment will provide an alternative production medium for television and for major motion pictures. However, programs produced in this new electronic format cannot be transmitted directly to home receivers because the spectrum requirements are too great for any practical delivery mode. They require special encoding and processing for transmission to the home.

In order to transmit the 30MHz bandwidth of HDTV produced programs, the Japanese have designed a compression system called MUSE. This squeezes the electronic program format into a standard satellite transponder of 8MHz or 12MHz for satellite delivery to the home. Herein lies an important

Gerald Moriarty: *It is vitally important to achieve a single standard for program exchange.*

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consideration for HDTV. In order to gain the full advantages it offers, programs will be transmitted either by satellite or wideband cable systems and not over the existing terrestrial broadcast transmitters.

The receivers currently required to receive such satellite services are extraordinarily expensive. Consequently, the daily one-hour HDTV satellite program that NHK began transmitting in June 1989 is targetted initially for reception by publicly accessible receivers in cinemas and shopping centres. The cost of domestic receivers is expected to fall progressively.

The Europeans have invested substantially in research and development over the past three to four years in a frantic bid to catch up with the Japanese — the European initiative has been undertaken by a consortium of European manufacturers under the Eureka Project.

Like the Japanese, the Europeans expect that future HDTV will be conveyed to consumers either by satellite or cable. Initially, all official European direct broadcast satellite television (DBS) will use a new form of encoding known as D-MAC (or a related version, D2-MAC). This will not provide any significant picture improvements to the viewer, apart from improved performance under rain fade conditions and the introduction of extra sound channels. However, D-MAC can be extended to HD-MAC to accommodate the wider picture possible from the studio. This is done at the expense of some of the additional sound channels in the D-MAC envelope.

At the studio end, the Eureka Group has developed studio production equipment based on 1250 lines, 50Hz, which differs from the Japanese. The picture dimensions of 16:9 are the same in both systems. The Europeans have proposed this as the new studio standard for electronic production and exchange of television programs and for major motion pictures. At least in the immediate future, material produced in either the Japanese or the European HDTV studio format will be mostly used by converting it to film and releasing it through the existing outlets, although HDTV theatres are expected to emerge over time.

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The standards debate

The international body responsible for radio and television standards (the CCIR) has been attempting to achieve a single world standard for program production and interchange. Until recently, the debate has centered around the Japanese and European systems.

It is vitally important to achieve a single standard for program exchange in order to avoid additional cost to program producers and users. Australia is critically aware of this need. Internationally we are the biggest program producer outside of North America and Europe. Australia is also a major buyer of television product. Consequently we will be significantly affected by the outcome of the standards debate. If different standards prevail, conversion between systems will be possible, but will incur additional cost and, potentially, degradation of picture quality through the conversion processes.

The common image format

Australia has proposed through the International Standards Committee a "bridge of maximum commonality". It suggests that, after some relatively minor adjustments to individual systems, it would be possible to link all of the proposed new standards for HDTV production and higher definition transmission with the exception of those which are simply upgrades to the existing coding systems of PAL or NTSC.

The convergence of technology and services in the communications and information sector is an increasing reality and HDTV will play an important role in accelerating this phenomenon in the future.

Like most good ideas, the concept is simple. The static picture area of each different system should be identical, having the same number of lines and same resolution in horizontal and vertical directions. The picture area is defined here as only that part of a frame seen by the viewer, leaving the blanked area between the lines and fields to be varied for the different standards' requirements. It is intended the standard would also set agreed values for other picture details, such as colorimetry.

The Australian plan proposed 1080 active lines for a common image active picture area, which permits a square pixel shape for the 16:9 aspect ratio display. Other parameter values that fit the concept may be preferable, and are now under consideration. The concept has been embraced by the North Americans, Japan and the Asian countries, and is being received warmly by broadcasters everywhere, even in Europe where the official position is being reserved for further study. However, European manufacturers favour a different approach in which the data rate of a digitised version of the television signal is held constant between different systems.

Non-broadcast implications

As well as minimising conversion difficulties for the global interchange of television and film programs, the great advantage of the common-image proposal lies in its adaptability to the many new uses for video in the HDTV format. In many of these applications, such as publishing and printing, remote sensing and medical technology, frame rate is not an issue. The number of frames per second can be left as a variable to suit the application. Conversion from one standard to another involves only frame rate conversion which, being entirely in the time domain, is relatively simple and free of quality side-effects. When the images do not have a common geometry, conversion in the space domain as well as the time domain is necessary and this is more complex and unforgiving of errors.

The common image proposal has the potential of establishing a common format for a vast range of future video applications. The proposal leaves open the way in which future high definition video images should be packaged and distributed. These decisions can be made to fit the particular service. The important fact, however, would be that the video image would be universally defined.

The convergence of technology and services in the communications and information sector is an increasing reality and HDTV, especially if it is based on a common image format, will play an important role in accelerating this phenomenon in the future. ■

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The entire Australian Yellow Pages and all metropolitan White Pages listings on one single compact disc? The ramifications of this massive information base for marketing a product or service are enormous.

ELECTRONIC PROSPECTING

BY ERNEST JOSEFIK

A complete list of pharmacies and chemist stores in Parramatta may not seem a very exciting item first thing in the morning — unless, just maybe, you are a super widget salesman, selling widgets to sport stores, and you've just discovered that two pharmacies in Cronulla have recently started selling widgets and are doing a roaring trade. What's more, your territory spans the whole of the western suburbs of Sydney and your boss is nagging you to do less driving around and make more calls per day.

Maybe you're a sales manager trying to divide up territories based on sales potential; or a marketing manager for a specialist printing firm trying to quantify your target market.

Whether you are a one person operation or part of a multinational corporation, if you have anything to do with sales or marketing then these or similar scenarios will be familiar — if they're not, then maybe you are missing out on some golden opportunities out there! But if you have ever tried to buy or compile an accurate list such as the one above you will have come to the realisation

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that it can be very time consuming, very expensive, or both.

It's not that the information is not generally available, rather it is often not available in the form required to solve a problem. To manage the amount of information in large databases has, until recently, required computers with large storage capacities and the cost of equipment has put this capability beyond most companies. Buying lists from companies who can afford the equipment can cost $300+ per thousand records just in rental fees, so even this can get very expensive if there is an ongoing requirement (isn't there always?).

There is a quiet revolution occurring in the world of marketing information, with the recent availability of CD-ROM equipment and databases.

But there is a quiet revolution occurring in the world of marketing information. The recent availability of CD-ROM equipment and databases has placed large information sources in the realm of even the smallest business. These CD-ROM machines are very similar to CD music systems, except that the disks contain computer data rather than music. The main advantage is the amount of data each disk can hold. For example, International Data Pty Ltd, an information bureau and developer of associated marketing tools and services, has available on one CD disk the contents of all 57 Yellow Pages directory listings throughout Australia *and* the entire metropolitan enhanced White Pages directories.

The beauty of this is not that you now have access to all this information — that can be done by picking up a phone book. Rather, it is the fact that you now have the option of sourcing only the information relevant to you at any one time, and in the order it is required. More importantly, this resource is available anytime the need arises.

You can conduct searches by postcode, suburb, telephone exchange prefix, STD code, line of business, industry classification or any part of the business name. That list of pharmacies in Parramatta can be obtained in a matter of seconds, as can all the manufacturing companies in Smithfield, or all the service stations in the metropolitan directories if you had the time and patience.

To access this information, all that's required, apart from the disk, is an IBM or IBM-compatible personal computer with a 20 megabyte hard drive and the CD-ROM drive.

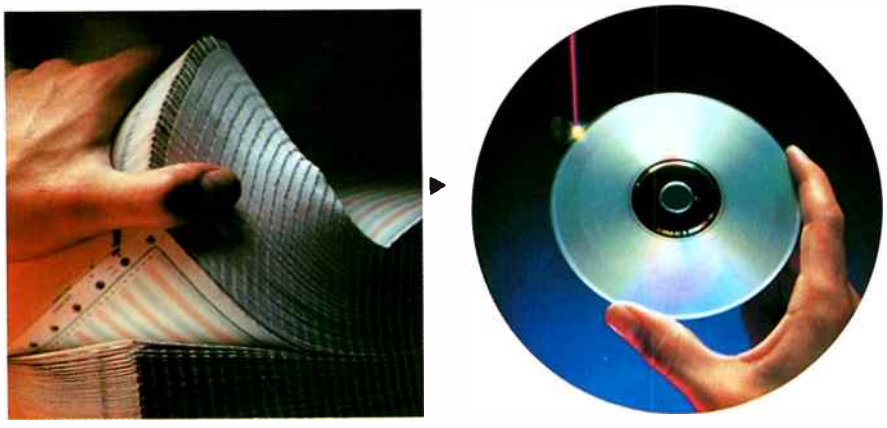
This DTMS (Desktop Marketing System), as it is called, is supplied complete with software to conduct all the data retrieval and management. The software is completely menu driven and appears simple to use. Even novice PC users would not have trouble mastering the main features quickly.

Apart from the search facilities, the DTMS software can also be used to cross-tabulate any two numeric fields and produce a spreadsheet-like table which can then be displayed graphically as a line, bar or pie chart. And for the serious marketers, there is a facility to add a mapping package to display data geographically on the screen, from the whole of Australia down to suburbs and towns. Street maps are just becoming available for the major Australian cities that will allow viewing down to a distance of 17 metres across the screen.

The CD-ROM hardware (or players — for the musically aware) retail for approximately $1400 and are available from a number of retailers including International Data. DTMS is available in two basic forms. For $795 you get the disk and software, giving you full listings and search capability but without the facility to print or download records to other media. In other words, you can look but not print. If printing is a requirement (long lists or mailing labels), or you need to transfer data to other databases this capability can be purchased. The cost depends on the number of records downloaded and varies between $600 for 5000 records up to $16,000 for unlimited access.

Already there are several CD-ROM disks available from a number of dealers, containing data as diverse as Australian Census Information, Business Directories, The PC-SIG Software Library and even the complete Oxford Dictionary. It is imagined that as the demand for this technology increases, the number of vendors producing, maintaining and distributing various databases will also increase, further lowering the cost of data while increasing the range of information available.

So, while the computer industry is still trying to decide whether the CD-ROM technology is useful or not, both small and large businesses have found an inexpensive way of obtaining information from some of the larger information bases available today. ■



From this to this. CD-ROM — a quiet revolution in the world of marketing.

READER INFO No. 324

World Radio History

NEW ZEALAND

A new consortium formed between local Railways and Todd Corporations and American MCI Corporation threatens to break NZ Telecom's monopoly, with plans for a telephone network based on a nationwide fibre optic link.

TELECOM: FEELING THE HEAT

BY JANE McSWEENEY

The New Zealand telecommunications market has finally turned on the heat in an attempt to seriously challenge Telecom's market share.

The heat is coming, predictably, from multinationals with big cheque books. The latest, and to date most viable, competition is the new consortium formed between the local Railways and Todd Corporations and the American MCI Corporation.

Their plans for a telephone network, based on a nationwide fibre optic link, follows Australian subsidiary company Telepac's moves last year to establish a satellite based service. However, the Railways deal looks most likely to be the one which will break Telecom's monopoly. Telpac has come out with the occasional statement saying it is still committed to an alternative network service, but it seems to be floundering as the big boys move in.

The Railways consortium could well save Railways, rumoured as it was to be in almost fire sale mode to relieve itself of massive debts. Its fibre optic network, destined to stretch the length of the country alongside the main railways trunk line, was considered by many to be a white elephant. Railways is rumoured to have already spent more than $15m on getting the network established, and then only in the North Island. However, it has plans to extend its link into the South Island — helped, no doubt, by the capital injection from Todd and MCI Corporations.

Railways was put on the back foot early this year when its original partner, new television channel TV8, withdrew, saying it preferred to use conventional means of transmission. Railways said at the time that it was undeterred by the withdrawal and continued to buy up equipment. It also continued searching for partners.

The fibre optic link was intended to beef up Railways' own internal communications such as routing trains, signalling and reservation systems. It was designed to replace an ageing pole line coaxial cable-based system. However, it quickly became apparent the technology was far too sophisticated and offered greater capacity and flexibility than could be absorbed by Railways. Deregulation of the telecommunications market helped turn what could have been an expensive mistake into a lucrative opportunity.

At the time of writing (December) Railways was rumoured to be in discussion with Cardinal Networks' Linc-based network services to provide an airlines style reservation system. Cardinal would consider moving its more than 100 sites off Telecom's network onto Railways'.

The early possible commitment from Cardinal Networks poses a problem for Telecom. Cardinal is a fast growing network service operator which recently established links into the United States. It is also considering franchise arrangements in Australia. It represents sizeable business, and the first indication that the Railways' fibre optic link is now a viable alternative to Telecom, despite its still being only North Island-based.

The early possible commitment from Cardinal Networks poses a problem for Telecom. It represents sizable business, and the first indication that the Railways' fibre optic link is now a viable alternative, despite its still being only North Island-based.

Telecom is thought to be worried that MCI and Todd bought into the deal too cheaply. Sources say the price was about $40m. The implication is that Railways will have to cross-subsidise its toll calls against local calls to make money. This could see Railways undercutting Telecom on short hauls. Telecom has consistently pushed the line that cross-subsidisation is bad business. It sees its competition and main market in business. To make its services more attractive to business, Telecom has reduced long haul rates at the expense of local calls. Railways has said it could also undercut Telecom in the tolls market by as much as 10 per cent.

But Telecom still holds the trump card, being forced to relinquish it only if the government steps in or if Telecom decides to be magnanimous.

Senior vice president, Ted Trimmer, said in December that it would be impossible to start the service if Telecom did not meet its publicly stated commitment to allow competition through fairly priced and reasonable connection services. Anti-competitive behaviour is controlled in an ad hoc way through the Commerce Act's provisions on misuse of a dominant position in a market.

Telecom also wanted to impose a four figure code for telephone subscribers wishing to select an alternative toll carrier when dialling. Mr Trimmer said this could be a marketing impediment.

However, the Railways consortium may be beaten in the marketing battles by another international consortium which has only recently shown its hand.

Bell Canada, the largest of 10 telecommunications companies that make up Telecom Canada, has teamed up with Broadcasting Communications, a wholly owned subsidiary of the Broadcasting Corporation.

While the joint venture was not signalled as such last December, BCL's managing director Arthur Stacey said Bell Canada was providing advice on the potential of the BCL network to provide switched telecommunications services.

BCL operates a nationwide microwave network used mainly for television and radio. It also offers the Taslink transtasman data communications service with Aussat.

READER INFO No. 302

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This small black box makes money for Australia by saving it in America.

The black box you can see above is actually an amazing energy management system.

And it's currently being field tested by the Baltimore City Council in 250 homes.

But it's not a piece of American technology. It was developed and manufactured by Alcatel STC in Australia.

So it appears that this small piece of ingenuity is set to make a big impact in the States, and become a lucrative export earner for Australia.

Alcatel STC. We're Australia's largest telecommunications company because we know how to compete.

ALCATEL
STC AUSTRALIA

C&M ALC 0004
READER INFO NO. 11

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The Melbourne-based Centre for International Research on Communication and Information Technologies (CIRCIT) is emerging as an important forum for policy development.

COMMUNICATION AND INFORMATION RESEARCH

BY LIZ FELL

The establishment of CIRCIT in Australia represents a unique opportunity for senior managers in business and government to expand their planning and policy horizons.

CIRCIT's brief is to study the implications of new information and communication technologies in all types of organisational and institutional settings at local, national and international levels.

Since CIRCIT opened its doors last July, it has promoted research and seminars in areas such as:

- emergency and disaster communications
- technology and management attitudes
- organisational design and management efficiency
- the use of telephone services
- the effect of multinationals on Australia
- technology transfer mechanisms in China
- high tech and youth employment
- international regulatory policies
- the communication satellite industry
- the effects of strategic export controls.

CIRCIT's founding director, Professor Bill Melody, says the information and communications industries are forecast to become the largest industry sector in the world economy by the 1990s.

Melody, a Canadian who came to Australia after founding a similar research organisation in the UK, maintains that technologically advanced nations will close the 20th century as 'information economies' or 'information societies'.

This means they will be dependent on complex electronic information and communication networks and will allocate a major portion of their resources to information and communication activities.

"What we are learning about the nature of change in the information economy is that social and cultural aspects are fundamental to change, yet they are often neglected in research and policy development," he explains.

"If you look at current studies on why the USA is not successful in this sector, the explanations all relate to a failure to coordinate information, develop knowledge and understand the relationship between culture and economics."

Melody believes this approach leads to a situation where 'econocrats' develop narrow policies and plans for corporations or governments, without considering the full range of implications.

CIRCIT's founding director, Professor Bill Melody, says the information and communications industries are forecast to become the largest industry sector in the world economy in the 1990s.

"It makes sense for the scope of policy analysis to be broadened," he says. "A classic example of this broad type of analysis was the seminar CIRCIT organised on Telecom's Community Service Obligations, where the implications went far beyond Telecom's revenues and costs."

He points to how seminar participants highlighted the importance of telephone access for activities such as the delivery of state-based social services, the work of volunteer groups, small businesses needing to reach customers, and finding employment.

"It's hard to get a job if you don't have a telephone," he observes. "That kind of consideration is important for policy."

The Victorian government has provided CIRCIT with core funding to the tune of $15m over five years, and Telecom has shown its support with a foundation grant of $300,000 for telecommunications-related research.

Melody says he selected Victoria as a base because the government has promoted the state — particularly Greater Melbourne — as a centre of knowledge-based activities for a number of years.

No other Australian state has implemented a long-term strategy to facilitate the transfer of skills and the use of knowledge for a future information society.

GOOD ADVICE

At CIRCIT's first seminar last August, senior business people received some practical advice from Professor Bela Gold, a distinguished US scholar and consultant. In his presentation *Harnessing The Potentials of Information Technology: The Critical Role of Senior Management*, Gold said: "There is a widespread belief among senior management that they should wait until new initiatives in information technologies have been perfected before they adopt them.

"The problem with this is that the time lost in waiting enables others to get ahead, and catching up becomes extremely difficult. Information technology is not something that you can buy, plug in and wait for it to work for you," Gold told the audience.

"Unless you are prepared to think it through and make a total investment in harnessing its potential with a carefully organised sequence of applications, you are wasting your time and your money."

Professor Bela Gold's seminar is published in CIRCIT's Policy Research Paper Series.

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He points to the way the Victorian government has developed a "knowledge precinct", which includes the University of Melbourne and the Royal Melbourne Institute of Technology.

It has also promoted an R&D centre on artificial intelligence and attracted as its director one of the world leaders, Dr Michael Georgess, an Australian who was formerly at the Stanford Research Institute in the USA.

The Victorian Government has provided CIRCIT with core funding to the tune of $15m over five years, and Telecom has shown its support with a foundation grant of $300,000 for telecommunications-related research.

Then there is a new Australian Electronics Development Centre — funded by Ericsson — together with a whole range of institutions designed to promote knowledge in all of its aspects. CIRCIT fits in well.

Melody argues that those nations and localities that establish a commitment to research on the information economy will have a clear advantage in the future.

The trouble is that the Federal government's response, though positive in some areas, consists mainly of a series of isolated initiatives: there is no evidence of an overall approach.

"There is a failure to coordinate activity, to adopt a systematic approach and to think in a long-term way," he says.

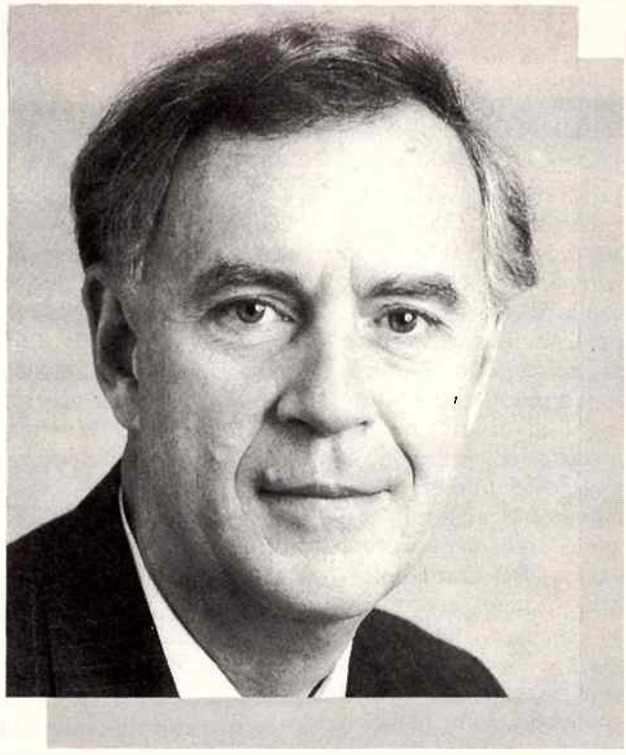
Transport and Communications, for instance, and Industry, Technology and Commerce, (which is concerned with innovation and development) proceed as if they never speak to one another. Educational developments are also separate.

By contrast, Japan — which Melody views as far from perfect — has a Ministry for Trade and Information (MITI) with clear and deliberate policies that are 'proactive'.

MITI, for example, maintains that it is in Japan Inc's interests to create incentives for people to cooperate on some aspects and to compete on others.

Melody believes Australia's future in the Asia Pacific and the global economy is driven by both threat and opportunity.

"There is opportunity if Australia takes a real lead — there are enormous benefits. There is also a great threat, because there is a severe risk that Australia could lose."■



Professor Melody comes from St. Antony's College, Oxford. He was founding Director of the UK Program on Information and Communication Technologies (PICT), (1985-88), and developed post-graduate teaching and research programs in the field at Simon Fraser University (Canada) and the University of Pennsylvania (USA).

Professor Melody has many publications in books, reports and professional journals on the subjects of the communication industries, technologies, economies and public policies and is a member of the editorial boards of many publications. He has consulted with local, provincial and national organisations — both government and corporate — in a number of countries, as well as several United Nations and other international organisations, and has provided expert testimony on a variety of telecommunication policy issues before regulatory and judicial authorities, as well as parliamentary and congressional committees in several countries.

For information on CIRCIT's activities contact: CIRCIT, 1st Floor, 4 Byrne Street, South Melbourne, 3205. ☎ (03) 616-8888 Fax (03) 616-8800.

World Radio History

Around the corner is a world where everyone is instantly contactable: a world where coming-of-age is not marked by legal drinking age but by being allocated a unique, life-long telephone number — a world of PCNs.

PERSONAL COMMUNICATIONS: A VISION

BY STUART CORNER

If you think personal communications are publications advertised by mail order companies with the assurance that they will be delivered in a plain brown paper envelope, think again! In the minds of telecommunications carriers, manufacturers and policy makers, personal communications is a vision; a vision of the future where every individual can be immediately contactable through a small pocket radio-telephone.

When this vision is realised, it will not be through a single, all pervasive, global radio or satellite communications network. (There are many reasons why such a network is impracticable.) The personal communications network of the future will be many networks, some of which are in place today — such as the old-fashioned public switched telephone network, and cellular mobile telephones — and some of which are yet to come.

Equally important will be another component: computer intelligence. The personal communications network of the future will comprise huge computer databanks which will track each user, knowing how and where they can be contacted at any time. For example, it will know when to route calls to your home telephone number, your office, your car mobile, or when to direct an incoming call to a voice messaging system because you don't want to be contacted.

Such a system has frightening political implications which have been given little attention in the present fervour of enthusiasm for newfound technological possibilities, but this is not the place to discuss them. So, let's concentrate on the main technical issues: where we are, today, in the move towards truly personal communications; how we will get from where we are now to the personal communications era; and when it might arrive.

Today, we have cellular mobile telephones; full two-way telephony based on a number of different analogue standards using a cellular radio system with cells varying from one or two to up to 20 kilometres across. Today there are three different air interfaces for cellular systems: the US developed Advanced Mobile Communications System (AMPS), the European Total Access Communications System (TACS) and the Nordic Mobile Telephony (NMT) system. Two digital systems are likely to emerge: the European Groupe Special Mobile (GSM) and the US Digital AMPS.

The personal communications network of the future will comprise huge computer databanks which will track each user, knowing how and where they can be contacted at any time.

Cordless Telephony 2 (CT2) technology is now a commercial reality. This allows the owner of a small portable unit to make calls so long as he or she is within about 200 metres of a radio base station. These units cannot receive calls and, unlike cellular, the caller cannot move out of range of one base station and into the area of another without losing the call. CT2's inability to receive calls can, to some extent, be overcome by carrying a pager, and later CT2 phones will incorporate these.

We have several different proprietary standards for the CT2 air interface (radio portion of the system), but the UK's manufacturers are working towards a common air interface (CAI) standard which should emerge within about a year. This would allow the same portable to be used on different networks, and is an essential requirement as it seems unlikely that in any country, Australia included, a single operator of public CT2 networks will be allowed to dominate the market. It will also reduce the manufacturing costs of the hand held units, an important consideration for the popularity of personal communications. Within Europe, work is progressing towards a Digital European Cordless Telephony (DECT) standard.

To increase the market for CT2 phones, and hence bring down the cost, it is envisaged that they will also be used as cordless phones in the home and for wireless PABX in offices.

Looking to the future, the UK has already received licence applications for its proposed personal communications network (PCN). The Department of Trade and Industry was expected to announce before the end of 1989 the names of the two operators it plans to licence; these will be in addition to the two operators of CMTS services who will also be allowed to offer PCN services.

In Europe, 21 companies are now cooperating on the development of a universal mobile telecommunications system (another name for the PCN) as part of the European Commission's Research into Advanced Communications in Europe (RACE) project.

In Australia, we have only one operator of cellular mobile telephone services, and no public CT2 service. Austel is conducting enquiries into whether we should have competition in cellular, and on how Australia should set about introducing CT2 services. Austel is due to report to the government by the end of March this year. If Austel maintains this very difficult schedule, immediate governmental decisions are unlikely with an

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election looming. So Australians might have to wait a while for their personal pocket communications.

When it does arrive, the personal communicator will be a hybrid beast. To provide the ubiquity of coverage required, it will need to be able to operate on several different air interfaces developed from present day cellular and CT2 standards. Proponents of PCNs envisage what they call macro, micro and even picocells. Macrocells are those used in the present CMTS. Several kilometres across, micro and picocells will be much smaller and are likely to be based on developments of CT2 technologies. So the pocket personal communicator will need to support both cellular and cordless air interfaces. This means the proliferation of different standards could present major problems to the creation of the truly personal communications network.

It is anticipated that the same technology that is used for public cordless telephony services will be used to provide cordless phones in the home. So it has been suggested that, to provide the massive infrastructure of a personal communications network able to support many millions of users, the same physical base station which provides the cordless telephone in the home could be used as part of the public network. In other words, if someone wants to make a call from a pocket communicator and he happened to be outside your house, his call would be picked up by your phone and routed into the public switched network from there. The technical problems in such a proposal are probably minor compared to the regulatory issues and convincing the public to accept such a concept.

One of the proposals for the UK's PCN, from Plessey, claims that, with the right decisions being taken by the UK government to make frequencies available, and with the appropriate choice of technologies, it would be possible to start covering the whole of the UK by 1992. As a consequence of its faith in the viability of the PCN, comes another prediction from Plessey — that by 1992 it should be possible to give everyone in the UK their own personal telephone number, which will be theirs for the rest of their lives.

Plessey believes that the starting point for such a network should be the emerging GSM standard for digital cellular (public cellular networks based on GSM are expected to start operating in 1991).

Plessey's PCN is based on a combination of mobile cellular technology and its Ptarmignan system, developed for military communications. There would be three levels of service, charged accordingly. Importantly, the same hand held unit would be used for all three.

At the lowest level, the user could make calls into the public network from his or her personal phone via either public micro basestations, cordless PABX or a unit in the home. These micro base stations would connect via a radio interface to macro base stations wired direct into the public network. Receiving calls via public base stations would not be possible, but so long as the caller was travelling slowly, calls could be handed over between base stations.

At the next level, the personal communicator would be able to access the PSTN anywhere in urban areas without needing to be within range of a micro base station. Again, handover would be possible at low speeds. The highest level would be for vehicle based travellers who needed access from anywhere in the country with calls being passed between base stations while travelling at high speeds.

Access for rural and in-vehicle users would be provided by means of a personal base station, located in the vehicle or in the rural home, similar to the public micro base stations used in urban areas.

Proponents of PCN envisage the system being hugely popular. Plessey says it would have to spend £2b ($4b) over 12 years to cover the UK, and it assumes a total subscriber base of 10 to 15 million (quarter of the UK population) in 10 years. Plessey claims that such a system could provide a cheaper service than the present public telephone network.

But perhaps Plessey's plans are a little optimistic. One of the submissions to Austel's enquiry into CT2 suggests that users of public cordless telephony services will be mainly those who are mobile and who "frequent certain types of public places." Sounds like the same people who order personal communications in plain brown paper envelopes! ■

MOBILEBITS

Japanese suspend use of lithium batteries

Nippon Telegraph and Telephone (NTT), Japan's major telecommunications network operator, has banned the use of rechargable lithium batteries in its portable telephone equipment. The move follows an incident in which a portable telephone started to smoke while in use, and led to an accident in which a user was burned.

NTT has since replaced — free of charge — all the lithium cells in use in its portable telephones with nickel cadmium alternatives.

Car manufacturers strike mobile phone deal

Australian car manufacturers moved a step closer to the day when mobile telephones will be a standard feature of production vehicles when General Motors Holden and Nissan Australia signed an agreement with Telecom Australia as the sole supplier of mobile telephones.

Each mobile phone in new Nissan or Holden vehicles will be installed in exactly the same way, so that if the phone does need to be serviced, technicians can follow nationally approved specifications.

Installation will be conducted Australia wide, through 360 Holden dealerships and 250 Nissan dealerships.

Creditphone distribution

Exicom Limited and Ferranti Creditphone have entered into an agreement where Exicom will distribute the Creditphone CT2 technology in Australia, New Zealand and South East Asia.

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One of the most important features of the new Telecommunications Act is that value added services (VAS) are open to full competition and that a VAS provider can ensure security of service by registering the VAS with Austel. There are advantages and disadvantages in this course, as **Ian Cunliffe**, senior associate at Blake Dawson Waldon, writes.

VAS & PNS: TO REGISTER OR NOT?

The Telecommunications Act, 1989, allows any person who wants to provide value added services (VAS) or private network services (PNS) to do so, within the terms of class licences issued by AUSTEL. There is no requirement for individual providers of VAS and PNS to obtain a licence or register or even inform AUSTEL as to what they are doing.

The Act enables providers of these services to register them with AUSTEL. However, at the time this article goes to press, after nearly five months of operation of the Telecommunications Act (which came into force on 1 July, 1989), nobody has registered either type of service. AUSTEL, apparently, actively discourages people from registering.

AUSTEL wants to be a facilitator rather than a regulator. The registration provisions of the Telecommunications Act are apparently seen by AUSTEL as smacking of heavy-handed regulation. Perhaps, too, AUSTEL does not want to waste its scarce resources on such activities. The Act, though, imposes a legal duty on AUSTEL to register a service if the application complies with the Act, and AUSTEL is satisfied that the service will be under the class licence.

Registration should not be a particularly difficult or costly process. The once-only fee to register is $200. Probably the strongest argument against registering, apart from the effort and cost involved, is the fact that the register is open to public inspection. Another reason not to seek registration might be to avoid the risk that AUSTEL, if confronted by a marginal application, will refuse registration — whereas, if the service-provider simply went ahead and provided the service without seeking registration, nobody might challenge. (This depends in part on an assessment of how aggressive the carriers — Telecom, OTC and AUSSAT — are likely to be in the months. . . and years ahead).

What are the advantages of registering? The Act says that, subject to one exception, if a VAS or PNS is registered under a class licence, the service shall be taken, for the purposes of the Act, to be supplied under the class licence. The exception applies where there has been a declaration by AUSTEL that the service is unlicensed. However, AUSTEL could only declare a registered service to be unlicensed where (since Austel registered the service) AUSTEL had varied the class licence so that the relevant service was no longer under the class licence.

Registration should not be a particularly difficult or costly process. The once-only fee to register is $200.

The Act says that a VAS or PNS may be taken to be supplied under a class licence even though it is *not* registered. But it also says that an *unregistered* VAS or PNS may be taken *not* to be supplied under any class licence, even though no declaration has been made that it is unlicensed.

One advantage of being registered is that a carrier would seem to be precluded from arguing in Court proceedings that a validly registered service is not being supplied under a class licence. The issue might otherwise arise in proceedings brought against a carrier for breach of its obligation to connect (and not to disconnect) VAS and PNS services, or in proceedings brought by the carrier for infringement of the carrier's exclusive rights.

For example, the Act's carrier-infringement provisions work this way: a carrier may, with the written consent of AUSTEL, apply to the Federal Court for relief where a person has engaged in conduct that involves an infringement of an exclusive right of the carrier under Part 3 of the Act. Given the scheme of the Act, a service being supplied under a class licence could not infringe a carrier's exclusive rights. The contrary view has been expressed by some commentators, but it would seem that in seeking to bring proceedings for infringement, a carrier would not get to first base if the VAS or PNS were currently registered.

The section of the Act allowing infringement actions would enable the carrier, if successful, to get relief, including an injunction and either damages or an accounting of profits. Interim injunctions could also be given.

As mentioned above, AUSTEL seems keen to discourage service-providers from registering. Rather, it encourages intending VAS or PNS providers to approach AUSTEL, which will express its view whether the service is covered by a class licence or not. AUSTEL apparently hopes that providers of such services should feel confident that, having expressed its view, AUSTEL will adhere to that view and refuse to consent to action by a carrier.

That may be. But AUSTEL's refusal to give its consent could be challenged by the carrier, for example, under the Administrative Decisions (Judicial Review) Act. If, for example, the Court decided that AUSTEL, in refusing to give its consent, had taken an irrelevant consideration into account, had exercised a power for a purpose other than the purpose for which it was conferred, or had

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Ian Cunliffe: *The stakes in infringement proceedings could be very high indeed.*

exercised a discretionary power in accordance with a rule or policy and without regard to the merits of the particular case, then AUSTEL's decision might be set aside or even reversed, and the carrier's action for infringement might proceed.

If AUSTEL simply adopts the approach that it will not give its consent to the carrier's action whenever this would involve AUSTEL allowing action against a person to whom it had given the green light, its refusal might well be vulnerable to being overturned.

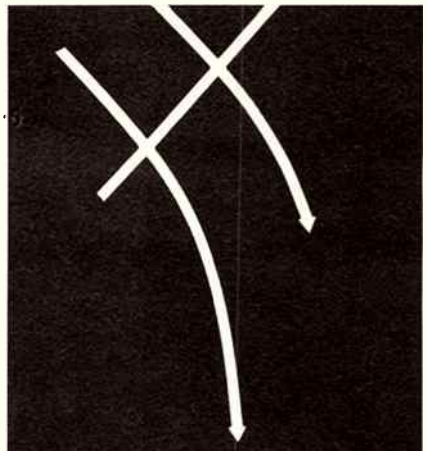
The stakes in infringement proceedings could be very high indeed — given that they might involve an accounting for all of the profits made by the operator from that service from the time it was commenced.

Even if a carrier is prevented from bringing infringement action by AUSTEL's refusal to consent, it can seek to bring matters to a head in other ways. It might, for example, summarily disconnect the unregistered service in question. If the service-provider responded by bringing action, the carrier could defend by asserting that the service was not a VAS or PNS, but was, in fact, a service which infringed the carrier's exclusive rights.

At the very least it would seem to be prudent for providers of VAS and PNS to get a firm ruling from AUSTEL from the outset as to whether AUSTEL regards a service as being within the scope of a class licence. But, given the stakes involved, careful thought should also be given to seeking the formal registration for which the Act provides.

Even if a carrier is prevented from infringement action by AUSTEL's refusal to consent, it can seek to bring matters to a head in other ways.

Under the Act, once formal registration has been sought and obtained the service provider appears to be secure from legal action by a carrier for infringement and from summary disconnection unless and until the service is deregistered. Deregistration cannot occur unless AUSTEL first makes a restrictive variation to the class licence. If the service is deregistered, there are various avenues of appeal and review open. If they fail, the service-provider has the option of ceasing the service — in which case no action for infringement appears to be available — or of making a considered decision to keep providing the service and risk disconnection and action for infringement. ■



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Local area networks have been around almost as long as computers, but it's only in the last few years that they've become cost effective for small and medium-sized businesses. In this issue, Jake Kennedy explores the elements of a LAN and raises critical issues to be addressed in setting one up; and Graham Starkins looks at LANS vis-a-vis ISDN.

A LAYPERSON'S GUIDE TO LANS

BY JAKE KENNEDY

Every reason to install a LAN (Local Area Network) can be summed up in a single word: efficiency. Efficiency in the use of expensive peripherals, efficiency in communications, and efficiency in data usage.

This isn't to say that a network is the only efficient way to manage a multi-PC office. It's a matter of considering the office's work practices and how they can be improved, at a cost that makes it worthwhile. Networking is only one of the options that needs to be considered; two others are — leaving things as they are and installing a multi-user system.

Installing a LAN is not simply a matter of running a wire between several PCs, a printer and the mainframe down the road. The basics for a network are a common pathway to share the data (and peripherals such as printers and modems) and a method of preventing one set of data from colliding with another, plus a method of directing that data to its destination(s).

Topology

The earliest method of joining PCs together used a ring topology — computer A is connected to B, which is connected to the printer, which is connected to C, connected to A; all 'daisy-chained' together. This is often referred to as a Cambridge Ring, after the British University where it was devised. Although it is certainly a workable system, it has an inherent fault: if one node goes offline, the whole system comes to a halt (the data is only transmitted in one direction, like the movement of traffic in a roundabout).

Most commercial ring networks use a parallel path around the ring which provides a detour if part of the net fails. The nodes in a ring can be connected by twisted pair or coaxial cables, or by optical fibres.

The second networking method used a star topology — think of a PABX with a number of phones hanging off it (that's what the originators at AT&T did). There's a central 'server' with a number of nodes connected to it, but not to each other. If the network length is less than 600 metres, star networks are usually connected by twisted pair cables, which limits data transmission to about

CAN ISDN COMPETE?

BY GRAHAM STARKINS*

The concept of providing a data connection to the desk from a digital PBX (utilising an extra telephone cable pair) is very attractive. However, the reality of the situation is that whilst the penetration of digital PBX is set to grow substantially in the next few years, only six per cent of PBX lines will have digital terminals attached.

Whilst the world has waited for the widespread availablity of ISDN services, the personal computer and then local area networks (LANS) have revolutionised the way that many organisations work. LANS have become so much a part-and-parcel of today's business environment that many companies have become totally dependent upon them for the continuation of day to day operations.

As fast as the computing infrastructure has fallen into place, ever increasing user demand for faster communications, extended resource sharing, and more sophisticated applications have made for a highly dynamic networking environment.

As a method of delivering IT services to the desk, ISDN is unlikely to make much progress. The fact that it offers a data rate of only 144 kbps is unlikely to hold much appeal to LAN managers when existing Ethernet and Token Ring systems operate at 10 Mbps and beyond (and are already bandwidth limited in some applications such as imaging). This is especially true when considering that the ISDN technology will not be any less expensive. In many cases, existing cabling structures which do not support ISDN services will prove to be a further barrier.

Where ISDN looks more likely to make an impact is full motion video conferencing, made available through impressive data compression techniques. But even here, high costs will prevent video conferencing from becoming a commercial reality for all but a small segment of the business market.

In summary, the failure of ISDN as a serious contender in local area networking is partly offset by its strengths in video conferencing and WAN connections, which indicate its potential in enabling people to work from home-based offices while maintaining high performance links with the main office. While this will not have any immediate ramifications for the way in which business is currently organised, it could lay the foundation for a restructuring of employment further down the track. ■

***Graham is business manager, Pacific Region, for BICC Data Networks.**

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one Megabyte per second (Mbs). ('Twisted pair cables' are very similar to those used to connect your telephone to the exchange; in fact, in permanent installations the same cable is used.) Since they are only handling traffic between the server and one node this is usually adequate. Over longer distances, coaxial cable or optical fibre can be used.

The simplest and cheapest topology is that using a bus structure. Here a trunk cable, usually a twisted pair, has peripherals and nodes connected to it like roads branching from a highway. One of the advantages of bus topology is that a wide range of equipment can share

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the cable and use of peripherals quite independently, and these devices don't necessarily have to be able to talk to each other. A drawback with this topology is that this method has the slowest data transmission rate.

A high data transmission rate is quoted by some networking vendors as 'a good thing' but, it's only a good thing if you need it. Consider the type of data that will be transferred across your network: if it's primarily small (say less than 100k) documents, then you probably won't notice whether the transfer speed is 10 Mbs or one.

IBM developed their own topology — the Token Ring — a star-wired ring. Here, the cabling radiates from a series of Multistation Access Units (MAUs, often referred to as 'wiring concentrators'). Up to eight terminals can be connected to a MAU, and these can then be linked to form a major network with up to about 260 PCs in it. The MAU uses relays to automatically bypass a node if the device is disconnected or another 'fault' is detected. The Token Ring uses a PC Adapter Card which is fitted to each PC in the network and provides the logical link and diagnostics for the system.

Signal transmission

Aside from the method of physical connection, LANS can use either baseband or broadband as a means of signal transmission. In baseband transmission, the digital data is transmitted in the same form as it was generated and only a single user can access the system at any one time.

The Cambridge Ring and Ethernet use this method. Ethernet employs coaxial cable which allows nodes to be separated by up to several thousand meters. This cable also has the advantage of allowing very fast transmission speeds, overcoming the limitation of the single-user capability by time-slicing (multiplexing) the cable's use.

Broadband transmission avoids the data collision problem by modulating the signal into different frequencies using band-pass filters for separation into different channels, like TV broadcasts. The user (device) tunes into a particular channel without interference from the others. For large numbers of users with a variety of equipment with different transmission problems, broadband will be the method of choice. As you might expect, it's also the most expensive.

Protocols

The third factor that defines a network is the access protocol used. Network protocols allow the members of the network to access the system while preventing them from corrupting the data of others. The two most widely-used protocols are token-passing and collision detection.

Token passing simply passes a 'token' (usually a three-byte digital code) from one member of the net to the next. Token-passing is particularly suited for ring networks: the token is passed in turn to each node until one is found that has data to transmit; the token is changed to show the network is in use and then passed on with the data (and the address of the intended receiver) attached. Each node in the ring reads the token and passes it on, if it is not the intended receiver. When the addressee is reached, it detaches the 'message' and restores the token

MAKING YOUR DECISION

The most critical decision to be made in setting up a network is the choice of an Operating System (OS) for the LAN. The decision is critical, because once implemented, it can be expensive and time-consuming to change.

The first decision should not only be based on what the network will be asked to do as soon as it is set up, but what it is likely to be asked to do in several years. Considerations such as whether or not an electronic mail system is necessary might seem ludicrous with only four users in a single office, but five years down the track, with 20 users on three sites, the question is not nearly so silly. Another example: remote access — the ability of a user 'remote' from the LAN to access it and (most of) its features over a modem — mightn't seem important today, but work practices are changing. For example, more and more companies have come to realise that keeping sales executives on the road and out of the office maximises sales; and the most efficient way for those on the road to work is with a portable PC. If that portable can't access the network . . . what a waste.

Security is one consideration that must be borne in mind from the first day of planning. Not just the three-level password type of security or maintaining data integrity, but physical security of the system and the data entrusted to it. This starts with ensuring the network cables are securely attached and out of the way of an errant foot, and might include the 'bolting down' of machines in high-traffic areas. It certainly includes physical security of your data.

Another factor to take into consideration is the support that the system needs — widely used systems are the easiest to find trained staff for. Still another factor is the amount of RAM the OS will need (it may be necessary to upgrade machines so they can be used on the net.)

Network operating systems can be divided into two very general categories: those derived from MS-DOS and those that originally were designed for mini-computer systems.

These DOS-derived systems all share a primary characteristic: peer to peer resource sharing. Each PC in the net is a server which shares its 'resources' (hard disk, printer, whatever) with the others.

The biggest advantage to resource sharing is that it allows flexibility in network design and use, and it's economical, even in a network with only two PCs. The biggest disadvantage is that as more devices are shared, response times increase. Another disadvantage to each PC's having an equal share in each resource is that it can complicate administration and management.

The two most well-known OSs based on minicomputer operating systems like Unix are Banyan's Vines and Novell's NetWare. Because minis are designed as multi-user, multitasking systems, these features needn't be 'patched' on or added through modules, although the need to emulate DOS and associated elements like NetBios is still there. Standard features usually include electronic mail, support for remote workstations, network bridging and print spooling. If these aren't included in the basic package, they are most-often available as inexpensive add-ons from the original vendor.

Typically, these systems offer faster performance than DOS-based ones

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to show the network is not in use.

The collision detection system lets each node listen to the network and find a gap when the cable is not in use. There is no control as such. If two machines try to use the network at the same time, a collision is detected by both and they each stop trying to transmit for a random period and then try again. This scheme is generally referred to as Carrier Sense Multiple Access with Collision Detection (CSMA/CD) or Collision Avoidance (CSMA/CA). This is the cheaper protocol to implement and is particularly suitable for bus networks, especially those with only a few PCs sharing a few peripherals.

Net to net

Unfortunately, it's not possible to add to a network ad infinitum. A Token Ring is limited to 255 stations per ring since every node needs to handle each frame of data, and Ethernet has problems as more and more stations scream for access to the net.

In fact, smaller networks offer a number of advantages over larger ones. For example, the smaller the network, the easier it is to maintain security; inter-net transfers are quicker; and a malfunction in one network can't interfere with operations in another. Most businesses function essentially as a collection of work groups: accounting, personnel, inventory control, marketing and so on. These are also logical groupings for small networks. Most of a business' data exchange will take place within these groups, but to realise the efficiencies that office-wide computerisation offers, they need to be connected together at some stage. This is made possible by one of three devices: a bridge, router or gateway.

Bridges connect independent networks, but keep local traffic local and forward only that data intended for a receiver on another network, using a 'filtering' process. In its simplest form, a bridge needs to be told which packets of data to filter, since it doesn't know which addresses are local and which are not; smarter bridges — sometimes referred to as 'learning bridges' — are able to work out the location of the addressee for themselves. Bridges are used to connect networks employing different media: fibre optics and co-axial cables, for example. The most efficient way to put performance back into a large, strangling Ethernet network is to subdivide into small networks using bridges.

Routers are used in networks where there is more than one path for the data to follow as it moves from one address to another. In large, divided networks using a number of bridges, there can be multiple paths to a destination; this often results in data looping endlessly and being duplicated, with the result of decreased performance. While the smartest bridges can detect loops and open them up, the surest (and most economical) solution is to use routers.

Gateways are used to connect LANS and mainframes. They are often described as translators: an incoming packet of data is disassembled and then 'translated' into packets that can be ready by the destination system. Because of the complexity of their task, most gateways are dedicated PCs.■

because software in the server itself handles simultaneous requests for data, and runs multiple applications.

Network features

As we saw above, a network can be defined in terms of its topology, the access protocol it uses and its method of signal transmission; and it can have its roots in either DOS or Unix. All of these offer their own advantages (and disadvantages) when choosing a network. But even more important to users and managers are the particular features of each networking system. If you're considering a network, the following should bear heavily on your choice.

Network administration will be the secret of a transparent, trouble-free network. What tools does the network operating system offer to manage the network? Is there a reporting system for network statistics? Are diagnostic utilities for configuring the server included? Is there a reporting method for bad packets and network errors? Is there a facility for assigning users priority access to resources?

Security features should offer multi-level privileges for access to disk drives, directories and files. For example, there should be the facility to allow (or not allow) specific users to read, create, modify or erase files. This is usually done through a system of passwords which is also generally used for the most basic network security: authorising access to the system.

Fault tolerant systems duplicate a critical disk drive or application on a second drive or server — if the first fails, the second carries on. There are also schemes that log critical transactions to a tape drive; in the event of system failure, the log can be used to reconstruct the data.

Dedicated servers will offer faster performance, but whether or not one is necessary depends entirely on how the LAN is used. Server-based applications can be a more efficient method of handling disk intensive tasks (like indexing a database), than leaving it to each workstation where the application is being run.

RAM usage was discussed above. Note that a number of systems offer blocks of memory on optional cards to cover the required workstation RAM.

Disk caching can improve network and application performance by storing frequently requested data in RAM.

Print spooling means that PCs in the network won't be waiting for the printer — the job is saved and queued in a spool (buffer). There should be the ability to change the order of spooled jacks and to 'kill' them.

Electronic mail systems should store and forward messages to a single user, a mailing list or to all users. They should also be able to advise a user that there is mail waiting to be read or that a message has not been received.

Take your time deciding whether or not a network is the solution for your particular problem. If you decide it is, then take your time choosing a system. Check the offerings from a number of vendors with different networking sytems, talk to someone who has had experience with the network you are considering (not just the vendor) and others who have 'networked' — it's a decision the office will need to work with for quite some time, so careful planning, right from the beginning, is imperative.■

— Jake Kennedy

READER INFO No. 326

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GET SMART

The future for smart cards looks promising, but the technology is still being used in trials by banks and other institutions in Australia. Once these institutions give a nod of approval, the smart card technology boom will follow.

It's a small world. A measure of progress and product maturity in our high tech environment is more power and intelligence in increasingly compact (and thus portable) products. The eighties, in fact, was the decade of the diminishing computer — from mega mainframes to desk-tops, then lap-tops and, now, the integrated circuit (IC) card, or smart card.

Maintaining the portability of the 'fantastic plastic' magnetic strip card, the smart or microprocessor card adds the active intelligence and data storage capabilities of a computer. It contains the electronic circuits to both store data and programs and to manipulate the data using the program.

It is like a personal computer in your pocket — the chip is quite powerful, and all that is needed is an external power source, which is the smart card acceptor. (See story overleaf.)

Developed in France in the late 70s by researcher Roland Moreno, the smart card has potential application in almost every aspect of life, from retail applications, site access, membership details, security and authentication applications to data access and delivery dockets.

The smart card has become so much a part of life in France, Scandinavia and Japan, that one company, Schlumberger, issues two million cards per month. (Schlumberger is represented in Australia, New Zealand and the Pacific region by Electronic Transactions, a unit of AWA Card Services.)

Joint managing director of Electronic Transactions, Alain Gottesman, says the success of the card is largely because it is not an elitest, complex object, but an everyday item, disposable and closely linked to the mundane, repetitive tasks of daily life.

That's been the case for ten years in France. They have developed from memory cards for simple applications such as pre-paid debit cards, to cards for security applications such as physical or data access control, to microprocessor cards which provide multi-functional security and storage capabilities. But in Australia, they have been slow to take off as payment cards because of the lack of acceptor points, the cost of manufacture and the absence of firm international standards.

Robert Bader, senior manager, R&D Smart Card Systems with Electronic Transactions, believes we are on the verge of embracing the financial

Smart card applications have been planned in almost every industry and while many have not yet been implemented they are only a short way down the track.

The first and most common use of the memory cards, or wired logic cards, was as pre-paid tokens. Companies like French Telecom and, more recently, Germany, Switzerland, Spain and Sweden, introduced simple cards for use in public phones. They can be purchased from a post office or corner tobacconist. In this token mode they can also be used as an electronic season ticket for payment of public transport, parking and bridge and highway tolls.

★ ★ ★ ★

Before we are too far into the nineties we will have our medical history contained on a card. In the case of an accident, or just a check-up, the doctor will be able to read the file from the card. Apart from the obvious benefits of portability and quick access there will be administrative advantages in decentralising memory banks of national mainframe computers.

★ ★ ★ ★

All the banks currently supplying corporate services like remote banking, EDI/EFT or cash management systems will adopt them for added security measures, a few of the major ones by mid 1990. Security issues aside, corporations will find a bonus in that the transaction data stored on the cards can be used as an audit trail.

★ ★ ★ ★

A multi-function employee card can be used as a key to enter premises, as an access device to computer terminals, as a means of recording hours, a personal portable file of employment details, and as a means of payment at the staff canteen.

Smart cards are being used on the production line. An example quoted by Schlumberger is of a card accompanying a car on the production line to determine colour, engine and transmission specification, seating configuration and so on.

Nissan Motors plans to issue smart cards in the Netherlands around April 1990, and in 17 other countries by 1992. The cards record user information including car service histories. They will be accepted by Nissan affiliated dealers and service shops and at car rental agencies, hotels and petrol stations with which Nissan has links.

★ ★ ★ ★

Pre-paid subscriber cards are being used by cinemas, fast food chains, retailers, car hire firms and courier services. Any business issuing pre-paid cards is likely to gain increased customer loyalty along with a positive cash flow. Sclumberger points out cards used in this way can also provide a ready source of market intelligence on customer buying or behaviour patterns.

★ ★ ★ ★

The Keyline Home Shopping Service in the UK is installing 500,000 home terminals and issuer supplied smart cards. The home terminal unit will be free of cost, but will require a deposit. Keyline is now arranging for cash transfer to the cards and for their use at POS units. The smart cards and reader/writers will be used for telephone system-based remote shopping services.

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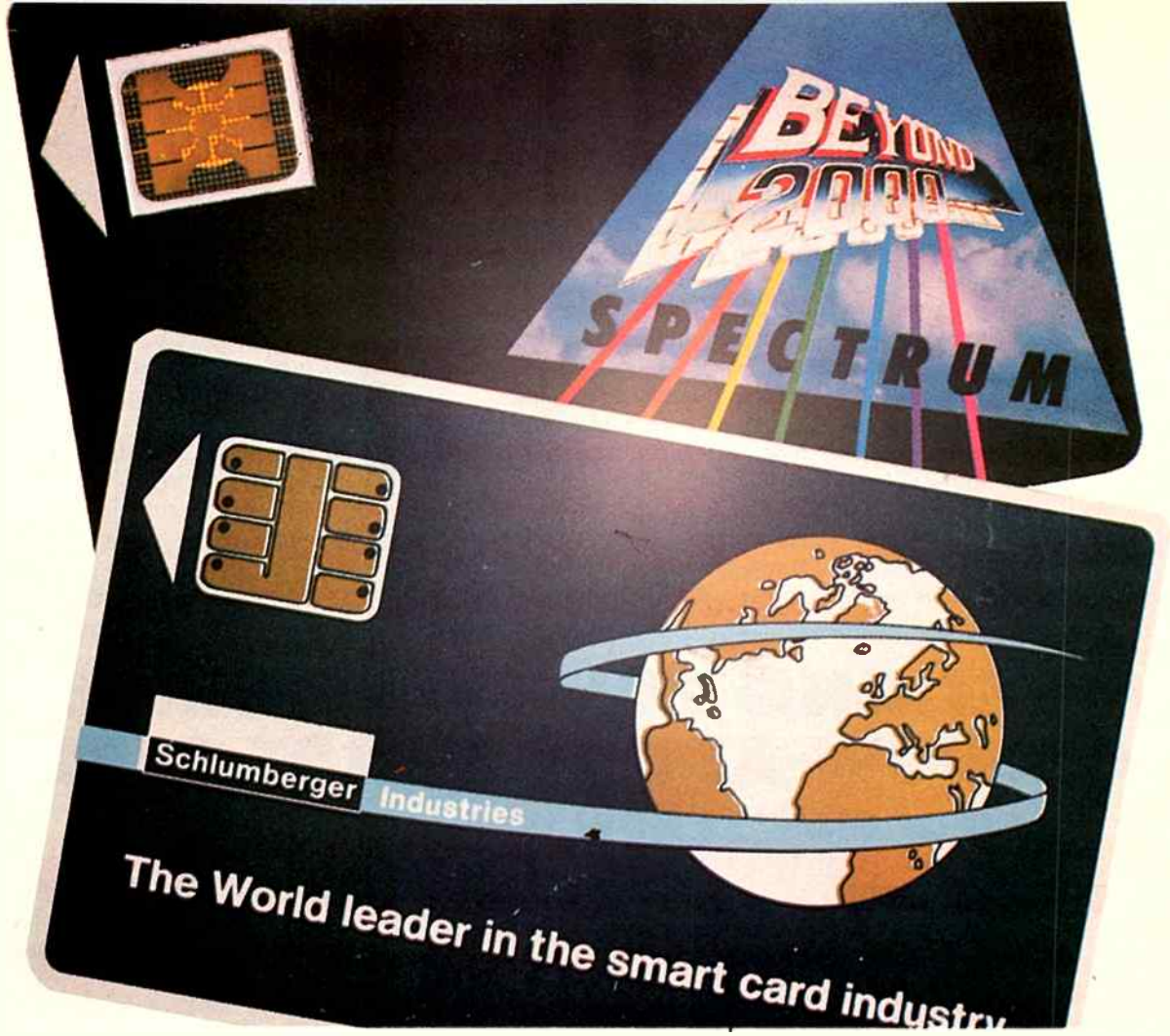

transaction cards with as much gusto as we embraced faxes and credit and debit cards. Once companies like retail bankers, Telecom or public transport authorities begin using them, it will, says Bader, be worthwhile manufacturing them in Australia.

But in other areas, implementation of smart security cards (computer access cards, ID cards etc) are in full swing, as business seeks new ways to secure information. The security commonly used right now is a call back facility. For instance, a company dials into a bank or third party network's (in the case of EDI) mailbox system and gets a ring back. From that method the bank or network knows the call is from an authorised workstation or client. However, they remain in the dark as to whether that computer has an authorised user behind it.

The more intelligent cards provide programmable logic, and include the capability to create your own applications using a card reader and encoder and your own PC. These cards have three separate elements which can be thought of as a static memory, working memory and what could be called a value added memory.

The static memory is the operating system embedded in the read only memory (ROM). The program, which defines the ID and user validation steps necessary to make the card operable, is written into the ROM at the time of manufacture and is frozen at that level.

The working memory is the random access memory (RAM); and the added value comes with the electrically programmable read-only memory (EPROM). EPROM can be divided into a number of partitions to store the data relevant to the card, like the card user's ID and the way that ID can be validated (currently that is primarily by PIN and name but other forms of digitised signatures or hand prints are being applied); or a record of transactions which, once entered, cannot be tampered with.

When smart cards developed from the basic ID and pre-paid debit card functions into truly smart cards — Logical Access Control (computer access) and authentication of financial transactions — it became possible to authenticate the message originator, and the integrity of the transaction, through cryptographic facilities and a so-called synchronous key management system.

In other words the issuer (bank) stores individual encryption keys in each smart card. To successfully access a service, the user must possess something valid — know the secret that is stored on the card and have the appropriate authority in the card. A company can have as many cards as they like accessing the bank from terminals in different locations; before a message goes out, an encryption process carried out in the acceptor terminal seals the message with an electronic signature or MAC (message authentication code) which attaches and travels with the message to the bank for verification.

Taking security one step further, Schlumberger claims that usage patterns can be statistically analysed so if the pattern or frequency of usage changes the card is automatically invalidated.

Microprocessor smart cards are increasingly being used to secure LANS, voice systems and hacker sensitive networks. For example, the US National

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Computer Security Centre at Fort Mead recently purchased over one million smart cards to help protect the Defence Data Network from hackers.

A new development likely to increase the adoption of smart card technology in Australia is, according to Bader, E2PROM — erasable electrically programmable read-only memory. E2PROM cards are either microprocessor cards or plain memory cards, but the memory is portable and thus the cards reusable. In Europe, courier and trucking companies plan to use these to store the routing of a driver or a package or pallet.

Says Bader: "The trick is to digitise information on the goods at the sender end (ie delivery information) and store that information on an E2PROM card which travels with the goods. (It is done now with bar codes, but they are limited by the small amount of information that can be stored.) At its destination, the information on the card can be downloaded to automatically update stock control, reconcile orders, deliveries and invoices, generate remittance advice and trigger payment.

Bader goes further to suggest this type of card could be valuable in EDI applications where there are small companies — like service stations or corner stores — not linked to their suppliers electronically. "What a network carrier with a sophisticated message delivery system can do, a portable smart card can do in a far more economic way," he says.

Apart from security angles and the possibility of living with a coin-free wallet (bridge and tunnel tolls, public transport and pay phone payments will be handled by pre-paid debit cards), smart cards have major cost advantages over their predecessors, the magnetic strip card, in that many transactions can be authorised off-line — authenticating both the card and the cardholder without reference to the host computer or the card issuer — because information is programmed in the memory.

Westpac's chief manager, banking

EVERYTHING YOU EVER WANTED TO KNOW ABOUT SMART CARDS

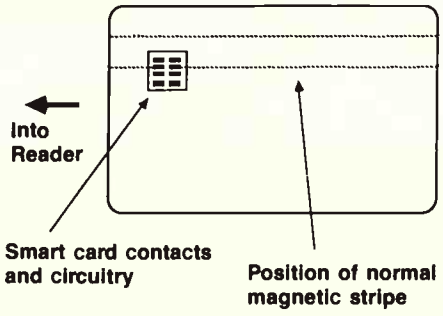
(BUT DIDN'T KNOW WHOM TO ASK)

BY DAVID KILMARTIN

The smart card has opened up exciting possibilities for applications in many areas of communications, data security and storage, personal identification and access control. Importantly, the smart card is a multi-application card and could soon replace almost every card in your wallet. For example, it may be used as a library card, multibank card, credit card, casino gambling card, building access card, medical benefits card, telephone credit card and still have room for many other functions yet to be discovered.

Competition in the smart card market is fierce in Europe and North America, and the technology is being developed for many useful applications. Now, and in the next few years, distributors of the European and North American manufacturers will be pushing smart card technology in Australia. Obvious candidates, initially, are the banks, some government departments and large businesses requiring security features to be added to communications links.

So, before these distributors try and sell you smart card technology, or before senior managers ask you whether you have considered smart card technology, it might be worthwhile to have some background knowledge.



The position of the smart card contacts and circuitry.

What is a "smart card"?

Firstly, a "smart card" is smart when compared with its relative — the magnetic strip bankcard (you probably own a few of these!). The smart card is the same size as a normal bankcard, but the actual circuitry covers a small fraction of the total card (1/40th); the rest is used for advertising.

The smart card contains memory capacity and a microprocessor integrated onto a single chip. The memory is divided into files which can have various types of access allowed — depending on the information contained in them. The card owner can create files and insert information. The card supplier may program the card with a specific file arrangement suitable for a particular application. The microprocessor is capable of processing data with a cryptographic algorithm.

Currently, most cards use the Data Encryption Standard (DES)* as used in Australia's EFT network, as this is the most secure symmetric algorithm available. In the future, other algorithms may also be implemented on the card, including the RSA asymmetric algorithm.

There are a number of models of smart cards available on the market, the difference between them being the amount of memory available on the card, the type of technology used to create the integrated circuits and the type of contacts used for interfacing with other equipment.

The ISO Standard

The International Standards Organisation (ISO) Standard ISO7816-1/2/3, entitled "Identification Cards — Integrated Circuit(s) Cards with Contacts" contains the basic characteristics of smart cards. Described in detail are the physical characteristics, contacts and the electronic signals and transmission protocols.

* *A complete description of DES is available in Australian Standard AS2805.*

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communications, Glen Davis, cautions that authorising off-line transactions carries associated risks . . . "particularly when, as currently happens in Australia, there are transactions written to the account when the card is not present (eg home banking, direct debit, direct credit, periodic payments). Then the account record in the card will be deficient until the card is put on-line and updated.

"So we will need a combination of card-resident rules for authorising off-line transactions and host-resident rules for transactions written when the card record cannot be updated."

Card and host resident rules may have some serious implications in the privacy debate. During the debate over the Australia card, concern was raised over the possible programming of cards to prevent spending on some items. One scenario raised was that dole recipients would have their money paid directly to their smart debit card and find, for example, when they presented the card, that they were barred from purchasing alcohol.

But those possible drawbacks are more than compensated for in the security and convenience that will be afforded users, whether they be mega conglomerates or welfare recipients.

According to Bader we will see, or even receive, a lot of smart cards in the next year or so. "There will be a lot of ID and membership cards and proprietory debit cards (store cards or private label cards) that will store the credit limit account balance and demographic information in the card. The available technology has to be managed, as we have done in the past year with security cards, and marketed as 'solutions'," he suggests.

Summarising from the banks' point of view, Davis believes smart cards are going to be great in EFTPOS and corporate banking applications — eventually. "Now is the time for careful analysis, planning and trials and for the support of standardisation," he says. ■

— Shelley Spriggs

But basically each smart card has eight contacts, whose functions are:

- I/O — for input and output of serial data to the integrated circuit inside the card.
- VPP — programming voltage input, to program or erase the volatile memory.
- GND — ground reference voltage.
- CLK — clocking or timing signal.
- RST — reset, may be used in combination with additional internal reset control circuit.
- VCC — power supply input.
- Application specific contacts not defined.

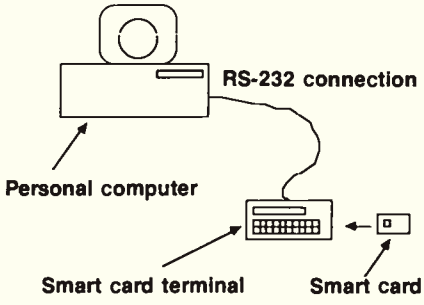
ISO 7816 is a sparse document, containing little of interest or value to the majority of people. The price of the document makes it a definite non-essential.

Smart card interface

The smart card is not a self-contained security module and it does not have its own power supply. Via the contacts described above, the smart card interfaces a smart card 'reader', or smart card terminal (SCT).

The SCT is basically just a card acceptor similar to the handheld EFTPOS terminals in supermarkets and slightly larger than the older style Hewlett Packard calculators. The SCT has an LCD display (similar to a normal calculator) and push buttons numbered 0-9 (plus one or two special function buttons). These push buttons allow a user to insert a personal authentication code (PAC) after the card has been inserted.

Although not available yet, it is known that a number of major computer manufacturers will soon be releasing PCs with built in card readers. This will simply mean an extra slot below the floppy disk drive. In this situation, the SCT keypad is substituted by the PC keyboard and hence this form of SCT will be markedly cheaper. There are, however, applications where it is desirable to keep the SCT separate as a peripheral.



A typical smart card security module.

The current trend is to provide a self-contained security module which can be added to existing applications without the need for extensive modifications. Standard security software is available now for the SCT, which can be downloaded into the SCT from any PC or other computer system. This software, with its easy interface, requires the users to make only small modifications to existing applications to add an extra layer of security. This approach provides a firm basis for the addition of further layers of security in the future.

Once again, the SCT and the smart card do not comprise a complete security module. The SCT must be connected to a personal computer. This is done via an RS-232 interface into the PC communication port. Users will then write their own software (or purchase it from the smart card supplier), to interface between the SCT and a particular application already existing (eg. an EDI application), or to create a new application (eg. PC access/ID verification etc.).

Before you purchase a particular smart card system, determine how much SCT software is included in the price of the system and how much the remaining software will cost.

The price

The price of a typical SCT is between $A800 and $1,500. Obviously, with multiple orders, the price per unit will decrease. Single cards can cost between $A5 - $A30, depending on model and availability and larger orders will bring prices down considerably. This situation exists in France where millions of smart cards are supplied as telephone credit tokens and discarded after use, the cards being so inexpensive to manufacture.

When they become available, built-in PC card acceptors will add about $A300 - $A400 to the base price of a PC. The price of SCT software is an unknown and depends on the deal between supplier and purchaser. Although not available yet, it may be possible to circumvent the supplier and purchase off-the-shelf SCT software, compatible with any SCT. ■

READER INFO No. 325

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DRUGS ON THE FAST LINE

Pressure from competition, customers and the Federal Government is leading major pharmaceutical wholesalers and manufacturers to adopt electronic data interchange (EDI) and introduce new business practices.

One of the first industries to implement electronic order taking is set to throw off its earlier systems to embrace EDI (Electronic Data Interchange) on an industry-wide basis.

As early as the 1970s the pharmaceutical industry has used handheld portable data terminals known as PDEs (portable data entry) to receive pharmacy orders. A pharmacist takes the handheld unit around the shop, determines which stocks to order and keys in the details, sending the data via the telephone line to the wholesaler. Since the first live receipt of orders, as much as 90 per cent of all orders to pharmaceutical distributors has been electronic.

In the light of recent conflict stemming from the Federal Government's pressure to leverage change into the industry and the modern problems associated with just-in-time (JIT) manufacturing, one leading distributor/wholesaler took the bit and initiated an EDI pilot with a manufacturing giant. That was 12 months ago and now the major players of the industry, Australia-wide, are gearing up to follow suit.

The wholesaler, Australian Pharmaceutical Industries (API), is a cooperative owned by retailers and run by a board of directors which is elected by practicing pharmicists in NSW. Customer responsiveness is therefore vital to API. The form of JIT being practised in this country is, as Kim Murchison, general manager operations and EDP for API says, "not quite soon enough, too often".

"Our industry is characterised by a group of manufacturers, the majority of which do not distribute directly to pharmacies, wholesalers/distributors and pharmacies/retailers.

"EDI held out the promise of improving the flow of goods through the pipeline."

"EDI held out the promise of improving the flow of goods through the pipeline, with some reduction in lead times, reduction in errors and possibly some cost savings, although that is not a primary consideration."

The manufacturer, L & K Rexona (Rexona was taken over by Lever & Kitchen last year), saw the offer to participate in the pilot as an opportunity to improve customer service (their customers being wholesalers such as API).

The 12-month trial between API and L & K Rexona was via the Telecom Plus/Ferntree Computer Services' Tradelink EDI network. It used the ANSI X.12 standard (the industry-wide network will switch to EDIFACT once that standard is firmly established) and involved purchase orders from the wholesaler to the supplier, and purchase order acknowledgement back to the wholesaler, giving information on any variation on the order such as delays on delivery, adjustments to quantities and so on.

The purpose of the pilot was twofold — to define what each organisation would have to do to introduce EDI; and to test the technical platform.

Benefits have not been obvious but, given the limitations of just one trading partner and a fair degree of manual interface, Murchison is happy that "the trial was as successful as we could expect it to be" — successful enough for other leading manufacturers and wholesalers in the industry, some of whom, along with API, Rexona, Telecom Plus and Ferntree have formed the Pharmaceutical Industry EDI Steering Committee.

Senior EDI consultant with Ferntree, Barry Jones, says the committee was established to get a degree of coordination in the implementation of EDI. "It is not a policing or monitoring body and it doesn't set rules, it exists simply to set guidelines".

The steering committee will guide the industry into full EDI through a

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step-by-step process of phasing in more transactions and more trading partners along the way.

The first stage will go until mid-1990 and involve about 30 companies exchanging purchase orders, purchase order acknowledgements and turnover orders. Turnover orders are those taken from pharmacies by manufacturers' sales representatives, who send the order to both the manufacturer and wholesaler. Explains Cindy Carpenter, NSW pharmacy account manager at L & J Rexona: "In effect, they are selling for the wholesaler, but in the long run they are selling for the manufacturer. At the moment, turnover orders can take up to two weeks to be delivered to pharmacies with the minimum being one week. Sales representatives go out for one week, deliver the turnovers on a Friday, and we [the manufacturers] transmit the orders to the wholesalers on the Monday; they, in turn, deliver the goods to the pharmacy during that week.

"With EDI, the representatives will deliver orders daily — as they file them through electronically we will on-pass them as soon as we receive them."

The second stage will begin mid-year, taking in another 60 organisations and will include delivery information, credit notes and price changes.

Outside of timing advantages, customer service will be further enhanced with the introduction of industry-specified elements like reporting back when 'out-of-stocks' will be available. API's Murchison says the industry has been plagued in recent years by out-of-stocks. "Traditionally, we pride ourselves on providing a 99 per cent service level on prescription orders, slightly lower on general orders. We are achieving that sort of level, but that is excluding items which manufacturers can't supply to us."

A stumbling block is the lack of computerisation at raw materials suppliers and retail outlets.

A working party set up by the steering committee to determine standards is currently working on a system whereby everybody maintains an electronic file on when out-of-stocks will be available and why they are not presently available. That information will be reported back in the purchase order acknowledgment and is, according to Carpenter, one of the most identifiable advantages of EDI.

Since the first live receipt of orders, as much as 90 per cent of all orders to pharmaceutical distributors has been electronic.

Over the horizon, transactions like new product information, forward demand patterns, and automatic stock-taking and ordering through information gathered at the point-of-sale will see the Australian pharmaceutical industry as fully automated as the related retail industries are becoming in other parts of the world. The stumbling block to reaching this goal is the lack of computerisation at the extremities of the production chain — the raw materials and the retail outlets.

At the periphery, Ferntree's Jones sees the possibility of adopting some of the transport practices of other industries: setting up receiving stations at the distributors where trucks have on-board terminals to receive information and are given a half hour time slot to off-load — if they don't arrive at the allotted time they are unable to dock.

The introduction of EDI in this industry will not necessarily be a smooth process. For one, product identification is a major factor to be tackled and EDI is the lever to get it underway. The PDE codes now being used by pharmacists to order from the wholesaler are wholesaler-specific. And what manufacturers' sales representatives key into their portables are individual manufacturer codes which, when transmitted from the manufacturer to the wholesaler, get unscrambled into the wholesalers' code.

And within the wider uniformity issue there is the question: to use an APN (Australian Product Number) or a TUN (Trade Unit Number) ? APNs are attached to the individual item identifying a retail saleable unit — the smallest possible unit. This is favoured by the so-called ethical manufacturers (those supplying prescription items) because they can supply one bottle.

Manufacturers of the ilk of Rexona supplying over-the-counter

READER INFO No. 323

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goods, and which also supply to grocery retailers, will not break up a carton, so they favour the TUN which attaches to a carton. They also have to supply bar codes, because their product will be rejected on the grocery side if it isn't bar coded.

Says Carpenter: "The pilot is running at the moment using APNs, but there is also a field for their (the wholesaler) product code, our product code and the TUN. It may be that the standard developed will continue to cater for the four indentifiers."

In addition, there is substantial work to be done on internal systems. "A big problem for all players in this business," says Murchison, "is not so much getting the data to push out to others, but in getting other company's data back into your computer. It is a relatively minor matter to change our computer programs, for instance, to generate purchase order data in a format that can be translated into EDI. But to take the trading partner's purchase order acknowledgement, absorb that into our systems and put the data through to the most appropriate places is a much more difficult exercise.

"It will take us something approaching five years to complete the entire process, including funds transfer — the logical conclusion of a purchasing document — and, yes, we are going to have to change the way we work!" ■

— Shelley Spriggs

EDIBITS

INTERNATIONAL ROUND-UP

A measure of the importance EDI is assuming, both as a revenue spinner for network providers and software companies, and as a new business strategy for successful corporations, is the number of surveys on market acceptance recently released around the world. After the flurry of pilot programs set up in the late '80s it is time to determine directions for the nineties.

EDI taking off

One study in the US by International Resource Development Inc reports the market for EDI services and software is "approaching the point of critical mass take off".

The four main ingredients that will bring users into the market in droves are finally coming into place: interconnectivity, standards, major vendors and users.

The report holds a warning that despite expected market growth in the 30-50 per cent per year rate for the next several years, competition between vendors will be so fierce that only the largest companies will be able to participate profitably in the provision of network services. And, on the software side, markets are so fragmented that it will be difficult for any company to carve out a consistently profitable position.

EDI use less than predicted

US-based EDI Research Inc, on the other hand, finds that big business isn't adopting EDI as quickly as its proponents had hoped, although it is seeing strong growth.

In their study "The State of US EDI: 1989" 1,504 companies (primarily Fortune 1000 companies) were interviewed: 52 per cent said they were not planning to introduce EDI in the next two years; 20 per cent didn't know; and 28 per cent were using it or planning to in the next two years.

The study found one of the strongest signs of robust growth was the number of trading partners most users have: projections showed the average number should rise to 66.8 by the end of 1990. That growth, concludes the report, should see market revenue rise to US$900m by 1993.

Lack of user awareness

This compares with US$235m for software and services in the European market over the same period.

Yet another survey of potential European users of EDI — this time by BIS MacIntosh — has revealed a surprisingly low level of awareness of the concept and benefits of EDI. The report survey published in the BIS MacIntosh "Electronic Messaging Information" shows European companies have the lowest awareness (27 per cent) compared to counterparts in North America (45 per cent) and Asia Pacific (29 per cent).

High growth, but no critical mass

Taking the middle line, the two major UK network operators — International Network Services (INS) and Istel — point out that although absolute levels of growth are impressive in terms of subscriber base and traffic volume, EDI has not reached the long-anticipated exponential growth stage.

Reasons cited for its slowish rise to critical mass stage (where an increasing number of companies begin to establish electronic relationships with EDI so EDI becomes a prerequisite of trading for many more) are that although the UK's top companies are signed up, the medium-sized and smaller companies have yet to go on-line; and of those that are signed up, few are using the service to the full — many more message types could be sent.

USSR shows interest

INS and Istel have begun discussions with Morflot, the Soviet science and technology ministry, on establishing EDI services for the USSR's international trading organisations. Both British companies anticipate the possibility of business in the Soviet Union for full service and support, including training and consultancy, to be worth milions of dollars.

Morflot is representing various industries including shipping, railways, road transportation and customs.

New networks

In Spain, Telefonica Services and Istel Ltd have formed a joint venture to market a network designed to cover the whole nation; RAET NV, the Netherlands-based computer software and services company, has also partnered with Istel to market EDI products in that region; Ireland's post office is offering the first EDI service in that country — also thought to be the first PO to adopt EDI; but Telecom Eireann has made a multimillion dollar agreement with INS which will lead to further EDI services in Ireland.

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NEW PRODUCTS & SERVICES

VERBATIM

Surveillance solution from GPT

A revolutionary security surveillance system, aimed at defence markets, has been developed by GEC Plessey Telecommunications (GPT) Video Systems.

Called the GVS10, the system transmits very high resolution images from closed circuit TV (CCTV) cameras.

Capable of operating across the range of data rates, 56-64kbit/s to 1.5-2Mbit/s, the system encodes the video image produced by a CCTV camera and transmits it over any digital network to a decoder linked to centrally controlled monitors. If appropriate, the transmission can also be easily encrypted.

READER INFO No. 303

New software improves electronic mail, database access and corporate reporting

OTC Dialcom has launched UpFront — an IBM PC-based business communications software package.

Controlled through menus and PC function keys, UpFront speeds up sending and receiving electronic mail, computer generated faxes and telex messages and simplifies database searches.

UpFront can send messages simultaneously to a combination of electronic mail boxes, fax machines and telex machines around the world.

UpFront also offers a reporting facility with its form design software.

The package can transmit and receive spreadsheets, graphics and binary encoded programs. This is done by using error correction protocols including XModem, YModem and Kermit.

All that's needed is a PC XT, AT, PS/2 or compatible computer with a minimum 512K memory, DOS 2.1 or higher, and a Hayes-compatible modem. It comes in 5.25" or 3.5" floppy disk versions.

Prices start at around $350 for a single package, with concessions available for multiple-users.

READER INFO No. 304

Kambrook caters for the busy executive with 'multiple workplace' computer

Kambrook has released what it terms a 'multiple workplace' PC for the busy executive demanding desktop performance and laptop portability.

The machine, which weighs 7.3 kg, can be keyboard selected to run at 12 or 6 MHz to accommodate a larger range of software. The PC includes a number of features, such as an 81-key keyboard with 10 programmable function keys, 1 Mb of RAM (expandable to 8 Mb), 40 Mb hard disk as well as a built-in 3.5" and external 5.25" high-density floppy drives.

The new PC features ports for an external keyboard, keypad, disk drive, Centronics parallel printer and a 9-in D connector for colour or monochrome monitor as well as two male RS-232 connectors.

The Kambrook Multistation, which includes a 40 Mb hard drive, 5.25" external floppy drive and keypad, is priced at $3500 (plus tax).

READER INFO No. 305

OTC Vanguard — Australia's newest value added network service

OTC Limited is now offering customised end-to-end national network solutions through the newly established OTC Vanguard Network.

Vanguard provides data communications across Australia with access available via telephone dial-up and dedicated line connections.

Users of OTC's value added services (VAS) such as the OTC IntelNet data base access service, OTC Dialcom electronic mail and OTC EXIT electronic document interchange services (EDI) will be able to access these via OTC Vanguard.

READER INFO No. 306

Handset purchase an attractive business proposition

Voca has extended its range of telephone handsets with the recent introduction of its new price competitive low-end unit, the ATX-10.

The ATX-10 comes fully equipped with features such as on-hook dialling, memory storage for 10 one-touch and 10 speed-dialling numbers, and battery memory back-up to protect against power failures.

The ATX-10 also has tone or pulse dialling, pause button, last number re-dial, and an earth/flash key for PABX compatibility.

READER INFO No. 307

New service offers toll-free calls to the USA

With AT&T's International 800 Service, overseas callers can phone US businesses at no charge to the caller. A new feature initiated in December 1989 permits US businesses to receive those calls on their regular business or home phones without having to add special dedicated lines. The service is available from 41 countries and businesses can select the countries from which they will accept calls.

READER INFO No. 308

Low-cost fault-tolerant processing

Stratus Computer Inc's new XA2000 Continuous Processing Model 30 provides telephone companies, enhanced service providers and large corporate users with a fault-tolerant processor that can distribute applications across their networks at low cost.

The Model 30 minicomputer is designed for distributed on-line transaction processing of

World Radio History

telephony services in telephone networks and at customer premises. It can be installed as an adjunct processor, service control point, intelligent peripheral or feature node to run applications for 000 emergency services, 008 number services, billing, telemarketing and voice processing. XA2000 Model 30s can also be distributed across corporate data communication networks as a fault-tolerant node to perform complex, critical message switching services for X.400-compliant electronic mail and electronic data interchange applications.

The Stratus system's open architecture enables it to interface with integrated voice data terminals through the PBX and to popular workstations over Ethernet and Token Ring local-area networks. Via IBM SNA and DECnet networking, the Model 30 can provide information to other minicomputers or mainframes for accounting, inventory, shipping and related back-room processing functions. The Stratus system also supports financial network protocols, such as VISANET, enabling it to automatically authorise customer credit on-line as soon as a call is received.

READER INFO No. 309

Siemens and ATC venture produces Comlock

Siemens and ATC have developed a controlled communication device — Comlock.

Basically, Comlock is an intelligent modem with a built-in processor. It enables a high level of security for data bases which can be accessed via the public telephone network, such as banking systems and Viatel.

A further advantage of the Comlock is that the host computer can be turned off at night and, if a remote user is authenticated, the Comlock connected to the host computer can power it up.

READER INFO No. 310

MILESTONES AND FORECASTS

The world's first talking magazine advertisement

On November 20, 1989, Australia and Asian/Pacific subscribers to the international edition of Business Week magazine were able to listen to the world's first talking advertisement, through semiconductor technology developed by Texas Instruments.

The advertisement is activated when a label covering the switch is removed. The advertisement's electronic message is delivered by a module the size of a credit card. The heart of the module is a TI integrated circuitry chip no larger than a baby's finger nail. Three tablet sized batteries provide power enough for 4,000 plays through one inch Piezoelectric speakers in the module.

Free calls to 008

From December 1989, Telecom Australia has abolished the 21 cent local call charge for 008 calls, which applied since the service was introduced in Australia 10 years ago.

The new pricing arrangement will allow customers to call a business with an Austwide 008 line from anywhere in the country at no charge.

Telecom has also reduced the call charges to organisations providing the service by up to 10%.

Since the service was introduced, Telecom has signed on 20,000 customers to 008 lines.

READER INFO No. 311

Voice mail — international networking at last!

Connect International is networking its ASPEN voice mail system with systems in the US and negotiations are underway with overseas companies who see this service as a valuable communication facility between their home and Australian offices.

For those US companies without an ASPEN system, Connect can organise a US bureau to provide the necessary mailboxes. Negotiations with vendors of other voice mail systems are under way.

International networking is expected to extend to Europe and UK

READER INFO No. 312

INTELSAT VI satellite successfully deploys British Aerospace antennas

A British Aerospace built antenna, the largest flown on a commercial communications satellite, was successfully deployed aboard INTELSAT VI communications satellite, launched in October 1989.

The spacecraft's large C-Band transmit antenna measures 3.2m (10.5ft) in diameter and is made from Kevlar honeycomb sandwiched by a carbon, Kevlar and boron fibre composite. This lightweight structure, weighing 30kg, is designed to maintain geometric stability over a temperature range between +100 degrees and −170 degrees C.

INTELSAT VI is a drum-shaped spin stabilised satellite measuring 3.5 m (12 ft) in diameter and 11.7 m (39 ft) long — with its "drop-skirt" solar array deployed. The satellite has an in-orbit weight of three tonnes. It will carry on average 24,000 telephone calls and three television channels simultaneously. In comparison, the first INTELSAT satellite, launched in 1965, had an orbital weight of 35kg and a capacity of 240 telephone calls or one TV channel.

READER INFO No. 313

New Commander to New Zealand and Fiji

The Commander E 105/208 Small Business System, developed by Telecom Technologies and manufactured by Alcatel STC is ready for export.

The new system is available in two models: the 105, with one line and up to five stations, and the 208, with two lines and up to eight stations. It has memory for ten numbers, a speaker for on-hook dialling, a conference call facility, and a variety of other practical features such as hold, recall and last number redial.

READER INFO No. 314

Siemens enters local production of DIN 41612 connectors

Siemens will manufacture the popular range of Eurocard electronic connectors (DIN 41612) in Australia.

These high-technology connectors are used in wide ranging applications, including communications, measuring and control electronics, military electronics, industrial and data processing electronics.

Local manufacture will enhance service to Australian customers who usually depend on overseas imports. Speed of service, flexibility to cater for customer-specific requirements for even small quantities and greater price competitiveness will result.

READER INFO No. 315

Unique electronics centre — the 'missing link' for development

The $4 million Australian Electronics Development Centre is a professional self-help electronics product development training facility designed to help industry and education face the challenges of the 1990s.

Through the Development Centre, companies can send their people as students to learn what technical risks there are and how to tie design and manufacturing together into disciplined product development. The AEDC will offer courses to help companies adapt to using a wide range of CAD/CAM systems and equipment.

The first intake of students was on November 20, 1989.

READER INFO No. 316

World Radio History

VERBATIM

CONTRACTS AND AGREEMENTS

Stratus Computer and Voicetek sign pact

Stratus Computer Inc. has announced an agreement with Voicetek Corporation to jointly market an intelligent voice network platform that combines fault-tolerant computers with high-performance voice computers.

The intelligent voice platform, called the IVP/2000, joins fault-tolerant Stratus XA2000 Continuous Processing Systems with Voicetek VTK-300 voice computers. The IVP/2000, an intelligent voice peripheral, will use an applications software interface to provide ease of applications development and tight integration across the two systems which comprise the platform.

Customers in the telecommunications field and a wide variety of other industries can use the IVP/2000 to offer enhanced voice services, such as voice mail, voice processing, advanced intercept services, telephone answering services, airline reservation hotlines, telemarketing, and banking or investing by phone.

READER INFO No. 317

OTC International gains Kiribati contract

Kiribati has approved in principle a joint venture with OTC International for the efficient running of the international and domestic telecommunications network for the next 15 years.

Kiribati, a string of 33 islands straddling the Equator and International Date Line in the central Pacific Ocean, is one of the most widely dispersed nations on earth.

Since April 1988, OTC International has assisted in the improvement of the Kiribati network under a joint management contract.

The proposal involves a $21m plus network development program for a satellite-based telecommunications system to link outlying communities within five years.

READER INFO No. 318

Texas Instruments to develop new videoconferencing system

Telecom Australia and Texas Instruments Australia have agreed to design and develop a new generation of digital hardware for videoconferencing.

The Australian joint venture agreement will develop a new system for converting a vision signal into a digital code.

The digital encoder and decoder, called a digital codec, will use the latest digital signal processing technology, incorporating several unique features which will greatly improve the quality of existing videoconferencing systems.

The first production model units are scheduled for delivery in early 1991.

READER INFO No. 319

British Telecom gives carphone its support

British Telecom (Aust) has established a special arrangement with The Carphone Group in order to further increase its hold on the PABX and switching system market via its range of Mitel products, the first of which was released earlier this year.

The Carphone Group has recently risen to prominence through its $4.5 million acquisition of a number of communications and smaller office automation companies including Melbourne based Otron, OPSM Security Systems and a number of Queensland independents giving it a major hold on office automation and business systems markets throughout the east coast of Australia.

READER INFO No. 320

OTC signs contract for Australia's first international ISDN exchange

OTC Limited has contracted Nortel for the supply of Australia's first international integrated services digital network (ISDN) exchange.

The $12 million contract includes the 12,000 line ISDN exchange and an associated international transmission maintenance centre (ITMC).

The first OTC international ISDN service will be a 64 Kbps service using OTC's existing digital telephone exchanges. It is due to begin to the US and Japan early next year.

The international ISDN exchange is scheduled to come into operation at OTC's Paddington ITC in late 1991.

READER INFO No. 321

GOING UP GROWING OUT

British Telecom strengthens senior management

British Telecom (Australia) Pty Ltd, has promoted its former general manager, Peter Hutton, to the position of managing director, Australia; Adrian Coote, formerly business manager, to the position of general manager communications systems; Nick Powell, formerly regional manager South Pacific to the position of general manager networks and services; Graham White, formerly regional manager City Business Systems to general manager institutional financial systems, and Neville Smith, to the position of general manager Tymnet, the McDonnell Douglas subsidiary which British Telecommunications PLC took over earlier this year.

British Telecom has also established its own R&D facility at Parramatta in order to better develop and provide communication products geared specifically to the needs of the region.

READER INFO No. 322

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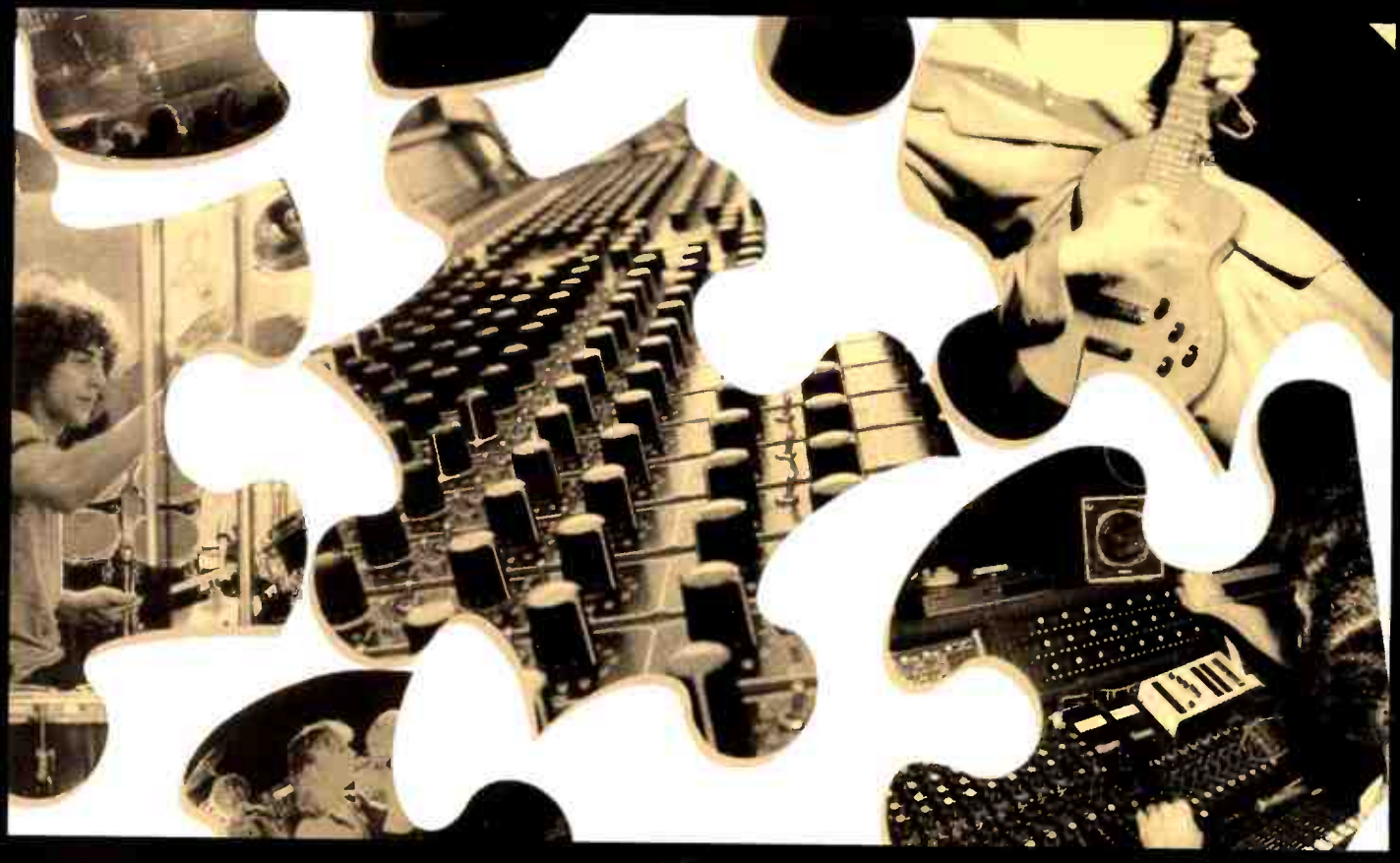
Don't be puzzled



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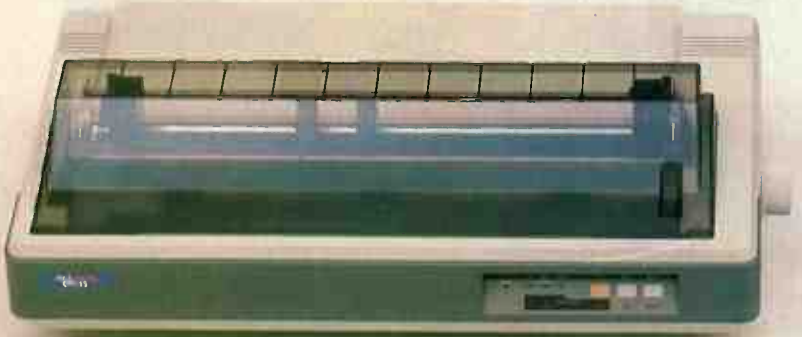
WORKSTATION

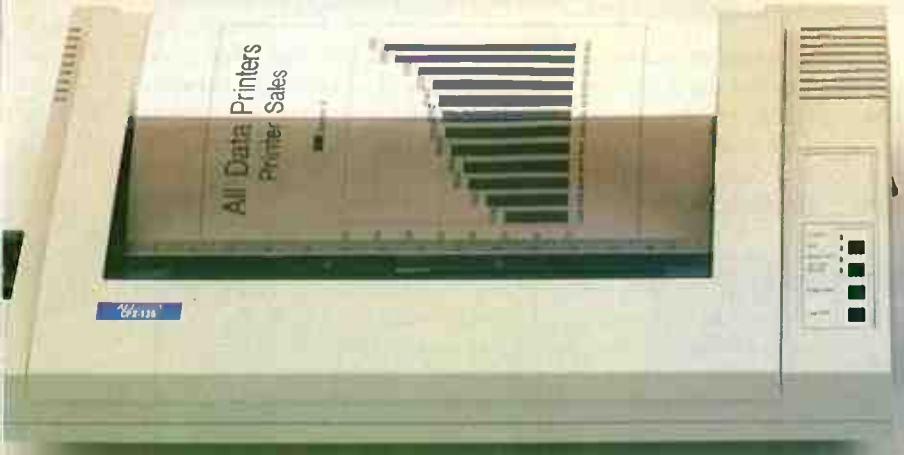
ETI'S COMPUTING SUPPLEMENT

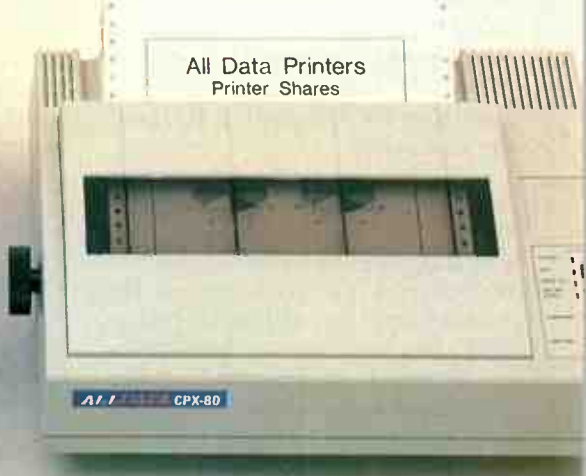
ALL DATA

PRINTERS AND PLOTTERS



NEW AGE AS SYMBOLS





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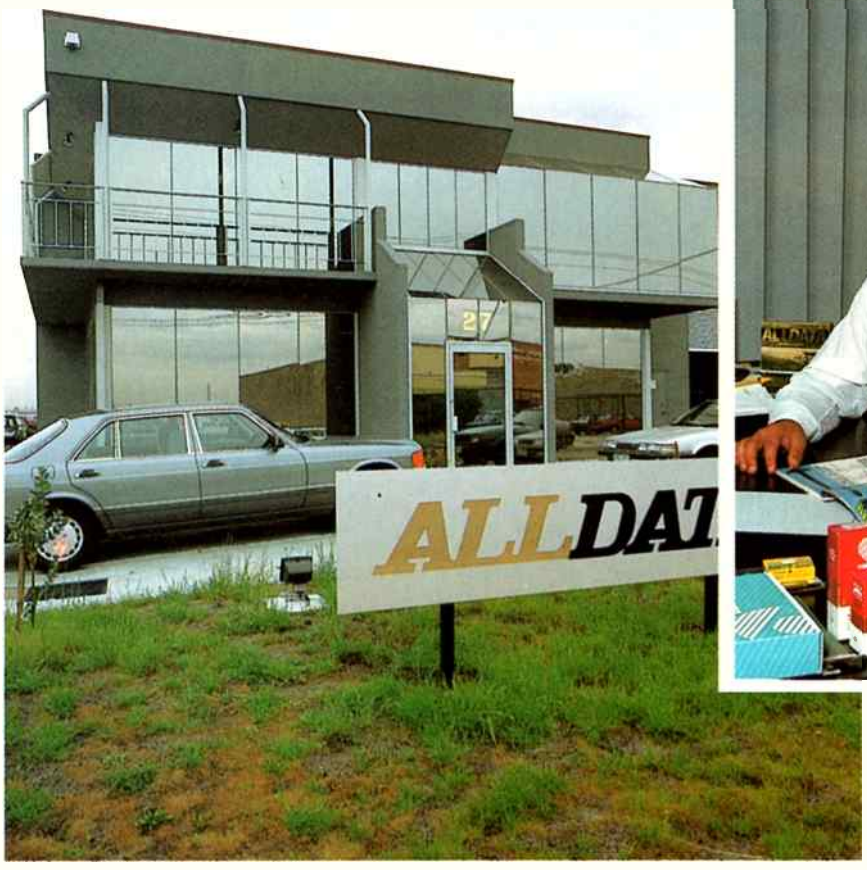
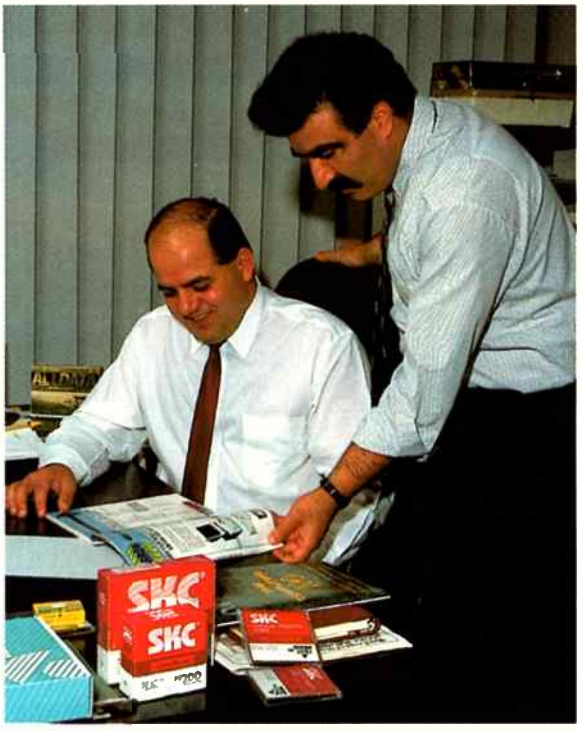
COMPANY PROFILE

ALL DATA: FROM STRENGTH TO STRENGTH





Left: All Data's new headquarters at Dandenong, Victoria.
Above: directors, Abraham Moussa (seated) and Michael Madi.

All Data Australia is one of Australia's leading manufacturers and distributors of personal computer systems and peripherals. Established three years ago by the directors, Abraham Moussa and Michael Madi, as a progressive computer retail outlet, the company has gone from strength to strength, and now ranks 85th in the Australian DP industry top 100, says the company.

All Data has continually strived to identify customers' needs and to supply the best possible equipment and support to satisfy those needs, at realistic and reasonable prices. This commitment to satisfying clients' needs has resulted in the introduction of a range of premium quality computer systems and peripherals and a truly phenomenal growth rate.

Having successfully introduced the Bristol and Arrow computer ranges to the Australian market, the company sought a premium range of printers to market under the All Data brand. The quality of All Data equipment, says the company, has resulted in a series of commendations by the industry's leading reviewers.

Today, clients can purchase almost everything they require from All Data, now truly a one-stop computer hardware supplier.

Today, clients can purchase almost everything they require from All Data, now truly a one-stop computer hardware supplier. The company runs its manufacturing, service and marketing operations from new headquarters in Dandenong, Victoria. All Data now has a full scale marketing and customer support division and believes that its on-going commitment to client support and service will ensure continued, substantial growth into the nineties.

COVER STORY

All Data Australia offers a full range of dot matrix printers for all applications. The range includes the CPF series of high speed nine-pin printers, the CPL range of high speed, high resolution 24-pin letter quality printers and the CPX multi-head line printers, with speeds of up to 245 lines per minute.

All these printers are available in 10" and 15" sizes and are backed up by a full one-year warranty. They offer near letter quality and draft modes. The range is manufactured in Japan by a reputable company to be marketed in Australia under the All Data brand.

World Radio History

A cursory glance at what's in the market place as we go to bed.

PRINTERS & PLOTTERS

Users of laser printers cannot help but be aware of the growing number of press advertisers offering refilled cartridges. Suppliers of OEM cartridges, not surprisingly, fail to be impressed by these services competing with them in the consumables market.

Recently, **Canon, Wang Australia** and **Rapid Ribbon** have gone public on the issue.

Canon, inventor of the laser beam printer and supplier of about three-quarters of the engines in use worldwide, argues that refilled cartridges can cause malfunctions in printer parts, including the motherboard.

Canon's Alan King says that anyone considering purchase of refilled cartridges should first examine the known quality and performance differences between these and originally-manufactured products.

"First of all," he points out, "the shelf life of an original cartridge is two and a half years, with the expiry date given on the carton. A specified shelf life can be given because the unit is built to OEM specifications and sealed in a bag until required for use. If an exhausted original is refilled, that warranty becomes automatically void — and for very good reasons. The original manufacturer has developed a toner suited to the developer unit manufactured by Canon. A third party toner may not be compatible, and therefore the print quality may not be up to Canon standards.

"Also, the fixing roller cleaner is supplied with the new cartridge. It is impregnated with silicon compounds to clean and lubricate the fixing roller, and if this unit is not supplied in refilled cartridges, the likelihood of malfunction and short life are greatly increased. One thing is clear, and that is growing industry complaints about cartridges filled with toner of unknown origin and quality. These complaints range from malfunction due to lack of lubrication, to shorting of the printer motherboard due to leakage — which in our experience means scrapping the machine," King says.

Wang's Steve Ewen says the cartridge has to be seen as a consumable that, unlike a motor vehicle, was never designed to be a maintainable item.

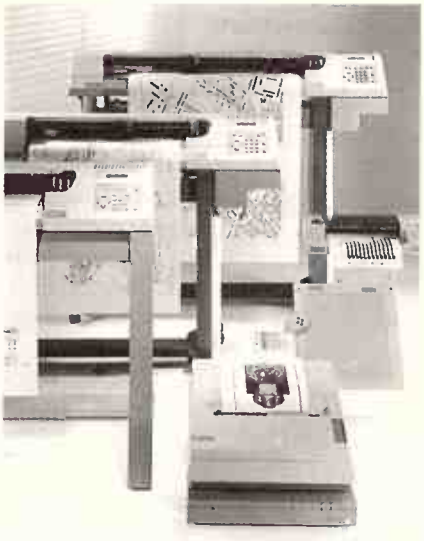
"It is a sealed unit. Break it open and you're flirting with danger. And disaster happens all too frequently to printer owners who opt for a cheaper refill. Inevitably they all come back and buy the original. We always suggest these kinds of questions:

How many times has the cartridge been refilled? (You can't tell).

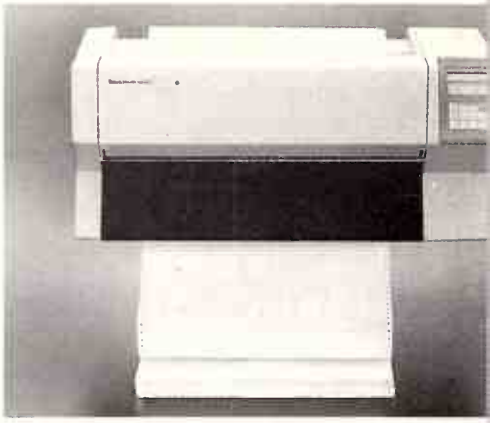
Yes, it's been refilled, but has it been refurbished?

We know it's critical for the toner and developer to be of the same compatibility as were the originals. Are they, now?

What is the source of the new toner and developer?



Océ provides the Australian design engineering industry with a wide range of graphics peripherals, pen plotters and thermal plotters.



Texas Instruments' Model 8930 compact printer combines the best of two worlds.

Are they impregnated with the same balance — in quality and amount — of silicon compounds?

What were the batch control mechanisms?

If there's a malfunction due to poor quality of a refilled cartridge, do you know that the warranty conditions are no longer valid — that you will be charged for the service and carry productivity losses?"

Rapid Ribbon's Esca Lluka said that every one of his customers who had bought refills had come back to buy originals.

"It's basically a lack of quality control that leads to so many failures and breakdowns," Lluka says. "The penny-wise, pound-foolish aspect surfaces when a faulty refill leads to machine failure and, in the case of shorting out the motherboard, machine write-off. If that's not false economy, I don't know what is. It would seem to me that if you have invested up to $8000 for a laser printer, you will make sure you spend that extra money for an original cartridge as commonsense insurance against partial or complete failure of the machine," Lluka opines.

It does not matter what we buy, caveat emptor remains the golden

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rule. As a purchaser, you may be between a rock and a hard place. You might like to save money on the refills, but here are the major players issuing dire warnings about warranties and the like. Car manufacturers do the same in the context of replacement parts, accessories etc . . . In the end, it's your money and your decision. And, in the end, if you guess wrong, it's still your money

WORD PROCESSING

The primary measure of quality in the word processing market is letter quality. With the main task of the printer, used with a word processor, being business mail-out (and the occasional presentation document) the printer had to work hard to replace the typewriter.

The innovation of near letter quality dot matrix, ink jet and laser printers

Epson's new low-end, 24-pin printer, the LQ-550.

has forced buyers to be very specific in defining their needs. For one-off letters and memos there is a series of high letter quality dot matrix ribbon printers available. With large numbers of letters, where speed is important, the ink or "bubble jet" printer is an economically viable step. The speed of a printer that simply fires a letter at a page means that large mail-outs can be handled quickly. And the type

The Gestetner Third Generation laser printer will help produce the world's most secure passports.

quality, with arguably 'higher resolution' than dot matrix printers, means letters look almost typed. Printing in colour on ink jet, however, does become hazardous.

Enter the laser printer. Just as fast as ink jets (if not faster), with type quality equal to any typewriter and Postscript capabilities (i.e. you can alter the font, letter quality and type setups after the document has been sent from the word processor), the laser printer is most versatile. But it comes at a price.

DESKTOP PUBLISHING

With the essence of desktop publishing being higher quality presentation, laser printers are currently the most popular means of production. Pictures, borders, headlines and subscripts are characteristics and features that begin to separate the men from the boys. Pixel size (resolution) and font capabilities mean that some laser printers are "more equal" than others.

GRAPHICS AND PRESENTATION

The realm of graphics and presentation lies only a block up the road from desktop publishing. The only real differences in address (in terms of suitable printers) is colour and price.

There are a number of colour laser printers and, lately, an interest in thermal wax printers, that enable presentation to reach dizzy heights. Computer graphic artists require capabilities in terms of both colour and texture that can do justice to graphics software packages better than a palette, brush and the imagination combined.

CAD APPLICATIONS

CAD applications are so widespread and specialised that both laser printers and plotters are used extensivly. Architecture, engineering design, specification drawing and even some presentation are among the many CAD capabilities.

Two main types of plotter are in common use today: the paper and pen type, where a pen is held and moved along an X-axis and the paper is rolled back and forth along a Y-axis; and the other, more recent type, which is the thermal plotter, capable of producing intricate drawings in much the same way that a fax does. Each version has its advantages and disadvantages in price, maintenance, running costs, noise, space and flexibility. Only the user can be the judge.

New dimensions

Canon says its LBP-8 III Series laser printer adds a new dimension to PC-based desktop laser beam printing.

The LBP-8 III offers scalable and rotatable fonts, more font choices, more speed, more memory and extraordinary graphics applications at a cost only marginally higher than standard non-PostScript driven laser printers according to Canon.

The LBP-8 III offers nine internal scalable fonts: four in Swiss and Dutch (regular, bold, italic, bold italic); Simbol regular; and Courier in regular, bold, italic and footnote in bitmap format.

There is a miniaturised IC font cartridge holding up to four times more fonts than is standard and two front-loading slots for bitmapped and

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A NEW STAR IS BORN

TYSTAR

COLOUR MONITORS

SUPER VGA

Alldata Australia searched long and hard to find a top class Super VGA monitor to compliment its high quality product range. One monitor emerged as a star amongst the rest – The Tystar Super VGA.

Tystar monitors from Alldata offer unparalleled quality, definition and reliability, at a more than competitive price to match.

Tystar Super VGA offers a crystal clear high resolution 14 inch screen to suit virtually every computer type, including compatibles and Macs.

Tystar's stunning full colour 1024 x 768 non-glare 0.31mm dot pitch provides the necessary capabilities for all your requirements, be they general, graphics or CAD/CAM/CAE.

Whatever your needs, you owe it to yourself to look at the Tystar Super VGA at a dealer near you. Anything less may cost you more than just money.

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scalable fonts, or a control card for printer emulations. The Series III will also accept downloadable fonts.

Point size varies from four to 1500 depending on the software and can be freely enlarged and rotated to landscape at 300 dpi high resolution. There is provision for shading and reversing, patterns, shadows and outlines, with 64 different kinds of shading patterns and modes that can be combined.

The III Series is available in three models; single bin feed, dual bin feed and dual bin with automatic duplexing. Cassettes are available in universal X1 format for all paper sizes and the two dual bin models will accept an optional envelope feeder with capacity for 50 envelopes in a wide variety of sizes. All three models produce output either face up or down and use Canon's patented interchangeable cartridge. More information from Canon Australia's Alan King ☎ (02) 887 0166.

Security printing

Meanwhile, **Gestetner** and **3M Australia** have been busy developing a process of security printing to be used in all Australian passports this year.

Gestetner has developed a Greyscale laser printer that has met stringent quality and security standards set by the Department of Foreign Affairs and Trade.

Adrian Stephens, managing director of Roland DG.

With this process, laser printed photographic images and details are printed onto an adhesive reverse image film, thereby ingraining the image and details into the glue of the passport laminate. Using this specially developed technique, attempts to tamper with the passport details, or substitute photos, will prove abortive.

Previously, although Australia has produced passports considered to be among the most secure in the world, tampering with details still occurred. The Department of Foreign Affairs and Trade Director of Passports, Mr Ted Radclyffe said, "No matter how secure the passport is, someone usually comes along and 'cracks' the security features". But using this technique, he believes he has solved this problem and says this process will eventually revolutionise passport security around the world.

Gestetner will market its technology to the world, first showing Greyscale laser printers at the COMDEX '89 Show in Las Vegas.

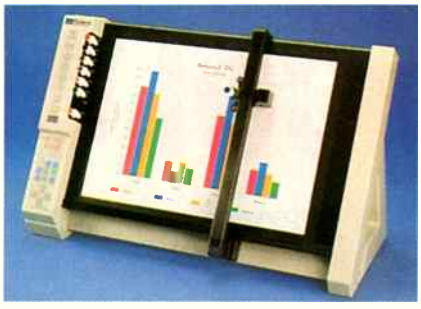
Along with domestic and international markets for other security printing applications such as licensing and visas, Gestetner believes the commercial applications for its new generation lasers will be widespread and will represent a significant development in Australian design and manufacturing. For further information contact Michele Greer, Gestetner Pty Limited, 12 Rodborough Road, Frenchs Forest NSW 2086, ☎ (02) 975 0555 Fax (02) 975 0445.

"Smart" Epson

Epson has a considerable share of the printer market and recently released the LQ-550, an 80 column, 24-pin dot matrix printer.

It features "Smart Park" advanced paper handling, printing of 180 cps in high speed draft mode and 60 cps in LQ; two built-in letter quality fonts, Roman and Sans Serif; convenient SelecType control allowing direct selection of the printer's major functions; special effects printing including Emphasised, Double Strike, Underline, Enlarged, Super/Subscript and Italic; black fabric ribbon cartridge.

Options available include; single-bin cut sheet feeder for up to 150 single sheets of paper; pull tractor unit for continuous paper handling and the use of multi-part forms; multi-font module which adds Courier, Prestige, Script, Orator, Orator-S, OCR-A and OCR-B fonts available in letter quality mode; film ribbon cartridge for higher quality printing, and Epson's 81xx series of interfaces.



Roland DG's DXY-1300 Computer-aided drawing machine.

The recommended retail price (inc tax) is $749. For further information, contact Epson in Sydney ☎ (02) 436 0333.

Thirty-two bit imaging

Elsewhere, **National Semiconductor's** NS32GX32 32-bit imaging system processor is being used by ALPS America in a new laser beam printer.

The NS32GX32 chip allows the printer to maintain a 20 page-per-minute output rate in a multi-user environment, even when printing complex graphics.

The ALPS LPX2020 printer is fully compatible with Hewlett Packard's LaserJet Series II printer, and can be upgraded to emulate Adobe's PostScript Page Description Language. Many options are available, including a 20-megabyte disk drive, a 1,000-sheet offset stacker and up to 8 megabytes of memory.

Crucial to the proper functioning of the LPX2020 in a multi-user,

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The *Printed Word* has never looked so good!

In true Alldata tradition, here is a top quality line up of some of the finest printers available. Alldata printers are built to a standard, not just a price. Yet it's comforting to know they're also probably the most attractively priced as well.

Whatever your needs, there's a quality Alldata printer to suit. Whether it's the budget priced CPF series, the advanced CPL series or even the multi head line printing CPX series, 10", 15", 9 or 24 pin, you'll find they're all meticuluosly designed for precise and impressive performance.

Before making a decision on your next printer, make sure you check the Alldata range on performance and price - we know you'll be pleasantly surprised.

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ADDRESS P/CODE

PHONE

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Postscript environment is the embedded NS32GX32 processor, according to Mark Romig, product marketing manager for ALPS.

The NS32GX32 microprocessor is designed specifically for the requirements of high-performance imaging systems such as desktop page printers with enhanced capabilities. Printers that use the NS32GX32 as a controller can maintain a constant page-per-minute output, regardless of the number of symbols or graphical representations being printed.

The device features large on-chip instruction and data caches, and a clock frequency of up to 30 MHz for high performance. Graphics processing is supported through multiple cost-effective floating point solutions. For low cost imaging systems, the GX32 supports inexpensive memories with a tuned interface and directly supports 8, 16 and 32-bit peripherals. The NS32GX32's optimising compilers and instruction set produce highly compact code, which reduces memory size requirements. These features lower overall system cost.

The NS32GX32 directly supports many of National's VLSI products and thus provides peripheral equipment manufacturers with all of the hardware building blocks required for a final product.

National first entered the imaging processor market in the first quarter of 1988 with the introduction of the NS32CG16 printer/display processor, which is targeted for the personal printer market. Additional applications for the NS32CG16 and NS32GX32 processors include facsimile systems, display terminals and scanners.

Olé Océ

Back in Australia, **Océ** acquired the graphics division of Schlumberger Technologies Pty Ltd which will operate in the future as Océ Graphics.

The new company will provide the Australian design engineering industry with a wide range of graphics peripherals, pen plotters, thermal plotters, digitisers and tablets from Océ's international resources.

Océ Graphics offers six A1 and AO professional plotters, from the low-cost G1820 to the G1835; the flagship plotter in the G1800 Series.

It features *Pen Manager* to exchange pens before they run out of ink; *Curve Manager* to smooth out curves for better line quality; *Soft Landing* to avoid pen re-bound at the start of each line; *Area Manager* for vector optimisation by area; roll feed and more.

The GRX300 and 400 Grip wheel plotters from Roland DG.

The key personnel at Schlumberger have transferred to the Océ team.

Products to come

Roland D G Australia let it be known that November 1989 and mid-1990 they would release six new graphic output products.

Roland spoke of new flat-bed technology; new applications to flat-bed technology; new and enhanced grip wheel or moving paper plotters; a range of thermal products and a new 1.25MB data buffer.

Plotters, like Roland's new DXY A3 series, offer both speed (420mm per second) and accuracy (12.5 microns) for both small CAD applications and cost effective production of check plots. Some users, utilising fine nib pens, have discovered that these new A3 plotters are accurate enough to produce plots capable of A1 expansion on Xerox enlarging photocopiers. Documents produced this way have been of sufficient quality to meet tender requirements.

Incidentally, Roland DG operates what it calls the Roland 'On-line' Club and publishes a magazine to keep customers and potential customers informed as to its activities.

For further information contact Roland DG, 50-52 Garden Street, South Yarra Vic 3141. Phone ☎ (03) 241 1254 fax (03) 241 1257.

Citizen PC printer

Distributor **Pantek Corporation** has released the Citizen GSX-140 black and colour printer.

The GSX-140, which retails for under $960, is the first dot matrix personal computer black and colour printer in this range to incorporate an intelligent VDU-type LCD "simple English" display for control over all the printer's functions. This display shows what function the printer is performing and how to control any of the other 75 functions such as print, colour, pitch, multiple fonts and page layout.

A Citizen "Command-Vue" diskette is provided with the printer for DOS PC users, which enables all printer functions to be set via the PC screen. Printer "macros" are available to enable four different types of total printer settings to be stored on the Command-Vue diskette or on the PC hard disk.

Twenty-four-wire print quality is achieved in 192cps or 64cps letter-quality mode and 360 x 360 dpi for high resolution graphics. The Colour-On-Command kit option enables the user to colour highlight a document or graphic. Seven colours for text and graphics are available.

The GSX-140 includes full paper handling capabilities, from single sheets to continuous-feed multi-part forms and continuous labels, while six resident fonts, including Roman, Sans Serif, Courier, and Prestige are included as standard.

The GSX-140 comes with the Citizen two year parts and labour warranty.

For additional information, contact Ben Wood, Pantek Corporation Ltd, 222 Park Street, South Melbourne, 3205. ☎ (03) 699 5097 fax (03) 699 9680.

High performance

Meanwhile, **Texas Instruments** has released four high performance compact printers which bring enhanced forms handling and printing capabilities to the TI OMNI 800 (TM) printer range.

The new range includes TI's Model 8930 and 8920 printers, which combine intelligent, versatile forms handling with flexible printing and paper handling characteristics and feature the Z-Axis Control Printhead Controller and Page-Finder, which enable the printers to automatically adjust to meet document thickness

World Radio History

and alignment.

An interactive control panel with Powerkey (TM) function keys provides ease of use, and a two-line by six-character liquid crystal display presents options such as print quality, font styles, menu status and other data.

Model 8930 has an 18-pin printhead which ensures crisp, readable text. With five print speeds, the printer can handle high-speed reports as well as letter-quality correspondence; print speeds include two rapid print modes (600 cps and 480 cps) as well as draft quality (400 cps), text quality (240 cps) and letter-quality (100 cps).

Seven colour printing is standard, and the Model 8930 also has a paper parking feature that allows users to feed a single form or other cut-sheet paper without having to disengage the tractor feed. Recommended price is $4,500.

Housed in a steel-reinforced chassis designed for heavy-duty use, the TI 8930 Compact Printer offers as standard RS-232 Serial and Centronics-type parallel interfaces and RS-422, RS-433 and current loop interfaces are optional. Residential emulations include TI 880/855, Epson (R) FX and IBM (R) Proprinter.

Model 8920 is ideal for businesses that need to print only continuous feed documents. This heavy-duty printer includes all the features of the Model 8930 except friction feed path and seven-colour printing. Recommended price is $4,200.

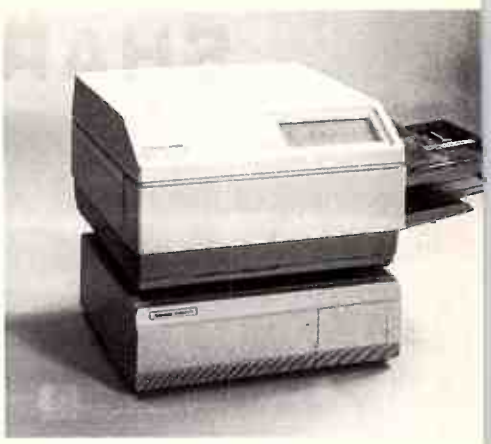
Two other printers, Models 830 and 835 are economical, reliable workstation printers with advanced paper handling features for low-end forms and personal printing needs.

Both these nine-pin printers can handle up to five-part forms at speeds up to 300 cps and combine personal printer advantages such as a user-friendly control panel with forms printing features such as short tear-off and a straight paper path.

For further information, contact Patrick Canturi, Texas Instruments Australia Ltd, 6-10 Talavera Road, North Ryde, NSW 2113, ☎ (02) 887-1122.

For PCB designers

Protel Photoplotting, a division of Tasmanian company Protel Technology, now offers a complete post-design service producing Gerber format photoplots using the PT101 Photoplotter.



Tektronix' Phaser CPS Postscript compatible thermal wax colour printer.

The PT101, wholly designed and developed by Protel for state-of-the-art benchtop accuracy and performance, will be available for sale to the Australian market in the near future.

As a special service to Protel software users, the company generates pilot files directly from Protel-PCB and Autotrax edit files, a

The GLX800 desktop, from Gestetner.

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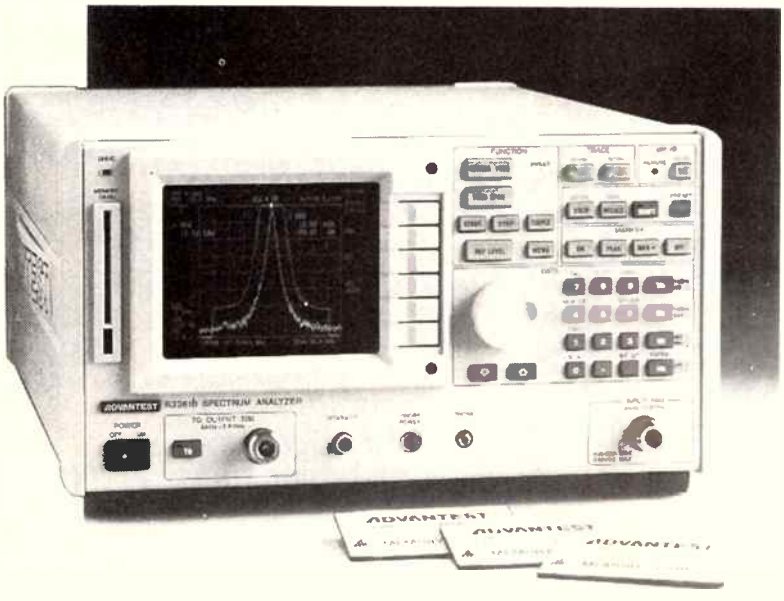

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time and trouble saving shortcut.

The plotting division also produces pen plots, laser check prints and manufactures complete boards, providing end-to-end service for the Australian electronics market.

The company will ship plots via courier, with next day delivery available to most centres, and with even faster turnaround available via modem transfer of user files.

For further information contact David Warren, Protel Photoplotting, ☎ (002) 73 0100 Fax (002) 73 1871.

Everything you're paying for

Gestetner has a range of laser printers which, the company says, "gives you everything you're paying for". The range starts with the GLC600, a six page-per-minute printer offering all the power, quality and graphics capability of a full-size laser printer but in a smaller package that is cheaper to buy and run. It comes in three models, all sharing the same processor and basic architecture but with a variety of emulation and font options.

Gestetner's eight page-per-minute range of desktop laser printers, the GLX800, is available in single bin, dual bin and dual bin duplex models. All models, right down to base, come with a full 1.5 MB memory, a wide range of fonts and emulations and the ability to work with three computers at once.

With Postscript becoming the standard in desktop publishing and typography, the GLP800 Scout Postscript laser printer offers real benefits, says Gestetner. Built around a printer controller designed for the company by Adobe Systems, the inventors of Postscript, the GLP800 Scout gives full access to Postscript, with speed and efficiency assured by a fast Motorola 68000 CPU operating at 16.67 MHz and 2 MB of memory as standard. It also has an inbuilt SCSI port providing much greater flexibility.

Ideal for use with mini, mainframe or large microcomputer networks, the L2000 + 20 page-per-minute printer will handle the printing needs of a large department or work group. The standard 2.5 MB of memory can be expanded to 6 MB simply and economically, says the company.

Further details from Gestetner, 12 Redborough Rd, Frenchs Forest, NSW 2086. ☎ (02) 975 0555.

Wide variety

Meanwhile, **OKI** has a range of printers to suit a wide variety of needs. The Microline 172 9-pin printer, offering four print modes, Pull Tractor for ease of paper handling, long printhead life and bottom paper feed, is compact, lightweight and will fit many small business applications.

Industrial workstation and POS printing needs can be met with the Microline 182 Turbo, says the company. Combining the best of the 182 series' features with added speed and durability, the Turbo will suit the 'toughest' needs. Bottom feed and short tear paper handling come as standard.

According to the company, the Microline 320/321 create a new standard for 9-pin printers. Offering high speed, versatility, durability and economy of use, says OKI, the ML 320 and wide-carriage ML 321 are designed to meet the most difficult of demands.

And in its 24-pin range, the ML

Continued on page 19

Looking into CAD?

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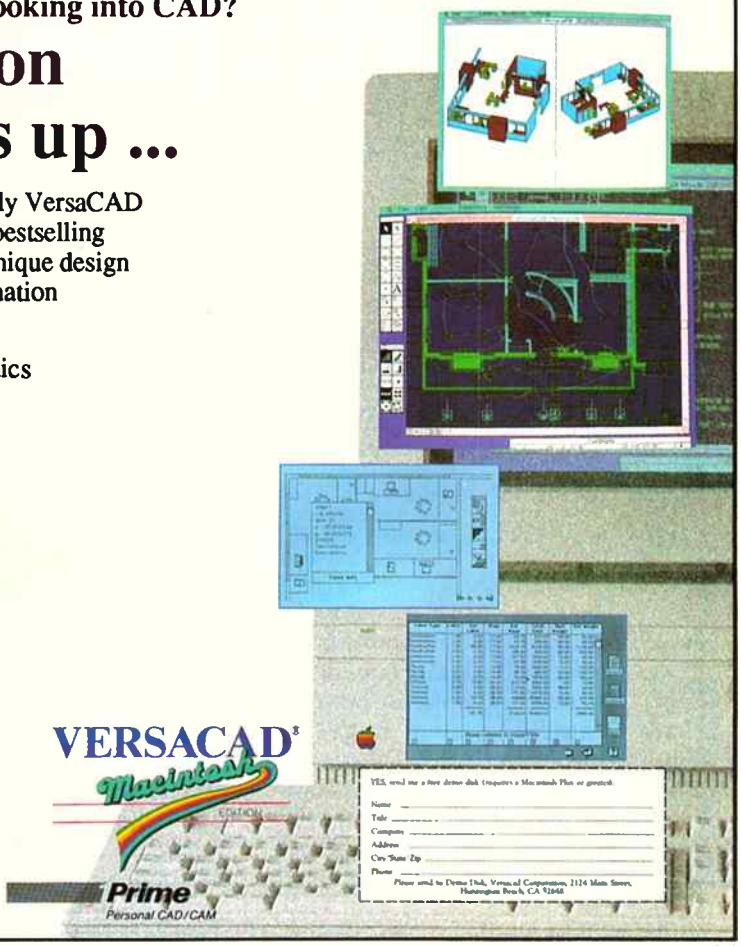

READER INFO No. 20

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Jamye Harrison reviews the new, improved AS1102 Australian Standard electronic drafting symbols.

NEW AGE FOR AS SYMBOLS

The recently released AS 1102 "Graphical symbols for electronic technical documentation" heralds a new age in the provision and revision of such documents, for this series has been co-released in both paper and magnetic (computer file) form.

Firstly, allow me to identify the documents in the series, discuss their presentation and explain their significance.

The AS 1102 series comprises the following documents;

TABLE A

AS 1102	Graphical symbols for electrotechnical documentation
AS 1102.101	General information and general index
AS 1102.102	Symbol elements, qualifying symbols and other symbols having general application
AS 1102.103	Conductors and connecting devices
AS 1102.104	Passive components
AS 1102.105	Semiconductors and electron tubes
AS 1102.106	Production and conversion of electrical energy
AS 1102.107	Switchgear, controlgear and protective devices
AS 1102.108	Measuring instruments, lamps and singalling devices
AS 1102.109	Telecommunications — Switching and peripheral equipment)
AS 1102.110	Telecommunications — Transmission

These parts supersede the following;

TABLE B

AS 1102	Graphical symbols for electrotechnology
AS 1102.1—1985	General, qualifying and supplementary symbols (first published in 1973, second edition 1981)
AS 1102.2—1981	Conductors and connecting devices (first published in 1973)
AS 1102.3—1983	Resistors, capacitors and inductors (first published in 1973)
AS1102.4—1983	Electron tubes and rectifiers (first published in 1974)
AS 1102.5—1983	Semiconductor devices (first published in 1972)
AS 1102.6—1982	Rotating electrical machines (first published in 1975)
AS 1102.7—1982	Measuring instruments (first published in 1975)
AS 1102.10—1985	Signal transmission symbols (first published in 1973, second edition 1981)
AS 1102.11—1985	Switching and protective devices (first published in 1976, second edition 1981)
AS 1102.13—1979	Microwave technology
AS 1102.14—1979	Telephony, telegraphy and transducers

You may have noticed that the superseded parts all carry one- or two-digit part numbers while the new parts are identified using three-digit numbers. As the AS 1102 standard was already considered *the* Australian Standard and was widely accepted by industry and technical colleges, Standards Australia decided to retain the series number but change the part numbers.

Part 101 commences with a preface explaining the provision of the new series and identifying the relevant documents and associated standards. I refer to the new AS 1102 series not as being revised but as 'provided'. This is because the series, as the preface explains, is not only a major revision but has been updated to align with the IEC 617 standard.

The preface explains that the IEC 617 has gained national and international acceptance, thus it would be counter-productive to merely revise the 'old' 1102 documents which were loosely based on the IEC standard. Why, then, not release the relevant IEC standards with Australian part numbers as the new Australian standards?

The answer, I think, is both a political and a technological one. Firstly, as I will qualify later, the Australian technological industry in general, and, indeed, Australian produced technology, in many areas, represents some of the most advanced products in their field in the world. Therefore, any set of standards would certainly need to be produced under Australian skies with the input of the relevant Australian bodies. Secondly, the provision of these standards as Australian, compiled by an Australian body, recognises that Australian industry as a whole is a force to be reckoned with on the world market and not just some extension of an American or European industry. (If we were to adopt somebody else's standards it would probably be more appropriate to use a set of Asian documents rather than European).

The ten parts I will review here are portions of a 15-part series. The missing parts are to be revised in due course and are as follows:

AS 1102.111 Symbols for location diagrams

AS 1102.112 Binary logic elements

AS 1102.113 Analogue elements

AS 1102.12 Electric traction — this part is wholly Australian and is not aligned with or based on any IEC standard. When it is revised it will be assigned a new three-digit part number.

A feature which is quite evident, and indeed, mentioned from the first pages of part 101, is the recognition of CAD (Computer Aiding Drafting) systems. This recognition is significant as it reflects the status of Australian industry, where more and more CAD systems are used to record, illustrate and document technical products.

However, Standards Australia has gone not just one, but *two* better. As part 101 details, all the symbols,

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PHILIPS

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or blocks, in AS 1102 have been developed so that they can be implemented on a grid with a standard modulus. The modulus they have used for reproduction is 2.5 mm, although any regular grid may be used. In this way, all connecting lines and intersections coincide with grid lines and intersections. The dimensions of rectangles and diameters of circles are multiples of the modulus, usually 2M (where M is the grid's modulus), although multiples of 1.5M, 1M and 0.5M are used where necessary.

As the document also outlines, a distance of at least 2M is provided between parallel connecting lines in order to meet the AS 1100.101 specification for a minimum character height of 2.5 mm. This requirement is an obvious advantage, say, when designating the pin numbers and signal names between the connections to an integrated circuit.

The second boon is that the AS 1102 series of symbols is also available on disk in three formats capable of being read and imported into most industry-standard CAD systems. The available formats are — DWG (for AutoCAD users), DXF (a format used by most CAD software for drawing exchange) and IGES.

The impact of this move is probably only partially evident at this stage. Obviously the Standards Association of Australia has not only recognised the advantages and wide acceptance of CAD technology but has, by releasing the blocks on disk, made a company's decision to 'standardise' now merely a financial one instead of one governed by convenience and compatibility with their internal procedures. Now, in the '90s in Australia, non-standarc technical documentation shall only be imposed by those few characters and corporations who choose to remain stagnant and thus, I hope, will rapidly become fossilised. Luddites, all — you have been warned!

Number	Symbol		Description
	Preferred form	Other form	
104-02-01			Capacitor, general symbol
104-02-02			NOTE: If it is necessary to identify the capacitor electrodes, the curved element shall represent: (i) the outside electrode in fixed paper-dielectric and ceramic-dielectric capacitors; (ii) the moving element in adjustable and variable capacitors; (iii) the low-potential element in feed-through capacitors.
104-02-03			Lead-through capacitor Feed-through capacitor
104-02-04			
104-02-05			Polarized capacitor, for example, electrolytic
104-02-06			
104-02-07			Variable capacitor Adjustable capacitor
104-02-08			

Figure 1

105-01-13		Insulated gate NOTE: For an example with multiple gates, see Symbol 105-05-17.
105-01-17		Several N emitters on P region

Figure 2

Presentation

The presentation, as shown in Figure 1, is reasonably clear, showing the standard and, where applicable, any alternate form of the symbol in the left-hand column and the symbol's description in the right-hand column. In certain places, instructions are given as to the preferred method of annotating the block. Also, certain symbols have cross-references to other symbols in the series. This usually only refers to a similar block, say between different types of diodes, and is often there as a means of qualifying the usage of that particular symbol.

For ease of reference, each symbol has a unique identifying

World Radio History

number which tells the user which part number the symbol belongs to, the section in the part and its own symbol code. The symbol's number is constructed thus;

104 — 05 — 04
Symbol number 4
Section number 5
Part number 104 (ie. AS 1102.104)

This numbering system is used in the reference index in part 101 to reference by name each and every symbol in the series. In order to align the AS 1102 symbols with the symbols contained in the IEC 617 designation an alternate numbering system is used to specify symbols unique to the AS 1102 series; they go as follows;

104 — 05 — A4
Australian Symbol number 4
Section number 5
Part number 104 (ie. AS 1102.104)

Overview

All in all, the clarity and scope of the blocks is excellent and on the verge of being exhaustive.

An aspect which particularly impressed me is where, preceding a section dealing with diodes and related semiconductors, a section was devoted to a set of five GENERAL symbols which permitted the designation of five different semiconductor properties or effects – Schottky, tunnel, unidirectional breakdown, bidirectional breakdown and backward (uni-tunnel) effect.

As with the whole series, this represents how the Standards Association has grouped certain sets of symbols. General symbols are "usually simple and characteristically common to a whole family of items". Qualifying symbols "are symbols that are added to other symbols to provide additional information". Block symbols "are simple graphical symbols representing an assembly of items and intended to indicate the function of the assembly, but they give no details about the items nor do they take account of all connections."

Number	Symbol	Description
105-03-01		Semiconductor diode, general symbol
105-03-02		Light emitting diode, general symbol
105-03-03		Diode where use is made of its temperature dependence
105-03-04		Variable capacitance diode (varactor)
105-03-05		Tunnel diode
105-03-06		Breakdown diode, unidirectional Voltage regulator diode Esaki-diode
105-03-07		Breakdown diode, bidirectional
105-03-08		Backward diode (unitunnel diode)
105-03-09		Bidirectional diode Diac

Figure 3

This aspect is advantageous; in providing for the versatility of the standard, perhaps as a new device or group of devices comes into use. Their characteristics can be described using these separate symbols next to, or as part of, the symbol. It also aids users, especially new users, of the 1102 system to conceptually grasp a symbol, its components, what it describes and its use. This may seem

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NEW AGE FOR AS SYMBOLS

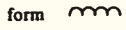
Number	Symbol	Description
104-03-01	Preferred form 	Inductor Coil Winding Choke
104-03-02	Other form	NOTES: 1. For transformer windings, see AS 1102.106. 2. If it is desired to show that the inductor has a magnetic core, a single line may be added to the symbol. The line may be annotated to indicate non-magnetic materials and it may be interrupted to indicate a gap in the core.
104-03-03		Examples: Inductor with magnetic core
104-03-04		Inductor with gap in magnetic core
104-03-05		Continuously variable inductor, shown with magnetic core

Figure 4

trivial but is definitely an advantage, considering how difficult it can be to implement or fully cross- reference a system or set of related symbols in one's mind. In short, this method helps to bridge the gap between an icon and what it represents by breaking each symbol, or icon, into sub-groups.

As you would expect, certain types of components are grouped together. For instance, the diodes are grouped together and published in order of simplicity as shown in Figure 3.

As you can see, the group of diodes published is quite comprehensive; many of you will probably not recognise some of the forms shown there. This is indicative of the series.

As should be expected of a set of standards, and is certainly prevalent in the AS 1102 series, where a symbol, or group of symbols, does not clarify to a reasonable degree the set of devices or equipment in a particular field an additional symbol is shown, for instance in Figure 4.

To give you some idea of the complexity of the documents, and how versatile they are, some distinctive symbols, shown because they stand out in some way from the crowd, are shown on page 17.

These symbols, in some way, give you an idea of both the complexity and simplicity of the standard symbols. They are used in a range of technological areas, from representation of certain forms of radiation as in 102-09-01,-02,-03 through to near complete instruments, as in 109-05-01 and 108-02-10.

Acceptance

As with all progression, time is the major factor indicating acceptance. Considering the scope of the symbols contained in the new AS 1102, and the rapid state of flux in the electrotechnical industries involved, it is only natural that it takes a while for most or all of the changes to become commonplace.

Many of you will be aware that The Apogee Group, in its contributions to ETI, uses a CAD system in the preparation of diagrams. To a large extent we attempt to follow the procedures dictated by the Standards Association of Australia. However, some of our diagrams have non-standard blocks or nomenclatures. These deviations are usually introduced to cope with the restraints of publication in a magazine format and these take two forms. Firstly, the material on which the diagram will be printed — a more porous paper stock is going to allow the ink to spread more. At certain sizes, some symbols can distort sufficiently to cause confusion. An example is shown in Figure 5.

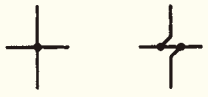


Figure 5

In the example, AS 1102 designates that the four-way interconnection of two conductors should be represented as for a mere intersection, but with the addition of a junction point. In some circumstances, especially if a diagram is 'sized down', the standard way of representing this can be lost amongst a sea of intersections and connections.

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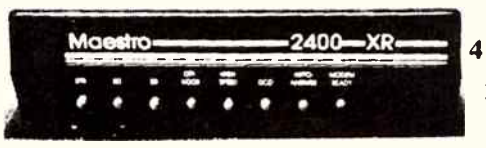

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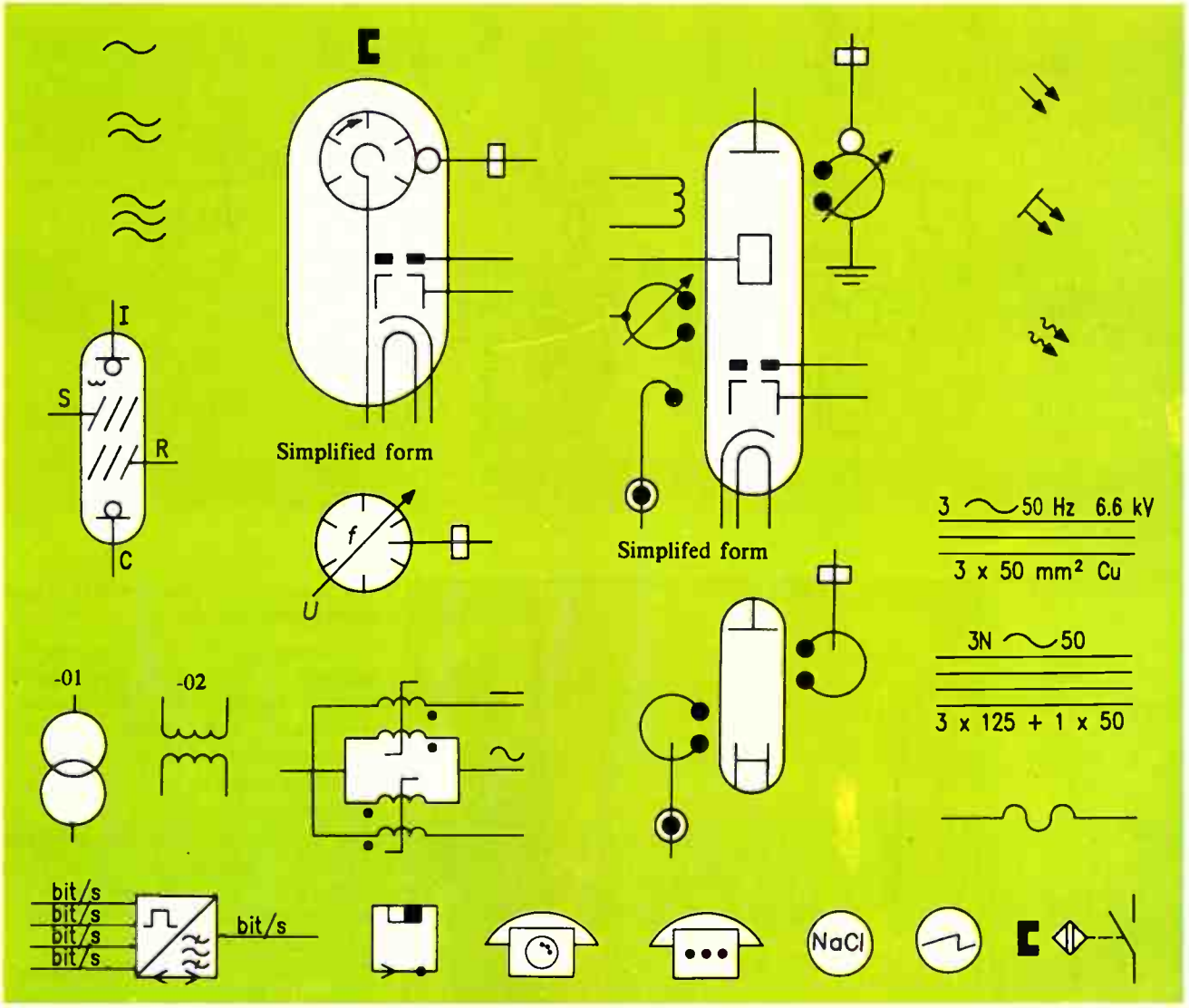
For this reason, we use a different technique.

A second consideration concerns us with the physical layout of an article or diagram, dictated by size and space. At times we will rearrange the structure of a drawing or use various "graphic short-cuts" in order to allow the drawing to be reproduced in the space provided. These deviations are required as most drawings of this sort, i.e. schematic diagrams, are usually reproduced in the form of plans and are used as a permanent record or reference for a company or industry. These are often printed on large sheets of drafting media — A3, A2, A1 and A0 size.

Below: some distinctive symbols.



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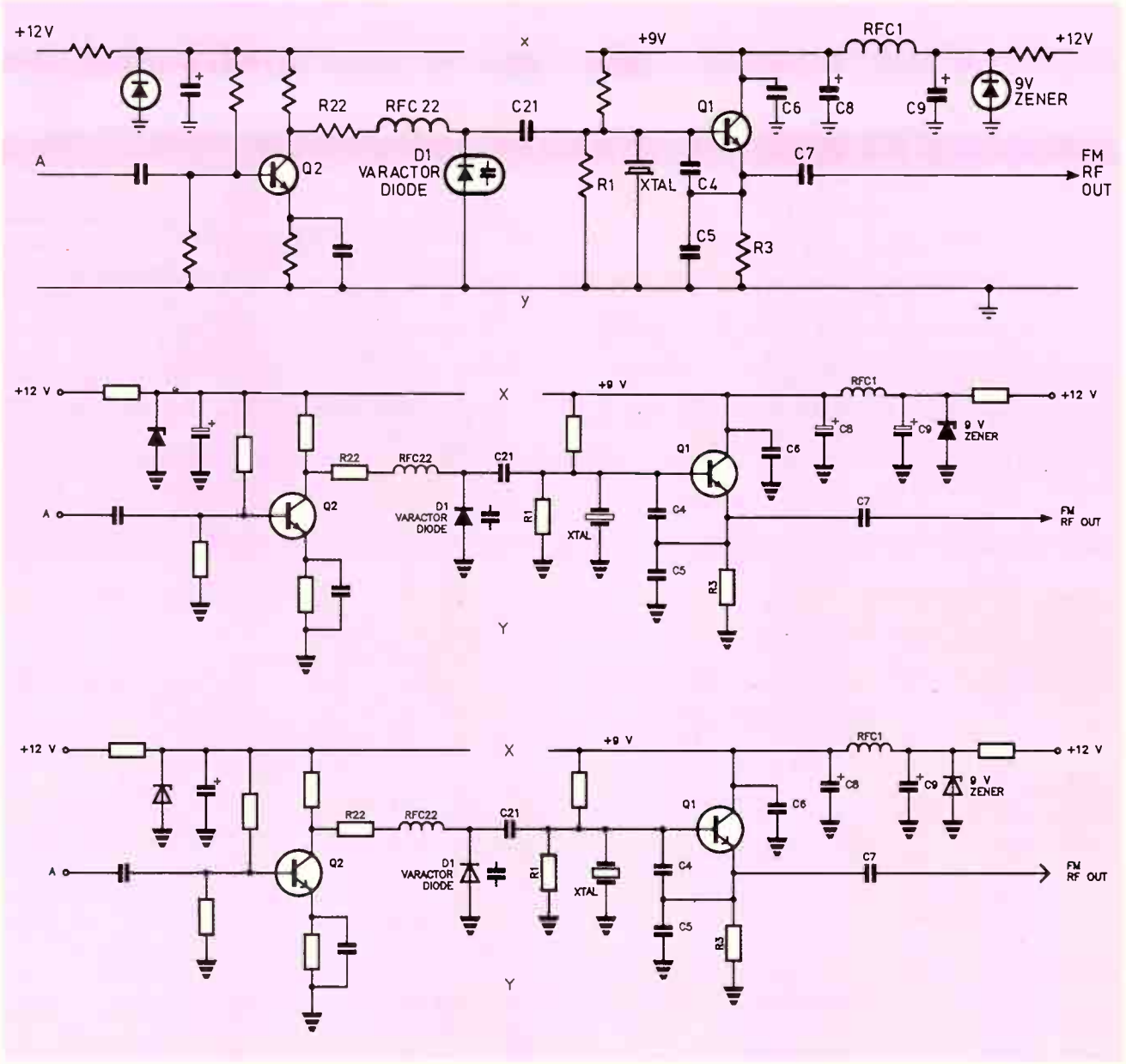

Figure 6

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The various symbols are published in both printed form and software.

Certainly, for our part, we will attempt to implement the new or revised symbols in our schematic diagrams and other graphic documentation. However, in our case, this needs to be done gradually as re-education of our audience, on this scale, can only be achieved through experience rather than instruction. So, bear with us as we implement the symbols in question — where necessary we will explain the introduction of radically different standards. ■

Contributed by The Apogee Group

Continued from page 11

390, 391 and 393 offer the latest technology. Features include low noise level, well-designed and lit control panel, compatibility and a wide range of fonts.

The OKILASER 400 LED page printer offers 4 PPM print speed, HP Laserjet Series 11 Emulation, 25 resident fonts, with a range of optional font cards, 0.5, 1.5 or 2.5 MB of memory and paper cassettes for all popular paper sizes.

Details from IPL-Datron Pty Ltd, 19-25 Wyndham St, Alexandria, NSW 2015. ☎ (02) 698 8211.

Highest resolution?

And **Toyo Corporation** claims its TPG-4300 full colour video printer gives the industry's highest resolution (300 x 300) and most accurate registration for "B" size colour hardcopies.

A built-in, high-speed intelligent video processing interface eliminates the need to write special software to drive the printer and handles CRT monitors up to a 1280 x 1280 resolution.

The TPG-4300 is easy to operate, requires no field installation, is virtually maintenance free and works with all popular high-end graphics display and image processing systems, says the company.

Their TP-6490 gray scale video printer uses a direct thermal process to give hard copies with a resolution of up to 1280 x 1024 and includes a fast Frame Grabber for 1280 x 1280 pixels.

More information from Amtex, 13 Avon Rd, North Ryde, NSW 2113 ☎ (02) 805 0844.

Lots to choose from

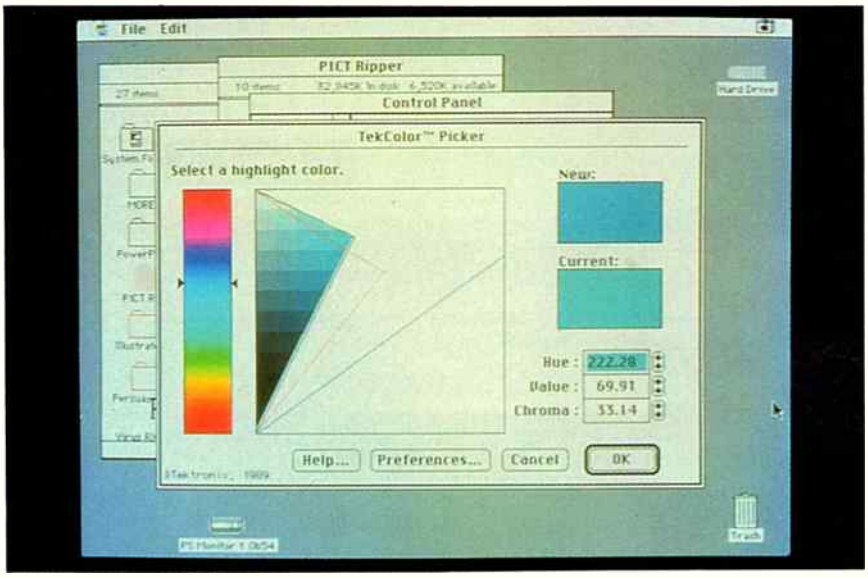
Distributor **TCG** has a whole range of printers and plotters to choose from.

JDL's 850 GL+ plotter/printer provides unattended plotting up to A^2 size. It has no pens to change or keep clean. A standard 1 MB (optional 2.5MB) plot buffer combines with a new parallel plotting capability for fast file transfer. Letter quality text is printed at 144 cps and draft print output at 360 cps in 14 crisp colours. A roll feed option allows continuous, unattended plotting. It features the universally-supported HP-GL command set.

The newest JDL plotter — ProPlotter — supports up to A1 size output in 20 colours, and shares the fast plotting heritage of the 850. ProPlotter allows single page plots up to 150 feet long with resolutions ranging from 180dpi and 360dpi.

Ioline's LP7200 represents a new dimension in large format plotters. Designed for extra wide applications, the LP7200 lets you generate hundreds of sizes of plots up to 72 inches wide.

A favourite with design engineers, says the company, the Ioline LP4000 delivers the flexibility, performance and reliability needed for sophisticated applications. Offering plot sizes A1 to



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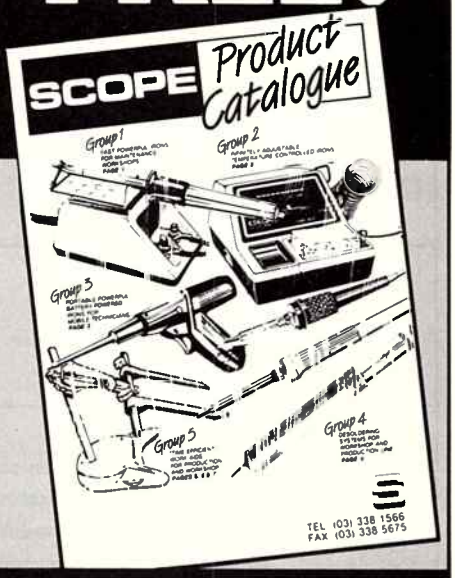

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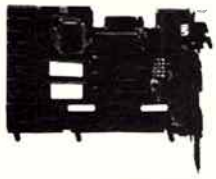

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PRINTERS & PLOTTERS

A0, the highly upgradable LP400 has up to 20 pens and accommodates a list of time saving features to maximise plotter performance.

Meanwhile, the LP3700 offers professional-quality and A0-size capability at a reasonable price. It is ideal for businesses where volume of output is heavy and cost is a factor. The LP3700's 8-pen Multipen Changer accepts up to 20 pens.

Another thermal plotter range from **RDK** includes new A2 and A3 models, and the A0 to A1 size larger format RY-T001 direct imaging thermal plotter.

Model RY-T001 operates at greater speed than pen plotters, but at less cost than electrostatic plotters. It produces drawings in under two minutes at eight dots/mm, with a maximum plot size of 46 x 33inches. It accepts standard HP-GL commands and accomplishes vector-to-raster conversion via a built-in 8MB buffer.

With the paper drive mechanism being the only moving part, the plotter construction is designed to reduce maintenance and increase reliability.

You can turn your printer into a plotter by simply adding an Eograph Plus board from **Eotron** . Regardless of what's been written into your application package, Eograph lets you generate graphics at your printer's highest resolution, with eight different pen widths.

Eograph takes advantage of almost any PC software program by emulating HP-GL and DM/PL and slots into any IBM, Compaq or other 100 per cent compatible PCs. You can print as many colours as your printer will allow, as every Eograph board is designed to accommodate future improvements. All popular — dot matrix, inkjet, laser or thermal — printers behave just like plotters when you have the Eograph board in your PC.

A faster and more colourful way to get high resolution hard colour copies is by using **Seiko's** D-SCAN range. Employing thermal link transfer technology, D-SCAN delivers screen data samples in as little as 60 seconds. A glossy finish can be printed on either A3 or A4 size plain paper or overhead transparency film making it ideal for any type of colour presentation.

The D-SCAN range offers resolutions of 200 and 300 dpi in the CH 5400 series and up to 2048 x 2944 resolution in the CH-5300 series.

Bruning's new high speed performance drafting plotters offer dual mode versatility and high

Canon's LBP-8 III laser printer.

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BYTING THE DUST: A STORY WITH A MORAL

BY KRYSTYNA COOPER

It was a case of the lights being on but no-one being at home for Mark, the new field service engineer of a well-known computer company, the day Illawarra County Council at Wollongong logged a call on its laser printer. This computer company was highly regarded in the industry for its prompt call-handling, and today was no exception.

As ICC's regular FSE was tied-up elsewhere, Mark was the man of the moment and quickly raced over to the site. Introductions and formalities dispensed with, Mark then investigated the problem and isolated the cause in no time.

The laser printer, a Ricco made DEC LN03, has a development drawer with a toner hopper where blockages are sometimes known to occur, causing blank sections to appear on the page.

The method commonly used to rectify this problem is to vacuum out the toner hopper and then refill with toner. A special vacuum cleaner is needed — one which holds a certain type of filter bag designed to trap the very fine, jet-black toner dust particles.

Mark proceeded to remove the toner from the internals, using a spanking new (first time used) vacuum cleaner. He marvelled at the incredible suction generated by the vacuum and knew that at the rate he was going, he'd be finished at ICC within the half-hour.

At one stage early on in the piece, the DP manager (who, by the way, ran a very tight ship) came in and remarked on how smoky and hazy it had become. Mark wasn't in the least concerned and with a "No worries, nearly done!" sent the DP manager back to his office.

Fait accompli, Mark turned round to unplug the vacuum and, to his absolute horror, found the entire room — walls, carpet, desks and chairs, all newly refurbished — caked thick with black soot!

He immediately assessed the situation and surmised that all the toner which had been sucked up by the vacuum cleaner had spewed straight out the exhaust end. He then discovered the new vacuum had been despatched without a filter bag!

Well, Mark just wanted to dig the biggest hole he possibly could and bury himself in it — know the feeling?

Reluctantly, he approached the DP manager, bravely smiled and blurted out, "I think you have a real problem here".

Mark spent the rest of the day cleaning . . . and cleaning . . . and cleaning. As you can imagine, it was an exercise in futility. Professional cleaners had to be called in; even they couldn't lift the toner.

So, all you FSEs out there, next time you're about to clean a toner hopper, first check your vacuum cleaner for a filter bag — otherwise you, too, may end up "byting" the dust.

productivity for CAD/CAM and project management hardcopy output.

The Zeta 924 and 936 are 24 and 36 inch plotters that use a wide variety of pen types including ball point, liquid rollers, nylon tip, and refillable and disposable ink.

And **Hitachi's** 674 and 673

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models offer the most versatile plotting functions ever realised in their class of plotters.

The 674 accepts a variety of sheet sizes from A4 to A1, while the 673 caters to A3 and A4 plots.

The Hitachi plotters offer high accuracy in carrying out a wide range of commands, including HP-GL based, for detailed CAD drawings. The 674 has four pens that plot at a maximum speed of 400mm/s, which is easily regulated from the computer keyboard or the plotter's control panel.

More information on all these products can be obtained from TCG, 30 Balfour St, Chippendale NSW 2008. ☎ (02) 699 8300.

Recent releases

Recent releases from **Dataproducts** include the LZR 650 laser printer.

The LZR 650 can handle applications such as high volume mailing, word processing, spreadsheets and business graphics. Printouts are produced with a resolution of 300 by 300 dots per inch.

The LZR 650 contains a broad selection of resident typefaces and is capable of supporting font cartridges and downloadable fonts. Output can be customised with an assortment of type styles and character sets.

From the same stable is the LZR 2655/LN laser printer capable of up to 1500 pages per hour for multi-user network applications.

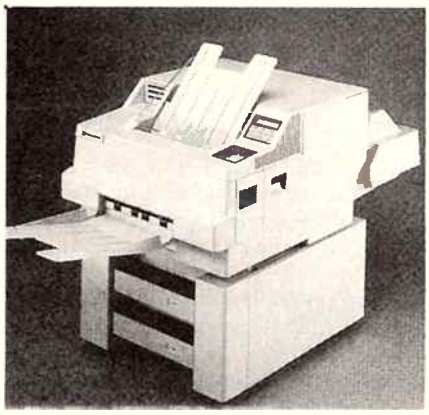
It has a full complement of 34 fonts resident. Download LNO3 PLUS format fonts are supported.

Further information about Dataproducts laser printers is available from Paul Press, Dataproducts Corporation, ☎ (02) 451 3533.

Two major assemblies

The 3700 system from **Xerox** contains two major assemblies: the controller and the printer.

The controller has the following components: keyboard/display with



The LZR 1260i with multi-cassette feeder, part of Dataproducts' LZR 1260 series.

7-inch diagonal screen; 50-megabyte internal disk; Source Data Module; reader for 5¼-inch double-density diskettes; 1 MB Image Generator Module; Control Module.

The printer consists of the following components: 1500-sheet main feeder; two 250-sheet input paper cassettes; Xerographic engine; 2000-sheet output stacker; extension

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13	38	63	88	113	138	163	188	213	238	263	288	313	338
14	39	64	89	114	139	164	189	214	239	264	289	314	339
15	40	65	90	115	140	165	190	215	240	265	290	315	340
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20	45	70	95	120	145	170	195	220	245	270	295	320	345
21	46	71	96	121	146	171	196	221	246	271	296	321	346
22	47	72	97	122	147	172	197	222	247	272	297	322	347
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for 11 × 17-inch or A3 paper; laser-equipped scanner; maintenance control panel.

The Xerox 4020 colour ink jet printer provides full personal computer compatibility and extensive software support.

The Rank Xerox range includes the 4030 desktop laser printer which emulates several popular desktop printers, including the HP LaserJet Series II, making it compatible with most personal computer software programs. These include applications such as word processing, desktop publishing, spreadsheets, computer-aided design, business graphics, database management, electronic forms and bar codes.

In addition to the HP LaserJet Series II emulation, resident emulations on the Xerox 4030 include the Epson FX-80, IBM Proprinter II and Diablo 630 ECS printers, and the HPGL 7475A plotter. Emulation selection is done either manually or under software control.

The resolution of the 4030 is 300 × 300 spots per inch.

There are eleven resident fonts provided with the 4030. The six fixed pitch fonts are used with the emulations, and the five proportional fonts are used only with HPLJ II emulation.

In addition to the 11 resident fonts, font cartridges may be used in either of the two ROM cartridge slots. Each font cartridge has a maximum capacity of 1 MB and is delivered in three different capacities, 128 kB, 256 kB or 512 kB, depending on the font size. 23 standard font cartridges are available.

Also from **Xerox** is the 4045 electronic printing system, a member of the Xerox Decentralised Electronic Printer Family.

It can be configured to a wide range of host systems and has the capacity to function in local as well as remote locations.

Printing jobs of single sets at speeds of up to 10 pages per minute, the 4045 is an efficient office printer. A wide selection of fonts, the ability to handle special applications from bar codes to letters with signatures, and excellent print quality are claimed by Xerox.

The Xerox 4045 has one paper-tray of up to 250 (A4 to 14″) sheets. The output tray holds up to 250 sheets. It can handle downloaded fonts and store permanent resident fonts on cartridges at the printer.

The Xerox 4045 implements the Xerox Decentralised Command Set (XDCS) and the Diablo 630. The Diablo 630 is an impact-type daisywheel printer; the 4045 supports a subset of this product's ECS/API configuration. XDCS is the command set used on the Xerox 4045/46, 2700 and 3700 Laser Printers.

The 4045 supports the following data encoding schemes: ISO 6937 — this is a code set derived by the International Standards Organisation, and includes multinational font characters; ASCII — this encoding supports the US ASCII code set, as well as other national sets and allows automatic code mapping to multinational font characters within the ISO set; EBCDIC — this is the data processing (DP) code set used by IBM; IBM PC — this is code set used by the IBM PC.

Dataproducts' LZR 650 laser printer.

The 4045 comes configured with one of four different interfaces; the SNA interface offering an IBM 3270 co-axial connection. (The printer emulates an IBM 3287 printer.); the IBM system 34, 36, 38 and AS 400 twin-ax connection. (The printer emulates the IBM 5219, 5224, 5225 and 5256 printers.); the parallel/serial interface offers either Centronics connections supporting the pin assignments and signals used by this interface or the serial interface supporting an RS-232-C connection and the asynchronous protocol. (This interface supports odd, even and no (ignore) parity as well as XON-XOFF (DCI-DC3), EXT-ACK, and/or Printer Ready flow control); the Dataproducts parallel interface offering Vertical Format Unit (VFU) emulation. This function, normally used with the Dataproducts configuration, is available with both parallel setups. It allows the 4045 to accept specially-encoded command bytes that control vertical print positioning on the page.

For more information on all these Rank Xerox products contact David Stringfellow, Rank Xerox (Australia) ☎ (02) 449 0449. ■

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World Radio History

Continued from page 38

mechanically secured so that no tension is placed on the coax plug and socket. To do this, I looped the cable over the back of the junction box where I clamped it in place with a small strip of scrap fibreglass pc board. Two 20 mm long self-tappers bight into the bottom end of the junction box's lid securing posts. The fibreglass strip is drilled accordingly. The final arrangement can be seen in one of the photographs.

Now you can insert the dowel and screw in the eye bolts. Note that the length of the dowel is such that its ends are recessed inside each port.

Time now to drop the wound toroid into the junction box and wire it up as per Figure 5. Leave those leads which connect to the balanced antenna feedpoint as long as they

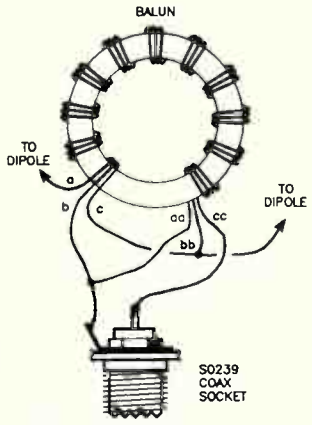


Figure 5. How the balun is wired-up.

are; feed them out through the slits in the dowel. The other leads may be cut suitably short. Ensure that you get the wire ends clean so as to get good soldered joints. You don't want a bad joint swinging around in the breeze 10 metres or so in the air. With some winding wire available, the enamel becomes a flux when heated to soldering temperature. "Leumex" and "Bixaflux" enamel are just two examples. Just apply heat to the wire and a little solder as the enamel begins to melt. Pretty quickly, you have a well-tinned wire end.

Carefully check that you've got the toroid wired correctly. Once you're satisfied all's well, you can seal up the housing inside with clear Silicone sealant. Apply some at the base of the eye hooks, too, filling in the space left in the port.

Slinging the balun

The balun assembly may be slung at the centre feedpoint of a wire dipole in a number of ways. Small cable 'eyes' may be passed through the eye hooks on the balun and the dipole wire tied off round these. The dipole wire should not be tied directly through the balun's eye hooks as the bending radius is quite small and this will compromise the tensile strength of the dipole

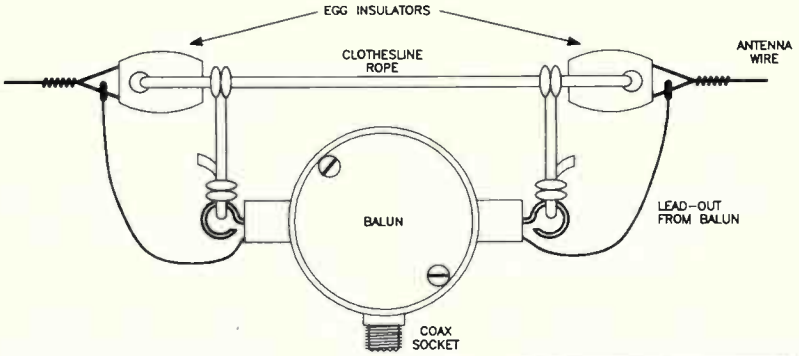
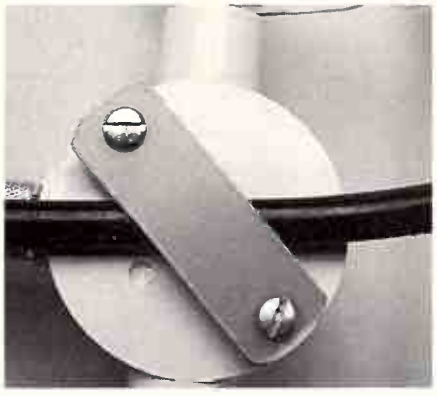


Figure 6. One method of slinging the balun assembly at the feedpoint of a wire dipole. See also the accompanying photograph.

wire. Such cable eyes are obtainable from ships' chandlers and some hardware stores.

Alternatively, the dipole feedpoint may be terminated to a pair of plastic egg insulators which are tied together with a short length of rope. Plastic covered 'clothesline' rope of about 5 mm diameter is ideal for this. The balun assembly is then suspended below the egg insulators as shown in Figure 6 and the accompanying photograph. The balun's

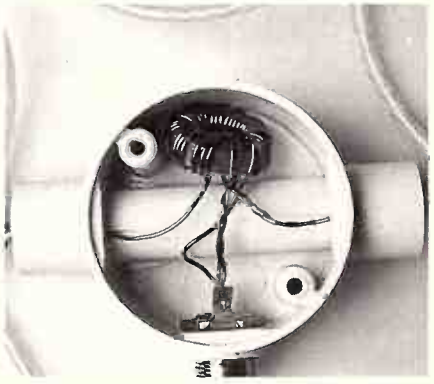


Rear view of the balun assembly, showing how the coax is secured. This prevents any tension being placed on the coax plug and socket. The arrangement works equally well for "half inch" coax (RG8 or RG213) as for "quarter inch" coax (RG58 or RG59). However, only sufficient tension to hold the cable in place should be applied, else you risk crushing it, with the possibility of a short circuit.

balanced feedpoint leads are looped up and soldered to the dipole wire adjacent to where it terminates to the egg insulator.

The feedline cable is clamped to the rear of the balun and a length of coax looped over the rope between the egg insulators and round to the balun's connector. The coax plug and socket are weatherproofed with a suitable tape and then more tape is wrapped around the cable here and around the cable leading down beneath the balun assembly.

Hoist your dipole high and check it out with an antenna noise bridge or an SWR meter. There should be no problem – unless you've cut the dipole too short or too long. Happy DX hunting. eti



Inside the completed balun assembly.

PARTS LIST ETI-753

1 x Amidon toroid core, type T80 or T94; 3 metres of 18 gauge (1.0 mm) enamelled winding wire; 1 x SO239 single-mount coax socket, with earth lug; 1 x 65 mm diameter, 3-way circular electrical junction box; 1 x 90 mm length of 18 mm diameter dowel; 2 x 20 mm o.d. screw-in eye hooks; 1-1.5 metres of 5 mm plastic-covered 'clothesline' rope; 2 x plastic egg insulators; 2 x No. 8 x 20 mm self-tapping screws; small scrap of fibreglass pc board; 65 x 20 mm Silicone sealant; sealing tape.

Approximate cost: $16-$22.

Contributed by The Apogee Group

NOTE: The Amidon toroids are obtainable from: Stewart Electronic Components PO Box 281 OAKLEIGH Vic 3166 ☎ (03) 543-3733, Fax: (03) 543-7238

The T80-2 (order FC360) and T80-6 (order FC361) cost $2.05, the T94-2 (order FC351) costs $2.27 and the T94-6 (order FC352) costs $3.03. Add 20% sales tax to all prices.

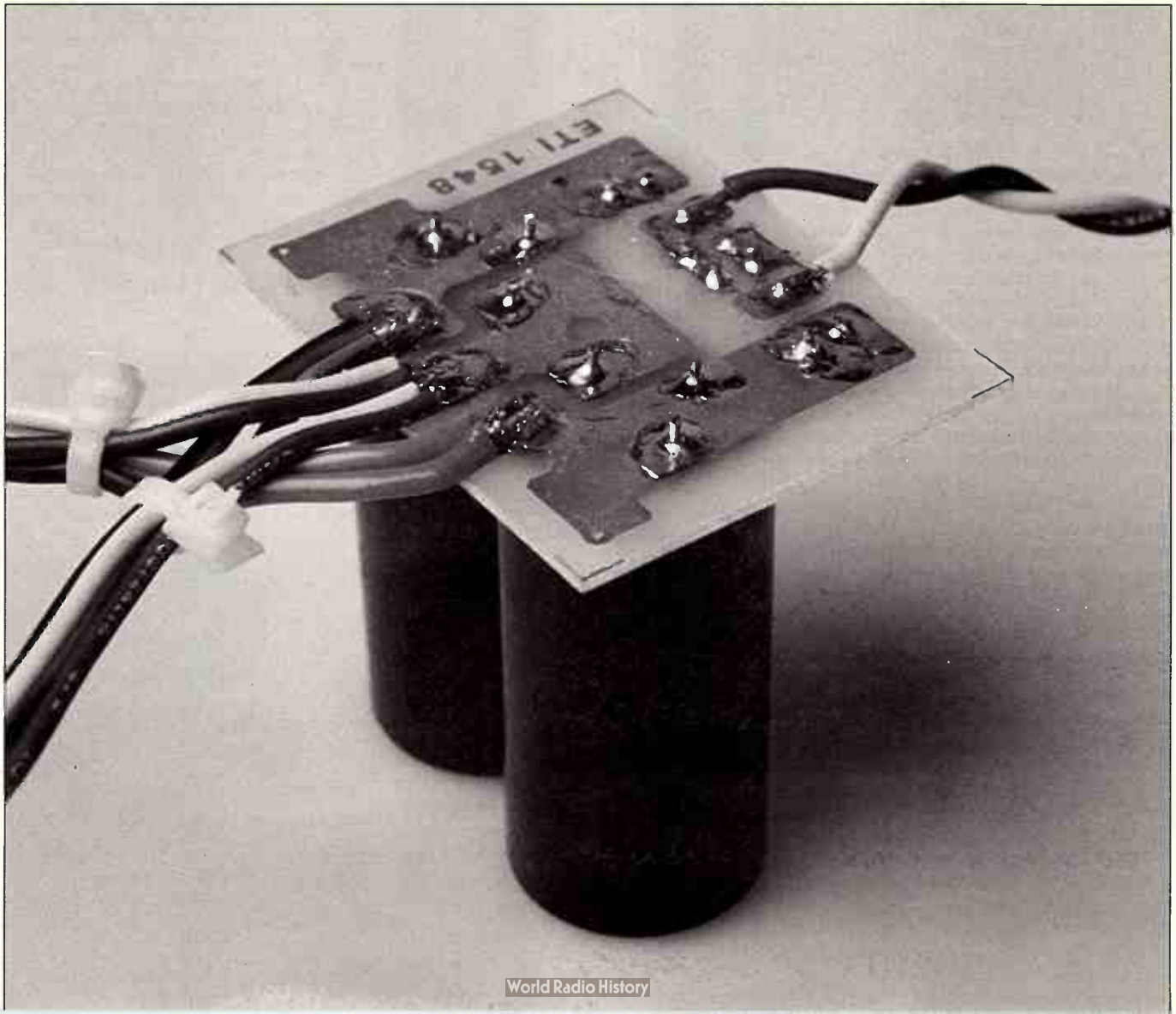
A selection of Amidon toroids.

World Radio History

A DUAL-RAIL POWER SUPPLY MODULE FOR AUDIO POWER AMPS

ELECTRONICS
ETI-1548

Here's a universal power supply module for use with audio power amplifier modules that require positive and negative supply rails up to 40 volts. It suits such amps as the perennially popular ETI-480, the ETI-470 and the more recent ETI-1430, or Digi-125. By Graham Dicker.



World Radio History

Possibly ETI's most popular project over the years has been the ETI-480 50/100 watt audio power amp module. It is still stocked as a current kit by all the major project kit suppliers. It is a real "work-horse" amplifier and tens of thousands have been built since it was described in the December 1976 issue. The ETI-470 (May 1979) was a 60 watt module featuring low transient intermodulation distortion, which subsequently formed the basis of the Series 4000 hi-fi stereo system, a very popular integrated amp a decade ago.

The most popular project of the past 12 months has been the ETI-1430 'Digi-125' audio power amp module. Many thousands of these have been constructed since it appeared in the May 1989 issue. We have had a number of requests to describe a power supply module for the Digi-125, as there is nothing suitable on the market and the supply described in conjunction with the ETI-480 has long been unavailable in kit form.

Details

As you can see from the circuit, two full-wave rectifiers are used to derive equal positive and negative dc supply rails using a centre-tapped transformer; capacitors C1 and C2 provide smoothing and energy storage.

The printed circuit board has been designed to suit single-ended pc-mount (RB) capacitors with pigtail leads, which are less expensive than can-type capacitors, which have lugs, for this application.

Suitable transformers to power amplifier modules of a given rating may be selected from Table 1 here, which also details recommended minimum values for the capacitors. As a rule, the value of the electrolytic capacitor in applications such as this is to use approximately 3-4000 uF per amp of peak rail current. Their working voltage rating must be *at least* equal to the required rail voltage, or preferably above that. Available capacitors for this application only come in a limited range of working voltage ratings, generally 25, 40 and 80 V. They vary considerably in size, too. In general, the commonly available 40 V rated RB-type capacitors are best used in this application.

With 28-0-28 V transformers, after rectification and smoothing, the supply rails will be around 39-40 volts, and some 37-38 volts under load. So, capacitors rated at 40 V are OK. *But*, if you use 40 V capacitors, you can't use a transformer with a higher secondary voltage.

In any case, a 100 watt module such as the ETI-480 or ETI-1430 requires +/– 40 V rails, so the combination of a 28-0-28 V tranny and 40 V-rated capacitors is ideal. Table 1 shows recommended capacitance values for differing amplifier power ratings, selected according to the supply current requirements.

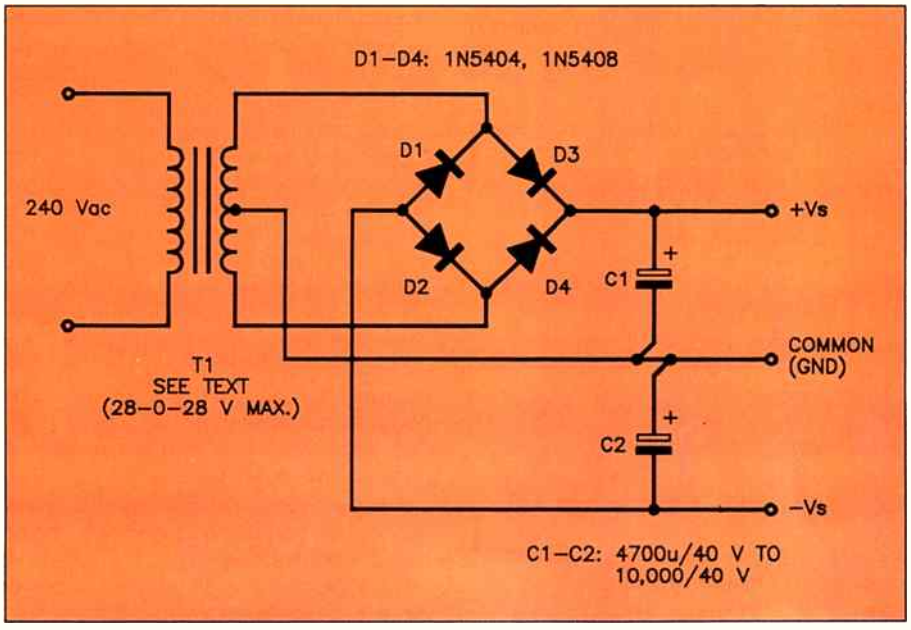
Under load, the supply rail voltages will reduce as a result of the dynamic regulation of the supply (transformer regulation characteristics, winding resistance, etc). To improve the regulation, larger electrolytics and a transformer with a lower winding resistance (higher current rating) may be used. In any event, with audio, it is wise to apply the adage "bigger is better", hence larger capacitor values improve matters.

Now here's where a curious fact pops up. In the normal course of events, you'd expect that, for the same voltage rating, capacitors of a higher value would cost more. Not so. If you shop around, 10,000u/40 V capacitors cost little more than 4700u/40 V capacitors, while the price of 5600u/40 V types can be astronomically more than either of the other two. Even 6800u/40 V capacitors, when you can find them, cost less. But, such vagaries may not always be the case. The simple answer is, use 10,000u/40 V capacitors if they're available and affordable.

AMPLIFIER POWER RATING	SUPPLY RAILS	TRANSFORMER SECONDARY	TRANSFORMER TYPE	C1, C2 (min.)
25-30 watts (ETI-480)	25-30 V	20-0-20 V/1 A 20-0-20 V/1.5 A	PL40/40VA PL40/60VA PF3993	4700u/40 V
50-60 watts (ETI-470, ETI-480, ETI-1430)	40 V	28-0-28 V/2 A	DSE-0144 PF3577	5600u/40 V
100 watts (ETI-480, ETI-1430)	40 V	28-0-28 V/3 A	DSE-0144* PF3577* 2 × either	10,000u/40 V

TABLE 1. This shows the transformer type and minimum value of C1-C2 required to power amplifiers of given ratings.

**** These 2 A-rated transformers may be used where the amp is not called on to deliver 100 watts continuously, otherwise two transformers with their secondaries connected in parallel need to be used.***



The diameter of capacitors suitable for use in this project are much the same, only their length varies with the value. Hence, whatever value capacitors you choose from Table 1, they will fit the pc board.

While transformers having a centre-tapped secondary, or two secondaries which can be connected in series, are specified in Table 1, two separate transformers with single secondary windings of suitable ratings may be used with their secondaries connected in series. For example, a +/– 25 V supply for a 25-30 W power amp may be derived from two 18 V transformers, e.g: DSE-1990

Circuit of the project — two conventional full wave, capacitor input rectifiers, fed from a centre-tapped transformer. Table 1 shows the various transformer and capacitor combinations to suit different audio power amp modules.

World Radio History

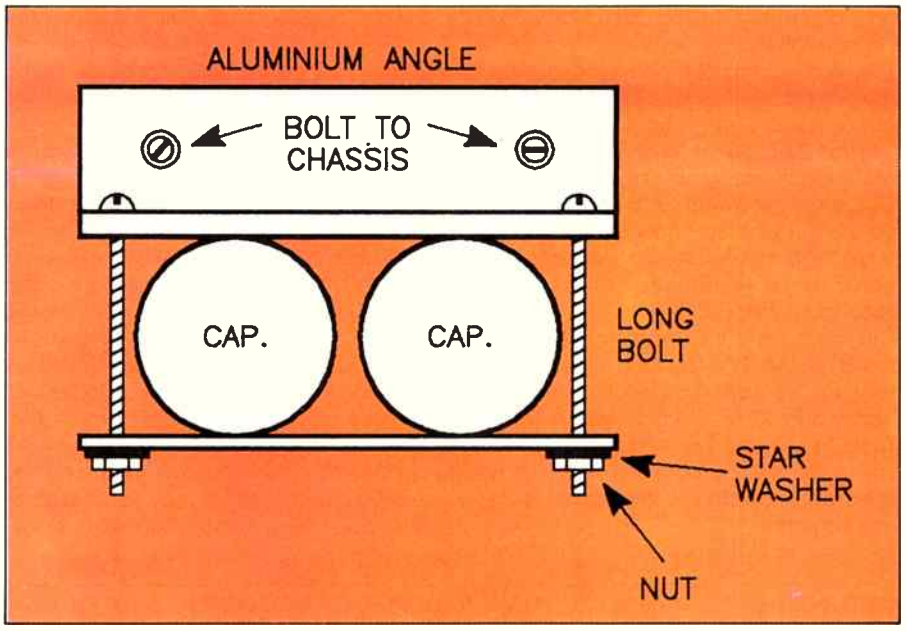


Figure 1. Suggested method of mounting the project. This is a top down view in which the pc board would otherwise obscure the arrangement seen here. The copper side of the pc board faces uppermost, allowing all interconnecting leads to be soldered directly to the copper tracks, or 'lands'.

from Dick Smith Electronics, which is rated at 2.2 A, or Ferguson PL18/40VA, which has two 9 V windings and is rated at 2.22 A. This may well prove to be a cheaper alternative to the single transformer approach, if you've got the room in your application.

The diodes specified are rated to carry an average forward current of 3 A. Their voltage rating – 400 volts PIV for the 1N5404 and 800 volts PIV for the 1N5408 – is more than adequate for the application here. Likewise, their peak surge forward current rating of 200 amps is more than adequate here, too.

Building it

The pc board holds just the four rectifier diodes and the two filter/smoothing capacitors. Large copper areas ensure low impedance and adequate current carrying capacity. Assembling the pc board is quite straightforward. First check that the component holes are all drilled and that their diameters suit the component leads. You'll find it easiest to solder the diodes in place first, leaving a few millimetres of space between the diode bodies and the pc board surface to allow some air flow for cooling.

Follow by mounting the capacitors. Note that these may have a 'locating' lead which is shorter than the positive and negative pigtails. This helps correct orientation of the capacitors on the board. If your capacitors don't have this feature, watch which way round they go when inserting them. Make sure you seat the capacitors right down on the pc board as this provides good mechanical rigidity for the assembly.

If your transformer has leads rather than terminals, arrange to mount the project and the transformer close together so that the transformer's leads are terminated directly to the board.

A suggested mounting method for the project is shown in Figure 1. The capacitors are mounted top down, seated directly on the chassis, and secured to an angle bracket with long bolts and a length of aluminium sheet. The angle bracket is bolted to the chassis, holding the whole assembly in place. This places the copper side of the pc board uppermost. The transformer's connecting leads, and the leads to the power amp module, can then be soldered directly to the appropriate 'lands' on the copper side of the board.

A less robust method, but quite effective nonetheless, is to again place the capacitors top down, using double-sided sticky pads to secure them to the chassis. This arrangement is quite adequate where the equipment is not moved often and/or is not subjected to mechanical vibration.

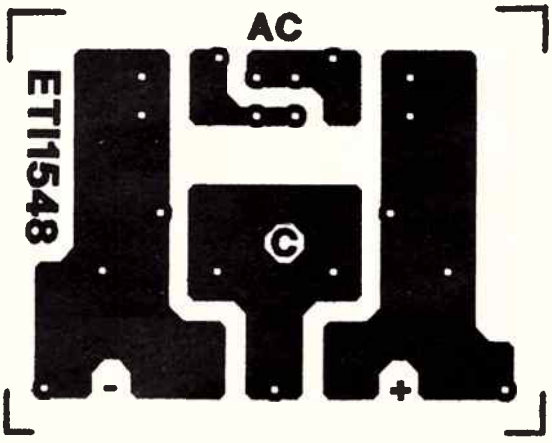
Supply wiring between the project and the amp module should be made with very heavy duty hookup wire, at the least (that is, 32 strands of 0.2 mm wire – known as '32 × 0.2'). When used to power a higher-rated 100 watt amp module, even heavier cable is recommended for best results, in the order of '41 × 0.32', known as ultra heavy duty hookup wire.

Remember that the amp module's 'common' should be wired directly to the project's common land, which you will notice is designated with a 'C' in the centre, and the loudspeaker common or negative connection should be wired *directly to the same point*. If you are going to connect the chassis to the circuitry common (circuit ground), then it should be wired to this point also *and not connected to any other part of the circuit ground, anywhere*. This avoids earth loops and other problems.

If your transformer does not have a centre-tapped secondary, but, rather, has two secondary windings, or if you are using two single-secondary transformers, then the leads from the transformer(s) that connect together to make the 'centre-tap' should *each* be connected to the project's common land. *Don't* connect them together at the transformers and take one lead from that connection to the project common. The charging currents for the positive and negative rail rectifiers will be shared in the one lead, which can increase ripple and noise on the supply rails.

Likewise, if you are paralleling transformers, connect the transformers together on the pc board, nowhere else.

While the project can be used to power a pair of 30 or 50-60 watt modules, using



Full-size reproduction of the printed circuit artwork.

World Radio History

Most RB-type capacitors have a third lead, which is the very short lead you see in this photograph. This lead is used to properly locate or orientate the component, as well as provide some mechanical stability when soldered to the pc board.

transformers and capacitors as recommended in Table 1 for 60 or 100 watt modules respectively, a single 1548 board cannot be used to power a pair of 100 watt modules, as it has insufficient capacity. In this case, two separate boards must be used, with separate transformers. This will improve the crosstalk and peak music power capability of the amplifiers.

When this project is used to supply two amp modules, wire each module to the supply individually, rather than running the supply and common connections from one module to the other and then to the supply board. This eliminates common supply and ground impedances, reducing crosstalk between the amp modules. eti

Contributed by The Apogee Group

PARTS LIST ETI-1548

SEMICONDUCTORS

D1-D4.....1N5404, 1N5408

CAPACITORS

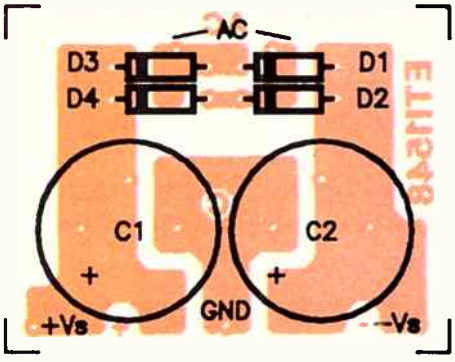
C1, C2.....See Table 1

MISCELLANEOUS

T1.....See Table 1

ETI-1548 pc board.

Estimated cost: $25-$30 without T1. $50-$68 depending on T1.



Component overlay for the pc board. Take care with the orientation of the diodes. I have made things easier by having them all face the same way.

"IDEA OF THE MONTH" CONTEST

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, proudly sponsors this contest with a prize given away every month for the best item submitted for publication in the "Ideas for Experimenters" column — one of the most consistently popular features in ETI magazine.

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World Radio History

USEFUL PROJECTS USING MUSICAL XMAS CARDS

ELECTRONICS
ETI-1202

God rest ye Merry Christmas cards! — to paraphrase a yuletide tune. Did you, your family or your neighbours receive some musical greeting cards this Christmas? Retrieve them before they're discarded — you can make some beaut projects using the electronic 'melody modules' inside! Roger Harrison shows how.

You'll find chip-on-board electronic musical modules in cards like these.

Musical greeting cards, as explained in my feature titled *Pop Technology* in the October issue last year, contain a tiny pc board carrying a chip and a battery, and the assembly drives a small piezo-electric transducer. Opening the card operates a simple switch which sets the electronics off playing a tune or a short suite of tunes. Some cards feature a conductive membrane keyboard and a 'mini piano' module, which enables you to play tunes.

These are the two, common, basic types of "chip-on-board" electronic modules you'll find in musical greeting cards. There are variants, but basically, they're all variations on a theme, if you'll pardon the pun. So, before getting into how you can adapt them to other uses, let us look at the basic characteristics of the two types.

The melody module

These comprise a chip which has a preprogrammed tune or sequence of tunes. The chip is a CMOS device featuring an on-board RC oscillator, direct drive of a piezo transducer, power-on starting and automatic power-down at the end of a tune or sequence. They are designed to operate from a 1.5 volt battery and, being CMOS, have very low power dissipation.

The data sheet for a typical device shows the chip operates with a 64 kHz time base, has a span of 36 notes (three octaves) and can play a tune or sequence of tunes comprising up to 128 notes. All this from a chip about 1.7 mm square!

Electrical ratings show an operating voltage (supply) range from 1.35 volts minimum to 1.65 volts maximum, with an absolute maximum of 2.0 V. Standby current is around one microamp! Peak current drawn is typically 2 mA. Clearly, it's specifically designed for battery operation. The manufacturer's data indicates the chip will withstand reverse supply polarity for a few seconds.

Figure 1 is the block diagram of a melody module chip, which shows just how sophisticated they are. The on-chip ROM is mask-programmed by the manufacturer; it is this software which determines the tune or tunes the individual chip will play.

The mini-piano module

These employ a quite different chip, designed for keyboard operation with a range of generally 13 or 15 notes. Most provide half-tone intervals and thus span just over an octave in range, but some provide

World Radio History

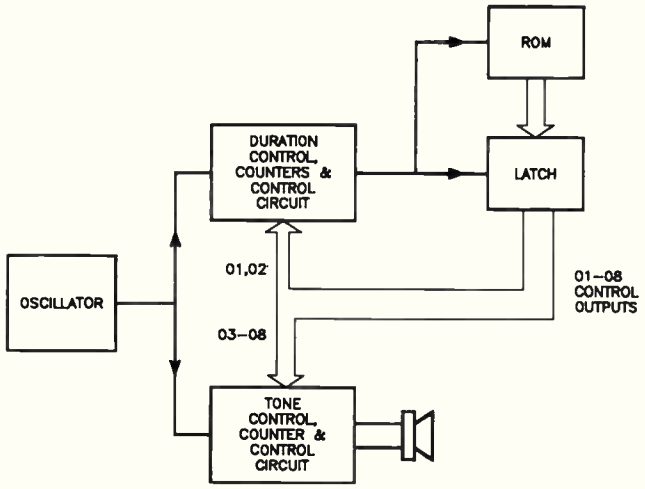

Figure 1. Block diagram of a melody module chip. The ROM is mask-programmed by the manufacturer and determines the tune or sequence of tunes the chip will play. Tunes available include Jingle Bells, Silent Night, We Wish You A Merry Christmas, Joy To The World and so on.

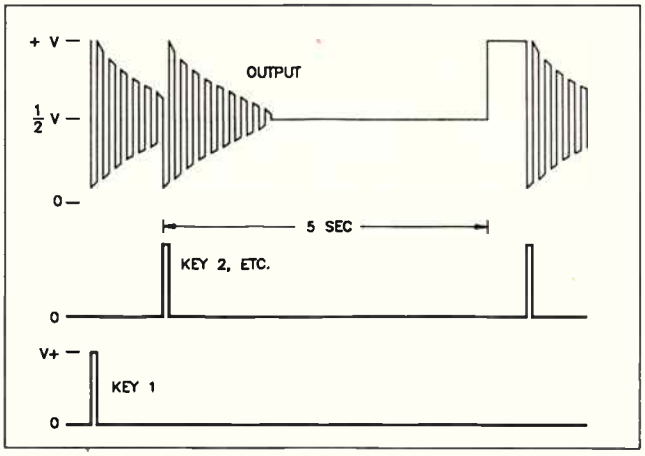

Figure 2. Showing the sort of output waveform delivered by a mini-piano module. When a key is hit, the selected note sounds and then dies away in amplitude until the next note is hit.

only whole-tone intervals spanning the best part of two octaves. The chips for these modules are slightly larger than the melody module chips, being about 2 mm × 1.7 mm. CMOS technology is used for these chips, too.

The chip-on-board, as with the melody module, will drive a piezo transducer directly. It features an on-chip RC oscillator, auto power-down and note decay so that when just one note is hit, the sound appears to 'die away' naturally. Figure 2 illustrates this.

The data sheet for a typical mini-piano module shows that it will operate from a supply voltage range of 2.0 V minimum to 5.0 V maximum. Standby current is given as typically one microamp, 5 uA maximum. In general, they are operated from two button cells which provide a 3 V supply. Operating current is specified as typically 3 mA, ranging up to 6 mA maximum. The key inputs are pulled up to the supply rail to operate a note and the chip's internal logic gives the highest note priority if two keys are activated at the same time.

Figure 3 shows the block diagram of a mini-piano chip; there's quite a bit to it, as you can see! Note the resistor marked "Rosc". This sets the operating frequency of the on-chip oscillator and the value used determines the basic pitch, note period and decay characteristics.

Getting your modules

Having collected a few unwanted greeting cards, you'll find the modules concealed beneath thin cardboard panels, secured in position with a rubber cement or a double-sided 'sticky patch'. The piezo transducer, used as a loudspeaker, will be secured in a similar fashion, or may just be stuck down with a length of sticky tape. You can prise the module loose with a sharp knife, but first pop the battery loose from its spring clip holder on the board. When you do this, note which tracks on the board are the positive and negative supply connections.

The next thing to do is remove the battery holder clip from the module. A small flat-bladed screwdriver is good for this. A little inspection will reveal how you can do this. With mini-piano modules, a flexible plastic strip with deposited conductive tracks makes the connection between the membrane keyboard and a series of tracks on the pc board, held in place by a clamp plate slipped over the edge of the board, as can be seen in the accompanying photograph.

Now for some projects!

New applications

I shall describe how you can employ such modules to make a modern day version of a music box, a musical piggy bank, a two-tone doorbell and a "stylus piano" (like the toy Rolf Harris popularised a few years back). With a little imagination and experimentation, I'm sure many readers can devise other applications.

Indeed, a mini-piano module would make

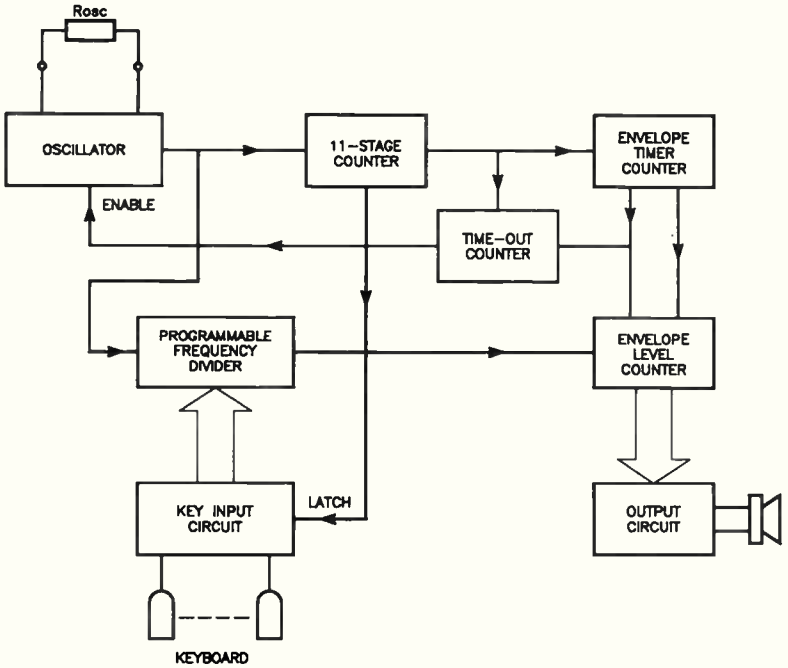

Figure 3. Internal block diagram of a mini-piano chip.

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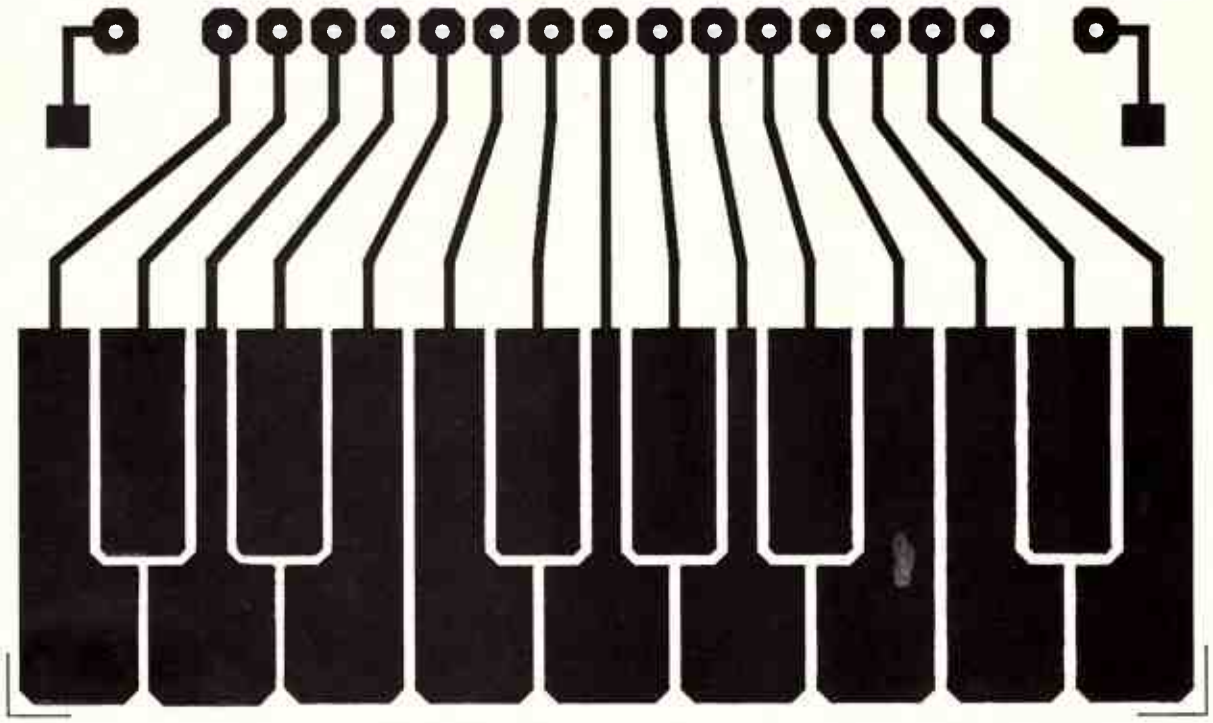
ETI-1202A STYLUS PIANO



Full-size reproduction of the ETI-1202A stylus piano keyboard.

Melody module from a Christmas card. The board is smaller than a postage stamp!

the basis of a simple computer-controlled keyboard instrument.

The basis for this range of applications is a small trigger/timer board (ETI-1202) which uses a 7555 CMOS timer. Configured as a monostable timer, it is used to power-up a melody module for a selected period, so that it plays one tune, part or all of its sequence of tunes, or just a few notes from the first tune. A pair of boards are used to make a two-tone doorbell in conjunction with a mini-piano module.

Another board, with a set of tracks making up a keyboard, is used in conjunction with a mini-piano module to construct the stylus piano.

PARTS LIST ETI-1202

SEMICONDUCTORS

IC1 ..... 7555, TLC555CP

RESISTORS all 1/4 W, 5%

R1 ..... 3k3

R2 ..... see text

CAPACITORS

C1 ..... 100n ceramic

C2 ..... 10u/10 V tant (see text)

C3 ..... 10n greencap or ceramic

C4 ..... 100n greencap

MISCELLANEOUS

ETI-1202 pc board; battery holder; 1.5 V battery; hookup wire.

Approximate cost: $7-$9.

The trigger/timer board

The circuit of the trigger/timer, shown powering a melody module, is given in Figure 4. This employs the CMOS 7555 timer in a triggered monostable configuration. With power applied, the 7555 is dormant until pin 2 (trigger) is pulled low (to 0 V), which starts the timer. The output then goes high for a period determined by the values of R2 and C2.

The beauty of the 7555 chip is that it is specified to work at a supply rail voltage right down to 1.5 volts, making it ideal for battery operation from a single 1.5 V cell, which also

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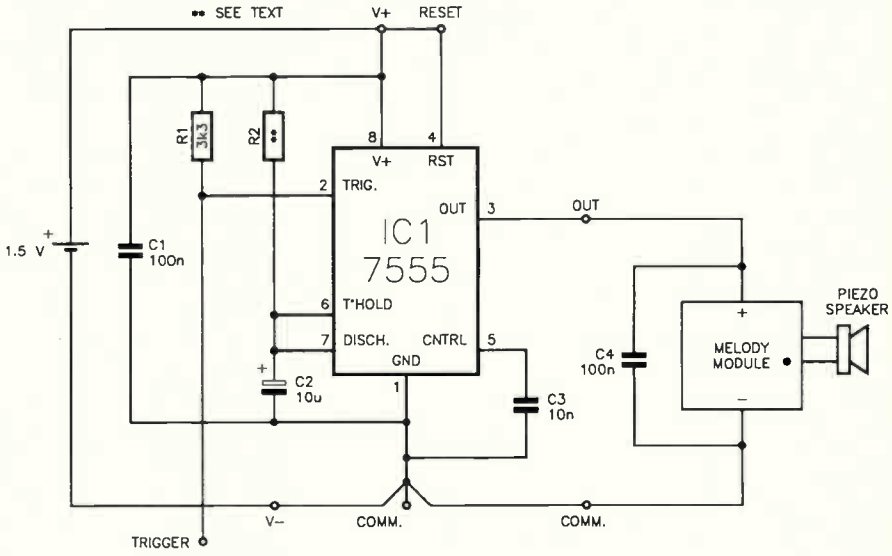
makes it compatible with the melody modules, which work only from a 1.5 V supply.

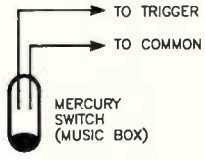
Both the trigger and reset pins of the 7555 are brought out to pads on the edge of the board, along with the output pin, ground (negative supply) and positive supply. Two 'common' rail pads are provided and a separate pad for the battery negative terminal connection. Provision has been made on-board to provide for a miniature vertical-mounting trimpot connected in series with the timing resistance, R2. Normally, R2 lays flat on the board, but when the trimmer is added, R2 is stood on end.

Note that, contrary to 'conventional' practice, the components mount on the *track* side of the pc board, their leads passing through holes in the pads, excess lead length being cut flush on the other side of the board. This allows the melody module and trigger/timer board to be mounted to anything, using just a double-sided sticky pad, the wiring between them then being directly accessible on the top side of each board.

There is nothing critical to assembling the trigger/timer board. Make sure you get IC1 the right way round. You can use a socket for the chip if you like, the machined-pin type being best in this application, as the pins are exposed on the topside of the board.

If you use a trimpot as part of the timing resistance, choose a suitable value to give the required variation and then choose R2,





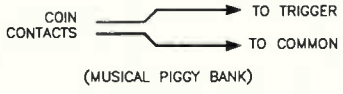
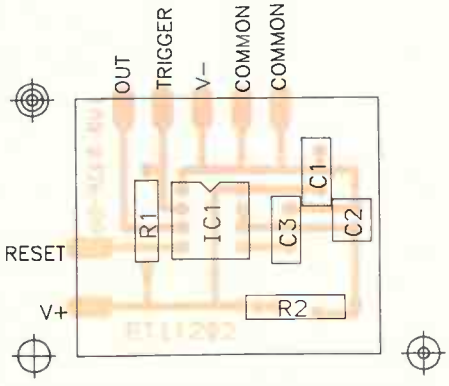
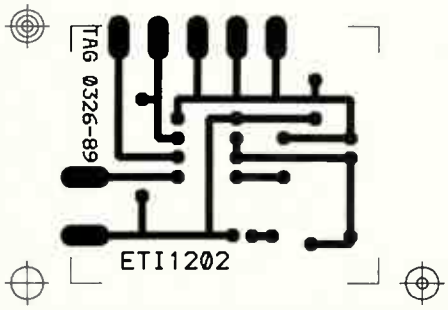


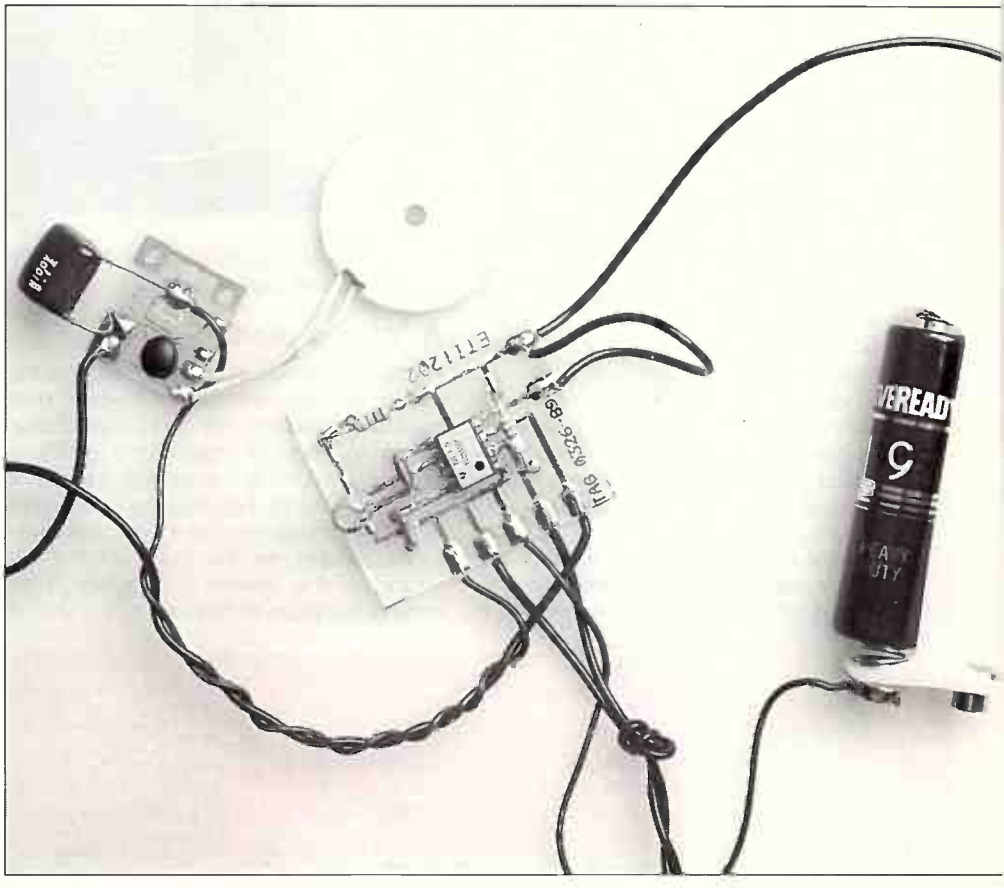
Figure 4. Circuit of the trigger/timer board, shown here connected to a melody module. Operation is explained in the text. The spot adjacent to one lead of the piezo speaker indicates the 'active' connection; the other lead connects to the positive rail.



Component overlay for the trigger/timer board. Note that the components mount on the copper track side of the board, with the leads passed through the holes and cut off on the non-track side.



Full-size reproduction of the trigger/timer pc board artwork.



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Musical Xmas cards

which will be in series, to provide a suitable minimum period. For example: a 500k trimpot and 470k for R2 would provide a minimum period of about five seconds and a maximum period of about 50 seconds. Or, with a 1M trimpot and 10k for R2, you would get a variation from 100 milliseconds minimum to 50 seconds maximum.

Note that the *exact* period will depend on the tolerance of the components. As tantalum capacitors have better tolerance than electrolytics, I have specified a tantalum type for C2.

A single 1.5 V 'AA' cell will last quite a long time powering a music box arrangement, possibly very nearly its shelf life. Quiescent current drain is only about 200 microamps. When a tune is playing, peak current drawn is about 2 mA.

A 'music box'

The melody module I used was of the three-tune variety. It took about 10-11 seconds to play each tune, with a pause between, completing the whole three-tune sequence in some 50 seconds. You can make up a modern day music box by interconnecting the trigger/timer board and a melody module as shown in Figure 4, and arranging to trigger the 7555 by some appropriate means.

I made up a "mysterious black box" with a trigger/timer board and melody module inside, with a couple of small holes in the faces of the box to allow the sound from the piezo speaker out. A mercury switch served as the trigger. Anyone picking up the box to "see what it was", would trigger it, whereupon tunes mysteriously issued forth!

I also converted a plastic money box by putting a melody module, timer board and battery inside so that, when coins were passed through the slot, they shorted a pair of contacts, triggering the timer and so causing a melody to play. Very popular with youngsters!

Suitable values for R2-C2 can be determined from Table 1. A period of three seconds allows only the first few notes of a melody to sound; a period of 11 seconds allows the whole of the first tune to play, while a period of 50 seconds or so allows the three-tune sequence to be heard.

I found it necessary to add a 100n capacitor across the supply pads of the melody module to ensure reliable operation. The value isn't critical, anything between 47n and 330n will do. I just soldered it directly on the board, with only short leads.

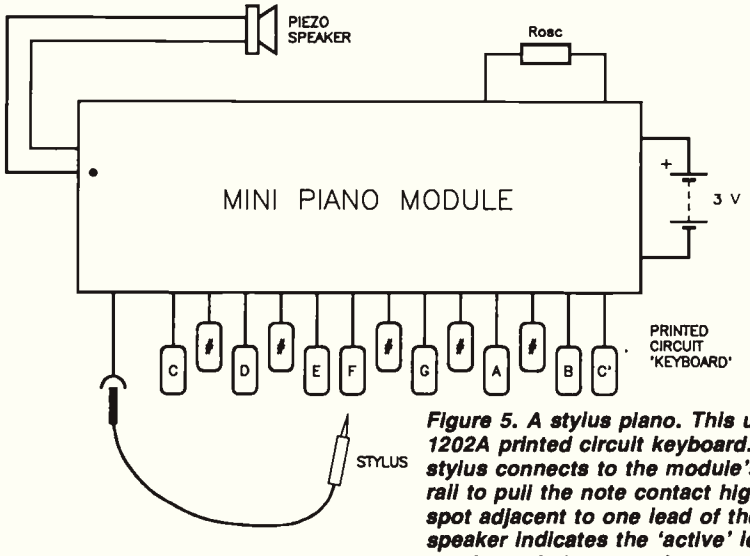

Figure 5. A stylus piano. This uses the 1202A printed circuit keyboard. The stylus connects to the module's positive rail to pull the note contact high. The spot adjacent to one lead of the piezo speaker indicates the 'active' lead. Rosc can be varied to vary the sound output characteristics.

A 'stylus piano'

If you disassemble a piano greeting card, taking out the mini-piano module and carefully peeling off the membrane keyboard, you can assemble a 'portable' piano' by mounting the parts to a suitably-sized all-plastic jiffy box. Stick the membrane keyboard on the jiffy box lid, and the mini-piano module on the inside of the lid, wrapping the flexible connection strip around the edge of the lid.

You can substitute an AA battery holder and batteries for the expensive button batteries. For a novel, wacky effect, mount a piezo horn tweeter on the outside of the jiffy box! (See *A note on piezo transducers* later in this article).

A stylus piano is assembled using the ETI-1202A pc board, which comprises a series of contacts arranged in a pattern like a piano keyboard. A lead with a 'stylus' – a pointed probe, such as a multimeter probe and lead – is used to make the contact which sounds the note. This board provides 15 contacts, as mini-piano modules may have up to 15 notes. If your module only features 13 notes, the top two notes (last two on the right hand end of the keyboard) are left unconnected.

The general circuit of the stylus piano is shown in Figure 5. The stylus is wired to the supply positive rail on the mini-piano module because the note inputs need to be pulled high to trigger a note, as explained previously.

TABLE 1

R2	C2	Period
1M	10u	11 sec
270k	10u	3 sec
100k	10u	1 sec
10k	10u	110 ms
1M	47u	52 sec

Period = 1.1 × R2 × C2

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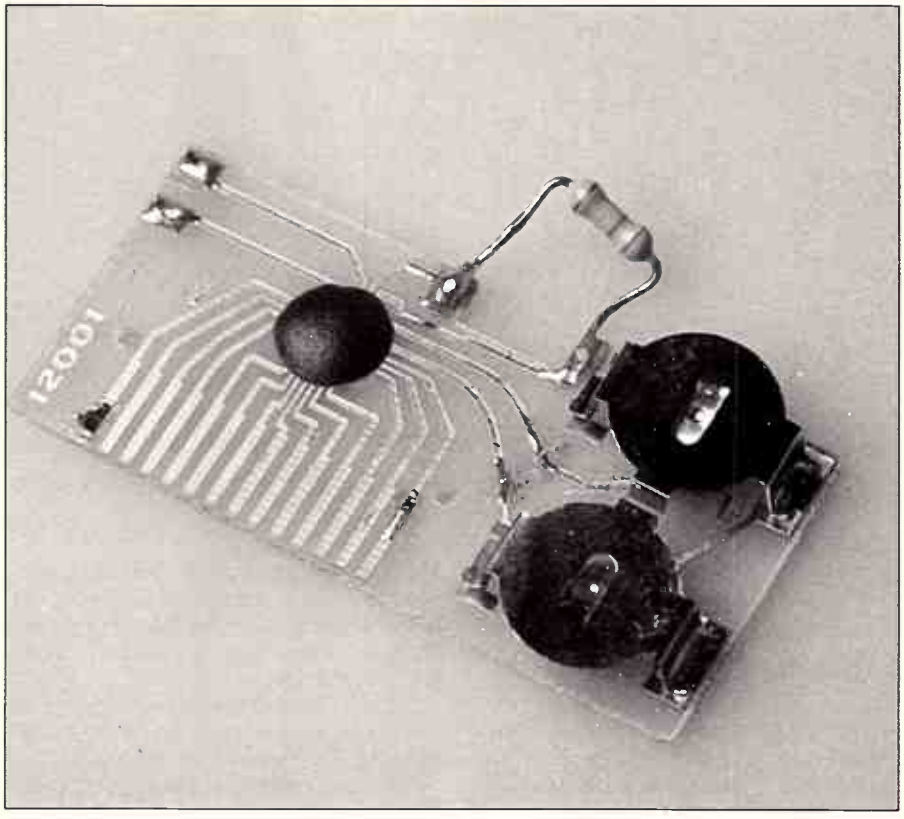
The 1202A pc board is screwed to the top of a jiffy box in place of the lid. You only need to drill two holes for securing screws, in the two corners along the edge opposite the keyboard tracks. I have not marked in hole positions as jiffy boxes vary somewhat between makers. The mini-piano module is mounted on the under (non-track) side of the 1202A pc board, secured with a double-sided sticky pad, and tinned copper wire links run through the board to the mini-piano module. The piezo transducer may be mounted on the top side of the board and wires passed through a small hole to the module. The transducer is also secured with a double-sided sticky pad.

To power it, I used a double-AA battery holder, glued inside the jiffy box.

Note the pads at either end of the 1202A board, separated from the others. These provide connection for the stylus lead at either the right hand end of the board, or the left hand end, to suit right or left handed players.

The resistor, Rosc, you'll notice soldered by its leads to the mini-piano module. You can experiment with its value to see how it changes the module's output characteristics. A change of one standard value up or down, I found, had little effect. Halving or doubling the value has a much more obvious effect.



A typical mini-piano module from a greeting card. This is a thirteen-note type.

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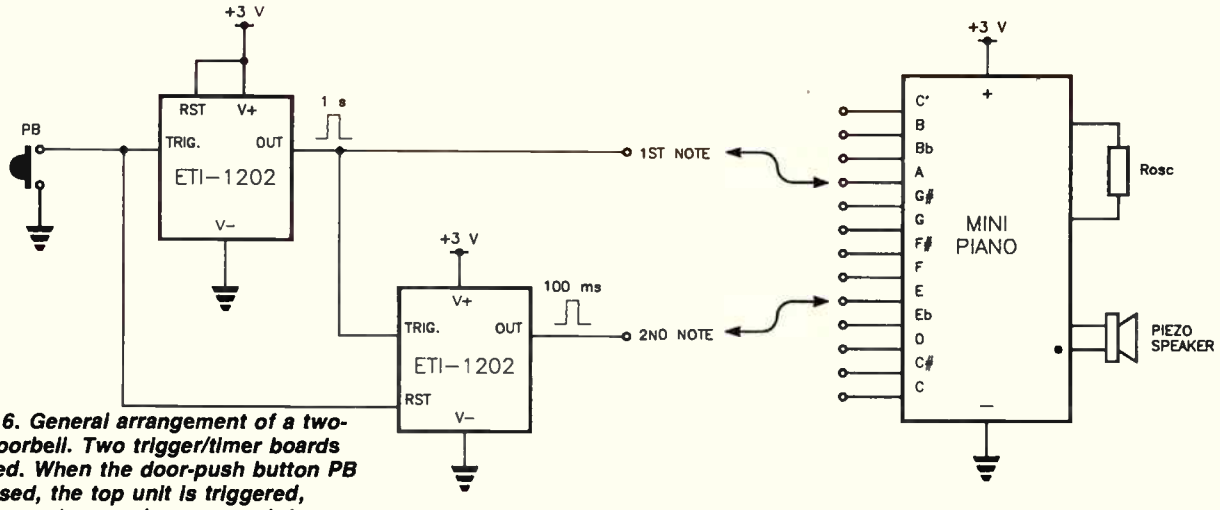

Figure 6. General arrangement of a two-tone doorbell. Two trigger/timer boards are used. When the door-push button PB is pressed, the top unit is triggered, providing a 1 sec pulse to sound the first note. The falling edge of this pulse then triggers the second unit which provides a pulse to sound the second note.

A 'two-tone doorbell'

A mini-piano module makes a good basis for a two-tone doorbell. The general arrangement is shown in Figure 6. Two trigger/timer boards are used, the top unit being arranged to trigger the lower one. When the door-push button PB is pressed, the top unit is triggered, which provides a one-second pulse to sound the first note. The falling edge of this pulse then triggers the second unit which provides a pulse to sound the second note.

The reset input of the second unit is linked to the trigger input of the first one so that its operation is inhibited when the pushbutton is pressed. The second unit's trigger input is linked to the first one's output – omitting the R1 pullup in the second unit which would otherwise 'hold on' the first note.

Values for R2-C2 can be chosen from Table 1. The first note should sound for about one second or so, and this determines the period of the first trigger unit. When the second unit is triggered at the end of this period, the first note is cut off. The second unit need only put out a short pulse to sound the second note, which will decay according to the piano module's characteristics. However, you could have both trigger units the same, set for a

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5	30	55	80	105	130	155	180	205	230	255	280	305	330
6	31	56	81	106	131	156	181	206	231	256	281	306	331
7	32	57	82	107	132	157	182	207	232	257	282	307	332
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20	45	70	95	120	145	170	195	220	245	270	295	320	345
21	46	71	96	121	146	171	196	221	246	271	296	321	346
22	47	72	97	122	147	172	197	222	247	272	297	322	347
23	48	73	98	123	148	173	198	223	248	273	298	323	348
24	49	74	99	124	149	174	199	224	249	274	299	324	349
25	50	75	100	125	150	175	200	225	250	275	300	325	350

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one-second period.

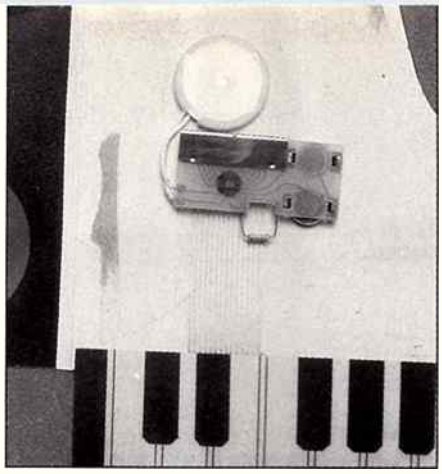
For a pleasant sound, choose two notes that are three, four or five semitones apart. If you have a rear entrance, you can add a bell-push switch there and hookup another pair of trigger/timer modules to sound two *different* notes, thus allowing you to discern which bell-push has been operated.

Loudspeaker output

If you wish to drive a conventional dynamic loudspeaker from a melody module or mini-piano, you'll need a small audio power amplifier. For this, I would suggest you use the ETI-1201 Intercom pc board (published in the January issue). It's low in cost and uses commonly available components.

Figure 7 shows how to hookup the ETI-1201 Intercom pc board to a melody module or mini-piano. A 10n capacitor is needed for dc isolation; the 10k trimpot permits setting the volume. A conventional rotary potentiometer (log. type) can be used if you want continuous control of the volume. The letters around the edge of the ETI-1201 block correspond to the letters on the ETI-1201 component overlay.

Any 8 Ohm speaker may be used. In fact, larger ones are generally more sensitive than the smaller diameter ones. Mount it in a housing to suit your application.



A mini-piano module revealed! The keyboard connecting strip can be clearly seen, the metal strip at the top of the board clamps it in place so that it contacts with tracks on the pc board. The resistor is referred to in the diagrams and text here as 'Rosc'.

Epilogue

With a little imagination and a modicum of ingenuity, I'm sure you could come up with plenty of other novel applications. For example, a mini-piano module could have a number of note inputs buffered by a couple of 4050 CMOS hex buffer chips, to interface it to the parallel port of a personal computer. Both the 4050 and mini-piano can be powered from 5 V.

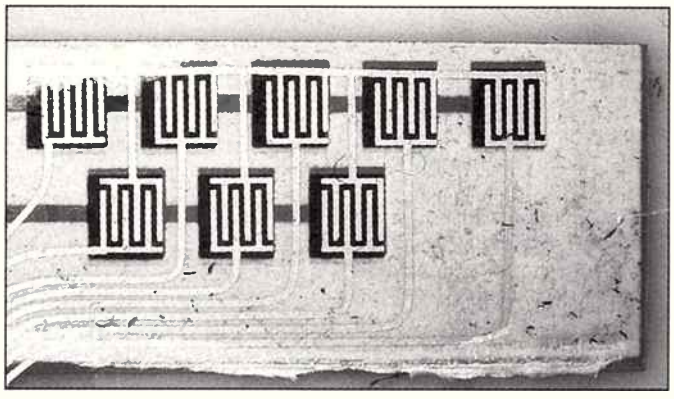
You could arrange a light dependent resistor to trigger a trigger/timer board which sets off a melody module. Hide the contraption in a cupboard or drawer so that it is set off when someone unsuspectingly opens it! eti

Contributed by The Apogee Group

A note on piezo transducers

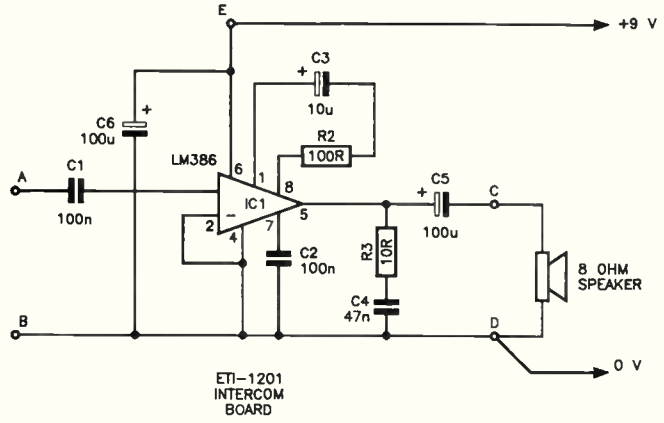
The piezo transducers used as 'loudspeakers' with these melody modules and mini-pianos comprise a circular piezo element clipped into a small plastic holder which has a hole in the centre. Don't take the piezo element out of its holder. The holder provides both a sounding board and protection for the element. The whole unit can be mounted using a double-sided sticky pad attached to the central disc on the rear side, where the wires attach.

You can get considerably more audio output by substituting a piezo 'tweeter' for the module's transducer. These are relatively cheap and some types available are remarkably sensitive, giving quite good volume with a module hooked up.



Rear view of the membrane keyboard from a piano greeting card, showing the arrangement of the contacts.

'Portable piano' made using parts taken from a piano greeting card.



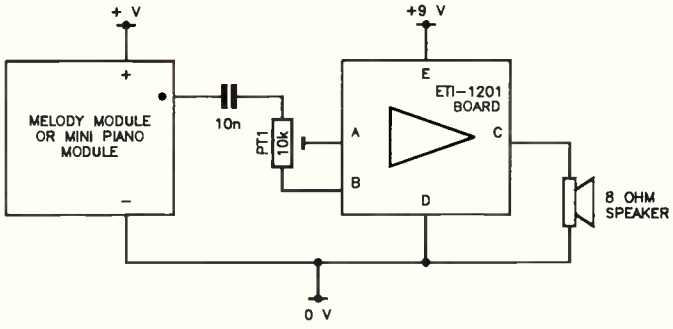


Figure 7. How to hookup the ETI-1201 Intercom pc board to drive a conventional dynamic loudspeaker. Volume can be adjusted with the trimpot PT1.

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ROGER HARRISON

ANSWERS & ARGUMENTS

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

The Digi-125 Amp Module and speaker protection

While Graham Dicker's Digi-125 Amp Module (ETI-1430, May '89 issue) is a terrific little project, and I appreciate the 'minimalist' design, I strongly disagree with the exclusion of supply rail fuses. If the output "goes dc", the full voltage of one or other of the supply rails is applied to the output – which has catastrophic effects on any loudspeakers connected, and in quick-short time! Loudspeaker drivers make expensive fuses.

L.M., Box Hill, Vic

In the last paragraph in the "How It Works" panel, on page 83 of the May '89 issue, Graham Dicker says, "No supply rail fuses were incorporated as, from my experience, the balance of expediency tips in favour of not having them. Often, I found transistors failed and protected the fuses!" Experience can be a good teacher!

If you feel more comfortable with fuses in the supply rails, by all means install them. Chassis-mount, twin fuse holders are available (e.g: catalogue number S15915, from Rod Irving Electronics stores). Or you could install automotive-type in-line fuseholders, one in each supply lead (e.g: Rod Irving Electronics' cat. no. S1593O, or Dick Smith Electronics' cat. no. S-4277).

Alternatively, you could install a "Polyswitch" positive temperature coefficient (PTC) thermistor in series with the speaker output lead (from OUT on the pc board component overlay, p.81 in the May '89 issue). Dick Smith stocks a suitable type, the RDE115A, catalogue number R-1799.

The above are simple approaches to the problem. Then there are electronic speaker protectors, such as the ETI-455 (March, 1980). Kits may be obtained from Rod Irving Electronics stores and All Electronic Components (Melbourne).

IEEE-488

I would like to see in ETI a series of articles on using the IEEE-488 bus, including programming hints in BASIC.

G.R., South Perth, W.A.

Terrific idea! Any 'experts' out there among our readers who'd care to contribute?

The IEEE-488 bus, or General Purpose Interface Bus (GP-IB), is now a widely-used interface standard for a host of electronic equipment and instrumentation – particularly test and measurement instruments. The more it gets used, the cheaper the 'option' becomes. Much, quite modestly priced, test gear boasts IEEE-488 or GP-IB facilities these days.

More RF!

Keep up the great work. Can you put more shortwave and VHF in Electronics Today.

B.P., Fern Tree Gully, Vic

Can we?! No problem, sir!

Doubtless you've noticed a few RF-type projects in the magazine over the past few issues; and we're happy to oblige. There are more on the way, too.

While we're on the subject, do any other readers have ideas on what projects and articles in this line you'd like to see in ETI?

US abuse

Who is responsible for the US-bashing in your magazine?

I'm getting tired of picking up every new copy (August, this time) and seeing my home country trashed so blatantly.

Please stick to electronics in your coverage and become a bit more of a responsible technical journal.

R.G., Angaston, S.A.

Could you perhaps be a bit more specific? I checked page 5, Ros Bromwich's editorial in "Frequency". Her last paragraphs are critical of last year's events in China. (Was she China-bashing?)

I turned next to News Digest. There's a little "Russia-bashing" on page 13 ('Phobos Probe Problems'). Hmm. Then to Arthur Cushen's "Kilohertz Comment". A couple of items on Voice of America, certainly not derogatory.

John Coulter's "Politics" column makes mention of the USA, but only in the context that they were earlier than Australia in certain environmental legislation.

Aha! "Moonwalk – The Twentieth Anniversary", must be something in this, I thought. Kathy Doolan's article is certainly fact-packed, could probably be considered a 'warts and all' look at the Apollo program and its lead-up to 'that one small step...' No US-bashing, by any stretch of the imagination.

Where could it be? David Smith's "A Cautionary Tale", on page 36, indulged in a little Hong Kong-bashing, well, more like berating, really. Maybe his perceived view of the Hong Kong practice of 'special prices for American tourists' is the problem?

Where to look next? Nothing in the projects, nothing in New Products ... the review of the Hughes Probeye Thermal Imaging Video System was complementary of this fascinating piece of US technology ... the Test & Measurement feature contained a flattering and factual 'cameo' of Hewlett Packard.....nothing mentioned in the Sight & Sound section...!

Well, wherever it is, R.G., you must have a keen eye and a fine sensitivity when it comes to US-bashing. What is a "...responsible technical journal?" One that is plainly factual, displays no social conscience and 'edits' critical commentary submitted by

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correspondents? What of the principals of 'free speech', or does that only apply to newspapers, TV and radio stations, news and business magazines...?

On the whole – August was not really a balanced issue – too much US-praising! Can't win 'em all.

Headphone Amp for the Series 5000

I would like to know if the pc board artwork and cabinet metalwork drawings for the Series 5000 Preamp (ETI 478) are still available.

I would also like to know how I can add a headphone amplifier to the Series 5000 Preamp so that the volume is adjustable using the Master Level control. I hope you can help me.

I think this column is a good idea as it allows the beginner to write in and clarify any points he does not understand and for the enthusiast to see how a project may be adapted for different and unusual uses.

I.B., Palmerston North, NZ

Copies of this project series are obtainable from ETI Reader Services, Federal Publishing, 180 Bourke Rd, Alexandria NSW 2015.

A headphone amplifier that is controlled by the 5000 Preamp's Master Level control should have its inputs connected to the Line Out sockets. You cannot directly connect headphones to this output as most will not have adequate sensitivity to provide decent listening volume. Also, you could not connect headphones directly to the line amp outputs because many will have too low an impedance for the NE5534's used here in the preamp. You will need a headphone amplifier. So what's suitable?

Probably the simplest solution is to use a high performance monolithic power amp IC, such as the LM1875 from National Semiconductor. Actual output power is not what you need in this application, but voltage swing, and the LM1875 can provide that, and at low distortion, too. Its specifications show it has a typical total harmonic distortion of less than 0.02% at 1 kHz and 10 watts output, which is quite acceptable. For this you can power it from +/– 15 V rails, which should be adequate for most headphones.

The chip comes in a 5-pin TO-220 package (like a three-terminal regulator, but more pins), and only requires seven passive components and a power supply. In a headphone amplifier application it would only require a modest heatsink. A printed circuit board, and even a full kit, is available from our correspondent, Graham Dicker, at:

PC Computers 36 Regent St KENSINGTON S.A. 5068 ☎ (08)332-6513

Ask for the LM1875 amplifier pc board, or kit.

Projects from Chip-On-Board Technology

I read with interest your article on *Pop Technology* in the October ('89) ETI.

I am the woodwork teacher at a local school, and am always on the lookout for new ideas for interesting projects that my students can build. I can see a lot of ways we could use the chip-on-board, and I would appreciate it very much if you could give me any information as to where such articles could be bought and approximate cost.

I also note the callsign; I am at present trying to get my Novice licence. I've passed theory and regulations exam, and am now working on Morse and hope to sit in February.

B. H., Healesville, Vic

Go to your local newsagency and buy up all their unsold 'musical' Christmas cards – in which you'll find C.O.B. melody modules! One of the major suppliers of C.O.B. chips and modules as described in my article is Elcap Electronics Ltd of Taiwan. They are represented in Australia by Energy Control International of Brisbane, who kindly arranged for, and supplied, the material used to compile the Pop Technology feature.

For your purposes, discarded musical Christmas and greeting cards will supply some electronics to 'play' with. For inspiration and information on projects using such modules, see Project 1202 featured this month!

Old Rockers never die

I write in regard to ETI Project 456, *"The Rocker" – 140 Watt Valve Amplifier*, published in the May 1980 issue.

After reading the article, I decided to look into tracking down the required parts. I have assembled the required resistors, greencap capacitors and the valves. But I can't find a supplier for the transformers, the Ferguson PF4357 power supply tranny with five secondary windings – one 6.3 V/3 A, one 6.3 V/6 A, one 47 V/50 mA, one 285 V/150 mA and one 565V/300 mA; and the output transformer, a Ferguson PF4357 with 5k plate-plate impedance primary to tapped secondary of 4 and 8 Ohms, rated at 200 W.

I am also having trouble with some of the capacitors.

8u/350 V axial electro 10n/5 kV ceramic disc or mica 100u/350 V can electro 24u/500 V axial electro 10u/100 V axial electro

I am going to endeavour to build two of these amplifiers. If you or anybody else reading my letter have any knowledge as to the location of any of the above please contact me.

P. Ashton,
35 Waterworks Rd,
Raymonds Hill, Qld 4305

I have published your address so that any readers who can assist can contact you directly. However, I suggest you contact the following firm.

All Electronic Components 118-122 Lonsdale St MELBOURNE Vic 3000 ☎ (03)662-3506.

eti

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8009	Blue/Aluminium	$79.00	$98.00
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8015	Black/White	$71.00	$81.00
8016	Blue/White	$71.00	$81.00
8018	Green/White	$71.00	$81.00
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BUFFOONERY

VANISHED VOLUMES AND OTHER TALES

I don't know about other readers, but over the years I have tended to accumulate rather a lot of books on electronics and related subjects. There are numerous multi-volume sets of data books, old and relatively newer text books, with imposing titles that are a tribute to the erudition of the author, tall books, short books, fat books, skinny books, expensive looking cloth-bound books, hard and soft cover books, books with and without dust jackets. A lotta books.

Actually, I ran out of shelf space so I have taken to stacking them on that one big shelf which every room boasts – yup, the floor! Trouble is, I *still* don't have enough shelf space.

One day – I keep promising myself – one day.

Now if you, like me, have accumulated a lot of books, or even a modest modicum of venerable volumes, doubtless you will have experienced that phenomena of *the vanished volume?*

It goes like this: you need to consult a certain title. You know without a shadow of a doubt that it is there. But you cannot find it. Search high, search low (look on the floor!), ask others to search, but never will it be found. Give up. Do something else.

As you casually pass the shelves on your way to some other place on an entirely different mission or matter, out of the corner of your eye – you spy The Title! There, on the shelf. As plain as day!

Immediately your desire, want, need, purpose for having the book disappears – the book reappears. This, as perspicacious readers will already have observed, is a corollary of the ubiquitous Murphy's Law, and is known as "The Principle of Inverse Visibility". That is, the visibility of the required volume is in inverse proportion to the need for finding it.

O'Halligan's Hypothesis (O'Halligan was a neighbour of Murphy's) has it that books harbour a deep fear of being separated from their immediate brethren. They fear the loss of security of being nestled between other books, wrenched from their extended family, perhaps to be – shock, horror – loaned to another human who is likely to callously mutilate their spine, cruelly crease page corners into dog-ears or irresponsibly remove and misplace the dust cover (if there be one). In other company, books displaying such fears would be called "spineless", would they not?

In order to avoid mishaps at the hands of such miscreants, and because books distrust even their owners, they have the ability to sense when they're being sought out and make the typesetting on their spines temporarily fade. Another ploy they use is to so arrange the angle of their spine such that it only reflects a single colour – the cover's background colour or that of the book adjacent, causing your eye to skip past so that you don't register the existence of the tantalising tome.

Now you know why libraries have a Dewey decimal number embossed in gold or silver on the book's spine and why they're located in alpha-numeric order on the shelves. But that doesn't fully explain why libraries don't suffer from a riotous rash of vanishing volumes. You see, it's every good librarian's duty to make friends with each book, knowing each by name, and have little chats with them occasionally. In this way, they secure the books' co-operation.

So, next time you go searching your data books for the data sheet on that LM34567 which the Fairola Data series Volume 1 lists as appearing in Volume 3, and said Vol. 3 is nowhere to be found, change the subject, go and do something else. Then, as you pass by the shelves on the way to the toilet, Volume 3 will appear in plain sight!

There is another way. Catch the tenuous tomes unawares. It tends to terminate their tedious time-wasting.

Wait till nightfall. Quietly move to the bookshelves, in the dark, to near the position (or suspected position) of the desired book. Wait 30 seconds for things to stabilise, then have an accomplice quietly and quickly turn on the light.

Accomplices can be uncooperative at dead of night, and inclined to disbelieve O'Halligan's Hypothesis. Infidels. That's why I'm making an infra-red remote switch for the lights in my study. One day. eti

Contributed by The Apogee Group

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CHALLIS ON PIONEER

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GOOD NEWS YEAR

Australian television had little of the high tech about it in the 1950s. Sydney-siders had to wait 24 hours to watch the Melbourne Olympics in 1956. But with the advent of Cablefilm, things changed! By Barrie Smith.

Videophones are already a reality, allowing everyone to be an intruder in other's homes; and with broadcast satellite links affording all of us the chance to cast our gaze not only across a city, but to the other side of the globe, it's hard to conceive a television world without instant video links.

In the 50s and 60s Australian television had little of the high tech about it: the '56 Melbourne Olympics obliged Sydney to endure a 24-hour viewing delay as the film recordings from each day's events trudged their weary way from Essendon to Mascot; Adelaide was only a little better off as a DC3 circled around Mt Gambier bouncing live signals down to the city on the Torrens.

All pre-recorded programming was on film. If a repiay of a live program was needed, the dreaded kinescope was wheeled out to engrave blotchy renditions of the original broadcast. If a news item arose outside the transmitter boundaries, a piece of film would arrive at the studio door. News breaks overseas would be seen on the electronic box no quicker than three to four days later, minimum.

The press boys had it considerably better. Radio-pictures of significant events one day could be in the newspaper the following day.

With uncomfortable similarities to today's computer revolution, as the silicon sheiks try to oust 'conventional' video as an imaging medium, the barrier then, as now, was and is capacity – whether it be that of a phone line, optical fibre, microwave link, satellite transponder, CD-ROM, hard or floppy disk.

One of the earliest attempts to send moving pictures between distant points was made in 1934, when film of the England-Australia air race winners was sent to the UK. Another try was in 1957 by BBC-TV, when pictures of the Royal Visit were sent from Montreal to London. Ten feet (three metres) of film was cut into 10 inch (25 cm) lengths, the pieces laid side-by-side, rephotographed and then sent across the Atlantic as a somewhat unusual, still picture. At the other end, some poor unfortunate then had to dismember and reshoot onto movie film each frame from the unified still to recreate the sequence.

Then, in 1958, Cablefilm arrived.

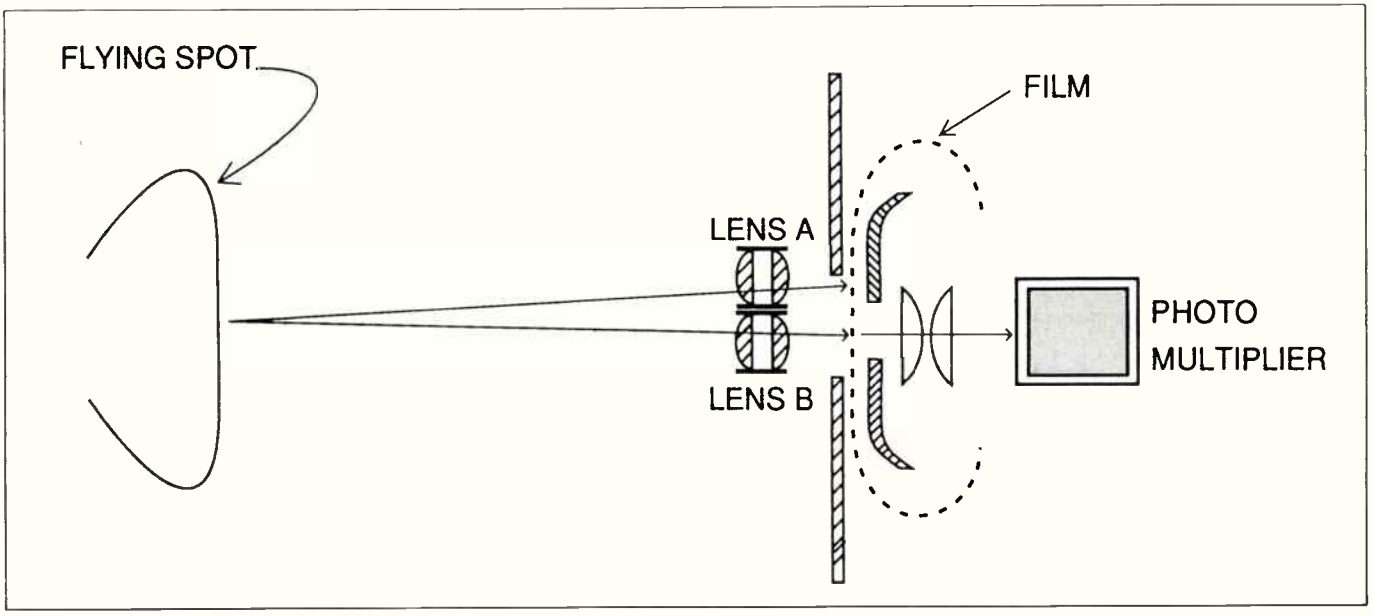
Based on the existing technology of single picture photo-telegraphy, or picture facsimile, transmitted over narrow-band radio or cable links, Cablefilm relied upon the image frame being scanned in a fashion similar to television.

> ***"The '56 Melbourne Olympics obliged Sydney to endure a 24-hour viewing delay as the film recordings from each day's events trudged their weary way from Essendon to Mascot"***

At the time, single picture transmission took ten to fifteen minutes per frame. The transmission time depended very much on picture detail, and on the bandwidth available for transmission.

The Cablefilm approach was:

1. Film the event.
2. Transmit over the line each individual frame of film. By accepting lower quality in the scanning, and because undersea cables permitted 10 times the bandwidth of normal



The BBC-developed film scanner used in Cablefilm; the device could both transmit processed film and receive/record on to unexposed film.

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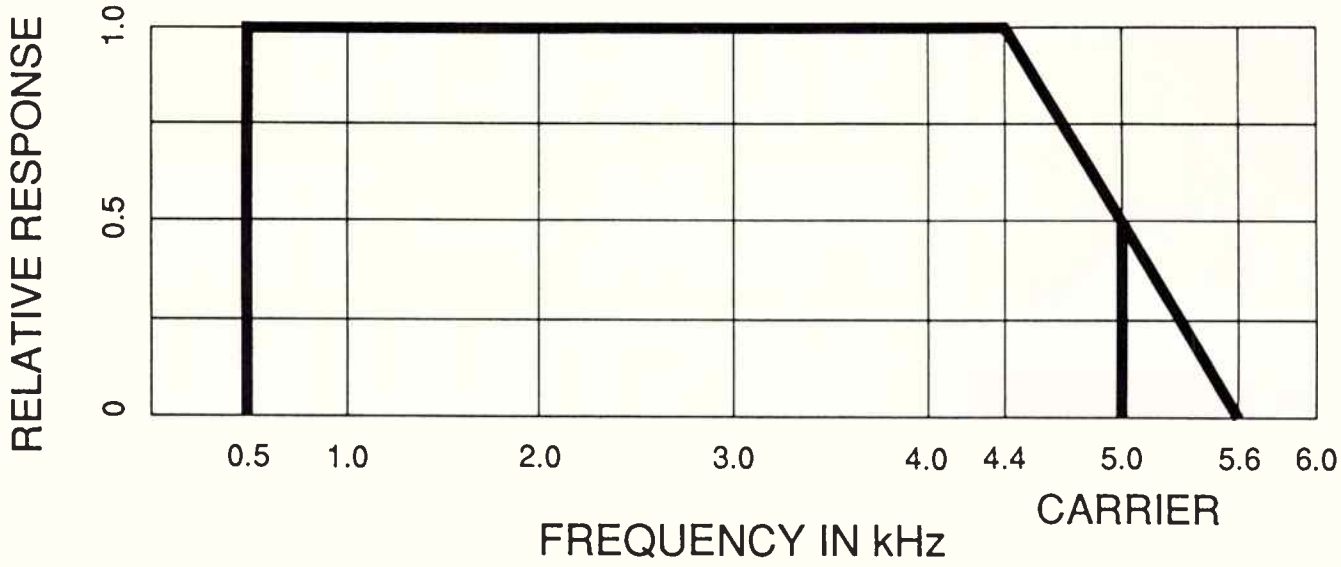

Characteristic of the vestigial sideband carrier channel, the video signal transmitted by the Cablefilm scanner was confined between 500 and 5,600 Hz.

phone lines, the time per frame dropped rapidly below 10 minutes.

3. At the receiving point, the incoming pictures were recorded on a film recorder a frame at a time.

4. Replay of the processed film at normal frame speed.

Cablefilm could transmit at 100 times the film's original running time, a one minute sequence taking one hour and forty minutes.

In practice, the original event was kinescoped from a local television broadcast, and edited down for Cablefilm.

The engineering approach was to reduce the point to point time in the system; using live video sourcing of the material assisted this, but did affect final quality.

Cable capacity was taken into account in the design of the transmitting/receiving apparatus. Early in 1958, it had been established that a bandwidth of 4.5kHz could be accessed by using the program circuit in the transatlantic cable. At the time, Britain's TV standard was 405 lines. With a cable capacity of 4.5kHz the scanning speed would have had to be slowed 660 times – a minute of material would have taken eleven hours to send!

News film in both the USA and Britain was predominantly shot on 16mm, so this became the common gauge. Experiments and subjective tests were made with suppressed frame kinescopes on 16mm. The standard decided upon was 200 lines per frame, with 360 picture elements (pixels) of horizontal resolution. Under these conditions, the scanning line frequency was limited to 25Hz, allowing one complete frame to be sent and received every eight seconds.

A further reduction in sending time was achieved by sending only the alternate frames. At the receiving end, each frame was recorded twice, restoring the material to its original length. Motion was observed to be jerky, but acceptable. One wonders if it would be acceptable today, when even the motion artifacts of US/NTSC to PAL 30:25 frame transfers are noticeable to many viewers.

The scanning equipment was based upon the design of the flying spot telecine, then common in TV stations. In scanning mode, as the diagram shows, the processed film was subjected to a flying-spot electron beam, which rapidly scanned the film top to bottom, side to side, via lens B. The beam, now modulated by the film frame, passed through and on to a photomultiplier, which converted the information to electrical signals. The signals were then passed on to the cable or phone link.

In receiving mode, the unit now became a camera: the incoming signals were used to modulate the brightness of the scanning beam, which then passed across unexposed film.

> ***"On June 18, 1959, film of the Queen's departure from Britain was seen several hours before she arrived in Newfoundland"***

Lenses A and B now came into play, as both operated simultaneously to record the incoming picture in duplicate on adjacent film frames.

Negative or positive film could be used at the sending end, but the receiving end always produced a negative film, by reversing polarity of the cathode ray tube when needed. The latter was a 35cm long persistence tube.

The sound track was usually sent at normal speed, seporately, over another cable circuit, then married with the image for printing.

Cablefilm was sent between New York and London by way of broadcast cables, which had the grandiose frequency range of 50 to 6,400 Hz – barely more than today's phone lines.

Due to attenuation and delay distortion, 5,600Hz was found to be the highest usable frequency on the cable circuits, and 5,000Hz was chosen as the system carrier frequency. Video signals up to 4,500Hz modulated this carrier, producing a transmitted frequency range of 500-55 600Hz.

It was discovered that transmission of a video picture was more demanding of the circuits than either speech or music. Compressors and expanders, normally used for audio transmission, had to be removed from the circuit as they distorted image rendition.

Inauguration of the system was in June, 1959, covering the Queen's visit to Canada. The first practical test had taken place only a month earlier between London and Montreal.

On June 18, film of the Queen's departure from Britain was seen several hours before she arrived in Newfoundland. A few days later, a short film of the official opening of a dam was shown in Britain just 45 minutes later. In September, similar coverage was achieved when President Eisenhower visited Europe.

The original intention of operating Cablefilm between New York and London was not fulfilled until September,1960. In the intervening period, the program circuit facilities had been re-arranged, causing a threefold increase in distortion. Back to the drawing board, as equalisers and other signal processors were redesigned. Despite this hiccup, Cablefilm was up and running. The cost at the time was £250 per minute, cost comparable with other news film sources. eti

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VIDEO TO FILM — THE AUSTRALIAN ANSWER

Until recent years, the most common method of video to film transfer has been by way of kinescope process, with results that left much to be desired. A new process, devised by Larry Wyner of Acme Photo Effects, is achieving unrivalled results. By Barrie Smith.

The relationship between video and film has never been a harmonious one. Until now, the interface has been a one-way journey. Material shot on film and transferred to videotape gains from the process, and is considered by most program producers and TV commercial makers to be the ultimate way to achieve superior electronic pictures.

It's only when you originate on video and wish to exhibit on conventional film projectors that matters begin to fall apart. Until recent years, the most common method of video to film transfer has been by way of the kinescope process.

In its crudest form a film camera was aimed at a television monitor and a real time 25 frames per second (in PAL) record made. Needless to say, the results varied in quality from poor to barely acceptable.

Image Transform, in California, pioneered a radical approach in the early 80s by copying onto film frame by frame, splitting the colour image into three-colour separations, and exposing the film's sensitive surface to the electron beam itself.

The quality improved dramatically and allowed much video material to be shown on cinema screens for the first time.

Soaring costs

Video and film production costs are soaring.

These frame clips, from Coca-Cola, Daily Telegraph and Kelloggs commercials, are on 35 mm Eastman colour and are examples of video to film transfers by Acme's new process.

Producers constantly look out for ways to maximise release, to justify today's bursting budgets. Whether it be a TV commercial, documentary, corporate video, or even a feature, it's becoming accepted that few productions can remain confined to their original medium, video or film.

Now, a Sydney company has come up with a proprietary process, which it claims is the ultimate. The company is Acme Photo Effects, founded by Larry Wyner.

Wyner has been around the film industry for twenty years or more, picking up wide expertise in production, laboratory processes, special effects and the challenge of making equipment do more than its designers ever envisaged.

He gained considerable praise for his optical effects in Churchman's cigarette and Coca-Cola commercials in the late 1960s. The synthetic colour techniques he devised were similar to those employed by Stanley Kubrick in 2001 – A Space Odyssey – a year earlier.

He's a film man and looks askance at video and its limitations. He has always felt that video and film should have managed a happier co-relationship long before this.

Having looked long and hard at the problem of relaying a video image to the film medium, he finally developed a way to extract every ounce of quality from the original videotape and place it onto 35mm colour film.

Ask him how he does it and there's a long silence – he won't divulge the tricks of his process. And why should he? He claims it's better than anything his rivals in LA and

World Radio History

London can produce.

However, in principle, a one inch videotape is replayed frame by frame, displayed on a monitor and captured by a 35mm (or 16mm) optical printer which exposes a special Eastman laboratory duplicating film negative. From this, colour prints are made for exhibition.

Wyner explains that film post production is now a mere shadow of its scale before the advent of electronic effects and digital post production.

Digital effects

The arrival, about five years ago, of very sophisticated digital effects units saw the TV commercial industry explode, and long-standing film methods of producing optical effects and titles were discarded.

Acme's film transfer process has smoothed the video/film interface. Being able to make copies onto 16 or 35mm Eastman Colour now allows an extension to a client's media plan, with cinema a now, very economical 'add-on'. Corporate video makers can also benefit, by an improvement in picture image by way of conventional film projection rather than inadequate video projection machines. Features can be shot on tape, and released in the cinema.

A number of producers in SE Asia are investigating low-budget feature production with tape origination and release via 35mm colour film, the latter produced by Acme's process.

Wyner says; "We can go to film from any tape format – VHS, 3/4 U-Matic High and Low Band, 1 inch C-format, and 2 inch quad in PAL or NTSC.

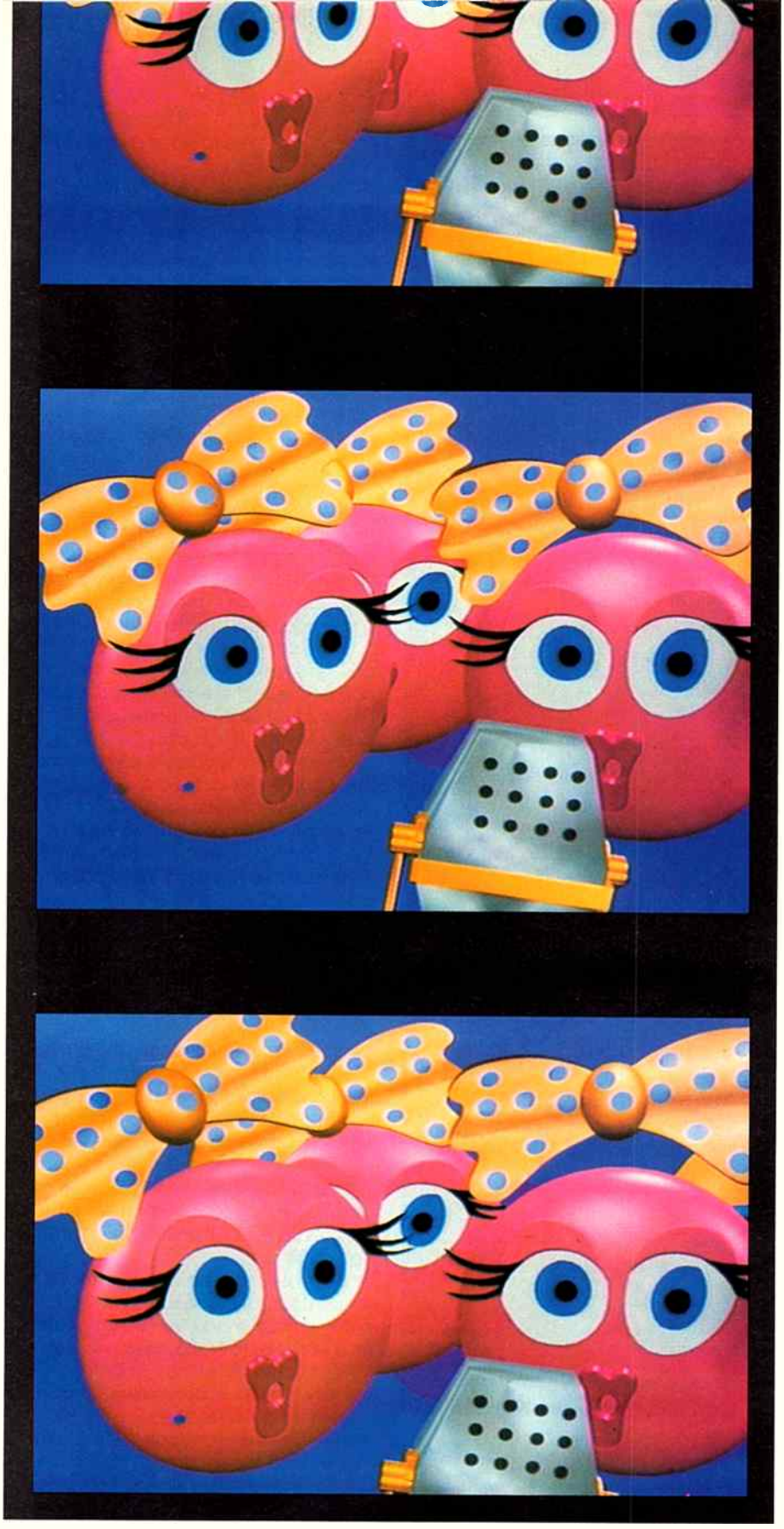
"Normally, we take the sound directly from the video tape, which is in digital format. There's no loss of quality in transferring from the video tape to a film optical sound negative.

"The sound can be supplied as a mono, standard stereo or Dolby stereo recording, and transferred to film in those standards. In post production, the audio is normally finished to a digital medium so that there is no loss on the way to sound on film."

His clients have included most major Australian advertising agencies, Film Australia, and the South Australian Film Corporation, Coca-Cola, Telecom, Adidas, and major newspapers. "We've also transferred a number of important corporate videos and presentations to film: East West Airlines, Nettlefold Industries, Coles-Myer," Wyner says.

Conferences and seminars often rely on big budget audio-visual extravaganzas calling for banks of 35mm slide projectors, and sometimes these are supplemented by large screen projection of video material.

Wyner comments, "An area that's growing all the time is audio visuals, and producers' increasing need to get back to a projection format that doesn't force you to lug 50 projectors around the countryside. We've transferred some quite large AVs to 35mm – some in widescreen format."



Big screen video projectors have also been found wanting by many operators. Their picture quality is prone to degradation from ambient light; alignment of the three colour beams is difficult and audience placement is restricted by the curved screen's narrow viewing angle.

Many are now finding that a better route for mass showings is to project a film print from the video on a portable 16 or 35mm

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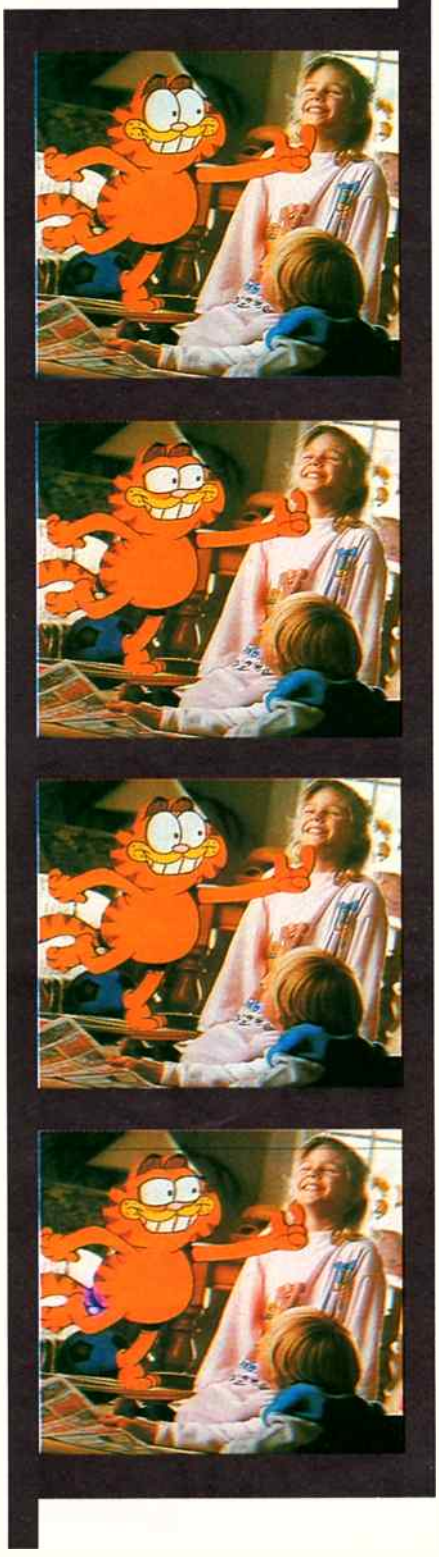

Wyner claims Acme's process achieves truer colours, better contrast and resolution equal to, if not better than, the only other two video to film transfers in the world.

projector, or even to stage a screening in a cinema.

"To date, we've transferred TV commercials (for SE Asia), but we're about to transfer two feature films and five documentaries that were originally shot on tape," says Wyner.

"There are only three processes of any consequence available – one in LA, another in London – and ours. In image quality, there's no doubt in my mind that my process is superior.

"The reason we've developed the process is that I saw the work being made by the other two companies and I thought it could be improved. That's why I modified the equipment, redesigned the engineering of the film side, and modified the electronic end. The system has been totally developed in Australia, and owes nothing to any techniques in use in other countries. It's also a new approach to transferring video to film.

"There are only three systems in the world, and ours is totally unique. A lot of clients appreciate that the service is a local one, both for Australian companies and for those in SE Asia and the Pacific.

"We get truer colours, with better contrast, because we've got control over image quality, colour, brightness and contrast that the others don't have. And we can balance the original tape, scene to scene, frame to frame to make sure all the picture detail gets onto the film.

"In terms of resolution we're certainly equal to, if not better than, the others."

Limitations

Wyner feels the only limitation to quality is the 625 lines of the PAL system. "That's the limit of our resolution. But, with these new component video systems (Betacam SP and Panasonic MII) and digital origination, with separate capture of chroma and luminance information, you gain much higher resolution.

"We're really interested in the development of High Definition TV with its 1125 lines. It's obviously the ultimate in resolution and quality.

"An unusual benefit of our system is that we can rack it for wide screen. Which means a commercial made for TV can be shown on a wide 1.85 to 1 ratio cinema screen. The re-framing is done at the transfer stage, and not later on via a duplicating process. So original quality is retained.

"The other companies are forced to make their wide screen transfers via an interpositive and internegative, taking the originals another two generations away."

In motion picture and video technology there have been few advances originating from this country. Acme's video to film transfer is one that deserves success, not only because it's 'home grown' but because it approaches a long-standing problem from a different direction. eti

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READER INFO No. 30

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HDTV & FILM: PARTNERS AT LAST?

As a practitioner in both areas, Barrie Smith can confirm that the once competitive industries of film and video have agreed to call a truce and have formed an uneasy partnership.

Every day it seems more evident that the once fiercely competitive technologies of film and video have agreed to 'put an end to the hostilities'.

It is no longer felt by video technicians that film is decadent and decaying, nor by film workers that video is an irritant that will rapidly pass from sight. Each side has agreed to accommodate the other, to gain from an improvement in the interface and to borrow tools and techniques from across the invisible lines of demarcation.

Motion picture cameras are now equipped with advanced methods of accessing a video split from the taking image for directorial reassurance, and advanced models of video production cameras can now accept high quality film optics and spend their studio hours on film dollies and camera cranes. The accepted method of shooting high quality material for TV is to originate on film and transfer, via sophisticated image processing devices, to videotape for subsequent broadcast.

The most convenient and best quality way of showing a video image to large audiences now is to project a film copy using a projector and screen, in a manner little changed since the days of the Brothers Lumière.

But television is also undergoing changes which are not of a technological nature. One has only to scan the financial pages of Australian newspapers to see how poor an investment a TV station/network has become. Audiences are growing tired of broadcast TV; only the freedom of choice, and novelty, of hiring a tape for the home VCR and large screen satellite TV in clubs have provided vitality in an otherwise lacklustre industry.

The big hope for the future of the medium is HDTV. The High Definition picture offers not only an increase in resolution and clarity for the viewer, using bigger screens, but also a more rectangular picture. Just like the movies!

This has not escaped the major motion picture manufacturers. For example, Rank has already produced a 35mm film to HDTV telecine, and the makers of film rawstock have seen their chance to grab an advantage, knowing that conventional magnetic image recording is nearing the end of its potential – with or without digital techniques.

Ever since Cinemascope first 'lensed' *The Robe* in 1953, people have warmed to the big, wide picture that fills every nook and cranny of their peripheral vision.

Joerg Agin, general manager and vice president of Motion Picture and Audio Visual Products Division, Kodak USA, recently painted the most complete picture of the future by describing how his company sees it, in a lecture to the British Kinematograph, Sound & Television Society.

His initial premise is that film is a high definition imaging medium, with a potential that surpasses that of HDTV. But no one technology has the resources to advance the creative possibilities of the industry by itself. Perhaps, Agin posed, the needs of the creative community (writers, directors, cameramen) could be best met by integrating the technologies of both film and electronics.

Dissemination systems that depend on the benefits of both disciplines are where the future lies, he believes.

An HDTV camera.

The Film Look

'The film look' is constantly heard as a reference standard when judging video program material. Nobody seems to want 'the video look'.

This 'film look' is the result of each film frame

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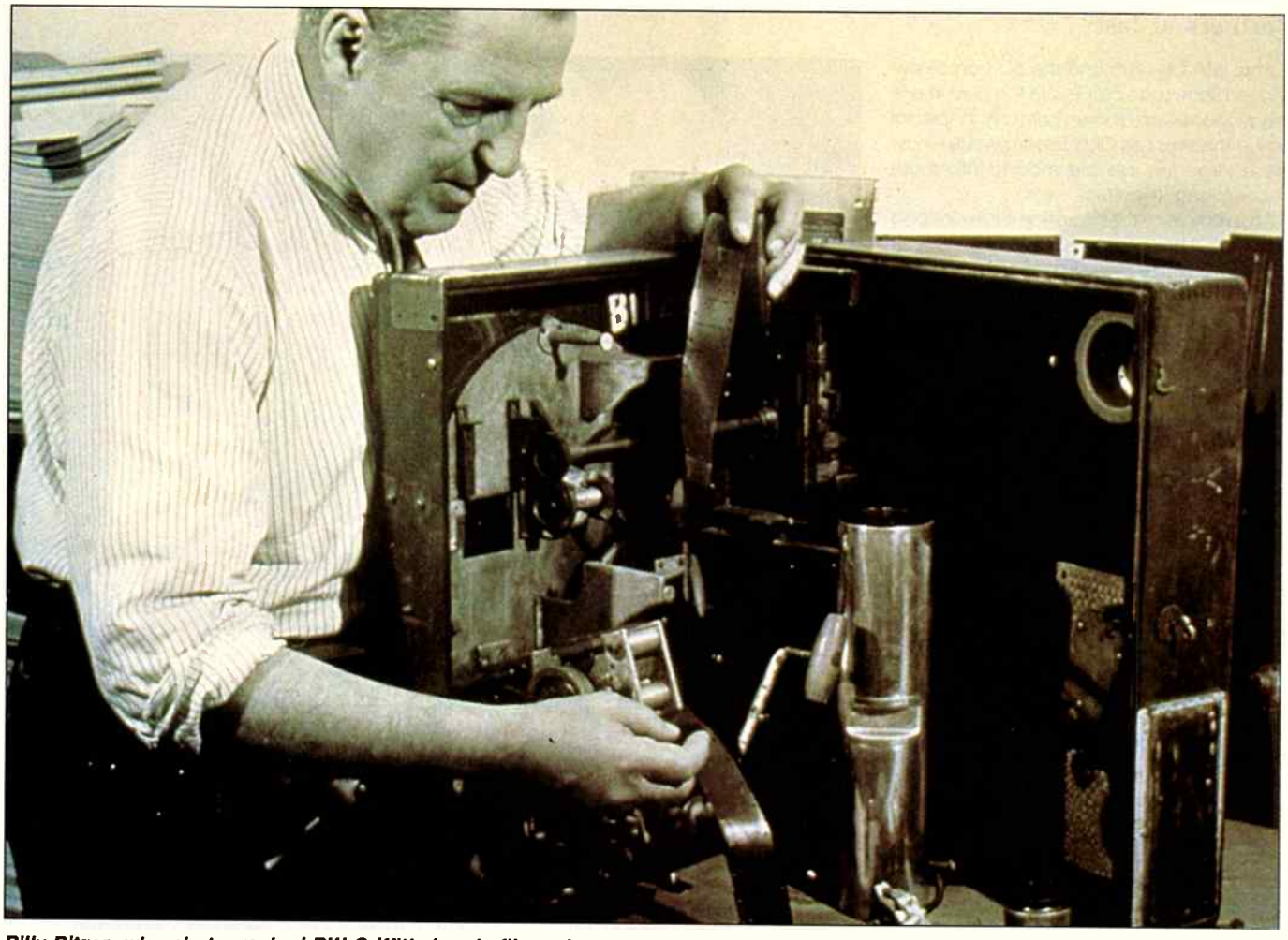

Billy Bitzer, who photographed DW Griffiths' early film epics.

combining the elements of solid state physics and advanced chemistry, with the random arrangement of actual dyes creating a picture the eye accepts as presenting a close facsimile of reality. Video's look is the product of electrons, phosphors and magnetic oxide.

Film has a greater dynamic range and sensitivity, with a capacity to reproduce a broad spectrum of colours and a wide band of neutral tones. Most films have a greater exposure latitude than video materials, along with the ability to handle excessively bright highlights, and reach into near-black shadows.

Resolution is higher with film (see panel) than any video system, including HDTV.

In January, 1989, Eastman Kodak introduced a range of 16 & 35mm motion picture films to supply the demands of high fidelity imaging. Labelled EXR, they promise to revolutionise existing methods of film production, enhance image quality, and offer attractive economies from increased new efficiency. The company feels that it is now even approaching the end of the road in the extension of silver imaging technology; they have expressed the view that the structure of the photographic image can be advanced by a factor of 10.

The 1125 line HDTV system operates at 30 frames per second; in this format each frame carries 532,836 pixels of image information. By comparison, each frame of 35mm in 4:3 ratio has 7,069,230 pixels, running at a speed of 24 frames per second.

A High Definition TV system would need 3248 scanning lines per frame to match the capacity of a single 35mm frame.

Again stresses the flexibility of film, its universality, and resistance to obsolescence. Film cameras of 60 years of age can still be pressed into service (not that one would), whilst, already, the eight year old HDTV is facing a changeover of cameras and recorders from analogue to digital image gathering.

As a method of distribution, HDTV faces a number of compatibility problems, most notably that of meshing into existing PAL system networks and satellite systems. HDTV has notions of supplanting 35mm film as the main production medium for the 90s and beyond. As yet, no-one is willing to take wagers on the outcome, but what is likely is that dissemination of programming could most likely be made via satellite to points of public exhibition, or by actual distribution of HDTV tapes.

Exhibition points could be arranged in purpose built theatres, equipped with large screen video display equipment. Cost of equipping these theatres begins at US$250,000 per screen for fairly small, low-brightness screens.

But, to reproduce an image of the size and brightness currently produced by today's 35mm would call for higher performance, more expensive video projectors such as the Eidophor. This calls for a signal bandwidth of the order of 30MHz, so total cost (screen and projector) rises to US$750,000.

A figure which confronts this level of investment capital is the gross annual revenue of an average conventional one-screen theatre in the USA – $220,000. Conversion to video projection would obviously require decades of operation to return the initial outlay.

And conventional cinemas are showing more than the well-established 35mm format. Across the globe, special format productions are being shown - two of the better known are the horizontally running

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Partners at last?

70mm IMAX system and the 60 frames per second Showscan process. In the past, these productions were shown primarily in special venue theatres (eg Qld's Dreamworld) – now these large formats are moving into more conventional theatres.

An example of this migration is the Kinepolis in Brussels. It has one screen for IMAX, another for Showscan, two for standard 70mm, and 2 stock standard 35mm theatres. Obviously a movie buff's paradise!

Directors of photography are showing interest in working with the big formats; Giuseppe Rottuno *(All That Jazz)* and Jack Cardiff *(Lawrence of Arabia)* have recently shot features in Showscan. This interest underscores a rebirth of 65mm (70mm projection) cinematography. To accompany this, four major camera manufacturers have demonstrated completely new, highly sophisticated 65mm cameras.

To service the return of these high fidelity processes, the new film stocks offer finer grain and increased image sharpness; and new technologies are appearing to enhance and extend the benefits of motion picture film. For one thing, it is likely that analogue sound on film will soon be replaced by multi-channel digital optical sound, with all the latter's advantages of crystal clear sound, zero hiss, noise and mechanical variations.

Kodak has also announced a production aid built into the new film stocks – Keycode. Until now, film used latent image edge numbers to identify position points and assist conformation of the negative and print in editing and laboratory processes. These numbers will now be accompanied by a narrow bar code imprint along the edge of the film; the interface of running length in metres and frames will now be afforded a correlation with existing video time code systems.

Joerg Agin went further with an outline of the company's scenario for a combination all existing image technologies – CCD, digital image processing, and the physics and chemistry knowhow of film – to create ways that will benefit the specific needs of motion pictures and video.

"To be specific, we are exploring the development of a digital image manipulation system that operates at an even higher resolution than is found in any current or proposed HDTV system," Agin said.

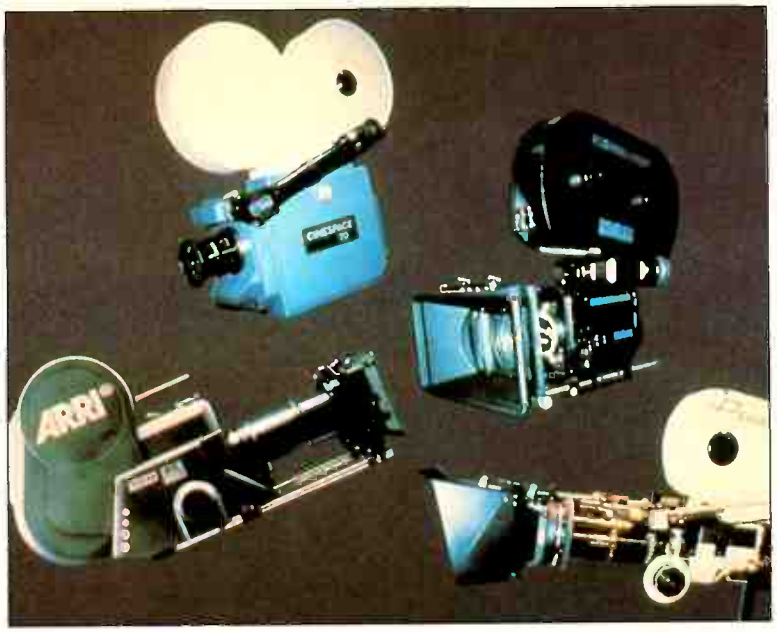
An immediate application could be in film special effects. The special effects elements could be shot on film, processed, then scanned and converted into digital data using a high resolution film scanner.

The actual production of the finished effects would take place on a powerful work station, with the tasks of matting, animation, optical effects, titling and the insertion of computer generated images completed within the digital domain. There would no longer be a need for complex, time-hungry to and fros with mechanical and chemical processes – methods that add not only to the cost of the finished effect, but contribute to quality degradation of the final image.

The final, digital product would then be transferred onto a high resolution film recorder, where a master negative would be produced. "For such a system to produce what is essentially a 'first generation' negative film, a digital image standard of more than 2,000 lines per picture height would be needed," said Agin. "But this system is not a dream. The technology exists today and is being used in fields such as computer-aided design, computer graphics and publishing."

Agin believes the intermixing of these technologies will have a major impact on cinema films, music videos, TV programs and commercials. He also feels sure that efforts currently being made by the company will carry the benefits of film quality directly into the home, via future systems of HDTV specifically intended for the domestic arena.

In summary, Agin predicted "that the future of film in the era of HDTV will be long and bright." eti



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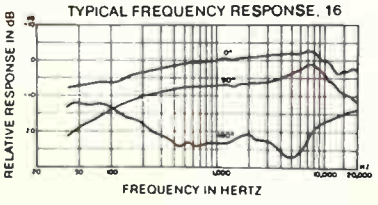

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THE SHAPE OF SOUND TO COME

Loudspeakers are changing shape, and British speaker manufacturer B&W is contributing to the trend in what can only be described as a radical way. And the industry is to get its own 'trade only' show later this year.

Robert Tronz, the head of innovative British loudspeaker manufacturer, B&W, was in Australia at the end of last year to present his company's "new directions" and new product line-up for 1990. B&W has long had a reputation for research and innovation, coming up with imaginative new loudspeaker products time after time. Its 801-Series monitor has enjoyed spectacular success for the best part of a decade. Plenty of their products have been successful in the market place, a few have not met expectations. But, that's life.

B&W's Matrix range has had disappointing sales in Australia, quite the opposite to the rest of the world, despite their technical excellence. Their retail price here may have had something to do with that, or the fact that they are more expensive than a conventional loudspeaker of equivalent cabinet size; their innovative and effective feature – the internal matrix of baffles which eliminates cabinet resonances, is not apparent from the outside.

But the situation may change with B&W's new Matrix range. The overall trend of integrating speakers into the modern living room has led a lot of manufacturers to sell their products on appearance alone, irrespective of sound quality offered or achieved. Different finishes, varying from the most elaborate veneers to lacquered paint finishes, are the in thing, apparently.

To cater to this, B&W has introduced two new floor-standing models featuring a new grille concept which is an integral part of the speakers' overall design. Dubbed the "Hi-Tech Interior Matrix Line", they incorporate new drive units with ferro-fluid cooled tweeters, simpler crossovers which we are told are 'better', and Monster Cable internal wiring.

The Model 1 measures 860 mm tall by 258 mm wide and 219 mm deep, while the Model 2 measures 950 mm high by 284 mm wide and 343 mm deep. As you can see, they are tall and slim – but not too tall. They are rated as suitable for amplifiers up to 250 watts. The Model 1 has a specified bandwidth of 40 Hz to 20 kHz within +/– 2 dB, the Model 2 covering down to 35 Hz. Sensitivity is quoted as 90 dB.

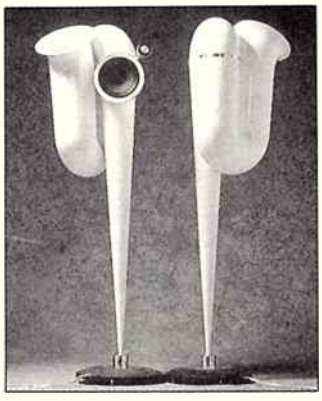
Really radical

Now what's this about radical new shapes? Have you seen the cover of a recent album released by the British pop group, Art of Noise, titled *Below The Waist*? Maybe you have, maybe you haven't. The cover features a picture of two peculiar-looking saxophone-shaped *loudspeakers*. Weird!

They are real, not a contrivance. They're called *Emphasis*, and were manufactured by B&W. Emphasis is the name of a design project by young British designer Morton Warren, which started out as an exercise for Morton's final degree thesis.

The speakers have attracted enormous attention in Europe, to the extent that, at the Berlin Hi-Fi Show last year, customers walked in and ordered them without knowing or caring about their final cost! Tronz believes this proves an hypothesis he's held for a long time, that "...exquisite design with functional technology can be sold at a premium."

The saxophone-shaped 'cabinet' forms an 18 litre bass reflex cabinet, the construction of which ensures no parallel sides. It provides multiple curvatures in all directions, imparting a very high mechanical stiffness to the walls,



guaranteeing no cabinet wall resonances, according to B&W. The internal cavity is filled with long fibre wool to absorb any organ pipe resonances.

The Emphasis speakers feature a two-way configuration, the bass driver having a Kevlar cone. The tweeter is mounted on a stalk, above the bass driver, allowing the diaphragm to "see" free space all round it in the immediate vicinity. This tweeter is a derivation of the metal dome unit used in the acclaimed 802 loudspeaker. Stereo imaging is said to be "exemplary in its class."

The accompanying picture of the Emphasis loudspeakers shows just how radical they are!

B&W is represented in Australia by Convoy International, 400 Botany Rd, Alexandria NSW. ☎ (02)698-7300.

Ampex Golden Reel Award

NEW ZEALAND group "When The Cat's Away" has received the Ampex Recording Media Corporation's Golden Reel Award for its album "Melting Pot".

The Award was presented by Ampex representative John Bicknell at the Air Force Recording Studio in Auckland, New Zealand. In addition, Golden Reel plaques went to engineer Nick Morgan and producer Ross McDermott, as well as to Tim Foreman, owner of Air Force Recording Studio, where "Melting Pot" was mastered and recorded.

In Golden Reel Award tradition, a $1,000 donation was made by Ampex to the charity of the group's choice. The donation went to Koru Care of New Zealand, which provides local and overseas travel assistance to terminally-ill and/or disabled children.

Ampex's Golden Reel Award is an international program honouring record albums that are recorded and mastered on Ampex audio tape and meet other requirements. Recognition is given not only to the artist but to the principal recording team members producing the master tape recordings. For further information contact Greg Martin, Ampex (Australia) Pty. Ltd., 61 Talavera Road, North Ryde, NSW 2113. ☎ (02) 887 3333, fax (02) 887 3150. eti

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Voice logging

VOICE logging by the year 2000 will be as commonplace as the office copier. That is the prediction of Trace Technology, Australian distributor of the West German ASC Voice Logging Data Recorders.

Mr Peter Della Tolla, managing director of Trace Technology, believes that the need to record conversations and instructions between individuals and between businesses will become normal practice in the next few years.

"The ASC range and technology has become the industry standard," he said. "ASC equipment is used in many of the major government and international business organisations throughout the world."

Further information from Trace Technology, 200 Rouse Street, Port Melbourne, 3207. ☎ (03) 646 5833, Fax (03) 646 5887.

READER INFO No. 204

Bitstream technology explained

BITSTREAM is used on some products by the Marantz company and was developed by the Philips group, which invented the CD. It is a new approach to design of the digital-to-analogue converters which turn a CD's digitally encoded signal into an analogue waveform which can be amplified and used to drive loudspeakers.

Instead of decoding information split up into 16-bit, 18-bit or 20-bit "words", it uses a one-bit "stream" of information, flowing at tremendous speed with 256-times oversampling.

Cycling at more than 10 million times a second, the one-bit Bitstream method is said to give a highly accurate reading of the digital signal, avoiding errors, glitches and distortion that have crept into multi-bit systems.

"We believe Bitstream will end the current 'bit wars', which have seen various manufacturers moving to 16-bits, then 18, 20 and even more in an attempt to overcome digital-to-analogue conversion problems," said Kym Biddell for Marantz Australia. "The problem is that with these multi-bit systems, each bit has to be given a very precise amount of current. There are 65,000, possible variations, and inevitably errors and distortion have crept in.

The Bitstream technology is not expensive. Kym expects Bitstream eventually to be used across the range from budget-priced models to high-end equipment. For information, please contact Kym Biddell, Marantz Australia, Australia Centre, Figtree Drive, Homebush, NSW 2140 (in NSW) ☎ (02) 742 8480 or (elsewhere in Australia) (008) 22 6861.

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PIONEER'S PD-71 CD PLAYER

"Pioneers" in the field of multi-play CD players, the company of the same name has now released a single-play CD player with such fine performance that Louis Challis proclaims it be (almost) unbeatable!

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The design engineers at Pioneer have always shown considerable innovative flair, not least in their development work as applied to CD players. Their most outstanding development has been in the field of multi-play CD players, which they literally pioneered, and which virtually all other manufacturers have since copied.

Irrespective of whether you believe, as I do, that multi-play CD players are at the forefront of the new wave of high fidelity equipment, the bulk of the market is currently filled by low cost, portable ghetto blasters and, surprisingly, high quality single disc players, of which the PD-71 is a particularly fine example.

The current trend in top-of-the-line CD players is typified by 18 bit digital to analogue converters, with 8 times oversampling digital filters, a single D to A converter and whose critical components are now invariably laser trimmed on the chip to achieve precise adjustment and optimum conversion linearity.

When I opened the distinctive Pioneer packing carton I was a little surprised at the appearance of the PD-71, which bore more than a passing resemblance to some of last year's Marantz and Yamaha top CD players. The front panel is something of a design departure for Pioneer, glossy black, with gold trim and lettering and a small recessed orange plasma display, centrally located. Below this is a large slide-out tray which displays the word "OPEN" as the tray is opened, and a fixed display configuration when the tray is closed and a disc is being played.

There are three sets of information – the first, the track number, the second, the track index number and the third the timing in minutes and seconds.

At the bottom of the slide-out tray are two long, narrow push buttons. The OUTPUT SELECTOR allows you to select DIGITAL OUTPUT (with a choice of straight electrical or optical) and/or ANALOGUE OUTPUT, all three of which are provided on the back panel. Your selection is indicated by means of two little LEDs, yellow for DIGITAL and red for ANALOGUE, which are placed close to the switch at the bottom of the tray. On the right-hand side of the panel is a similar switch which controls the display. When the display is on, the matching red LED is off; conversely, when you activate the switch, the LED lights up to tell you that the player is not dead, but that you have switched off the display. Adjacent to this light is another yellow LED, which reminds you that you have selected the PAUSE mode.

The controls on the right-hand side are quite conventional, with a large PLAY button with a small, triangular green LED, smaller buttons for TRACK SEARCH (forward and reverse), and larger buttons for PAUSE, STOP

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Pioneer's PD-71

Dimensions:	**457mm wide x 324mm deep x 127 high**
Weight:	**9.5kgs (excluding remote control)**
R.R.P.:	**$999**

and OPEN/CLOSE. The numerical selector keys are relatively small, with numbering which is not as legible as I would like, but which sensibly places the + 10 and 20 (or greater) keys at the top.

At the rear of the player are a pair of gold-plated RCA coaxial sockets for the analogue output signal, a single RCA coaxial socket for the electrical digital output signal, and one of the new breed of optical connectors so you can use an optical fibre cable to feed your amplifier.

When I tried to open the cabinet to inspect the construction methods, and to examine the circuitry, I was confounded by the complexity of the cabinet construction. It is far more heavy and solid than that to which I have been accustomed in recent years. In this respect, Pioneer has gone to considerably more trouble than most of its competition, with double panels on virtually all major surfaces; this has helped to achieve both acoustical and electrical isolation improvements.

The electrical parameters of this CD player are its 'tour de force'. As our objective measurements confirmed, the frequency linearity of this player is ± 0.1dB from 5Hz to 20kHz, which is significantly better than the manufacturer's claimed ± 0.3dB from 2Hz to 20kHz. This is equal to the best I have seen, and, frankly, if the performance were to be any better I would most probably be hard pressed to measure it.

The frequency linearity of the digital to analogue converter is exceptionally good all the way to -60dB where it is 0.2dB high. This performance is only marginally out by + 0.4dB at -70dB, picks up again to + 0.3dB at the -80dB level, and then displays the classical + 4 decibel deviation at -90dB that virtually all CD players exhibit at the extreme limit of their range.

The measured channel separation of the PD-71 is exemplary and probably the best I have measured. At all test frequencies the channel separation is greater than 100dB, and this is achieved with a uniformity that has to be admired.

The measured distortion characteristics of the player are excellent all the way down to 60dB, where the distortion is 0.79%. This slowly creeps up to 8.79% at the -80dB level. The PD-71's distortion figures are good, but not really significantly better than any other CD manufacturer, as there are theoretical and practical limitations in the 16 bit/18 bit technology which inhibit their ability to change what is very much a 'status quo'. Neither Pioneer, nor anybody else, is currently capable of breaking it. Nevertheless, it is only fair to point out that there is not much point in breaking this nexus, as very few people are able to hear THD distortion products of the order of 8% in a signal which is already -80dB down when compared to the peak recorded signal levels on a disc.

When I compare linearity of the emphasis signal output against the theoretical recorded levels, it is clear that this is a 'reference' compact disc player, as the output of these signals exhibits a deviation of less than 0.1dB. In much the same way, the measured signal-to-noise ratio is 103dB unweighted, 113dB(A) without emphasis and 1dB better with emphasis.

These outstanding figures are directly attributable to the use of an 18 bit D to A conversion chip, which provides a small, but unquestionably desirable, advantage in terms of enhanced signal-to-noise. Some people, of course, will still argue that CD players don't really need this advantage and that you can't hear the difference, but I now strongly support the school that says that if your fundamental electric noise component is reduced, then the resulting signal is closer to the original recorded signal and the overall purity of your software is enhanced.

The frequency accuracy of the recorded signal was within 0.2Hz at 20kHz and this is also indicative of the trouble and effort that Pioneer has put into the design and construction of this particular CD player.

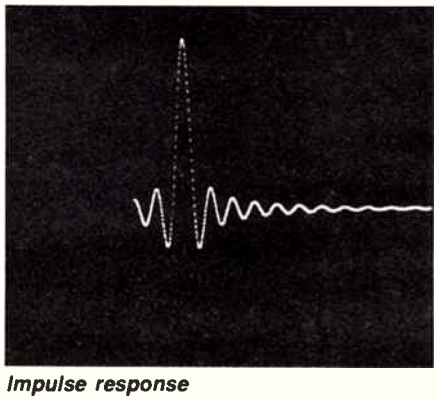
The impulse and square wave tests displayed exemplary performance, with hardly a trace of ringing or lack of uniformity. The dirty record tests, interrupted data tests and black dot and stripe tests were all passed without a single hiccup. More significantly, the player was able to play all but one of my 'nasty test discs' without any real complaints and convinced me that the laser scanning system really does perform well.

The subjective evaluation of this player proved to be a delight. As you may have noticed, the quality and available range of the latest CD software is outstanding. The first of the discs that I selected for my assessment was a recent release of Beethoven's Symphony No. 5, which is unquestionably his most popular symphony and one of the best ever written. This has been coupled to Schubert's Symphony No. 8, his famous unfinished symphony, and one of his most moving and memorable. These two have been recorded by Lorin Maazel, conducting the Wiener Philharmoniker (CBS MDK 44783).

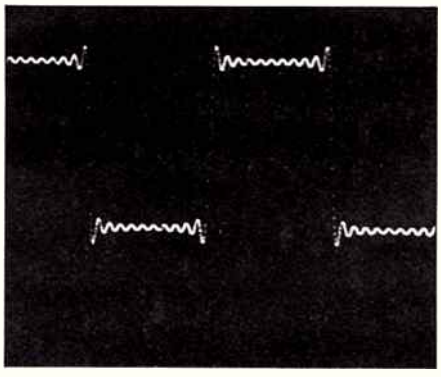
Listening at home, in my living room, with its carefully controlled ambience, I found that the PD-71 provided an unblemished rendition of this music.

I moved to a recent release of Schubert's 9th (or the Great Symphony) with Sir Charles Mackerras conducting the Orchestra of the Age of Enlightenment – unusual in that all of the instruments used by the orchestra are 'period instruments'. Thus the authenticity of the sound, quite apart from the quality, makes this a very special record (Virgin Classics VC7 90708-2). I was attracted to this record because of my association with Sir Charles late last year, when I was entrusted with the design of the rehearsal hall for the

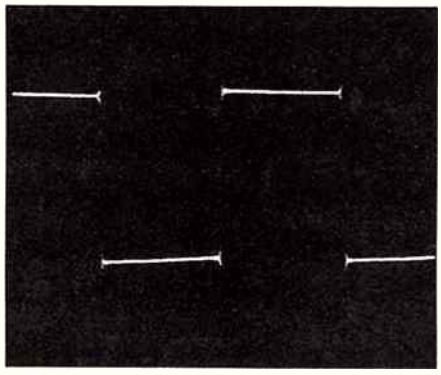
Measured performance of Pioneer PD-71 Compact Disc Player.



Impulse response



1kHz square wave



100 Hz square wave

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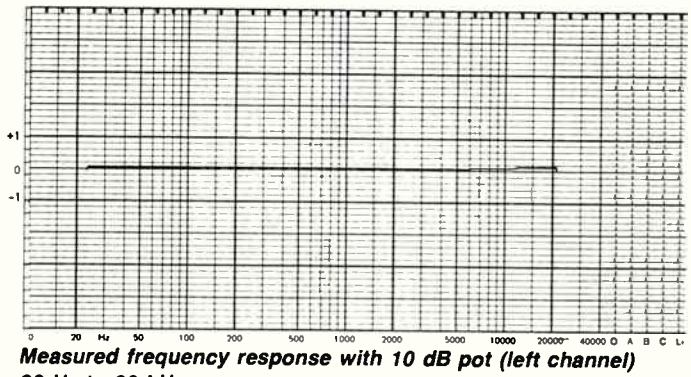
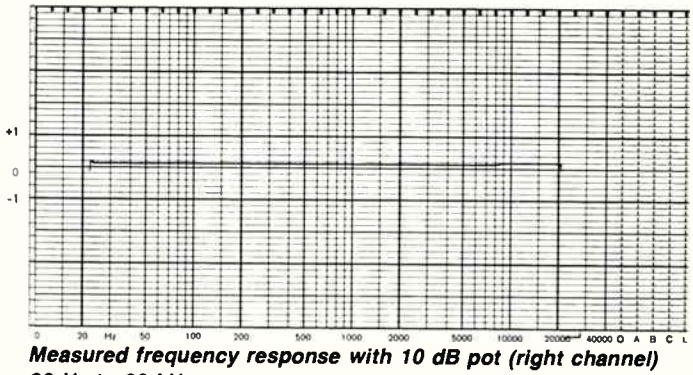
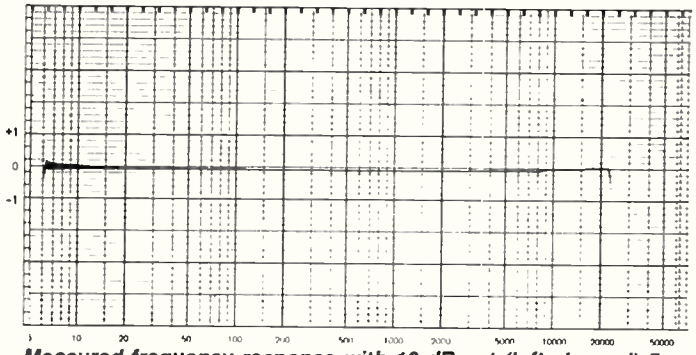


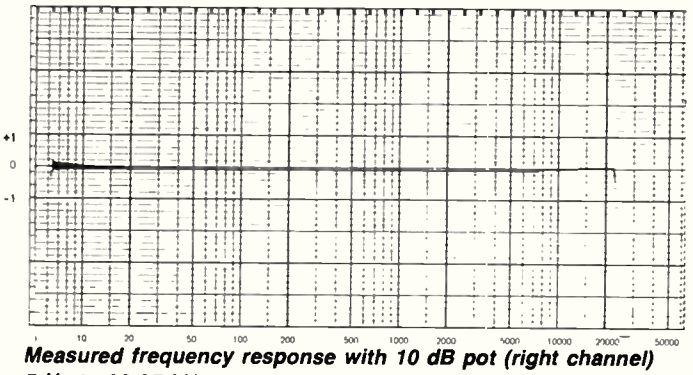
Measured frequency response with 10 dB pot (left channel) 20 Hz to 20 kHz.



Measured frequency response with 10 dB pot (right channel) 20 Hz to 20 kHz.



Measured frequency response with 10 dB pot (left channel) 5 Hz to 22.05 kHz.



Measured frequency response with 10 dB pot (right channel) 5 Hz to 22.05 kHz.

Elizabethan Theatre Trust Orchestra. Sir Charles used the hall during rehearsals for the Bicentennial production of the Master Singers, and proved to be both a supportive and appreciative client. I was impressed by his ability and incomparable style, very much in evidence during rehearsals and clearly displayed on this disc.

The third disc I played was a brand new release from ABC Classics, *Vivaldi's The Four Seasons,* played by the Tasmanian Symphone Chamber Players (ABC 838904-2)and recorded in Tasmania. This disc is a credit both to the individual players and to the capabilities of the ABC's technical facilities and professional staff. It exhibits a degree of mastery which we would not normally expect from the 'Apple Isle'.

Now that I have had the PD-71 in use for more than three months, I must say that I have only one minor criticism of this CD player. That criticism doesn't even strictly relate to the player, but rather to its small and very practical remote control player (CD-PDO32). This miniscule remote control lacks a remote volume control. With that added feature, the PD-71 would be unbeatable in terms of its quality reproduction and its equally important ergonomic practicality for any serious music lover. eti

MEASURED PERFORMANCE OF PIONEER COMPACT DISC PLAYER MODEL NO. PD-71 SERIAL NO. JE 2603060T

1. FREQUENCY RESPONSE 20 Hz to 20 kHz ±0.1dB
   5 Hz to 22.05 kHz ±0.1dB

2. LINEARITY @ 1kHz

NOMINAL LEVEL	LEFT OUTPUT	RIGHT OUTPUT
0 dB	0.0	0.0
-1.0	-1.0	-1.0
-3.0	-3.0	-3.0
-6.0	-6.0	-6.0
-10.0	-10.0	-10.0
-20.0	-20.0	-20.0
-30.0	-30.0	-30.0
-40.0	-40.0	-40.0
-50.0	-50.0	-49.9
-60.0	-59.9	-59.8
-70.0	-69.8	-69.6
-80.0	-79.7	-78.9
-90.0	-87.6	-85.8

3. CHANNEL SEPARATION

FREQUENCY	RIGHT INTO LEFT dB	LEFT INTO RIGHT dB
100Hz	102.6	103.0
1kHz	102.8	102.8
10kHz	102.2	102.5
20kHz	100.6	102.3

4. DISTORTION (@ 1kHz)

Level	2nd	3rd	4th	5th	THD%
0	116.5	109.5	118.9	112.8	0.00084
-1.0	117.2	114.5	-	108.2	0.00077
-3.0	115.3	111.3	117.2	109.0	0.0009
-6.0	119.4	103.7	108.4	106.5	0.0016
-10	116.5	106.5	109.2	100.7	0.0017
-20	109.2	86.8	99.4	92.4	0.0095
-30	97.8	77.4	96.8	80.4	0.029
-40	94.1	73.7	82.0	70.2	0.055
-50	80.6	61.1	72.5	56.1	0.28
-60	71.0	54.4	-	46.0	0.79
-70	55.9	31.4	52.5	48.8	2.73
-80	31.4	22.1	33.6	34.0	8.79
-90	14.5	23.6	18.4	16.6	27.6

(@ 100 Hz)

0	119.3	108.6	124.8	103.7	0.0012
-20	105.3	87.5	112.8	90.4	0.0082
-40	84.5	75.7	89.6	69.3	0.06
-60	65.1	52.3	59.7	47.4	0.78

@ 6.3 kHz

0	103.0	106.4	107.8		0.0024

Transport screw NOT in travel position when unpacked

5. EMPHASIS

FREQUENCY	RECORDED LEVEL	OUTPUT LEVEL (L)	OUTPUT LEVEL (R)
1kHz	-0.37 dB	-0.3	-0.3
5kHz	-4.53 dB	-4.5	-4.5
16kHz	-9.04	-9.1	-9.2

6. SIGNAL-TO-NOISE RATIO

Without Emphasis	103.4 (Lin)	113.0 dB(A)
With Emphasis	104.6 (Lin)	114.0 dB(A)

7. FREQUENCY ACCURACY
   (19998.8 kHz) -0.2Hz for 20kHz test signal

8. SQUARE WAVE RESPONSE
   (See photos)

9. IMPULSE TEST
   (See photo)

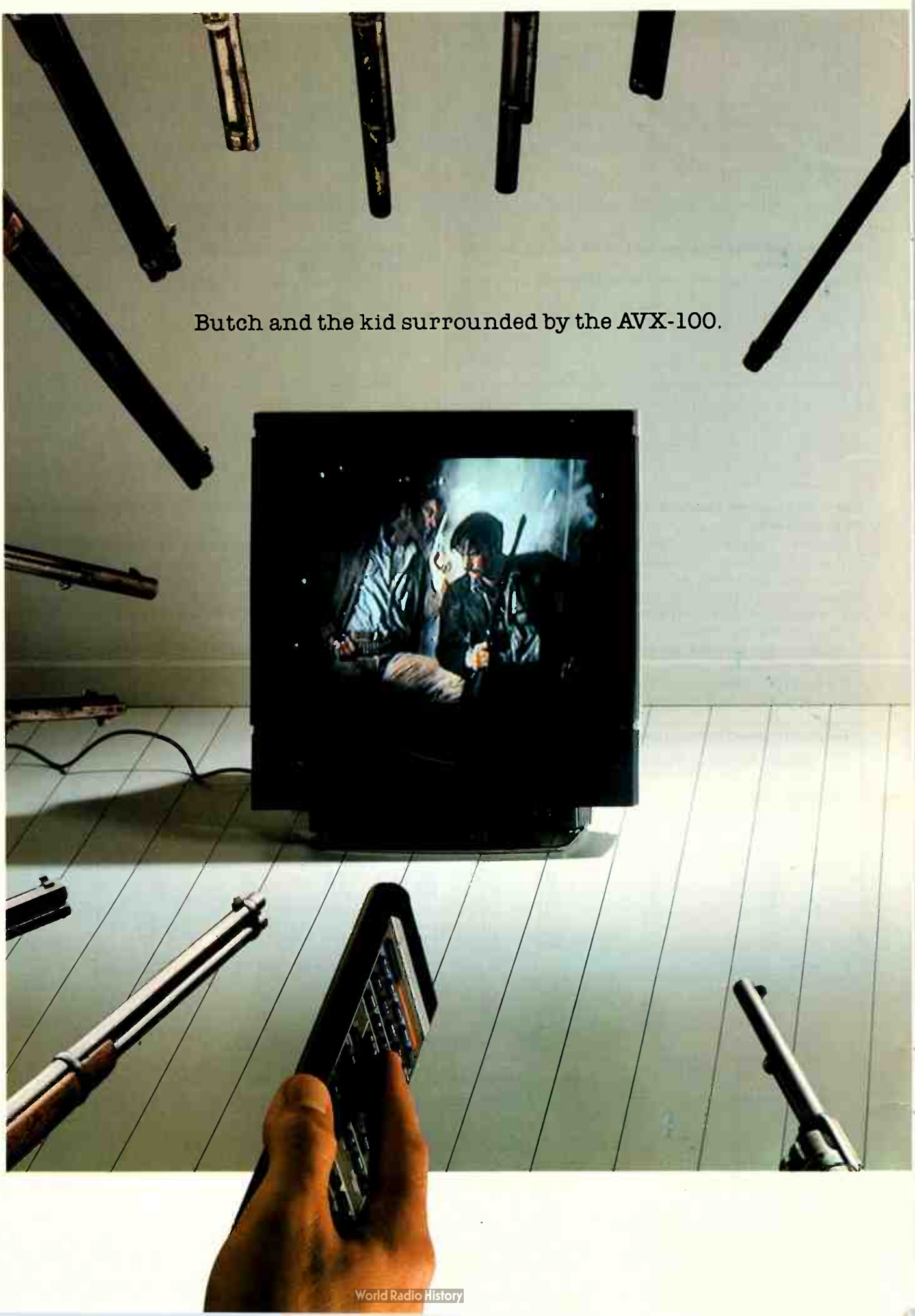
DIRTY RECORD TEST
Using Philips NR4A (410-056-2)

Interruption in Information Layer
400 micrometer; passed
500 micrometer; passed
600 micrometer; passed
700 micrometer; passed
800 micrometer; passed
900 micrometer; passed

Black Dot at Read out Side
300 micrometer; passed
500 micrometer; passed
600 micrometer; passed
800 micrometer; passed

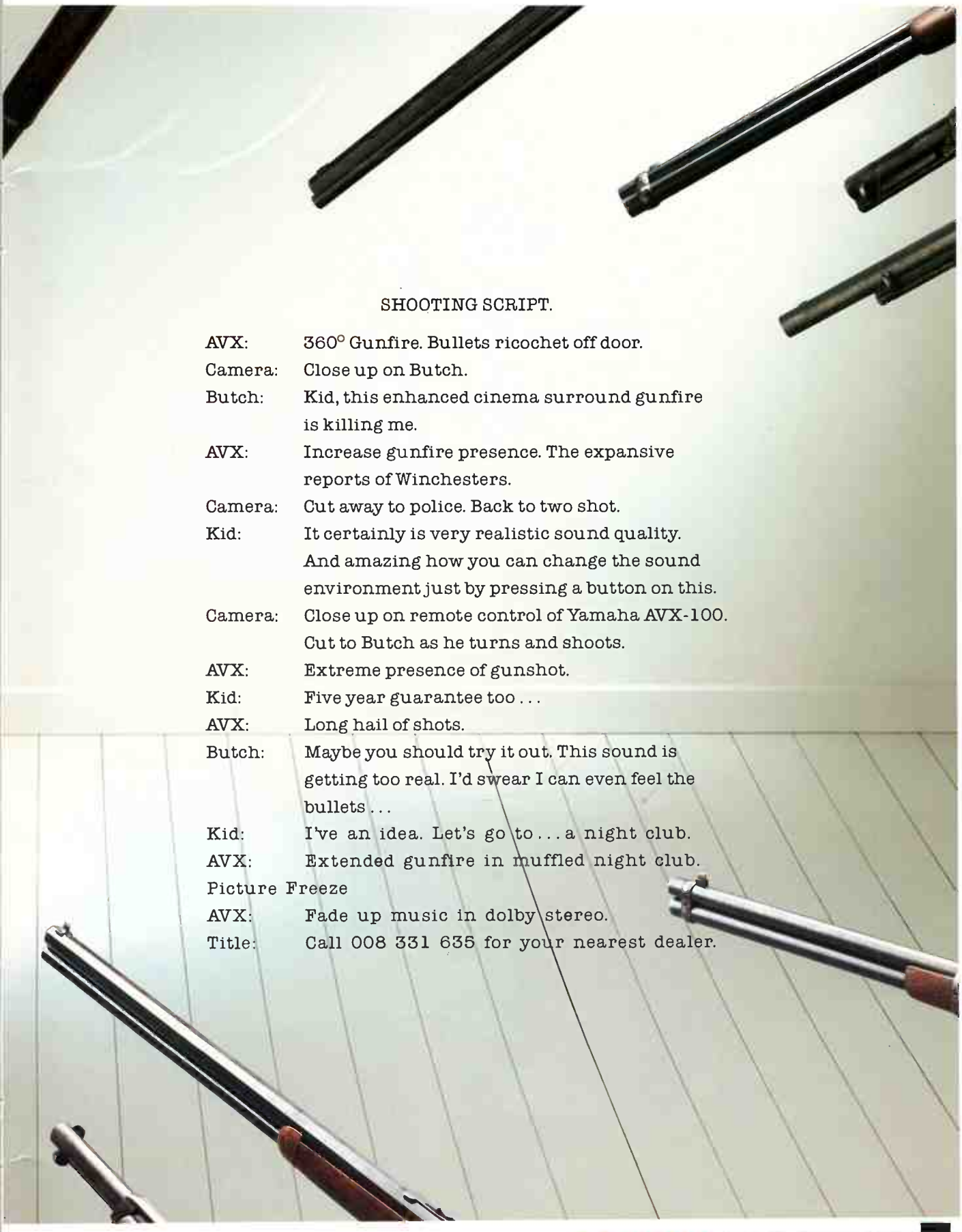
BLACK STRIPE TEST (passed)

World Radio History



Saatchi YAM 052/B

World Radio History



SHOOTING SCRIPT.

AVX: 360° Gunfire. Bullets ricochet off door.

Camera: Close up on Butch.

Butch: Kid, this enhanced cinema surround gunfire is killing me.

AVX: Increase gunfire presence. The expansive reports of Winchesters.

Camera: Cut away to police. Back to two shot.

Kid: It certainly is very realistic sound quality. And amazing how you can change the sound environment just by pressing a button on this.

Camera: Close up on remote control of Yamaha AVX-100. Cut to Butch as he turns and shoots.

AVX: Extreme presence of gunshot.

Kid: Five year guarantee too . . .

AVX: Long hail of shots.

Butch: Maybe you should try it out. This sound is getting too real. I'd swear I can even feel the bullets . . .

Kid: I've an idea. Let's go to . . . a night club.

AVX: Extended gunfire in muffled night club.

Picture Freeze

AVX: Fade up music in dolby stereo.

Title: Call 008 331 635 for your nearest dealer.

READER INFO No. 33

YAMAHA

AUDIO – VIDEO AMPLIFIERS · 5 YEAR WARRANTY

World Radio History

FLUKE AND PHILIPS - THE GLOBAL ALLIANCE IN TEST & MEASUREMENT

FLUKE

PHILIPS

Other meters show half the picture

The new Fluke 45 has dual display versatility.

With 2 multifunction displays and 16 different measurement capabilities, the new Fluke 45 does virtually everything you want a meter to do. And for a surprisingly affordable price.

The 5-digit, 100,000 count dual displays give you more information in less time — and with less effort. For example, measure the VDC output of a power supply while measuring the VAC ripple. Or check the amplitude and frequency of an AC signal. From a single test connection!

And the Fluke 45 is designed to make complex measurements easier, with standard features like a 1 MHz frequency counter, Min Max, limits testing (Hi/Lo/Pass), Touch Hold® and Relative modes. There are 21 different reference impedances for dB measurements; in the 2 Ω to 16 Ω ranges, audio power can be automatically displayed in watts.

Accuracy to get the job done right.

The Fluke 45 is a true-rms meter, with 0.02% basic dc voltage accuracy and 100,000 count resolution on both displays. Basic dc current accuracy is 0.05%, making the 45 ideal for servicing 4-20 mA current loops. Closed-case calibration simplifies the calibration process and increases uptime.

Even an RS-232 interface is standard.

Connecting the Fluke 45 to PCs, RS-232 printers and modems is as easy as attaching the cable. An IEEE-488.2 interface and rechargeable batteries are available as options.

Get everything you've ever wanted.

For all the information on the new Fluke 45, contact your local distributor.

FLUKE 45 DUAL DISPLAY MULTIMETER

- Dual Display
- True-rms voltage and current, including ac+dc
- 0.02% basic dc voltage accuracy
- 0.05% basic dc current accuracy
- 1 MHz frequency counter
- RS-232 interface standard
- dB, with 21 reference impedances, and audio power calculations
- Compare and Relative functions
- Min Max and Touch Hold® functions
- Optional PC software for RS-232 applications
- Optional IEEE-488.2 interface, battery pack
- One year warranty

READER INFO No. 55

For Further Information Contact Your Local Philips Test & Measurement Organisation: Sydney (02) 888 0416, Brisbane (07) 844 0191, Melbourne (881) 235 3666, Adelaide (08) 348 2888, Perth (09) 277 4199, Auckland (09) 89 4160, Wellington (04) 88 9788.

World Radio History