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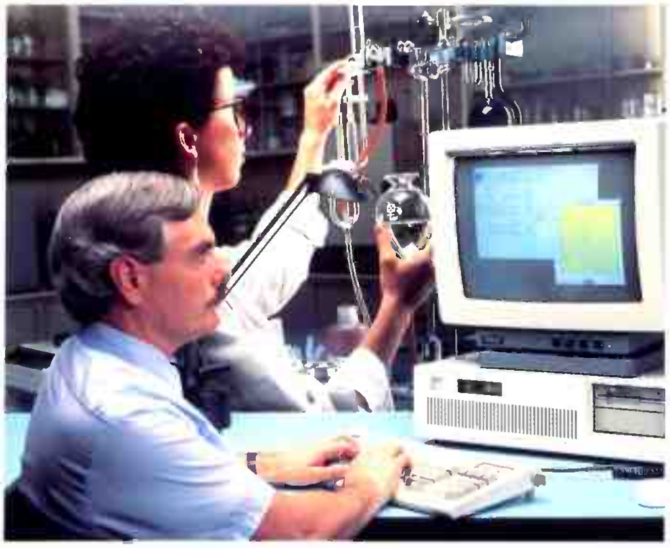

Electronics Australia WITH eti

Volume 53, No.7

July 1991

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

How Sony developed the tiny TR-55 'Handycam'

Firms like Sony rarely say much about the development of new products, presenting them as a 'fait accompli' for all to admire. In our story beginning on page 12, Barrie Smith provides a rare glimpse behind the slick marketing facade.

Professional electronics: data acquisition feature

In this month's professional supplement we look at tools for data acquisition, including two impressive new Australian products: the Datataker 600 digital data logger, and a 386SX based industrial single-board computer from JED Microprocessors. (See page 112)

On the cover

Peter Murtagh, who recently joined EA's editorial staff, is shown here wiring up one of his simple projects for experimenters — to be described in a new series of practical articles for beginners, starting next month. (Picture by Peter Beattie)

Video and Audio

Features

Projects and Technical

Professional Electronics

Columns and Comments

Departments

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LETTERS TO THE EDITOR

Radio project?

First, I would like to congratulate both Peter Phillips and the magazine on the 'Basic Electronics' series, which is quite interesting.

However, the reason I am writing this letter is because I haven't seen many radio projects in your magazine recently. I would like to know if EA could establish a design of a new superhet shortwave radio covering approximately 0.5-30MHz and able to resolve AM, CW and SSB — hopefully using descrete transistors and not expensive and/or hard to get IC's.

Unlike normal AM/FM radios, communications receivers with the mentioned features are still expensive and I am quite sure home construction is a cheaper alternative. Also, how about a new RF signal generator project?

Ron Steinfeld,
Glen Waverley, Vic.

Comment: We'll see what we can do, Ron — but neither kind of project comes into the 'easy' category. Some of the basic components needed are rather hard to get nowadays, in any case. But thanks for the suggestions — and for the kind words about 'Basic Electronics'.

Seeks manuals

Please let me first say how much I enjoyed the Forum section on ELCB's. Being an electrician in light industry, I can relate to the topics that were raised.

I wonder if you will please ask your readers if anyone can supply me with photocopies of a user manual for a University Oscilloscope Model UC-3, and an Audio Generator Model UAG-22D.

Also if anyone has a power supply for an ex RAN oscilloscope Hartley Model CT436 for sale.

Roy Davies,
28 Villa Road,
Waratah West, NSW 2298

Donations sought

I am writing to ask if your organisation (or readers) could send magazines and publications of various subjects to contribute to our education centre library.

The staff and inmates would appreciate this gesture greatly, as you would be assisting in furthering the education of inmates.

Ms Maureen Regan,
Senior Education Officer,
Reception Prison,
PO Box 13,
Matraville, NSW 2036

UPS or SPS?

Your comment on the letter from Victoria Maule of Critec Pty Ltd (March 1991) missed a very important point for users.

Why buy a UPS when an SPS will do the job at half the cost?

Brian Falconer,
Tercel Consulting,
Carlton, Vic.

Comment: I was trying to be polite, Brian. But it's a good question, isn't it?

Vintage bouquet, tip

I enjoyed Peter Lankshear's article on the 01A valve in the April issue.

A contemporary of the 01A was the 80: a 5V, four pin, double diode high tension rectifier. If your 80 died, and you had no spare readily to hand, an 01A would gallantly fill the gap. Its 6.3V filament would work on a 5V and the grid and anode oblige as double anodes.

I am well aware that in this era of solid state this titbit about the 01A is of absolutely no use to anyone.

However, perhaps it is the sort of knowledge that should not be lost as we oldsters die off — and it might come in useful if someone ever introduces 'Trivial Pursuit in Electronics'. You will then be able to score in answering the question: 'What four pin triode valve could double as a high tension rectifier?'

Ben Furby,
Campsie, NSW.

Comment: Thanks for the bouquet and the snippet, Ben. By the way, Peter Lankshear dealt with the grand old '80 in the August 1988 issue.

More on the Toidi

I found your recent translation and precis of a French scientific treatise of considerable intereset, and in particular, the description of the new sub-atomic particle, the Toidi.

LETTERS TO THE EDITOR

[illegible]

I also note your puzzlement at the basis of the word itself.

In this context, it takes little intelligence to perceive that it is derived from a contraction of the word used to describe a small distant object moving at high speed, the Planetoid.

I must confess that the derivation of the ultimate 'I' does perplex me somewhat.

I suspect that it may well represent the authors' attempt to produce a group word by the inappropriate attachment of a Latin plural ending to a Greek robot.

If this analysis is correct, then the French authors have produced a quite serviceable and relevant word to describe sub-atomic particles which congregate in quantum packages.

However, quite apart from writing to compliment you on the high quality of the translation of this obscure French paper, I thought your attention should be drawn to the discovery of a new gravity field particle cited in another French scientific publication, *Limbercile*, coincidentally appearing in the April 1991 edition.

This particle is said to possess nul mass, and given its derivation and character is appropriately named the Citanul. It seems that the researchers have been able to demonstrate that it travels at speeds exceeding that of light.

Indeed it appears to move so fast that it traverses the whole of finite space-time so quickly that it returns to its point of departure the instant before it sets out. For this reason, it always appears to remain in the same place.

To an academic in an associated field, this strange behaviour suggests more than a casual link with the Toidi.

Indeed profound cogitation suggests that the interaction of the Toidi with the Citanul may well give rise to a further and as yet undiscovered fundamental particle, which could well be involved with the formation of Black Holes.

If discovered, as anticipated, such a particle should most properly be named the 'Woozul'.

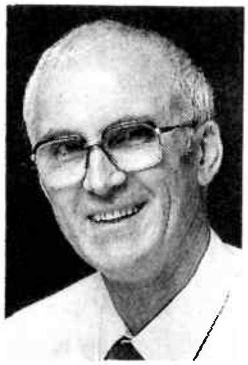
Overdun D. Umer,
Assoc. Professor,
Mugworry University,
Claytons, NSW

Comment: Message received and understood, Professor!

DROP US A LINE!

Feel free to send us a letter to the Editor. If it's clearly expressed and on a topic of interest, chances are we'll publish it. — but we reserve the right to edit those that are over long.

EDITORIAL VIEWPOINT



Surges and simulators

As in many other areas of human endeavour, developments in electronics often seem to take place in periodic surges. Things can be fairly quiet for a while, and then there will be a sudden burst of activity.

The surges in activity are generally confined to a few specific fields at any one time, and while there's a lot happening in one area, things are often fairly quiet in others. This is just as well, I suspect — if big developments took place across the board, we'd probably all go into instant mental overload, trying to adjust to it all!

So far, one surge that is certainly taking place in 1991 is in digital oscilloscope or 'DSO' technology. Last year, DSO's were extremely expensive, esoteric devices largely confined to specialised research labs; now almost every instrument maker is releasing new lower priced, easier to drive general-purpose models, and the future of all 'scopes seems very likely to be wholly digital.

I think I've identified another surge, too. This is in electronic circuit simulation software. No less than three different PC- based simulator packages have turned up at our office in rapid succession over the last few months, for us to try out and review. As some of our readers will have noticed, I've been playing with them myself — the second review is printed in this month's issue.

Fairly obviously, the developers of these packages are now making a concerted effort to break out of the rarified academic and research environment that has been the province of such programs until now, and are trying to persuade the rest of us to use them as well.

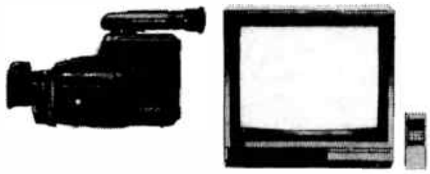
There's nothing wrong with this, of course. I'm sure computer simulation of circuits has a very important role to play in the future of electronics, and probably even more so in the harsh competitive world of private industry than in the cloisters of academe and the ivory towers of research. In fact an experienced design engineer told me recently that he now regards a circuit simulator as an essential tool for efficient design, and I'm sure he's right. Quite apart from anything else, they offer an extremely efficient way to predict the noise performance of a circuit, or the effect of component parameter variations.

All the same, I believe the developers of simulator packages have quite a job ahead of them. Selling these packages to academics and research boffins was no doubt fairly easy — they've been using them for decades on mainframe computers, and presumably jumped at the opportunity to be able to run one on their own PC. But judging by my experiences so far, these packages are still going to need a fair bit of work before the rest of us turn off our soldering irons and swing over to 'virtual electronics'.

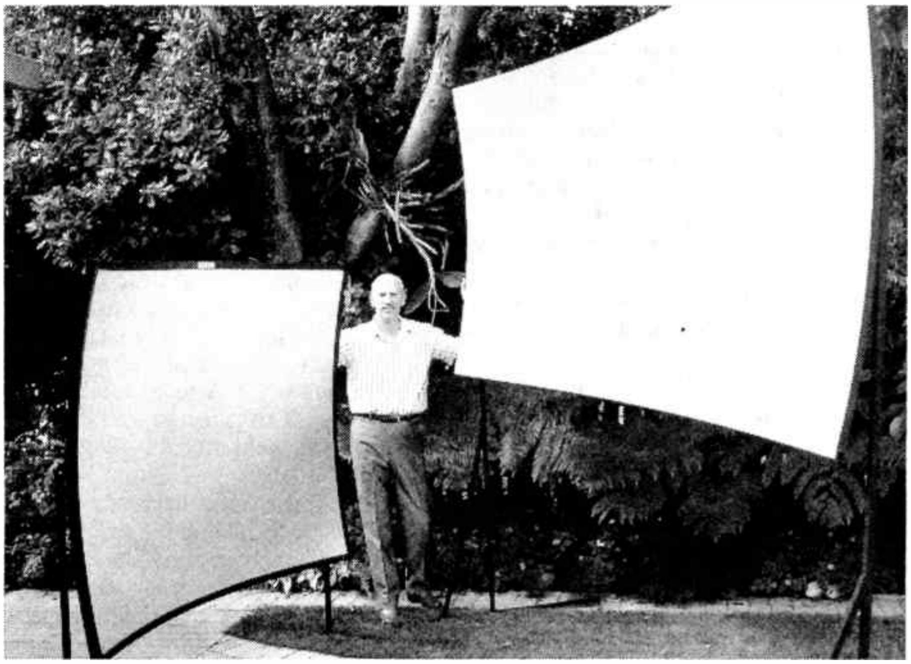
Judged against a lot of modern PC software, many of these programs are still highly priced, relatively unfriendly and hard to learn. So while their developers may *want* 1991 to be the year of the circuit simulator, as well as the year of the DSO, the *real* surge in simulators may take a while longer...

Jim Rowe

What's New in VIDEO and AUDIO



Improved video screens



Brisbane company Super Screens was established by principal John Stephens when he became dissatisfied with the video screens that were previously available. He found these had unacceptable levels of picture drop-out at the sides, a narrow viewing angle and poor efficiency.

The Super Screens product uses a special high-efficiency industrial screen material, with a frame that creates an optimal bi-concave shape. Four models are available, with screen sizes ranging from 1450 x 1140mm to 3600 x 1500mm. The screens can be wall mounted or free standing, and the frames can be fitted with castors for ease of movement.

For further information circle 181 on the reader service coupon or contact Super Screens, 5 Trochus Street, Mansfield 4122; phone (07) 349 2386.

Personal CD player has radio, remote

The newest Philips product for music on the move is a personal headphone radio compact disc player, packed with innovative features which won it the CESA Product of the Year Award.

Designed for either in home or portable use, the AZ6897 has CD and radio facilities found on larger portable models — yet it is small enough to be taken on 'power walking'. Its special built-in features include an introscan which quickly gives the listener a 'preview' (five seconds) of every track; a backward and forward music search function to find favourite passages; and a shuffle facility which randomly selects tracks from the disc in play.

A multi-function display shows relevant details about the disc, both before and during play, as well as indicating the programming modes and tracks. Large conveniently located keys on the top operate all CD functions like play/pause, forward and reverse skip, music search and stop. A wired remote can also operate these and the search functions.

The AZ6897's PLL digital AM/FM tuning system has 20 presets evenly divided between the two bands and can be set to automatically store the strongest signals. Its digital display shows frequency, wave band, preset tuning and FM stereo and tuning can be protected while the unit is on the move by pressing a hold key.

Additional features include an easy to read digital clock, Philips Dynamic Bass Boost for enhanced bass reproduction and a headphone socket with volume control.

Second generation still video camera

Canon's new 'second generation' ION still video camera records up to 50 images on a reusable 2" floppy disk. Its point-and-shoot operation, built-in flash and automatic features allow for quick and easy 'electronic photography' of any subject. Images can be played back instantly via connection of the camera's video output to any VCR or video monitor.

A new film adaptor for the ION has been produced which enables film negatives and transparencies (slides) to be converted to ION video images, both for image storage on the camera's floppy disks, and for presentation on a video screen.

Canon claims that the RC-260 manages to enhance the 'Canon image' created by the earlier RC-251, while at the same time dealing a blow to the pursuing competition. It achieves this by offering expanded functionality and a more comprehensive line of accessories, in an even more compact and lightweight model.

Weighing 420g (without battery or

disk), and measuring only 111.5(W) x 42 (H) x 113(D)mm, the RC-260 easily fits into the palm of a hand, and becomes the first truly 'pocket' size still video camera ever produced.

Camcorder buying guide from Hitachi

With the addition of two new 8mm models to its domestic camcorder range, Hitachi Sales Australia claims to be the first Australian firm to market models for all three domestic video formats — Video 8, VHS-C and full-size VHS.

The new models are the VME8E compact lightweight model for travellers, and the larger VME16E model with optional manual over-ride on most controls, and a remote control unit.

To assist potential camcorder buyers in choosing the model and format best suited to their individual needs, Hitachi has produced an information booklet which endeavours to compare the formats in an easily understood fashion. The book has been written specifically for the Australian consumer, and is available free.

Called 'The Clear Guide to Buying a Video Camera', it is available by either ringing Hitachi on (008) 032 689, or writing to Hitachi Sales Australia, PO Box 213, Moorabbin, Victoria 3189.

Top-of-the line Philips car CD

The Philips DC980 car radio/CD combination unit is that firm's new top-of-the-line model. The unit has a high-performance CD player, an FM/AM radio tuner and a high-power amplifier, and is designed for slot-mounting, with a recessed handle so that it can easily be removed from the car to prevent break-in and theft.

The ergonomic control panel offers maximum operating convenience at night ('night design').

A choice of orange or green background lighting colours can be selected by a switch to match the dashboard illumination of the car.

The DC980 is microprocessor controlled, so that despite its many functions, operation is easy even while driving.

The radio tuning system has a PLL synthesiser with crystal oscillator, ensuring high frequency stability and precision. The tuner covers the FM (stereo) and AM bands.

The Autostore (AST) system stores the frequencies of the six strongest stations on the AM and FM bands in memory. The DC980's memory can also store 12 FM and six AM stations — a total of 18 stations. A built-in battery maintains the memory contents when the set is switched off.

The built-in CD player has Philips' Digital Dynamic Range Compressor, which provides extra amplification, for soft passages without influencing the sound quality — reducing the disturbing effect of background noise in the car (for example tyre and wind noise).

The tracks of a CD can be played in random order for a new and different play sequence every time. Tracks can also be found using 'Music Scan', which plays the first 10 seconds of each track.

The LCD display shows play information such as elapsed playing time per track or for the entire disc.

With its 2 x 25W output, the amplifier has sufficient power to allow music to be enjoyed or speech to be understood clearly, even against high background noise levels. Two loudspeakers can be connected to the amplifier.

Two additional separate amplifiers can be connected to the DC980 by a four channel gold-plated, cinch/phono preamplifier output. A fader control allows the front-rear sound balance to be adjusted.

The unit is switched on and off by pressing the volume control, which therefore does not have to be rotated from the preferred setting.

The amplifier has separate controls for treble and bass adjustment, and a loudness switch that corrects the frequency response at low volume setting.

Recommended retail price for the DC980 is $799.00.

'Wet and Dry' CD cleaner

TDK claims that by using the CD-C1 'wet and dry' CD cleaner, you will maintain your CD in excellent condition.

The CD-C1 comprises two special pads, and to clean a CD you apply two or three drops of cleaning liquid to the 'wet' pad and wipe radially (from the centre hole outwards).

Then, before the cleaning liquid has had time to dry, you wipe the surface of the CD with the white (dry) pad in the same radial pattern. This is said to result in a totally clean and dust free CD surface. The clean pads can be replaced when worn or dirty.

The CD-C1 has an RRP of $24.95 and is available at TDK dealers and selected department stores.

SA museum of audio recording

A rare collection of antique audio recording equipment from the 1940's to 1960's has been opened in Malvern, South Australia, by Mr Neville Ellison, a former associate of the late Australian tape recording pioneer Jack Ferry. The museum includes two wire recorders, three magnetic disc recorders, seven Australian-made and 36 other reel-to-reel tape recorders, and also features the 'Ferry Collection' of 10 recorders and allied equipment, made in South Australia by Jack Ferry.

Other items on show at the Ellison Museum of Magnetic Audio Recording and Playback are dictation machines, cartridge players, cassette players and some 41 different old radio receivers.

The majority of displayed items are restored to working order.

The museum is located at 67 Cremorne Street, Malvern SA. Appointments can be made to view the collection by ringing Neville Ellison on (08) 274 1103. ■

Pioneer's A-400 'minimalist' amp

Well-known Japanese amplifier manufacturer Pioneer Electronics has put quite a bit of effort into producing models designed to 'crack' the somewhat quirky but influential English hifi market. Here's a first-hand report on the firm's new A-400, which was released in Australia in April.

by JIM ROWE and ROB EVANS

The name Pioneer is very well known in audio circles around the world, as the Tokyo-based firm has been turning out good quality, competitively priced amplifiers ever since the valve days. And just about all of their amps have easily qualified for the label 'hifi', at least as far as the vast majority of the world's consumers have been concerned. Of course like most Japanese firms, Pioneer has mainly concentrated on the middle-range areas of the market, where the bulk of sales have always been — and no doubt will always be.

An eminently sensible strategy, and one which when coupled with a soundly designed, well made and attractively priced product, has generally been very successful. It's not by chance that Japanese manufacturers have become major, if not dominant players in the world hifi market, along with other consumer electronics areas like TV receivers, VCRs and CD players. But the hifi market has always been a little 'different' from other areas. Particularly in Britain, which has somehow always seen itself as the only real repository of genuine 'high fidelity' technology — both in terms of the ability among manufacturers to make it, and also the ability among listeners to discern it.

Only British hifi enthusiasts have truly 'golden ears', in other words, and accordingly only British designers and manufacturers have had the ability to produce equipment capable of achieving the highest and purest fidelity.

Sure the Yanks could produce the biggest speaker systems, and amplifiers with the highest power output (they need them anyway, because their speakers are so inefficient). But high fidelity? They wouldn't know the meaning of the word. And as for the Japanese, they were good at churning out zillions of lightweight and reasonably priced boxes, with lots of impressive knobs and acceptable 'middle of the road' performance for undiscerning consumers — but again, not *true* high fidelity. Not performance that would convince a true British purist!

Or so the British have believed — a comforting belief happily fostered by the somewhat quirky British hifi magazines, over the decades, no doubt to show their support for local advertisers. And the funny thing is that they've somehow also managed to convince many of the world's other hifi enthusiasts, as well. So much so that if a hifi product does well in the UK, the odds are that it will also do well in

the US, Australia, New Zealand and so on. If the British like it, it must be truly hifi...

In other words, Britain has somehow managed to establish itself as the world arbiter of true hifi. And the fact is that in recent years, the winds of change have been blowing in the British conception of a hifi amplifier.

There's been a trend away from tone controls, loudness controls and fancy filtering, and towards a 'minimalist' philosophy: an amplifier with an almost spartan lack of controls, but instead with even greater emphasis on achieving the highest possible performance in terms of low distortion, minimal noise, high stability and freedom from transient 'nasties'. In short, on pure hifi reproduction rather than a lot of fancy frills.

Now there's nothing wrong with this philosophy, of course. It makes a lot of sense, particularly if you're aiming at producing amplifiers to sell at a competitive price. Every 'frill' on the front tends to cost money, which in terms of performance could often be spent better on the 'works' inside.

Inevitably many of the filtering circuits used for tone control and other kinds of signal 'doctoring' also introduce various kinds of distortion and noise, too — so leaving them out can often provide a worthwhile improvement in terms of basic performance. In any case, the widespread adoption of FM stereo transmissions and CD's as the main source of signals means that the need for tone controls and filters has almost disappeared, for many users.

Of course until now, most Japanese manufacturers have chosen not to offer this kind of 'minimalist' amplifier. Presumably this was because they wanted to see if the world's other markets would follow the British trend in this direction. Perhaps the Americans' traditional love of fancy features and facilities would survive the British 'no frills' movement, with other markets going for the familiar 'lots of knobs and switches' amplifiers as well.

But a couple of years ago, it apparently became clear to firms like Pioneer that the British influence was still strong, and the minimalist trend was spreading. So they began working on their own designs, and amplifiers like the new A-400 and its smaller brother the A-300 are the result.

Bearing in mind the influence of the British, there was only one logical place to release them first. If the Brits accepted them, even grudgingly, the odds are that they'd do well everywhere else.

Well, they were released in the UK late last year, and the Brits did indeed accept them. Not only had Pioneer obviously designed the new amps especially to suit 'the discerning British ear', but it had gone to considerable lengths to produce them according to the true minimalist philosophy — and achieve the appropriate results.

There have been various articles in the UK hifi magazines comparing the new amps with traditional British 'true hifi' amplifiers, and generally concluding that they compared extremely well. In fact there was even a faint whiff of panic in some of the reviews, based on the fact that the A-400 and A-300 offered performance that compared very favourably with British amps costing considerably more.

Anyway, the overall reaction was so good that Pioneer has obviously been encouraged to release the new amps in other countries, including Australia. And that somewhat long-winded preamble hopefully gives you a good idea of the story behind their release.

What you get

At a distance, the A-400 may look superficially like many of Pioneer's other models. But when you get closer, the differences soon emerge. Apart from anything else, there's now only three main controls on the front panel: a large volume control and two signal selector knobs, one to select the listening source and the other for the recording source.

Apart from these there are only a push-on/push-off power switch, with its own tiny LED indicator, a headphone socket — and a tiny button used to switch in the 'moving coil' phono preamp, just to the right of the volume control. This latter button could easily have been on the back panel, of course, as you'd normally only set it once to suit your cartridge, and then forget it; but Pioneer has for some reason chosen to bring it out to the front.But apart from that tiny lapse, the front panel is very clean and uncluttered.

There are no tone controls, no fancy filters and no plethora of secondary controls or function buttons. The only slight complication is that the volume control is really two separate controls, ganged together by a friction coupling between split front-and-back knobs, so you can make minor relative balance adjustments should this be needed.

Things are also quite straightforward at the back, too. There's the usual twin row of RCA connectors for the various inputs and recording outputs, labelled here Phono, Tuner, CD, DAT/Tape 1, Tape 2 and Line. The only other noteworthy point is that the connectors are all *tin plated*, rather than the recently fashionable gold.

Further along at the centre of the rear are the four speaker terminals — in this case sturdy 4mm screw terminals, rather than the usual somewhat lighter spring-type connectors. Not perhaps a major point, but one that impressed the British mags considerably.

And finally there's the mains power input. Here the interesting aspect is that unlike most other amps from Pioneer and other Japanese makers, the A-400 is fitted with a genuine three-conductor mains cord and three-pin plug.

Gone is the familiar but specious double insulation; this amp is intended to be earthed, and in fact there's a warning label pointing out that it *must* be earthed.

It's clearly designed to conform to the established hifi tradition of single-point earthing (oh frabjous joy!), not only as far as the complete system is concerned, but internally as well — as you discover if you open up the case.

When you do this, you also discover why the A-400 seems a little heavier than you expected, with a weight of

The rear of the amp looks much the same as many others. But note the screw terminals for the speaker connections and the three-wire mains cord — this amplifier is earthed, as all of them ought to be.

8.0kg. The main contribution to the extra weight is a very husky power transformer, measuring about 100 x 110 x 90mm, and with a 52mm lamination stack.

It's of the conventional E-I lam type, rather than the toroidal type favoured by the most fanatical purists, but it's big, and also provided with a stout copper wrap-around strap to short out leakage flux.

The core is also insulated from the amp's chassis, to prevent any possibility of eddy currents straying and inducing hum into the PCB.

Other nice features inside the case are the use of a single large PCB, for virtually all primary signal processing; slider switches for input and record signal selection, mounted on the PCB back near the input connectors to keep signal paths short, and actuated from the front-panel controls via flexible 'cables'; a separate small PCB for the mains wiring, kept well away from the signal PCB; liberal use of copper-plated PK assembly screws, for good conductive bonding coupled with vibration damping; and a large hexagon-cellular heat-sink for the power transistors, mounted vertically in the centre of the case over a perforated ventilation grill punched in the bottom.

Needless to say the main chassis, although formed from only 1mm sheet steel, is strengthened by being embossed with Pioneer's favourite hexagonal-pattern presswork. Even the plastic feet underneath are provided with internal hexagon-cellular reinforcing.

The only thing we really didn't like inside the case was the lack of any kind of protective covering, over the power transformer's 240V primary terminations (which are on the top, in this case).

These are usually covered with a flap of 'elephant hide' fibre sheet, or similar, to ensure that a service tech's hand can't accidentally come to rest on them. It would be nice if the A-400 conformed to this rule, which is written into many safety regulations.

On the electrical side, Pioneer doesn't provide a circuit schematic so it isn't easy to discover too much about the fine details.

However the accompanying brochure explains that along with the features noted above, the A-400 and A-300 both incorporate a special 'Super Linear Circuit' (SLC) output stage. This uses a complementary pair of output devices, connected in an unusual configuration with current mirroring, which is designed to make them cancel out each other's nonlinearities.

As a result, the output stages are said to have very low inherent distortion, requiring much less than the usual amount of overall loop negative feedback. This in turn gives the output amps very high stability, and also improves high frequency response by obviating the need for phase compensation.

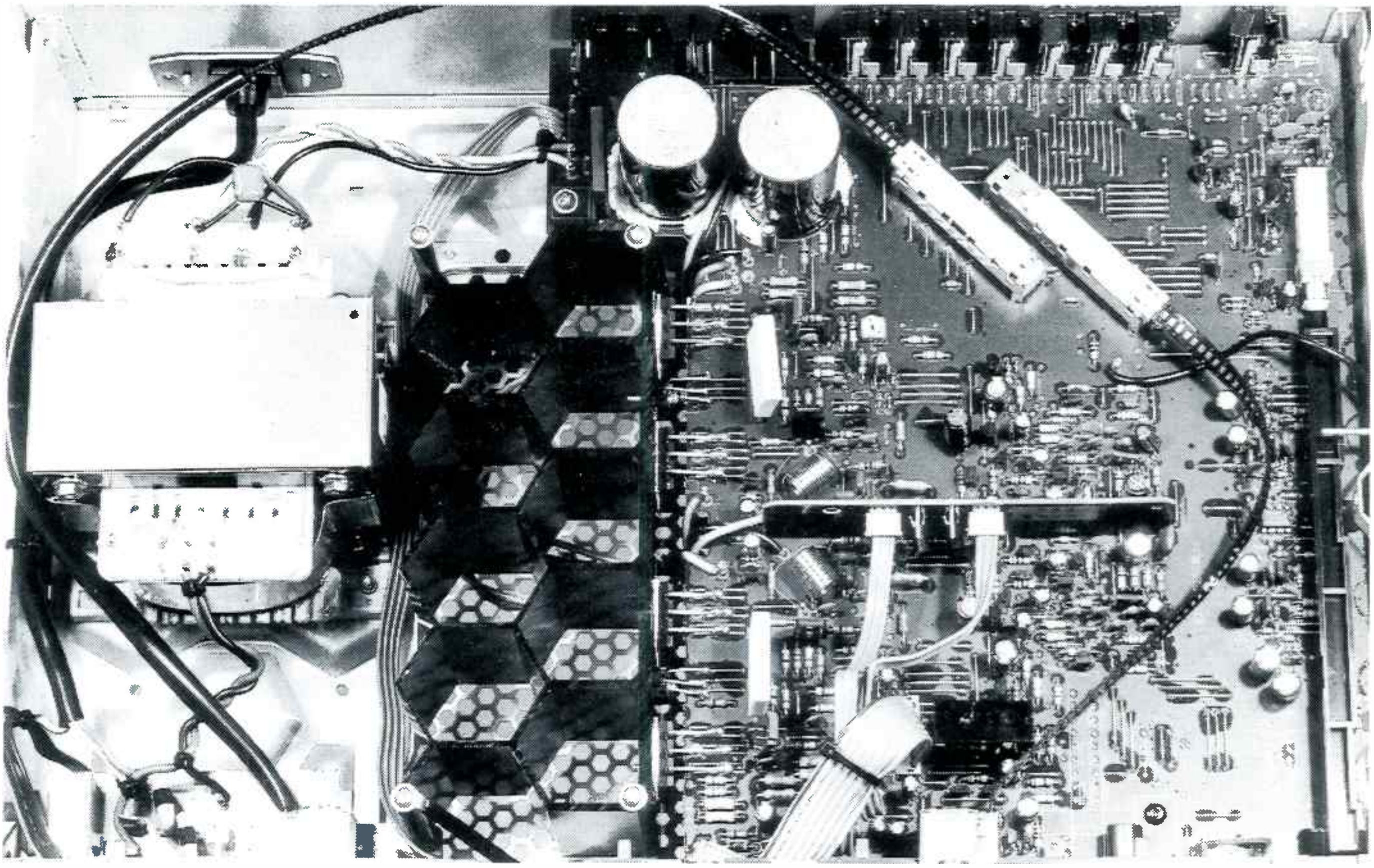
The output stages apparently also require relatively low drive power, allowing the use of a higher impedance predriver and lowering noise.

How it performed

On test in the *EA* lab, the sample A-400 gave a very good account of itself — although in a couple of minor areas, we couldn't quite match the quoted specs.

The continuous power output before clipping measured 58W per channel into 8-ohm loads and 80W per channel into 4-ohm loads, both figures being comfortably over the specs.

The THD at 50W output into 8 ohms



Inside the amp. Note the husky power transformer on the left, complete with copper shielding strap, and the single main PC board with the two input selector switches near the rear and operated remotely from the front controls.

was 0.028%, just under the rated 0.03%, while that for 70W output into 4 ohms was 0.08%, a little higher than the rated 0.05% but only marginally so.

On the other hand our measurements for IHF 'music power' output gave figures of 60W/80W/110W into 8/4/2 ohm loads respectively, again with both channels driven. That is, the 8-ohm and 4-ohm figures were basically almost identical to the continuous figures, whereas Pioneer's quoted 'dynamic power output' figures are rather higher: 70W/100W/135W, measured with the EIA dynamic test signal. This was with a mains voltage of 243V.

These differences are not particularly important, of course. The main thing that one can conclude is that the A-400's power supply is very well regulated, and allows the amp to cope well with all likely transient current requirements and dips in speaker impedance curves — apart from having sufficient continuous output rating to cope with most reasonably efficient speaker systems.

No doubt this is due to that husky power transformer, and the pair of sturdy 10,000uF/50V reservoir caps.

Measured channel separation for 50W output into 8-ohm loads was -77dB at 1kHz and -58dB at 10kHz, measured with a shielded 1k resistor used to terminate the input of the measured channel. These figures are fine, and probably difficult to better without going to separate power supplies.

The frequency response measured within 0.3dB from 20Hz to 20kHz for the phono inputs (both MM and MC positions), according to spec, while that for the CD, tuner and other 'line level' inputs measured from 3Hz to 100kHz within 3dB — slightly better than the spec, at the bottom end.

Here it was interesting to note that the top-end response rolled off quite slowly and smoothly, being only only 0.5dB down at 35kHz — confirming Pioneer's claim that its SLC output stages require less loop feedback and hence less phase compensation and high-end rolloff.

Perhaps this is a bit academic, but the purists do claim that a smoothly extended response gives 'sweeter' treble...

Our measured signal to noise ratio figures for the line level inputs were -99dB for the volume control at minimum, -97dB for maximum volume setting and -90dB for a typical '12 o'clock' middle setting. Similarly we got figures of -88dB and -76dB for the MM and MC phono inputs respectively (volume control at 12 o'clock), with shielded 1k input termination resistors.

All of these figures are taken against the input level to produce rated output of 50W RMS into 8-ohm loads, incidentally.

While the S/N figures for the line level inputs are not as good as Pioneer's quoted figure of -108dB, in practice the difference is rather academic. The figures for MM and MC phono input are actually better than spec, so that vinyl disc enthusiasts should be particularly happy.

The measured input sensitivity for full rated output turned out to be 145mV for the line inputs, 2.5mV for the phono inputs in MM mode and 230uV in MC mode. These are all very close to spec, while the overload levels for the phono inputs were again very close to spec at 160mV and 13mV respectively. The RIAA equalisation was within 0.4dB over the 20Hz - 20kHz range, but didn't implement the proposed IEC bass rolloff.

In short, then, the A-400 gave a very nice set of measurements. Accordingly we tried it out for a few weeks in a typical home listening environment, coupled to two different pairs of good quality enclosures and fed with a range of reference signals from high grade CDs, as well as others from a good FM stereo tuner.

Here again the results were very impressive. With virtually every kind of programme material the reproduction was particularly clean, with no edginess or other colouration apparent even after extended listening. In fact it struck us as an exceptionally docile amp — not in the performance sense, because it certainly delivers full and satisfying sound over the full audio spectrum — but more in the sense that it is essentially 'transparent', doing its job with no fuss of any kind.

It's a very nice amplifier, in other words, and one which seems to satisfy the minimalist/purist criteria very well indeed. No wonder the British mags were impressed!

And the price for the Pioneer A-400 is a very reasonable $599. So if you're happy to forego tone controls and other largely redundant frills to get purely an amp that provides this very impressive order of performance, and at a good price, it should undoubtedly be high on your list.

The A-400 and its smaller brother the A-300 should be available from Pioneer dealers Australia wide.

However if you need further information, including details of your nearest dealer, Pioneer has an information hotline on (008) 338 439. ■

HOW SONY MADE ITS TR-55 HANDYCAM

When Sony released its 'smallest ever' TR-55 Video 8 camcorder in early 1990, it was an impressive *fait accomplis*. As with most of Japan's high tech products, little was said about its development — all we could do was respect the achievement. But here's a glimpse of the effort and interactions that had taken place within the company, in developing 'Project GoGo'.

by BARRIE SMITH

When it was announced early this year that Columbia Records' name would be changed to Sony Records, it was apparent that the world of consumer electronics as we have known it, since AG Bell made the first phone call in 1876, was about to change — or already had changed — irrevocably.

But the change has been going on for decades; ever since the USA restructured post-WW2 Japanese society, and allowed its business fraternities to effect a self-restoration.

Now, after little more than 40 years, the world is submerged beneath a sea of this industrious country's products — cars, video camcorders, cassette players, CD units, etc.

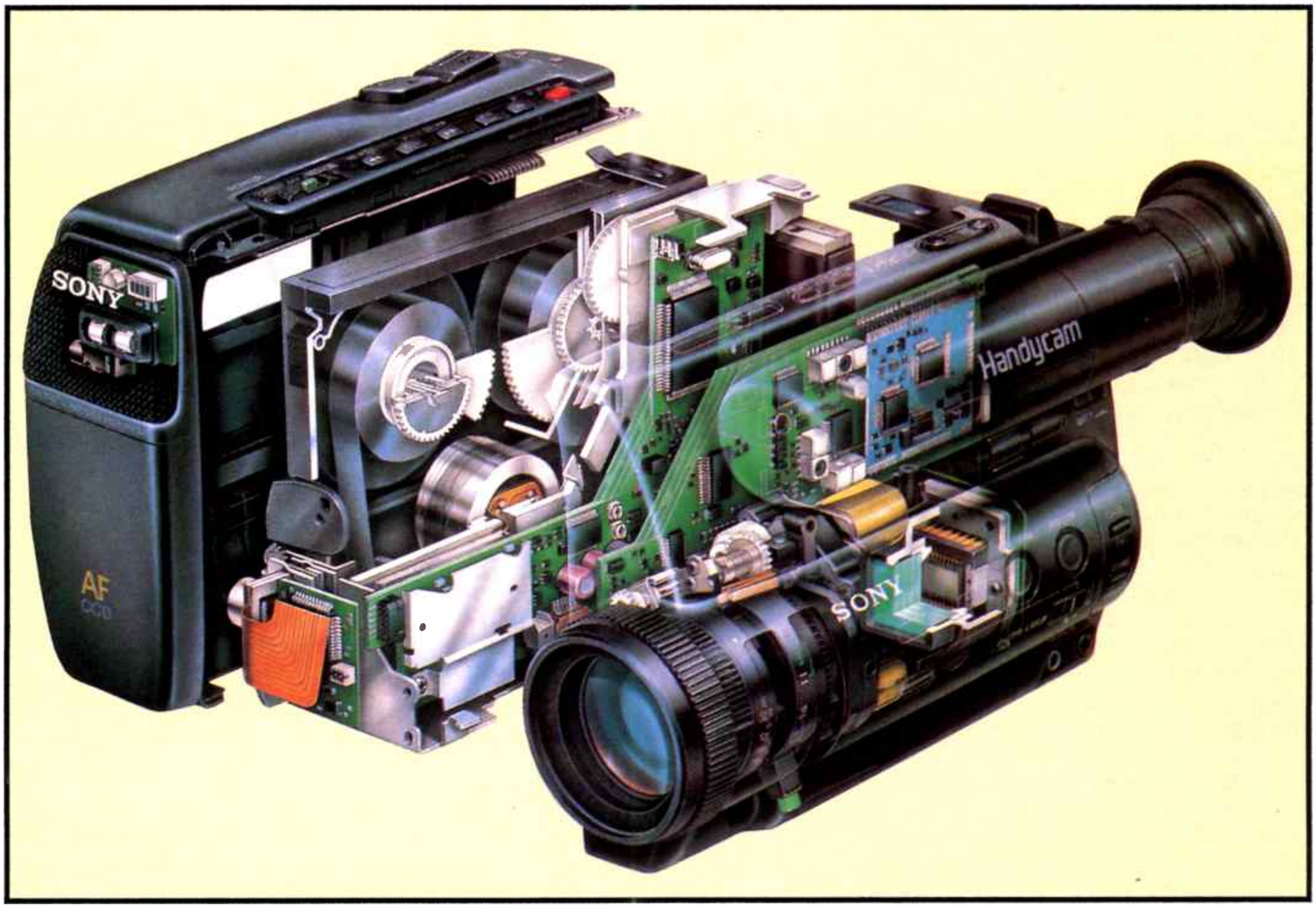
The products may be ubiquitous, but few know much more about these products than the logo denotes, or the advertising asserts.

In contrast, most of us can boast a little knowledge of the beginnings, achievements and modus operandi of most Western electronic companies — Philips, Siemens, RCA, etc. But how many can relate any profile or history of the major Japanese companies?

One which has come out of the closet, so to speak, is Sony.

'Upstart' firm

Major Japanese companies like Mitsui and Mitsubishi have been around for a century or so. Even Matsushita can trace its lineage back to 1918. But sedate Japanese business circles still consider Sony Corporation an



This photo shows just how small the TR-55 Handycam really is. The miniaturisation was the result of a management demand to shrink the internals to 75% of the previous model.

'upstart', rising from the ruins of a crushed society only in 1946.

Beginning with capital of only $500, two young engineers founded a company called Tokyo Tsushin Kogyo, and started operations in a run-down building on the city's southern edge.

Masaru Ibuka was already a businessman with excellent connections; Akio Morita was the eldest son of a prosperous sake brewing family.

The first product was a heating pad, consignments of which the two delivered with a $100 Datsun pickup. But the pair had their eyes on export, and on producing products a little more esoteric than footwarmers.

By 1950 the company had produced a bulky and expensive tape recorder. The name Sony had appeared (from American 'sonny boy' and the Latin *sonus*, meaning 'sound'), which gave it a more marketable image.

However, the company still suffered from the Western perception, particularly in the US, that Japanese products consisted of little more than clockwork toys and pocket lighters.

What changed this — at least for Sony — was the company's purchase in 1954 of the rights to a Bell Laboratories' patent for a compact new electronic device: the transistor. Using this technology, in 1955 Sony produced Japan's first tubeless radio.

By 1957, Sony engineers used the transistor and innovative miniaturisation techniques to make the world's smallest transistor radio. Ever with an eye on marketing ploys, the small receiver was claimed to be 'pocketable' — although Sony never did say which pocket! Being bigger than a man's standard shirt pocket, the sales force wore specially tailored shirts with pockets slightly larger than normal. The radio was a hit.

1968 saw the 'Trinitron' colour TV set emerge, capable of displaying a brighter, sharper and more accurately hued image than any previous product. Even today, in both video and computer monitors the Trinitron is arguably a world standard.

Then in 1979 the first 'Walkman' cassette player appeared. So far 60 million have been sold worldwide.

The Handycam project

This writer has never been over-impressed with the public relations' outpourings of Japanese consumer electronics companies.

When a new product is launched, much of the waffle that appears centres around the product, its features and technological wizardry within. But little is ever heard of the actual human content, nor the conflict and commitment that are expected and fundamental to any successful pioneering and technologically advanced project.

Much of this anonymity is due to the Japanese regard for the team effort, and the submersion of the individual's role in almost every activity.

However, behind-the-scene details have appeared of Sony's Handycam video camcorder project, showing that the inter-personal engagements that ensued in the development of the miniature machine were little different to those found in any corporation — Asian or Western.

The company had once before been thrashed by its competitors, in the battle for a world standard domestic VCR format. Betamax, still felt by many to be the technically superior standard, lost the war with JVC's VHS — mainly due to the opposition's promotional muscle power.

When the marketing battlefield of camcorders appeared to be a likely new zone for another combat, Sony was not loathe to engage.

By the mid '80s many world markets seemed to be showing a preference for VHS and the smaller VHS-C cassette machines — but the camcorders themselves still carried an unappealing bulk.

Sony could see the hand about to write on the wall — again. Its Video 8 camcorders were attractively contoured machines, but offered no major selling points over the VHS camp, and were not much smaller.

Management decided a major change in the company's product line was needed. The order to 'shrink' their camcorders was handed down — regardless of the cost.

Art director's role

Yuji Morimya is in his early thirties. It was he who drew the first sketches of the new Handycam, intended to replace the company's somewhat overweight current products. But his designs met a wall — the engineers said they were impossible to work from, impossible to bring to the production line.

But, being a company enthused with a mid-20th century aggression possessing almost messianic overtones, Sony propelled the project ahead with massive doses of development capital and technical resources — it was prepared to forego immediate profits for a marketing edge 'down the track'.

And the track was a surprisingly short one, that startled the rest of the industry.

Today, well over a million Handycam machines have been sold worldwide, and a host of clones have

appeared from other manufacturers — in both Video 8 and VHS-C formats.

'Handycam' is now in danger of becoming a generic word, as much as 'Walkman' became, and industry identities predict the small palm-sized camcorder as being the biggest area of growth in the next 10 years.

1986 beginning

But I'm jumping the gun. Sony's market research had shown that the existing camcorders — including their own — carried the stigma of being bulky, clumsy, hard to balance and too heavy to lug around on holidays. Virtually the only people using them were new parents, eager to capture their progeny's initial gurgles — and almost no one else.

Cue Sony's senior manager, Minoru Morio. It was his task to carry out the order from top management, to reduce the size of the company's video making product.

The other figure in the story was Takahasi Kono, Sony general manager and the project's chief engineer. Kono was given the directive by Morio to miniaturise the Video 8 line to a smaller, handier product — yet still retain the quality and performance level of the existing larger machines. A stir in the market place was the obvious aim.

Kono at first refused to consider the proposition as a practical one. The executive demand was for a reduction in size of 75% — that is, to a quarter of the existing product size. Kono felt that a lowering in bulk to 50% was possible — but not down to a quarter. And not within the given time frame of 18 months!

But the company was well-known in the industry for its ability to shrink product — its audio line being the best known example of determined miniaturisation.

Towards the end of 1986, project 55 or 'Go-Go' was begun ('5' is pronounced 'go' in Japanese). Kono set his target date for the eight day of the eighth month of the year 1988 — '8' is a fortuitous number for the Japanese.

The task was to shrink every part in the current camcorder — a total of 2,200 parts — to at least a half, or a quarter their current size. Not only that, but the engineers had to develop a new tape transport and drive, to handle the Video 8 cassette.

Mr Takahasi Kono, Sony General Manager and the chief engineer of the Handycam TR55 project.

Longer tape wrap

Helical scan heads, as used in all consumer video products, have the unfortunate characteristic that they occupy an inordinate amount of space compared to their prime bulk. This is out of proportion to the task they perform — to record on tape in a small, rectilinear cassette.

One way to reduce the size of the drive and head assembly was to increase the tape wrap. Previous Video 8 machines had employed a wrap of 190° around the drum; project 55 steered for a smaller drum, calling for a 292° wrap. Result: same tape length in contact with the head assembly, but a smaller diameter drum. This gave a weight saving of 60%.

Mr Yuji Morimya, art director and designer of the Handycam TR55.

The loading mechanism was also changed to a flat design, and slimmed to a mere 5mm. Weight saving — 40%.

Size and weight were further lowered by using a four-layer PCB scheme, thus doubling the ICs' mounting density by a factor of two.

The mechanical components were packed tighter, so reducing further the drive and transport areas. Sony sourced the parts for the project not only from its own plants, but also from over a hundred other suppliers. All arrangements were conducted tightly and under strict security.

Art director Morimya began work with only a simple sketch and the technical specifications given him by the engineers.

Taking three months, he poured the specs into an IBM computer, which gave him an output of possible configurations and layouts for the new machine. Then, after penning more hand drawings, he built a model out of plastic foam and showed it to the project engineers.

They were less than impressed. Its appearance, they agreed, was attractive. But it was too small — and would run the risk of an internal 'melt-down' from the heat of the densely-packed circuitry.

But Kono, the engineer, supported the design approach. However, fundamental problems still prevailed. Normally, Sony product development sees 95% of the parts in final design stages when the overall design is set.

But the Handycam project had only 65% of the parts completed — with only eight months left on the schedule.

One component that was so far behind schedule that it was still at the development stage was the small microphone — designed around a pair of horizontally-opposed, omni-directional condensers; the arrangement was chosen to produce clearer audio pickup, and at the same time reduce wind noise.

This item was so important that its failure would cause a virtual closure of the entire project.

At the same time, a major dispute arose between the designer and the engineers about the placement of the cassette well.

Morimya wanted it on the right, under the cover flap, and the user's hand. The engineers felt the arrangement was awkward, and that the cover piece added weight.

The matter was only settled by the

team leader carrying the camcorder around with him for a week, almost living and sleeping with it for 24 hours. The tape well stayed where it was intended.

Aware that the new camcorder could create a whole new raft of competition, Sony decided to redesign the lens to make it more compact, thus reducing the fore-to-aft length of the unit, and gave the CCD a low light sensitivity of 5 lux — when figures of 7 and 10 lux were the norm.

All servo systems of the 55's deck section were set to be controlled by a single, high-performance 8-bit microprocessor, permitting higher integration and a faster processing speed. Size reduction was the aim, but picture quality was expected to rise with it.

By June, 1988 the mike was working. A factory was selected near Nagoya for the Handycam's assembly — but the deadline of 8-8-88 was soon to pass.

Despite this Kono moved to Nagoya to set up manufacture, using a robot assembly line; in the meantime a massive advertising campaign had begun, based on the '55 — Go-Go' theme.

And the model name — TR55 — stuck. Coincidentally, TR-55 is the same model number as Sony's first transistor radio — 30 years earlier.

Second wave

By November, 1990 the second wave of Handycams arrived on the Australian market. There are now two models:

TR-45 with 1/3" CCD — 291,000 pixels (effective). The video recording system uses four rotary heads, helical scanning. Audio uses a rotary head in FM mono. The lens is a two speed power zoom: 6x — 7-42mm, F/2.

TR75 Video 8 Camcorder, similar to the TR-45, except for a 470,000 pixel CCD sensor and a zoom lens of eight times: from 8.5-68mm, F/2.

Industry comments on the new models have been less than complimentary: many say the company should have waited for a longer period after the introduction of such an initial ground-breaking design as the TR-55 Handycam.

Perhaps this envious response is to be expected. Not only has the Handycam become an appealing new product, but created a whole new branch of the camcorder tree for all manufacturers to climb. And Sony appears to have galloped ahead of the VHS-C competition — at last. ■

Scientific Odyssey To The Solar Poles:

THE TORTUOUS JOURNEY OF A MODERN ULYSSES

After a long and wearying struggle to be launched, a small spacecraft is now making its way through the millions of lonely kilometres between the planet Jupiter and our nearest star — the Sun. When it reaches its destination in another three years, it should provide a wealth of scientific information on the Sun and its emissions.

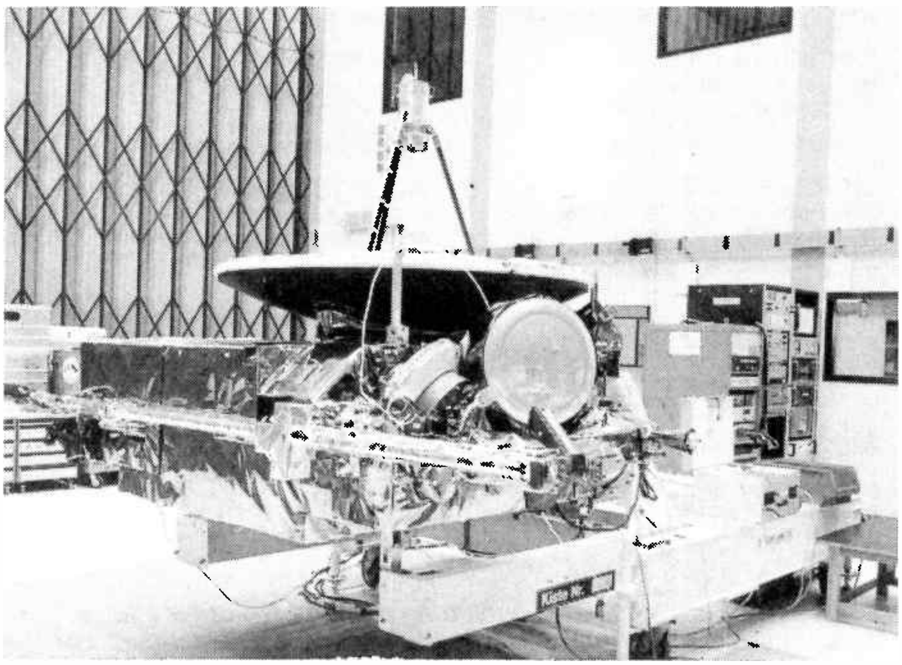
by KATE DOOLAN

In Dante's masterpiece Inferno, Ulysses is the hero of a voyage that takes him beyond Gilbraltar, which at that time was a journey beyond the perimeters of the known world. In October 1990, another Ulysses set out on a rather longer journey to the unknown.

The modern Ulysses will be travelling to the Sun, via Jupiter, to study the solar polar regions, which are still largely unknown to scientists.

The modern Ulysses, like its counterpart of old has led an equally tortuous journey to reach its goal of being launched into space for the start of its real journey.

Originally conceived in the late seventies by both the US National Space and Aeronautics Administration (NASA) and the European Space Agency (ESA), the 'Out of Ecliptic' as it was then known was to be a twin spacecraft that would fly over the solar south pole, pass through the ecliptic and then fly over the solar north pole. The other spacecraft would fly in the opposite direction and give scientists a stereoscopic view of the Sun.



Ulysses spacecraft was assembled at the European Space Agency, where it is shown here undergoing final testing.

In 1979, the project was renamed 'The International Solar Polar Mission' (ISPM) which NASA felt was more indicative of the scientific goals of the project. In 1980, however, the ISPM suffered a major setback when NASA announced that due to difficulties with the first flight of the Space Shuttle, the ISPM would be delayed until 1985 at the earliest.

The next year saw a larger shock to the ISPM team, which had an even greater impact than the decision of the year before. Citing financial difficulties, NASA cancelled their spacecraft. This led to the loss of several experiments, as well as damaging relations with the European Space Agency — which were already troubled by delays to the shuttle and ESA projects. It was also at this time that the launch was again delayed: this time to May 1986.

In 1984, the project was again renamed. This time it was christened 'Ulysses', which became its permanent name.

In 1986, the spacecraft was transported from Europe to the Kennedy Space Centre in Florida for further testing and in preparation for its integration into the shuttle *Challenger* — once this had flown Mission 51L in late January.

Again Ulysses was delayed, after the *Challenger* explosion on 28 January 1986. At first, it was thought that it could still be launched in May of that year, but as investigations on

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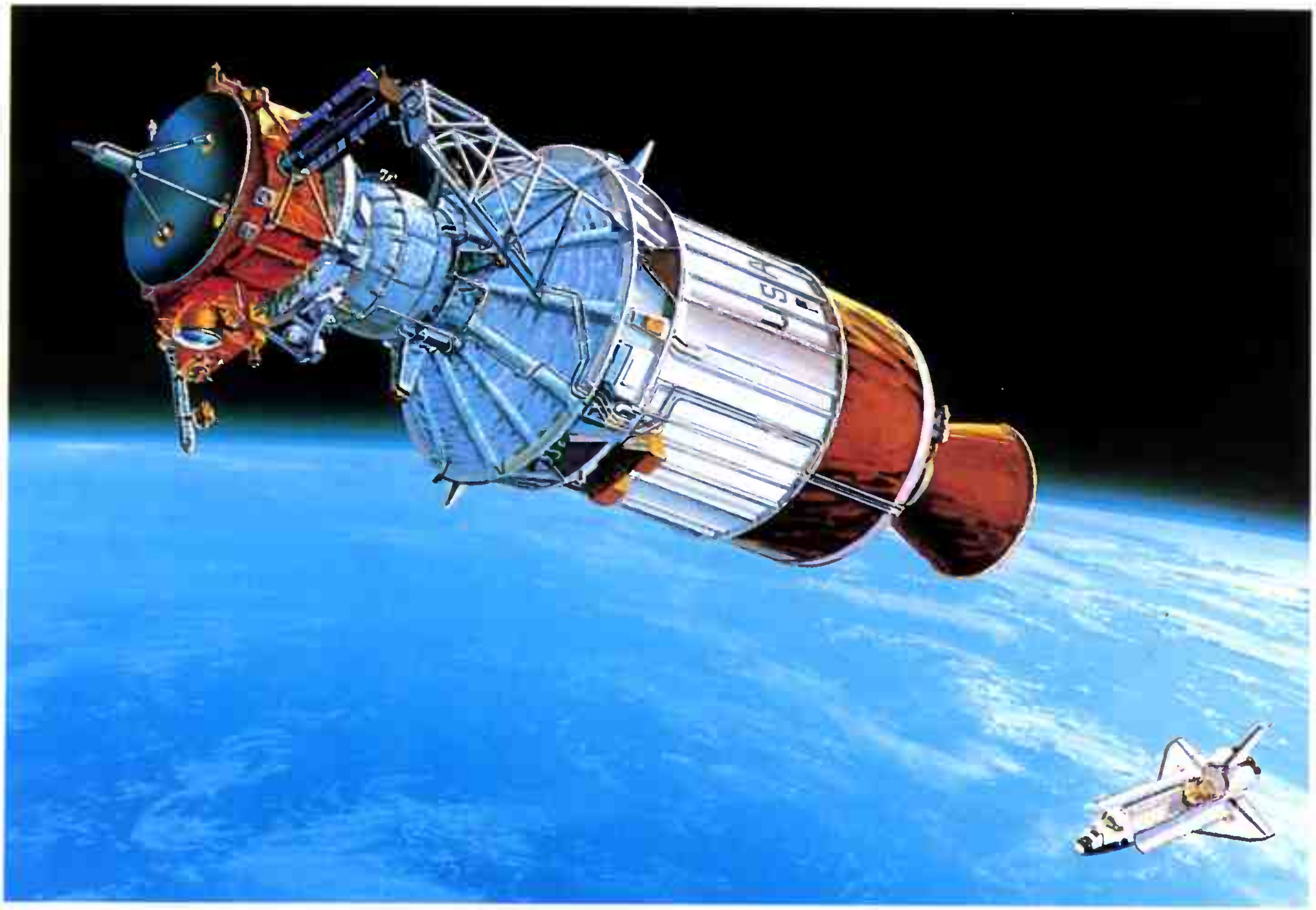


Challenger progressed, it became clear that the shuttle would be grounded for at least two years.

Ulysses was returned to storage in Europe, whilst several important decisions were made about its future. Launch would now take place in October 1990 and instead of Ulysses being powered by the liquid-fuelled upper stage Centaur, it would be using the weaker (and safer) Intertial Upper Stage.

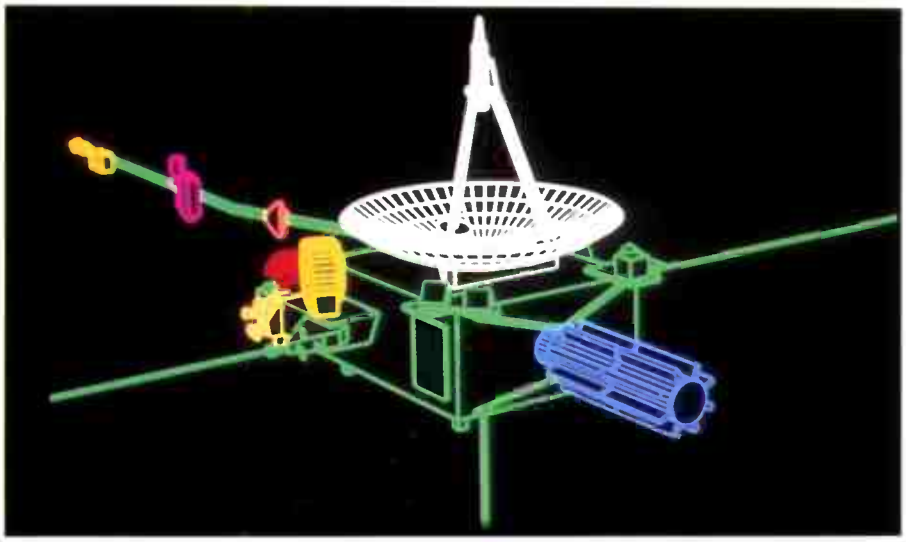
Modest size

The Ulysses spacecraft comprises a main spacecraft bus measuring 3.2 metres in length, 3.3 metres in width and 2.1 metres in height. Weighing in at a light 370 kilograms, Ulysses is one of the lightest payloads ever launched by the Space Shuttle.

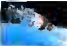
After being deployed by the shuttle, the spacecraft will deploy a 5.6 metre radial magnetometer boom which carries several experimental sensors. A 72.5 metre radial dipole antenna and a 7.5 metre axial monopole will also be deployed, both of which will serve as antennas for the radio wave plasma experiment.

The main computer on the spacecraft is the onboard data handling system. This system is responsible for processing commands received from ground controllers, as well as the managing and supply of all data received from each of the spacecraft's scientific instruments. The system also includes a decoder unit, which will process the incoming signals from the spacecraft's radio and it will then pass commands to the other systems.

Remote units will handle input and output to and from the spacecraft's systems and the data storage unit, which comprises two tape recorders. Each of the recorders can store 45.8 million bits of data, which represents



A CAD representation of the Ulysses spacecraft in flight configuration, with its antennas deployed.



Ulysses

from 16 to 64 hours of data taking, depending on how data is sampled.

The attitude and orbit control system is responsible for determining 'Ulysses' attitude in space, as well as firing thrusters to control the attitude and spin rate of the spacecraft.

The system includes a redundant computer, sun sensors and the Reaction Control System, which has eight thrusters and 35 kilograms of monopropellant hydrazine fuel, stored in a single diaphragm tank mounted on the spacecraft's spin axis.

Ulysses' power source is the Radioisotope Thermoelectrical Generator (RTG), which is similar to those used on *Voyager* and *Galileo*, as well as other solar system exploration missions.

RTG's are required for these missions as solar arrays would be too large and too heavy to launch by any available rocket. In the RTG, heat is produced by the decay of Plutonium-238, which is then converted into electricity by thermocouples.

Ulysses' communication systems include two S-band receivers, two five watt S-band transmitters, two 20 watt X-band transmitters, two small low gain antennas and the high gain antenna.

The high gain antenna is used to transmit in either the S or X band as well as receive in the S band. The low gain antennas are used to both receive and transmit in the S band.

The spacecraft receives commands from Earth on a frequency of 2111.607MHz in the S band. Ulysses can transmit to Earth on 2293.148MHz in the S band or 8408.209MHz in the X band.

Tracking and data acquisition for the Ulysses mission will be provided by NASA's Deep Space Network (DSN).

The DSN has complexes in California, Spain and Australia, which are spaced 120° apart in longitude around the Earth. So as the Earth rotates, a given spacecraft will always be in view of one of the DSN stations.

During most of Ulysses' mission, the DSN will be in contact eight hours a day. The spacecraft will record all of its engineering and scientific data during the 16 hours it is out of contact. During the eight hours of contact, the spacecraft will transmit the stored data from its on-board tape recorders.

Plans call for a 30 metre antenna to be used to transmit and receive from Ulysses. To conserve antenna coverage during busy periods at the DSN, Ulysses' ground controllers can call on the 70 metre dish antenna to communicate with the spacecraft.

The larger antennas permit a higher data rate. Data received from Ulysses is transmitted to the Jet Propulsion Laboratory in Pasadena, California by a combination of satellites, ground microwave links and land lines.

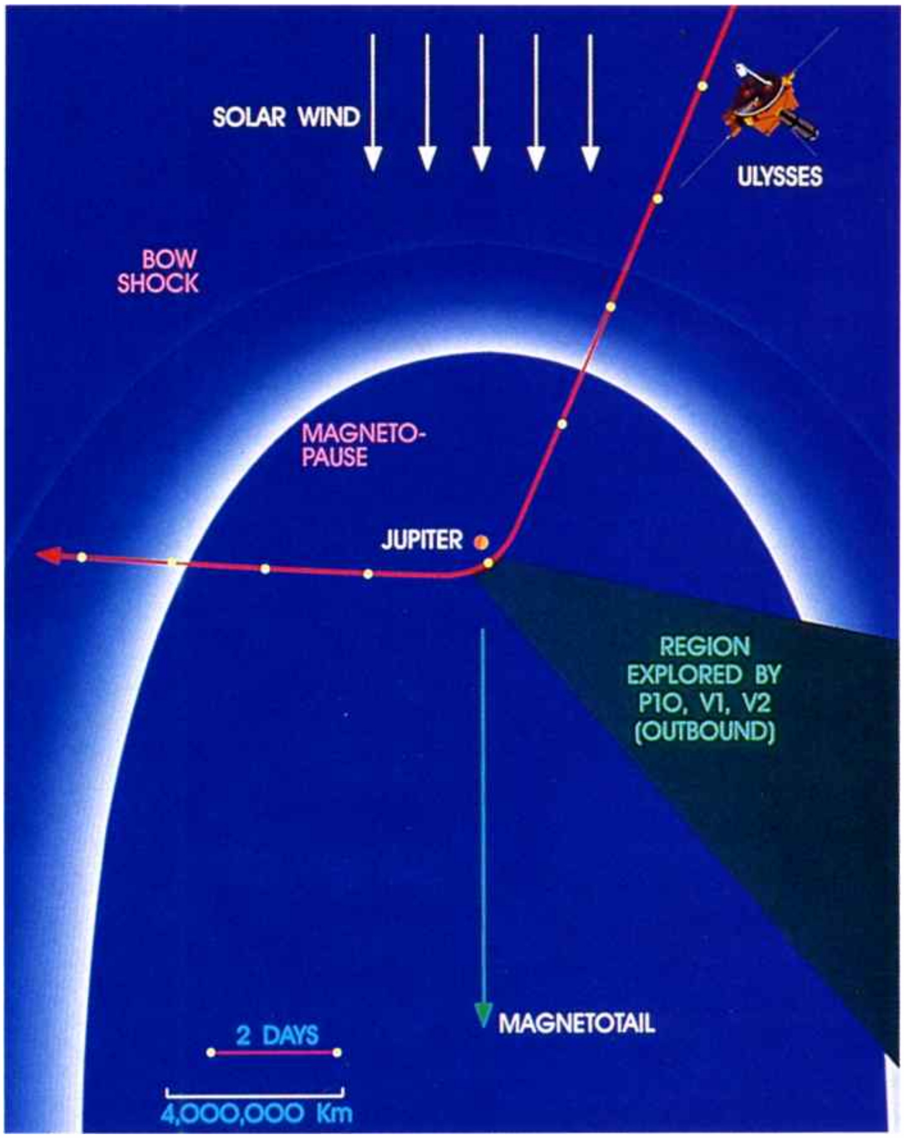
Scientific payload

Ulysses' scientific payload comprises nine instruments. The spacecraft's radio will also be used to conduct experiments. The experiments concentrate on all areas of solar science and are expected to increase our knowledge of Earth's nearest star.

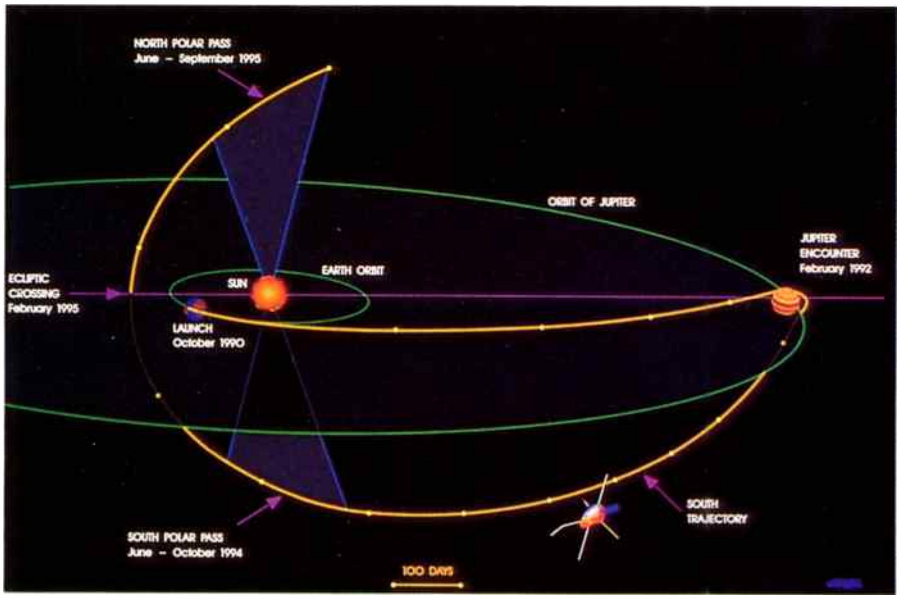
The main areas of study will include the Sun itself, its magnetic fields and the streams of particles generated by the Sun — better known as 'Solar Wind'. Another area of study will be interstellar space below and above the Sun.

The Magnetic Fields experiment will investigate the strength and direction of the Sun's polar magnetic fields — about which very little is known, as they are too difficult to observe from Earth. The investigations will also try to determine the specific regions of the Sun's corona from where solar wind originates.

The Solar Wind Plasma experiment will investigate the strength and direc-



A close up representation of Ulysses' February 1992 'close encounter' with Jupiter. It passes within about five hundred thousand kilometres of the planet, in order to use its gravity as a slingshot.



A CAD representation showing the overall concept of the Ulysses mission and the details of its trajectory. After leaving Earth it journeys to within half a million kilometres of Jupiter, where it uses that planet's gravity field as a 'slingshot' to boost it out of the solar system's ecliptic, and into a solar polar trajectory. The dots represent 100-day intervals.

tion of solar wind, which comprises electrons and charged atoms.

The experiment will measure these ions and electronics for things such as speed, temperature and density.

The solar wind is expected to be different near the poles, and scientists hope it will be easier to make measurements in those areas rather than near the Sun's equator.

One familiar instrument that will be missing from the Ulysses spacecraft is a television or imaging camera, in contrast from that which was put to great use during the *Voyager* encounters. Being so close to the Sun would prove too difficult for any television or film camera: the Sun would easily prove too bright to take photographs!

Away at last!

The long awaited launch of STS41 took place on 6 October 1990, when the space shuttle *Discovery* launched from the Kennedy Space Centre. Before the flight, there were serious doubts that the launch would take place because of the nuclear power used in Ulysses.

Several environmental groups sued NASA for a permanent postponement of the flight, citing dangers to the environment should the shuttle explode and the RTG's sprinkle southern Florida with nuclear fallout.

After a court battle, the launch order was given by the same judge who made the ruling about a similar case the year before — that being for *Galileo*.

After the successful launch, *Discovery's* crew made up of Commander Dick Richards, Pilot Robert Cabana and mission specialists Tom Akers, Bruce Melnick and Bill Shepherd reached orbit and immediately began preparations to deploy Ulysses.

At the beginning of Discovery's fifth orbit and at an altitude of just over three hundred kilometres, Tom Akers flicked several switches and Ulysses was at last deployed from the shuttle's payload bay. One hour later, after Ulysses reached a safe distance from the orbiter, the two solid fuel motors of the Intertial Upper Stage and the Payload Assist Module fired sequentially, sending the spacecraft on a trajectory to the planet Jupiter. Ulysses' initial velocity of more than 70,000 kilometres per hour was the fastest departure ever achieved for any Earth built craft.

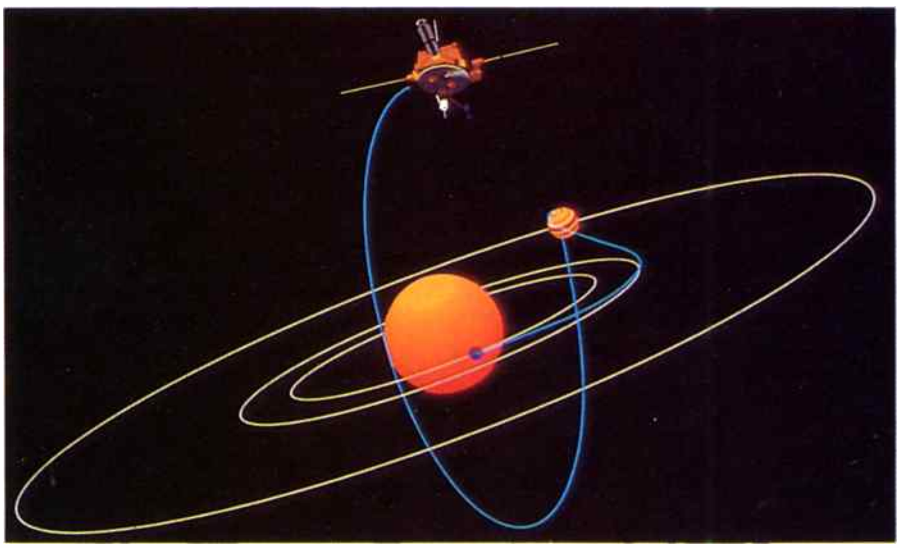
On arriving at Jupiter in February 1992, Ulysses is first to measure and make observations of the planet. These observations are expected to cast new light on Jupiter, as they will be made in areas of the planet that neither *Voyager* nor *Galileo* spacecraft visited.

Ulysses will then swing around the planet, and using the gravity of Jupiter will continue on a path that will eventually take it out of the ecliptic.

The lone explorer will make its first pass of the solar south pole in May 1994. At the end of Ulysses' first pass in October 1994, the spacecraft will then fly to the solar north pole, arriving there in May 1995. It will continue its mission until 30 September 1995, when the Ulysses mission is expected to end.

The Ulysses mission to the Sun, after its tortured journey from the drawing board to the end of its mission, will in the words of its ancient counterpart, be 'To Follow After Knowledge and Excellence', and give us a complete new view of our nearest star.

The author would like to thank Mary Hardin of the Jet Propulsion Laboratory, for her assistance in the completion of this article. ■



This CAD representation depicts the trajectory Ulysses will follow around the Sun, after leaving Jupiter's gravity field.

FORUM

Conducted by Jim Rowe

SuperPAL versus HD-MACzilla: take your seats for round 2, folks!

The subject of choosing the 'best' technical system for future satellite television broadcasting is obviously one that can arouse a surprising amount of interest — not to say passion, as I've discovered in the few weeks since the April issue was published. The response to that month's initial debate on the subject has been impressive, with letters, phone calls and faxes arriving from near and far...

Yes, I know I ended up last month's discussion with the suggestion that this month we might tackle the subject of problems with construction projects. But the response to the April column has been so lively that I'm forced to bow to reality. Obviously there's far greater interest in the great MAC vs. PAL debate, so without further ado let's get stuck into round two!

Almost as soon as the April issue went out, there was a letter from the reader who had triggered off the Forum debate in that issue: Mr Keith Walters, of Lane Cove in NSW. And as it was Mr Walters that gave us all the opportunity to discuss the subject, I guess we'd better give him the right of first reply. Here are the salient points from his latest letter:

Thank you for publishing my letter on the MAC system in the April issue. I didn't mean to frighten you. (Maybe you should have dug out Tony Rafty's old 'Let's Buy an Argument' cartoon to head Forum for this month!)

I would just like to clear up a few points. Firstly, your opening explanation contains a small error. In the seventh paragraph you said: 'Then the final 'to air' video signal is split back into its components...', etc.

This is incorrect. In normal TV broadcasting, the final composite video signal goes straight into the transmitter where it amplitude modulates the vision carrier directly. What you described is, in fact, what happens with the ABC and SBS MAC transmissions!

Regarding your comments re 'chaos': while your physical description of the current European broadcasting situation is reasonably accurate, I really don't see it being anywhere near as vexatious in operation as you seem to have imagined.

The important thing is, a PAL satellite feed can be taken from virtually anywhere in Europe to anywhere else in Europe, and then fed into the local TV network for transmission. While the actual transmission standards may vary as you say, the local population will surely be equipped with suitable receivers to match. Multi-standard sets are readily available, for viewers who wish to tune to transmissions from neighbouring countries using different standards.

A far bigger problem would have to be the different languages used!

Of course there's always the problem of Uncle Slodoban finding that the beaut set he's carted all the way back to the old country won't work when he gets there. But I hardly think that justifies overhauling the whole European broadcasting system. Better education would be more appropriate.

In any event, like so many of the other 'problems' associated with modern TV broadcasting, they could be solved just as effectively and far more cheaply without resorting to the MAC approach.

Next, regarding my comments about the misleading demonstrations of HDTV vs conventional systems: my point was that these demonstrations are intended purely to convince our broadcasting authorities (through us) that it would be worthwhile forcing our broadcasters (and us) to spend billions of dollars on upgrading to HDTV.

And I suppose if you compared a standard PAL (or NTSC) picture to that available from HDTV, you might — just might — be able to make a case to justify the enormous expense that would be involved (though I seriously doubt it).

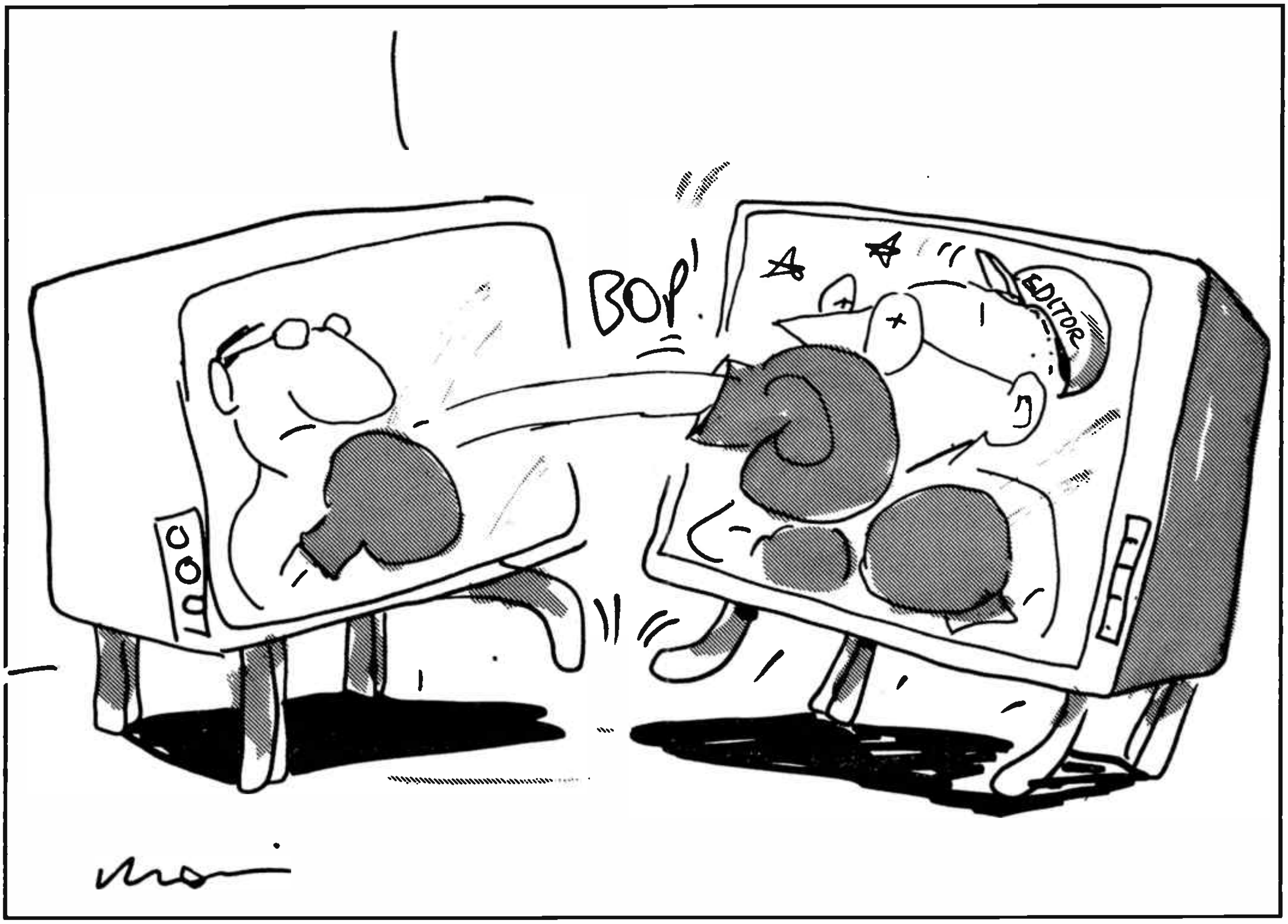
But if, instead, you did the comparison between HDTV and PAL (or NTSC) re-engineered to exploit its full potential (which is what Super PAL and Super NTSC actually are), the argument for moving to 'true' HDTV would become very dodgy.

The important thing is, the enhanced PAL and NTSC formats, for all practical purposes, ARE still PAL and NTSC, while MUSE and HD MAC etc., are completely new systems. With enhanced PAL and NTSC, both the viewer and the broadcaster can upgrade to higher picture quality at their leisure, for a quite modest outlay. Indeed, all a broadcaster need to do to start broadcasting in one of the enhanced formats is simply to obtain a videotape that's been encoded that way — you just put it in your normal studio tape player and away you go!

With HDTV, this is simply not possible — the conversion has to be all or nothing.

Unfortunately, the strong message I kept getting at the HDTV demonstrations

FORUM



is basically: here we have yukky old PAL (or NTSC) on an ordinary colour TV set, while over here we have the near religious (albeit expensive) experience of viewing HDTV on a $5000 receiver, with nothing in between! This is very misleading — they know damned well that the picture given by the vast majority of existing PAL and NTSC receivers falls a long way short of what the systems are really capable of, without requiring any exorbitant additional expenditure.

Now a final word on 'digital' TV sets. When I said I've never seen or heard of any sets using the new technology, what I meant was that I'd never seen or heard of any such sets appearing in stores or in people's homes.

Certainly I've experienced the benefits of similar technology used in broadcast TV production equipment, so I know what an improvement it can make to the picture. My point was: in the nearly 10 years that the technology has been available, it has had only a negligible impact on the market. I wasn't trying to imply that no such sets existed — only that they obviously hadn't been able to sell many!

The message I get is one that proponents of HDTV would rather ignore: that the importance the public attaches to image (and sound) quality has been grossly overestimated.

Thanks for those further comments, Mr Walters. I stand corrected regarding the error you noted in my introduction. Looking back, I must have somehow assumed that the luminance and colour information would need to be separated again before feeding to the transmitter's vision modulator. But once you have a complete composite signal, with PAL encoded colour and gated burst, etc., I guess there's no reason why you can't feed it directly to the modulator.

Mr Walter's clarification of his position regarding the comparison between enhanced PAL and HDTV is interesting, and I find myself in agreement with at least some of the points he makes. Particularly with his final one, about the degree of interest in image and sound quality by the average viewer.

In reality I suspect the vast majority of viewers are quite happy with the picture and sound they get from today's 'standard' TV sets, even those that are delivering very poor performance compared with the current system's potential — for whatever reasons. I agree with Mr Walters that the main push towards HDTV seems to be from the proponents of HDTV systems themselves; there certainly seems to be very little clamour for them from the actual viewers.

In fact I recall seeing somewhere a report suggesting that because the real benefits of HDTV are only really evident when you present it on a really large screen, there's unlikely to be any significant viewer interest in the format until good large-screen displays become available at a competitive price.

The same report suggested that there was more potential viewer interest in the 'widescreen' 16:9 display format as such, rather than in high definition TV, because the wider format is closer to the field of view of the human eye.

Respected engineer

But let's move on to the next writer, who in fact is none other than the highly respected engineer Neville Thiele — former Director of Engineering Development for the ABC, Past President of the IREE Australia and famous around the world for his work with Dr Dick Small on the design of loudspeaker enclosures.

I'm delighted that Mr Thiele has

honoured us with some comments based on his vast knowledge and experience in this area, even though he directs a few diplomatic barbs at my own comments in the April column, as well as those of Mr Walters. For at the same time, he manages to clarify a number of points that were raised in the first discussion, and in very informative fashion:

When the April issue arrived, with your piece in Forum about MAC, I decided that I must write to you to put a few things straight.

First of all, MAC WAS invented in Europe, in the laboratories of the Independent Broadcasting Authority (IBA) in England, by Drs Mike Windram and Keith Lucas. I had the marvellous luck, and privilege, of visiting them at Crawley Court in September 1981, when they had just published their first report on MAC, and of discussing it with them at that early stage. Within a year though, Keith Lucas had left the IBA and joined Digital Video Systems of Toronto in Canada, to adapt MAC for the North American 60Hz market. Then Digital Video Systems was taken over by Scientific Atlanta of, need I say, Atlanta in Georgia.

When Australia decided that MAC was the only possibility for the satellite HACBSS service, Digital Video Systems through Scientific Atlanta was the only possible source of production equipment — which they re-developed from their 60Hz version, with a minimum of change, for our 50Hz system. Thus our Australian B-MAC, although a 50Hz system is quite incompatible with the European 50Hz C, D or D2 MAC transmissions. It uses a different sampling frequency, Dolby ADM sound in six channels, etc.

Again, MAC was NOT developed initially with encryption in mind, but simply to produce the best quality pictures from a satellite transmission at a minimum of expense. To explain this, we must first remember that, while the noise picked up in a terrestrial AM transmission is substantially flat across the band, the noise in an FM satellite transmission is 'blue' — that is, its level rises with increasing frequency at the rate of 6dB per octave.

In most signals, such as sound and monochrome television, there is less energy at the higher frequencies, so that their frequency components can be pre-emphasised in transmission. Then a complementary de-emphasis on reception restores the original signal, and at the same time reduces any noise picked up along the way. But when high energy information, such as the colour subcarrier and its sidebands in colour television, is carried at the high frequencies, pre-emphasis cannot be applied to any great extent without overloading the transmission.

Also, in general, high frequency noise is finer in texture and so less visible. But in PAL, any components of noise at frequencies close to the colour subcarrier are demodulated as low frequency colour noise — whose coarse texture is much more visible, particularly in large areas of saturated colour. This was noticeable in the older studio videotape machines, which of course record the signal as FM, and also in the PAL signals from the British Sky satellite service. For this same reason, home VTR's transpose their colour subcarriers to the lower frequencies as 'colour under'.

In PAL via satellite, the problem can only be reduced by increasing the power from the satellite or the size of the receiving dish, either of which is expensive. Otherwise the user must simply put up with the noise.

MAC solves problem

MAC overcomes this problem by transmitting the luminance and colouring components sequentially in time, in each line. The process of time compression before transmission and expansion after reception actually increases the magnitude of the received noise a little, but the major part remains at the highest frequencies of both luminance and chrominance, and therefore remains less visible.

Encryption came to MAC only after it had crossed the Atlantic, where it was proposed for use in Pay TV by the Satellite Television Corporation (STC), since defunct. From its great data capability proposed initially for digital sound, some could easily be diverted to other purposes such as encryption.

Receiver compatibility is a problem only when receivers are not equipped with a SCART plug. For the last six years or so, more and more receivers have been equipped with these plugs, which accept baseband video. Thus the most expensive 'monitor' part of the receiver, i.e., the picture tube, cabinet, deflection system and power supply, becomes common equipment which can accept television signals in RGB or YUV form, whether they were received initially as component or composite, from terrestrial or satellite transmissions in AM or FM, from receivers in MAC, SECAM or PAL format, or from VCRs or computers — by passing them through a small and comparatively inexpensive receiving and/or decoding 'black box' as required.

Mr Walters' pieces irk me particularly because of their mixture of fact, ignorance and bombast. You treated his nonsense far too gently, Jim. You need not have backed down. I assure you that received picture quality WAS the major factor behind the initial development of MAC. The effort to 'lock up' or 'squeeze out' the Japanese came with the adaptation of MAC to HD-MAC for higher definition television.

On the subject of PAL vs. components in studios, Mr Walters asserts that there will always be some loss of quality in transcoding between PAL and components, and that therefore studios ought to stay all-composite-PAL. But the second argument in no way follows from the first. Of course every transcoding process causes some loss of quality. So also does every process of amplification and transmission by cable or microwave, in every link from input to output.

But any intelligent engineer knows that this is a matter of proportion. In assessing the feasibility of a system, he first finds out how much degradation each link produces, and then makes sure that on any path the sum of inevitable degradations does not rise above a perceptible — or even, if that cannot be avoided — an 'acceptable' level.

For example, every studio has at least one digital effects unit, to produce those cunning, and dare I say tiresome, wipes, dissolves, page turns, etc., that television producers cannot do without. All of these, as far as I am aware, process digital components. Do they contribute perceptible degradation? I think not.

Mr Walters says that the Betacam format is dead. Sony must be highly amused. Six months ago I saw in an English commercial station two large newly-installed Library Management Systems using the Betacart format for assembling programmes from video cassettes.

Besides, the problems of transcoding between PAL and components can be, and are, overcome by originating material in component form, and only transcoding to PAL at the last possible point in the system. In another part of that same English station, an area had been newly installed for producing promotional material — in which, along with advertisements, commercial stations most treasure their technical quality. It produced everything in the digital 4:2:2 component format, including a D1 videotape machine, and delivered its output in that digital form to every area that required it.

Further, the main studio had recently been re-installed with cameras providing

analog component outputs — which for the present are coded to PAL, but will be available when the studio, in the 'evolutionary' manner deprecated by Mr Walters, finally moves to all-component operation. Not finally this year or next year perhaps, but soon enough, whether the final transmission system method is MAC, enhanced PAL a la Faroudja, or some other method — digital bit-rate reduced video using COFDM or whatever.

Mr Walters' allegation that SBS transmissions were 'soft', apparently because of excessive transcoding, was so grotesque and contrary to my own experience that I checked with Brian Madeley, SBS's Chief Engineer, before sitting down to write. Sure enough SBS, like ABC, distributes its signal from Sydney via B-MAC on the satellite. But the signal transmitted in Sydney goes direct to the Gore Hill transmitter from the North Sydney studios. 'Have you noticed how 'soft' the pictures are?' Candidly, no.

I hope this might be of use, Jim. I am reminded that my last contribution to Forum was in April 1951, just 40 years ago.

Thank you indeed for your comments, Neville. I for one found them particularly interesting and helpful, especially your explanation of the limitations of FM satellite transmission for composite colour TV, and the reasons behind the development of MAC. I certainly hope you don't wait another 40 years before making another contribution to Forum — we'd appreciate a much more frequent access to your knowledge and powers of explanation!

Needless to say I'm relieved to find that I was right in saying that the MAC system had originated in Europe, too. It does seem a pity that the system now seems to have fragmented into so many different and incompatible versions, though, doesn't it?

I liked Mr Thiele's point about many recent sets having an input for RGB or YUV component video, too. As he points out, this means that for many people the cost of changing over to a MAC or full digital system need not be as major as Mr Walters has suggested. All that they're likely to need is the right 'black box'.

Mind you, it would still be necessary for people to buy a new set or monitor, in order eventually to watch HDTV in its full 16:9 aspect ratio — and such sets or monitors are likely to remain quite expensive for some time, as Keith Walters would no doubt want me to point out. But I think the point that Neville Thiele is making is that many people would *not* be forced to throw away their old sets, merely to watch MAC transmissions. Presumably they could even watch HDTV in a fashion, if they're prepared to put up with either a 'letterbox' type presentation or a display showing only the centre 75% of the 16:9 picture.

It's interesting to learn from Mr Thiele that stations like the one he visited recently in the UK are in fact upgrading to component operation in 'piecemeal' or evolutionary fashion, and with no significant degradation in performance. His example of the widespread use of digital effects units is also interesting, indeed suggesting that transcoding from composite PAL into digital components, fancy processing and then transcoding back into composite PAL again can't be regarded as producing significant degradation. In fact the fancy effects that I've seen myself certainly don't seem to be noticeably inferior to the rest of the programme material — sometimes they seem sharper and cleaner, if anything!

First-hand details

Moving right along, the next response is one that came in the form of a faxed letter — all the way from Britain's Independent Television Commission (ITC), in none other than Crawley Court, Winchester, Hampshire. I didn't know we were read so far afield, and it's flattering to discover that we are. The writer is Mr Paul Gardiner, of the ITC's Standards and Technology department, and you might perhaps expect his contribution adds further detail to the information supplied by Neville Thiele on the origin of the MAC system:

Having come across the April issue of Electronics Australia, I read with interest the discussions concerning the MAC system (I did not have the benefit of seeing the January issue referred to).

Perhaps I may make a small contribution by giving you a few first-hand details concerning the history of MAC, which was indeed first devised in Europe, by engineers at the Independent Broadcasting Authority (IBA) in England.

It was in January 1981 that the European Broadcasting Union (EBU) held an historic series of demonstrations at the IBA in Winchester, of proposals for a digital component studio standard. Agreement was reached on a particular set of parameters, which subsequently became adopted as a world standard — referred to as CCIR Recommendation 601.

At that time, it was generally accepted that the up-and-coming satellite services would continue to use conventional composite colour systems, such as PAL and SECAM. At the IBA, however, a search began for a new signal format that would

allow the improved picture quality of a component studio to be conveyed to the viewer, and which would at the same time be better suited than PAL to the noise characteristic of FM transmission systems.

The first MAC system was demonstrated by the IBA working through an RF channel by the end of 1981, and was officially introduced into EBU discussions in January 1982. Several IBA engineers were involved in the development of MAC; in particular, Dr Keith Lucas, who first conceived the idea of the MAC vision format.

In Europe, the development of MAC proceeded in collaboration with other European broadcast organisations, leading first to the C-MAC/packet specification published by the EBU in June 1983, and to the subsequent development of D2-MAC, D-MAC and high definition HD-MAC. Meanwhile, Dr Lucas left the IBA to join Scientific Atlanta, developing B-MAC.

Although MAC evolved in somewhat different directions in North America and Europe, the format of the basic vision signal is common to all MAC systems, and has changed little since it was first devised at the IBA in 1981.

Again I'd like to thank Mr Gardiner for his contribution, which again confirms that I was actually correct in stating that the MAC system was developed by 'Europe's technical experts', in my January editorial. It looks as if I got that part right, at least!

Other aspects

The space available for this month's column is rapidly running out, but I think we have room for one more letter. This came from Mr Ron Demkiw, of Cabramatta in Sydney, and the first part of Mr Demkiw's letter partly echoes the points made by Neville Thiele and Paul Gardiner regarding the origin of the MAC system. However because he adds further detail again, I'm reproducing this section — as well as the rest of the letter, where he makes some interesting comments about the other aspects of satellite TV broadcasting that were discussed in April:

I wish to make the following comments in regard to April's Forum.

1. It is sheer nonsense to state that Scientific Atlanta invented MAC. Actually, MAC is the remote descendent of the incompatible 'sequential' colour TV systems proposed in the United States in the early 1950's, such as the CBS system. MAC as we know it originated from Dr Walter Bruch — 'the Father of PAL' — in the 1970's, in the context of videotape recording. The Japanese made a similar proposal in the same decade, and in 1980 Schonfelder, Brand, Muller and Wendler of West Germany advanced a system called 'Timeplex' for domestic videocassette recorders. In 1981 the Independent Broadcasting Authority realised there was an application in direct satellite broadcasting, and called it 'MAC'. Scientific Atlanta can only claim credit for perfecting one variant: 'BMAC'. 'DMAC' is an IBA proposal and 'D2MAC' was developed by the French and West Germans.

2. In direct satellite broadcasting applications, the compatibility of PAL is illusory. There is no way in which an ordinary television receiver can pick up a satellite TV signal. Firstly, the signal is FM; secondly, it is in the SHF band; and thirdly, the audio would be on a digital subcarrier for which the viewer would need a decoder. The viewer already has to make a considerable investment in a satellite dish and satellite receiver. In that event, for satellite TV applications it makes sense to go to a more advanced system, particularly one that could be later 'enhanced'. If some satellite TV viewers have to buy an extra 'black box' in order to continue using their existing TV's, it does not seem to be asking much. Besides, eventually all premium priced Philips TV's will probably have an inbuilt D2MAC decoder. It is likely that a person who can afford satellite TV can afford a new TV.

3. New satellite TV channels should come from entirely new TV stations. If new TV stations are built from scratch, they should be all video component — analog or digital — from camera to uplink.

4. Component video CAN be introduced on a piecemeal basis. If the equipment replacement begins at the camera and progresses to the final encoder in a fashion that ensures that transcoding proceeds only in the direction of YUV to PAL, then it is a possible to have a more harmonious co-existence of composite and component. Rather than have component 'islands' we want an advancing 'tide'.

5. One can be philosophical about setbacks to the MAC system, because it can already be considered to be obsolete. There does not seem to be any long term future for any HDTV system unless it is all digital, which HD-MAC and MUSE are not. In the United States, investigation of all HDTV systems except all-digital ones have been abandoned.

It appears that it will be feasible, due to recent technological breakthroughs in video bit-rate reduction, to transmit all-digital HDTV over terrestrial 'taboo' channels. At the same time, enhanced PAL, attaining 700 lines of horizontal resolution and widescreen display, within the normal video bandwidth, could be possible.

However, it must be pointed out that so far, the two approaches above exist only as computer simulations. Either system requires a TV set to have the computational capabilities of a small mainframe computer. Before hardware can be offered for sale to the public at prices it would pay, it will be at least 10 years. This is less than the length of time that is envisaged for HDMAC services to grow and develop.

On the other hand, many of the vaunted merits of HDTV and E-PAL, such as widescreen display and freedom from cross-effects, etc., are available in the MAC system NOW. A completely compatible system is undoubtedly possible, but has to be dismissed for the immediate future. Only the MAC system offers the prospect of better pictures within the next few years.

Thanks for your comments too, Mr Demkiw. If I have understood your letter correctly, you seem to be saying that MAC (and perhaps D2MAC in particular) is really the only logical choice if we want improved satellite TV reception in the near future, rather than semi-compatible systems like enhanced or 'super' PAL. But you're also apparently convinced that even MAC would only be a short-term answer, before we inevitably swing over to a true digital system — is that right?

That evaluation seems pretty sensible to me, anyway, and I agree that using a MAC system as a transitional one shouldn't necessarily involve much more additional expense for most people. If you're buying a dish, downconverter and satellite receiver front end, the additional cost of a MAC decoder 'black box' is surely not going to be of great significance, as you and Neville Thiele have both pointed out.

Of course now that the Government seems to have duck-shoved the whole idea of Australians as a whole having access to DBS and Pay-TV, the subject seems to have become rather academic, doesn't it? It looks like most of us aren't going to see satellite TV for some time...

And that's about all the letters we have space for, this month. There are at least two other letters on the same subject that I'd like to present next month, though, so stay tuned. ■

[illegible]

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NEW BOOKS

UHF/microwave manual

THE ARRL UHF/MICROWAVE EXPERIMENTER'S MANUAL. Published by the American Radio Relay League, 1990. Soft covers, 277 x 209 x 24mm. ISBN 0-87259-312-6. Recommended retail price $40 (optional floppy disk $20 extra).

Most people familiar with 'RF' are aware that the design and construction of transmitters, receivers, components, transmission lines and antennas for use at UHF and microwaves tends to be rather different from the techniques that are appropriate for lower frequencies. And with more and more use of these higher frequencies for communications, navigation and other purposes, knowledge regarding the specialised techniques involved has been expanding very rapidly — so much so that the ARRL has now produced this new manual devoted completely to the basic theory and practice of UHF/microwave communications.

In his foreword, ARRL executive vice-president David Sumner K1ZZ notes that it is planned to accompany this volume soon with a second one, containing construction projects. Judging from the present volume, this should produce a pair of manuals that will provide today's and tomorrow's UHF/microwave experimenters with the kind of invaluable reference information that the original *ARRL Handbook* has provided for generations of people working at HF and VHF — both amateurs and professionals.

Written by about 26 different contributors, many of them professional engineers and/or academics as well as radio amateurs, this volume provides a wealth of solid theory and practical information on propagation, microwave devices, transmission media, design techniques, antennas and feeders, microwave fabrication, measurements and computer aided design. Some of the information has previously appeared in the League's monthly magazine *QST*, but a large proportion has been written especially for it. And as usual with ARRL publications, there's an excellent balance between theory and practice.

Also available (separately) to go with the present manual is a companion floppy disk, which provides some 26 different computer programs to run on an IBM-compatible PC, and assist with design calculations. Of these 25 are written in BASIC, while the remaining one is in compiled Pascal. The programs on the disk cover such tasks as design of loop yagi, long yagi, log periodic, helical, horn and parabolic dish antennas; system noise figure calculation; design of transmission line transformers, resistive attenuators, waveguide filters, matching networks, microstrip lines and inductors; and calculation of path loss.

In short, the book alone provides an excellent information resource for anyone working at UHF and microwaves, with the optional disk providing additional help with design calculations. Congratulations to all involved in this project, and I for one look forward to seeing the companion practical volume with great interest.

The review copy came from Stewart Electronic Components, of 44 Stafford Street, Huntingdale 3166 (PO Box 281, Oakleigh 3166), which can supply copies by mail for the prices shown. (J.R.)

HEMTs and such

SEMICONDUCTOR HETEROSTRUCTURE DEVICES, by Masayuki Abe and Naoki Yokoyama. Published by Gordon and Breach Science Publishers, 1989. Soft covers, 216 x 141mm, 98 pages. Price US$60.00. ISBN 2 88124 338 X.

This is the eighth volume in Gordon and Breach's 'Japanese Technology Review' series of monographs, of which other volumes have been reviewed in these pages. Edited by prominent academics and researchers in Japan, the monographs provide insight into specific areas of current technology, from a Japanese viewpoint.

As is clear from the title, the current volume deals with the theory and applications of semiconductor 'heterostructure' devices — devices whose behaviour depends on the special conducting properties of a 'heterojunction' region, usually between regions of GaAs and AlGaAs. The most well known of

these is the HEMT or 'high electron mobility transistor', which offers impressive performance at microwave and millimetre-wave frequencies. The book's authors both work in the research laboratories of Fujitsu, in Atsugi.

Basically it's split into two sections, the first of which discusses the physical principles and operational characteristics of HEMTs, along with their analog and digital applications. The second section then deals with the resonant tunnelling hot electron transistor or 'RHET', the resonant tunnelling bipolar transistor or 'RBT', and recent advances in the technology of InGaAs-based devices. It also discusses the microwave characteristics of resonant tunnelling devices.

As with the other monographs in the series, the material is presented clearly and concisely and has informative illustrations. Each section is also provided with an extensive list of references, allowing further research if desired. This would make it a good choice for anyone wanting or needing an authoritative reference on heterostructure devices.

The review copy came direct from Harwood Academic Publishers, of PO Box 786, Cooper Station, New York NY 10276. No information was supplied about any Australian distributor, but the publisher apparently runs a 'Science and Arts Society' book club which will sell direct by mail to individuals, at discounted prices. (J.R.) ■

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HIGH TECHNOLOGY AND THE BANANA REPUBLIC

Why is it that on the whole, Australia can't seem to build itself a viable, up to date and competitive manufacturing industry? Here's an attempt to answer that question, by an engineer who put a lot of effort into building up a local hi-tech manufacturing firm — only to see it become a victim of financial pressures.

by LAURIE LARSEN

Many developed nations are embracing high technology as a means of achieving affluence, growth and power. The reasoning behind this is fine, but let us pause, and reflect on high technology at the consumer level.

Your new car with its computer controls, with its electronics coupled to sensors, is your new toy. This is exciting and great, but let this technical wonder malfunction, and service is required — then it is very likely that frustration and disappointment will reign.

Your personal computer fails and you lug it in for service. Be prepared for delays and excuses, with the usual "We'll have to get a part". You may also end up after months of more excuses being told "We can't get the part".

When your washer or one of your other space-age appliances stops working, then it is usually less wearisome to simply buy a new one. Your colour TV, video recorder and all the other trappings of an affluent society are great, as long as they continue to work and don't need service.

Let's look at this service problem and its causes. When life was simple and life's comfort aids were also simple, most malfunctions could be resolved, and fixed, at the user level. There were few inbuilt design mysteries. Then along came semiconductors and the silicon chip, with research and development moving with it. Engineers and scientists were trained from high school in this new technology. At the chip level it is easy and cost effective to build complexity, functions and features into designs.

A new technical philosophy was born with the chip, or microprocessor, as an integral part of the new age products. A fresh breed of technician arrived: the software writer, and with him data systems proliferated until our whole way of life was altered. When this mass of micro-technology passed from infancy to adulthood, the people involved in its growth became a sub- culture — where bytes, bits, floppies and hard discs became another language, understood by those involved but alien to the average person.

This technology was like a cancer, as it eventually controlled the host — be it cars, entertainment, banking or home products. And like the integration of an alien culture, problems came with it.

Support lost

Training of the necessary technical people to service these sophisticated products skilfully has lagged behind the speed with which they are becoming an integral part of our lives.

When design, development and manufacture were done in Australia there was close liason between Sales, Engineering and Service — which meant that upon a product's release, all concerned were conversant with it. But with the relocation of our manufacturing industries to low labour cost countries, whole sectors of industry disappeared from Australia. And when the manufacturing went, the support industries also disappeared.

One manufacturing industry that disappeared was consumer electronics — that is, TV and radio manufacturing, etc. This industry was supported by component manufacturers who supplied it with Australian designed and manufactured components.

Now almost 100% of electronic components are imported, and all relevant technology associated with the development of these is done overseas. This means that Australia's electronics capability now relies completely on imported bits and pieces. With the disappearance of consumer electronic manufacturing and its support industries, a valuable training ground for oncoming technical service people no longer existed. Therefore today's emerging service technicians largely lack diverse industries in which to gain solid grounding in technical service 'knowhow'.

Apart from the service departments of some appliance retailers, many servicemen are self taught and muddle their way through, with the subsequent disenchantment for those needing service for their foreign-designed and produced products.

Dying breed

A dead, or at least dying breed in Australia is the experienced circuit designer. Any advertisement for technical staff produces a collection of half-baked hopefuls with little actual experience — and worse, few places to get it.

The vast range of impressive computer, communication, entertainment and industrial electronic products available in Australia today are mainly controlled by large scale integrated circuits (LSI's), with the technology of masking and processing (apart from some software writing) being done overseas. The fact being that the countries that designed the products now control both the markets and the research and development.

University education is a very necessary part of any society, but unless a reasonable proportion of the graduates belong to technology and there is fertile ground in which to grow, after graduation, our nation will slip further behind those bustling energetic ones to the North of us. In Australia, at present, there are now two defined areas which offer limited scope for graduates in electronics engineering.

They are the telephone communica-

HIGH TECHNOLOGY AND THE BANANA REPUBLIC

tions and the areas associated with it, and the computer industry.

The latter, unfortunately, usually consists of a series of imported boxes, and printed circuit boards which are then assembled into systems, by an engineer. What is in each box, at board level, is usually of little concern to a systems engineer.

In Australia, 'grassroots' research and development is an ailing and reducing factor, which profit-driven companies rarely encourage.

An answer to high labour assembly costs could rest with robotics, but here the spectre of support industry also looms. Most robotic assembly systems are imported, and computer controlled, with major components of precision mechanics.

Service is a critical factor for the efficient use of the system. This is not just some technician running through a series of tests — it needs highly trained, and experienced people who are relaxed with more than one discipline. It also needs a support industry that can rapidly fabricate an urgently needed precision part, be it mechanical or electronic.

If we get past this hurdle we enter the numbers game, which after all is the reason for robotic assembly. Our geographic position in the world means a long haul to any potential export market, which logically adds to costs.

Unfortunately we, like it or not, are perceived overseas to be unreliable both in delivery and quality, and we are not seen as a serious manufacturing country. This position, of course, equates to a large handicap in the export derby.

With our small population internal regeneration is not possible to compensate for unavailable export markets, and our almost 'open door' policy to imports only compounds the situation.

The answer to these problems cannot now be found politically. It is too late for that, and as productive creativity is a short commodity in the Halls of Power, no solution is possible from there. We have harnessed our nation's destiny to others, and are grateful to receive in return low commodity prices — plus huge debts, to finance our standard of living.

We have politicians frantically trying to damp down internal demand — which is trying to fix the result, instead of the cause. This means that our standard of living was, and still is, harnessed to wool, agriculture and minerals.

This should never have been allowed to continue. We had the chance for change years ago, but the retention of the status quo was so easy. Even at this late date our leaders speak wistfully of returning wool and mineral prices, instead of examining other options.

Heads in the sand

When the German camera and the Swiss watch industries were replaced by technology, our own heads were in the sand, preventing us from seeing wool ever being replaced by synthetic fibres. But this is now well advanced, being helped along by our pricing policy.

What we must not be confused about is this: we must drop our dependence on low return primary industries, and embrace value-added secondary industries — preferably technology based, but aimed at world markets.

Of course this is going to cost effort and money. But Japan's success was only possible because of worker, banker and government attitude and contribution. Maybe it is too late.

Unfortunately if that is true, the 'banana republic' scenario could be our destiny in the twenty-first century.

As a short term band-aid during this term of low demand for wool and minerals, should we not look at making it *harder* to import finished goods into Australia?

It is apparent that internally we have the capability to buy more and more imported products, recession or not — often at high prices. But because of the low return we receive for our export commodities, our nation cannot finance the external costs of these products, without large borrowings.

It really doesn't take an Einstein to see the problem and the solution. But it would take some real courage from our politicians, especially after the relevant industries were previously destroyed by them (for whatever reasons).

As we are moving to low, or even zero, tariff levels, we should, for once, hesitate and see what benefits we Australians accrue from these projected changes. Especially when in reality many countries have both visible, and

invisible import barriers of some kind. There should be no return to inefficient manufacturing.

But let us analyse that inefficiency — is it volume, quality, design, or purely cost related? All of these can be set right, with a will to do so and the correct manufacturing climate created by the Government, unions and the manufacturers.

Imagine Australia's sudden involvement in a shooting war. Our supply lines are cut, and we are on our own. The army would, because of lack of manufacturing and support industries, rapidly sink into a true rifle-armed infantry. Even replacement radio equipment is unavailable locally, there being virtually no Australian manufacturer of the components or semiconductors which are the heart of modern communications.

Our much vaunted high-tech army, navy and air force electronic equipment could rapidly become costly inoperative junk.

Think this is an exaggeration? It is not, rather it is a frightening situation for a once prosperous country.

Many causes

We can blame our politicians, who of course must accept some of the responsibility for part of our decline. We can blame greedy unions for high wage demands, but they are only reacting to cost pressures.

We can blame our financial institutions for their quick-buck philosophy. We can also blame our Australian lack of work-pride, our 'She'll be right, mate' mentality. The cause, of course, embraces all of the above but there are also other reasons. National leadership, lack of foresight and statesmanship to name a few, among many.

We are approximately 17 million people — over governed, over taxed and over controlled, who are now paying for the mistakes, incompetence and omissions of the past. We have a billion-dollar edifice erected to the vanity of our politicians, and yet, conversely we receive begging letters from hard pressed institutions to assist in the support of families in poverty.

We have a welfare system which is used and milked by the unscrupulous. We pander to vocal minorities, irrespective of the cost. Our legal system is inhabited by the greedy, feasting on misfortune. Our health system is an unhappy mixture of greed and dedication.

Our society has grown cynical of all things associated with 'government'. With the threat of a banana republic hanging over us, not much thought is directed into the growth of the nation — the main effort instead going into wondering just how we could have been led into this situation.

We are now positioned like a failing business, where the manager has lost control, or concern. Where the main action is retrenchment, where decisions are crisis based (and therefore desperate) and where the remaining employees perform their duties in a half-hearted and demoralised fashion.

All this took us 200 years to achieve. Our two hundredth birthday was feted by the world, and politicians took credit wherever possible. But a nation is more than glass and concrete structures, of cluttered highways, and of posturing politicians. It is frightening to realise the high proportion of our export earnings that is used to pay interest on our borrowings. Everyone is paying, in one way or another.

It would be interesting to consider, in hindsight, what could have been achieved by our manufacturing industries if only a part of this huge amount had been available for modernisation of manufacturing plant and export market generation. ■

About the author

Laurie Larsen is an experienced electronics engineer who spent 10 years building up and running his own business in Sydney, developing and manufacturing micro-processor based appliance con-trollers. By early 1987, Appliance Control Systems had nearly 70 employees and was exporting products worth around $12 million per year. However later in the same year the business was forced to close, due to financial difficulties.

After graduation, Mr Larsen spent a year doing research into the Peltier effect, decay in phosphors and C14 dating. He then spent 10 years at EMI, as Development Engineer in charge of the Special Projects Laboratory. During that time he developed an automatic cross-correlator for use by the Australian Naval Research Laboratories, and a proton magnetometer for airborne mineral surveys.

Other inventions to his credit include an automatic shutoff for steam irons, now in world-wide use, and a method of controlling relays with a microprocessor for arcless high-current switching. Both of these are patented.

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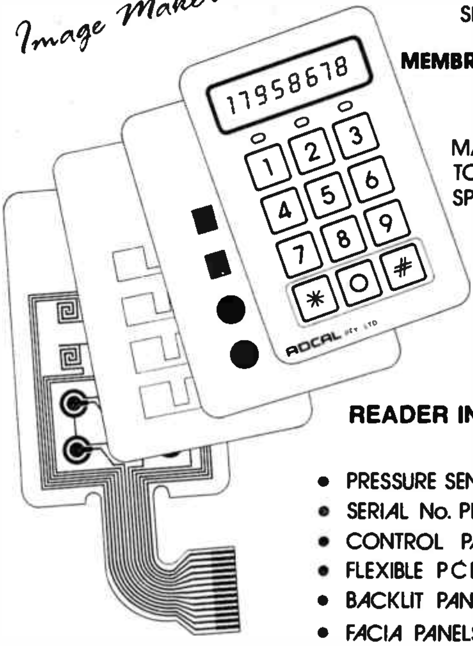

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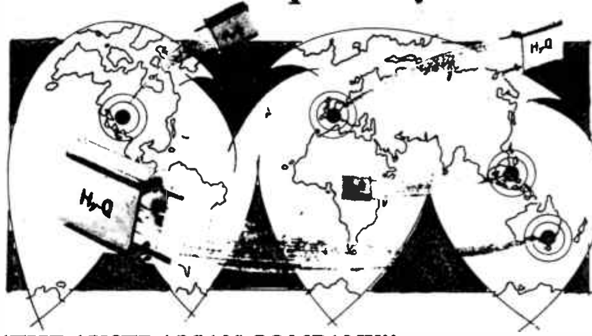

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Moffat's Madhouse...

by TOM MOFFAT

Why won't the Government DO something?

I was watching a programme on ABC television the other night: 'Overseas and Undersold'. It was investigating the reasons Australia sometimes doesn't succeed too well on world markets. In this instance, it seemed to be because our businessmen were not entertaining their contacts in the correct manner, in places like Japan and Taiwan and Hong Kong. Or because of our wharfies and our waterfront system, seen as a 'joke' overseas.

We saw inventors of products with international potential, stymied from square one. "I worked my guts out to produce this thing, but I couldn't get any government help". Or — "I took it from department to government department, but they just passed me on to someone else..." Again: "The government just didn't seem interested in..." (etc, etc).

Does the government run our lives? Well, I suppose it does in many ways, but do we have to encourage it? Lie back and think of England, as they say?

Why is it that the minute somebody comes up with a good idea in Australia, the first thing they do is go to the government? I have learned from experience that the smartest thing to do is to turn around and run the other way, as quickly as possible.

The government, of course, encourages people to become dependent on them for business success. Every state has its 'economic development corporation' or 'development authority' or, would you believe, 'business incubator scheme'. They are supposed to help people with ideas get their projects off the ground ("I'm from the government and I'm here to help you..."). They provide advice, and sometimes money, but there are always strings attached. More than strings — tentacles!

One tends to get sucked into these things. If the government hears you've got something good going, the appropriate department may approach YOU, offering to help get your product to market. Well, not exactly offer; you are 'urged to apply'. This means paperwork, and lots of it.

I once worked for a firm that produced various electronic gadgets, mostly of my own design. We decided to have a go at the 'assistance' being offered.

"Fill out these forms", we were told. "Prepare a submission", and then... "You'll need to prepare a business plan".

We went immediately into red tape mode. There were three partners in this business, and they set about preparing the financial side of the submission — production schedules, expected cash flow, and lots of other accounting.

My job was to prepare technical descriptions of the products we wanted to promote, and I also had to provide evidence that I was capable of designing the products that I had just finished designing.

This whole exercise took several weeks of round-table discussions, followed by long sessions in front of the word processor. Further development work was pushed aside during this time; the weeks produced many computer disks full of text and facts and figures, and reams of paperwork, all ready to give to the government. The real purpose of our business, coming up with innovative electronic products, was put on hold.

Once the paperwork was submitted, we started receiving visits from government 'experts', who didn't really seem to have any idea what we were trying to do.

This one guy kept saying he 'had a handle on it', as I tried to explain our products in the most basic possible way. He would then report to other people, who would then come back and make me start explaining at square one all over again.

Meanwhile our development work languished in the corner.

One of our prize ideas got a big knock-back from some academic fellow connected with the federal government, because he said the partners involved in the venture 'had no experience in business'. This was despite the fact that one of the partners was also the state manager of a national automotive parts firm, and another had made enough in the earthmoving business to buy himself a $200,000 yacht as his latest toy. The guy who had recommended against our idea had floated straight out of a university into his government department; he'd never had to spend a day in 'business' in his life.

The only government assistance we ever got in the end was from an industrial designer, who helped design the cases and packaging for our products.

He really did work hard for us, both within the government and at his own home. But the only product of his that ever made it to market was rejected by many buyers because it 'looked too amateurish'.

The thing worked great, it just looked like a backyard job, and people wouldn't buy it.

Despite the recession ills, there are still some very successful businesses operating today. A few years ago I went to a Christmas function thrown by a Tasmanian electronics company, which continues to thrive and grow despite the hard times.

After quite a few beers I got into a real heart-to-heart chat with the firm's managing director. I asked him if the government had helped in any way toward his quite startling success, and his answer was short and sharp: "I told them to go to buggery!"

I guess what this businessman meant was that over the years, he had avoided spending the thousands of non-productive hours needed to fill out government forms, returns, and reports to account for whatever assistance he might have received.

It seems that a large proportion of companies that do receive assistance

fail in a short time. Their establishment is announced with much ballyhoo — maybe even the Premier turns up to cut the ribbon. And then six months later, bang! There's a closing down sale, 40 people retrenched, and the company goes bye-bye, perhaps still owing a few million to the government.

I sometimes suspect one reason this happens is that these companies start out with big ideas and big debts, but they promise to provide jobs, which turns on the government. But, as we all know, the bigger they are the harder they fall.

I know of many people now who are no longer in the 'official' workforce. They either got the boot when their employer was 'rationalising', or they chose to get out while the going was good. I am one of those people.

When the crunch comes you have the option of going on the dole, or of trying to construct a job for yourself. Around Tasmania at least, the second option is by far the most popular, and many enterprises are now being run by one person, from home.

The voice of experience has taught those people (us) a couple of home truths: don't go into debt, and stay clear of government assistance.

You can spend your whole time doing what you do best, and if it goes bung, at least you can simply cease trading without ending up owing thousands of dollars to someone else.

This must be the original 'cottage industry', doing business the way it was done a hundred years ago.

As I said, I was pushed into this unofficial workforce by the demise of my last full-time employer. I did a bit of contract design work, wrote lots of magazine articles, but still had trouble making it above what is generally accepted as the poverty line. Thank goodness for working wives!

But then I got brave; I took the plunge into a home manufacturing business, a cottage industry, in the form of the Listening Post II project.

I decided to do the whole thing myself, no financing, no middlemen. I would personally produce Listening Post II kits, right there on my dining room table, and sell them only by direct mail.

As for finance, I managed to dredge up $500 from the family's life savings to buy enough bits to produce the first 10 kits. If the project turned out to be a 100% dud and not one person ordered a kit, I'd only be out the $500 and a lot of wasted time.

As it turned out, the first 10 Listening Post II kits were sold the day after the January issue of *Electronics Australia* published Jim Rowe's review of the project. So the profit from those, along with the fee I got for writing the article in the *Radio Experimenter's Handbook*, gave me enough bickies to finance the parts for a further 50 kits.

These went like hot cakes, and the money from *them* financed the bits for another 50 kits and the purchase of an IBM-AT clone computer to use to develop the EGA, VGA, and Super-VGA versions of Listening Post II.

The second run of 50 kits sold as quickly as the first lot, so this time I used the money from them to buy parts for a run of 100 more kits. This was starting to turn into big bucks, but again it was not borrowed money — it was just the income from earlier sales.

By now the *Radio Experimenter's Handbook* itself had come out, and this unleashed a mighty demand for the Listening Post II kits. The second 100 disappeared within a couple of months, so now I've just ordered the parts for a third run of 100.

If, for some reason, the orders stop coming tomorrow, I'm stuck with the parts for 100 kits, almost. But I've been a bit conservative, and only ordered 50 circuit boards and 50 of the special switches used with the Listening Post II kits.

These are the things that are useless for anything but Listening Posts. But if I'm stuck with the rest of the stuff, I'll just have to come up with some other project using those parts. And I've already got a few ideas cooking, whether the next 100 kits sell or not. Anyhow I'm now pretty well committed to doing an Amiga version of Listening Post II, so that should account for a lot more kits — I hope!

What this all means is I've at long last stumbled onto a way to *concoct* a job to replace the one I lost, without any outside finance and without any help (or interference) from the government.

I won't even attempt to claim it's as easy as working for a boss. I'm now working 60 or 70 hours a week (this is being written on a Sunday afternoon), for much the same pay I used to get for 40 hours when I had a 'real' job. But at least I'm working, and once I get some efficiencies sorted out I hope to have a thriving little business.

Many Listening Post buyers have asked for a list of other kits I have available, so I can certainly see which way things are heading. Stay tuned for further developments!

It is with sadness that I predict that many of you employed people reading this column this month, will be without jobs next month. That's the way the system works at the moment.

Just last night I was talking to a guy on my amateur radio set who was moored on a small yacht in Sydney Harbour. He was alone, aimlessly heading north after losing his job in Melbourne to, as he put it, 'the policies of Hawke and Keating'.

The poor guy must think it's the end of the world; I certainly did when I got the boot. But he'll eventually come drifting back, once he's got his act together and learned to accept his position. Maybe he'll find a way to make some money. Or maybe he'll MAKE a way to make some money.

So my advice to any of you out there who find yourselves on the scrap-heap is this: you can obviously do something useful, or you wouldn't have had a job in the first place.

Maybe now's the time to start doing your thing for yourself and your family, instead somebody else. Maybe the loss of a 'job' is what was needed to push you into a more satisfying life than you've ever had before. Think about it! ■

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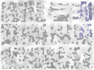

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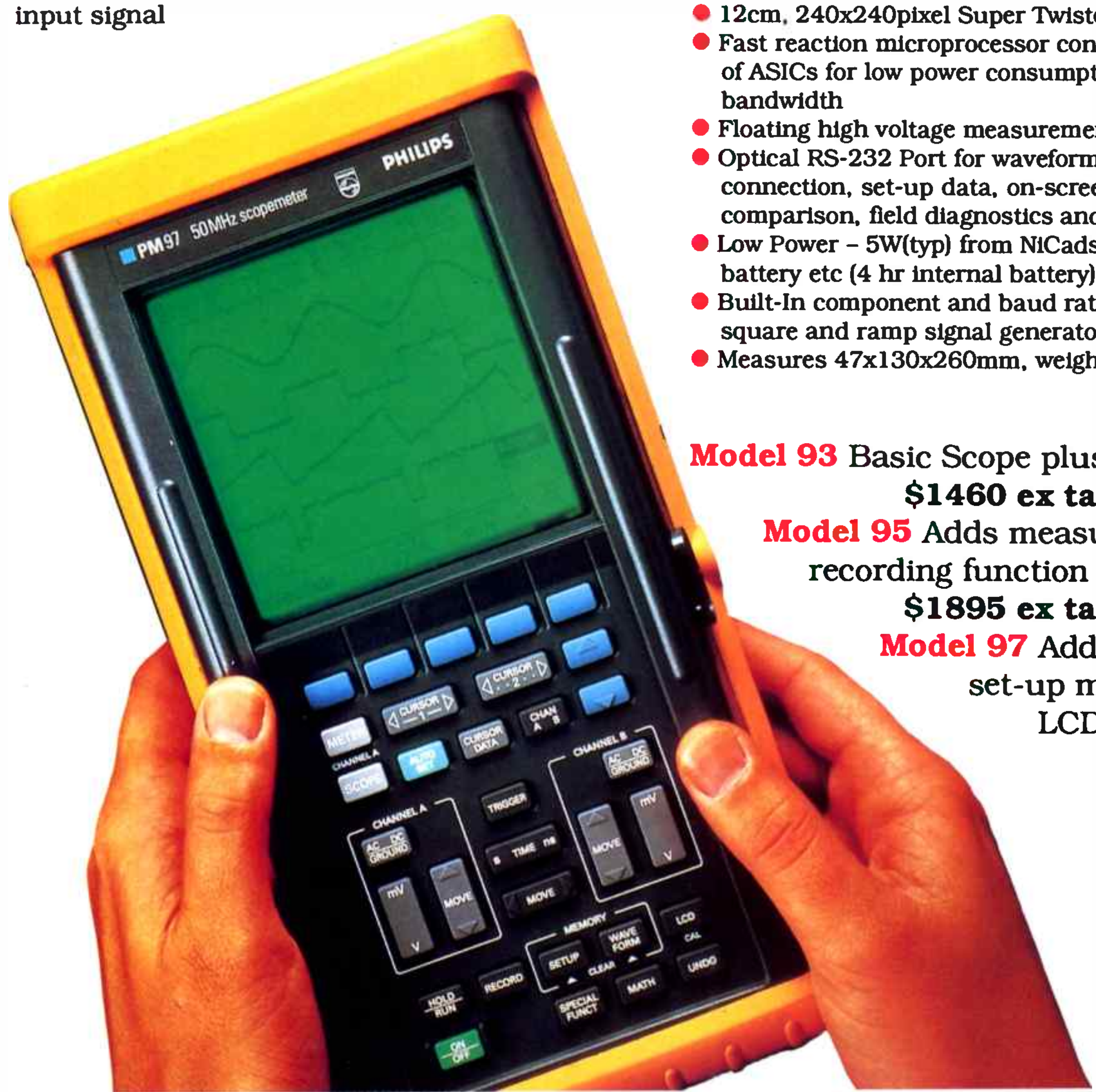

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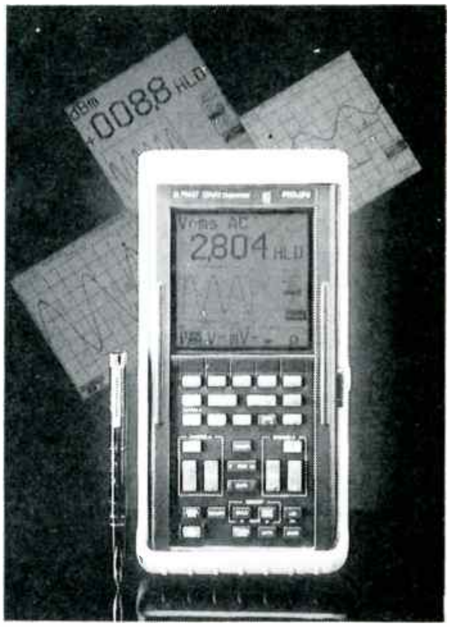

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THE SERVICEMAN

The rifleman, the duck hunter and a way to rejuvenate old valves

If you're wondering about the two gun-toting individuals in the heading, they're actually the same bloke — me, as you'll discover when this month's first story unfolds. I was almost driven to take a gun to the set concerned, too!

It all began when a colleague brought in a Thorn model 9001 colour TV and asked if I would be prepared to try to fix it for him. It was fitted with a Mitsubishi 'K' chassis, a development from the earlier 'G' chassis.

He had been working at it, on and off, for a fortnight and was now thoroughly fed up with it. I knew before I started just how he felt, and when I'd finished I knew even better the frustrations of going round and round in circles and learning nothing new each time round.

The symptom was 'No Colour' most of the time, with only rare periods of not very good colour. Nothing could be done to provoke the return of colour — neither vibration, nor heating, nor cooling had any effect. The set seemed to choose its own time to show colour, and its own time to turn the colour off. It was as good as a permanent failure, at least from the servicing point of view.

My friend had checked the voltages around IC602 (the subcarrier oscillator) and IC603 (the demodulator) and had found one voltage dramatically different to those shown on the circuit diagram.

This was at pin 16 on IC602, which was showing 10.15 volts instead of the 1.77 volts specified. He looked at the waveforms around the 4.43MHz crystal and found that the oscillator was running, but with what he felt was a substantially reduced amplitude.

He had tried changing the chip, and then the crystal, but without any success. He had checked many of the resistors and capacitors in that area, but still without success. It was at about this time that he decided that a new approach was needed, and another technician was really the best way to get that new approach. And that was how the set landed on my bench.

I began my investigations by confirming most of what he had found. Then I went one better.

I set up a table of voltages listed for all pins on all three IC's on the video board. This included IC601, a bandpass amplifier ahead of the two already mentioned. This gave me a list of 48 voltages (3 x 16 pins), and told me what I should expect as I worked my way around the circuits.

One thing I have found useful for this type of work is a small cassette tape recorder with a built-in microphone. I set the recorder running, then went round the circuit with a meter, speaking aloud the voltages on each pin as I measured it. This way I didn't have to interrupt my measuring to note down the voltages. It was all going onto the tape.

After I had taken all the voltages I needed, I rewound the tape then played it back while I wrote the values against each pin number on the list previously prepared. Wherever there were differences, I highlighted them with a marking pen, which made them very easy to pick up later.

When my list was complete, it showed up *five* pins that were nowhere near the rated value. Three of them were on IC601, the bandpass amplifier, and the other two were on the oscillator chip.

Pin 3 on IC601 was reading 15.1 volts, instead of 0.01V. Pin 10 was 10.15V instead of 1.77V, and pin 14 was 8.5V instead of 0.01V. On IC602, pin 13 was showing 3 volts instead of 0V. And of course pin 16 had 10.15V instead of 1.77V, as my colleague had found.

Now I had to see what I could make of all of this.

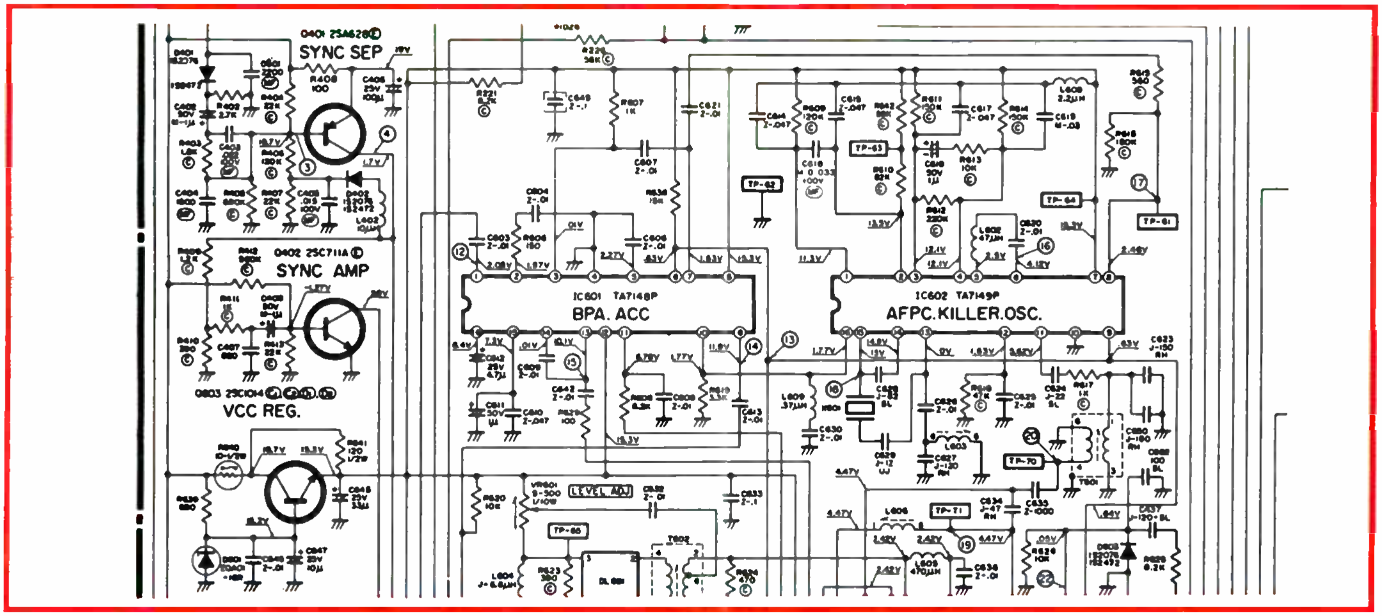
One of the voltages was easy to explain. Pins 10 on IC601 and 16 on IC602 are tied together, so it was natural that they should be at the same voltage — even if it *was* the wrong one.

There were three wrong voltages on the bandpass amplifier chip, so it seemed a possibility that the chip could be faulty. It took only a few moments to change it over, but all that proved was that changing the chip was a waste of time.

I checked all the resistors around IC601, but found nothing unusual. My friend had already checked those around IC602, which left only IC603 as the not-very-likely source of trouble. I changed that chip, and also checked the relevant resistors while it was out of circuit. Nothing!

After all of this, I could say with confidence that the fault was not going to be revealed by any DC measurements. This left only AC measurements, and for these my CRO was going to be invaluable.

To open the account, I reviewed my memories of old classroom lectures. Just



The colour decoding circuitry of the Thorn model 9001 colour TV receiver, which gave the Serviceman considerable difficulty in this month's first story. The set simply wouldn't produce a colour picture, and the cause was very elusive!

what was needed to produce colour? Well, a chroma signal, of course, and subcarrier bursts. But also some kind of reference pulses from within the set, to gate the bursts.

In fact, the burst looked a very likely candidate in the present troubles. It is needed firstly to synchronise the subcarrier oscillator. Then it also provides the ident signal that locks the PAL phase. And finally, its presence is necessary to unlock the colour killer.

So if there is no burst, there can be no colour, even if everything else is perfect. I began by looking first for the gating pulse input, and then for a burst signal output.

In most colour sets, the gating pulse is derived from the line output stage. In these sets, colour can only be displayed on a properly locked monochrome picture. In the 'K' chassis however, the burst is gated by sync pulses, so that colour can be displayed even on an unlocked picture — should the horizontal oscillator be off frequency.

This discovery led me back to Q401, the sync separator transistor. I guessed that this was working correctly, because the picture was properly locked and stable. The important thing was that it gave me a reference, that I could trace through to the appropriate chip pin.

It also allowed me to use the CRO's dual beam facility, to check the time delay between the pulse out of the sync separator and its application to the burst gate input to IC601. This proved the integrity of the delay network around C643/644, L607 and D602.

I had a look at some of the other waveforms around the chips, but they made little sense. There were no waveforms shown on the circuit diagram, which was one of the reasons my friend had given up on the job.

I had *one* advantage over him, though. I had a copy of the service manual for the 'K' chassis, rather than just the circuit diagram. The manual included an outline of the chroma circuitry, although it lacked much of the detail that I would have subsequently found useful.

Nevertheless, the description showed me where to look for chroma, for keying pulses, and for the burst gate waveforms. The manual also included various waveform diagrams, although these were so poorly printed as to be of little real value.

It was the peak-to-peak values clearly printed under each diagram that was of most use. With this information, it took no time at all to find that most of the inputs were correct, but that almost no processing was going on in the circuit.

There was normal chroma information going into pin 1 on IC601. The gating pulses were correct on all three chips. The subcarrier oscillator was running, although its output was less than half of the specified amplitude. And finally, the burst seemed to be appearing normally at pin 13 on IC601.

The chroma block diagram showed that the burst was fed not only to the decoder chip IC603, but also back into IC601 at pin 14. Yet this pin was one of those that I had found to be presenting a significantly wrong voltage.

Inside IC601, pin 14 was shown as feeding the ACC stage, which in turn controlled the ACC amplifier, whose output signal appears on pin 3 — another of those that I had found with wrong voltages.

What's more, pin 3 should have shown a replica of the chroma input on pin 1. But it carried nothing like that. The only waveform I could detect on pin 3 looked for all the world like a series of burst pulses.

When I compared this output with the luminance signal, I realised that the pulses corresponded to the chroma transitions from one colour to the next, in the colour-bar output of my pattern generator. Each time the subcarrier phase changed, it was somehow allowed through the ACC amplifier.

At this point I reviewed what I had learned about the problem.

I had chroma going in, but only very weak and distorted chroma coming out. I had what looked like a normal burst, and a working subcarrier oscillator. So if I could somehow defeat the colour killer, I should see colour on the screen — and perhaps that might guide me toward the true nature of the fault.

Unfortunately the 'K' chassis has no killer threshold adjustment, and hence no easy way to change its function. The only useful control is VR620, labelled as 'Sub Colour'.

When I turned that up full bore, I found that there was a trace of flickering colour on the screen. This responded to adjustment of L603, and I was able to get the subcarrier to float around what seemed to be a steady 4.43MHz. But it wouldn't lock.

It seemed to me that the main problem

[illegible]

was that there was no chroma coming out of the ACC circuit. It looked like a classic 'lock-out' situation — no chroma out because there was no chroma out to unlock the killer. Except that, from the block diagram, the killer had nothing to do with the ACC bias.

I spent quite a long time looking carefully at the circuit diagram and wondering what kind of component fault could cause 'no colour'. Somehow, I felt that those wrong DC voltages must be a clue, yet I was satisfied that they must originate inside the chips — nothing I had found so far suggested an external cause. Still, until I *found* the cause, I had to keep trying. So I decided to remove components from the board, for more accurate tests.

Eventually, I settled on two electrolytic capacitors around IC601, and several high value resistors associated with the oscillator in IC602.

I removed C612, a 4.7uF 25V electro on pin 16 of IC601. This tested OK, but I don't trust low value electros, so I replaced it with a new one. It made no difference.

I did the same with C611, a 1uF 25V cap. This was an even more likely candidate for 'wrong value', but it too tested perfect and its replacement was of no more use than the previous one. All the resistors around IC601 were fairly low value items, and all checked out more or less perfect while in circuit. So I moved on to IC602.

This had R611 and R614, both 150k ohms, and R612 of 220k ohms, each feeding the subcarrier oscillator and the auto phase control circuit inside the chip. If any of these were significantly off- value, it could conceivably make the oscillator run at the wrong frequency — crystal control notwithstanding.

In-circuit testing gave all sorts of funny values for these resistors, so I took them out of circuit for more precise checks. There was nothing wrong with any of them.

Then I thought of my frequency counter, and wondered if that would show me if the oscillator was running at the right frequency. I have found this a useful test on a great many sets, but it won't work on all of them. This was one of the minority. Or perhaps it was the unusually low amplitude of the oscillator, that wouldn't trigger the counter. I don't know, but that test was inconclusive.

Up to this point, I had been rather like a rifleman, targetting individual components and not surprisingly, missing most of them. I had certainly missed the faulty component. It began to look as though I needed to adopt the 'duck hunter' approach — use a shotgun to scatter pellets all over the board.

This decision was influenced by the difficulty in removing and replacing the board, each time I wanted to change or adjust a component. Getting the board out required the removal of no less than nine plug and socket assemblies, and three plastic hinge clips.

Replacement was a reversal of this process, complicated by the fact that some of the plug pins were out of sight. It was easy to mis-assemble them, leading to all kinds of weird symptoms. I had already broken and repaired three of the flying leads, and I was just about fed up with the whole deal.

So I loaded my shotgun. I planned to replace every component around the chroma stage. I had already changed the chips, the crystal and the electrolytics. Now it was time for the resistors and capacitors.

It was while I was checking to see if I had all the required parts that I realised that I hadn't yet tested any of the small

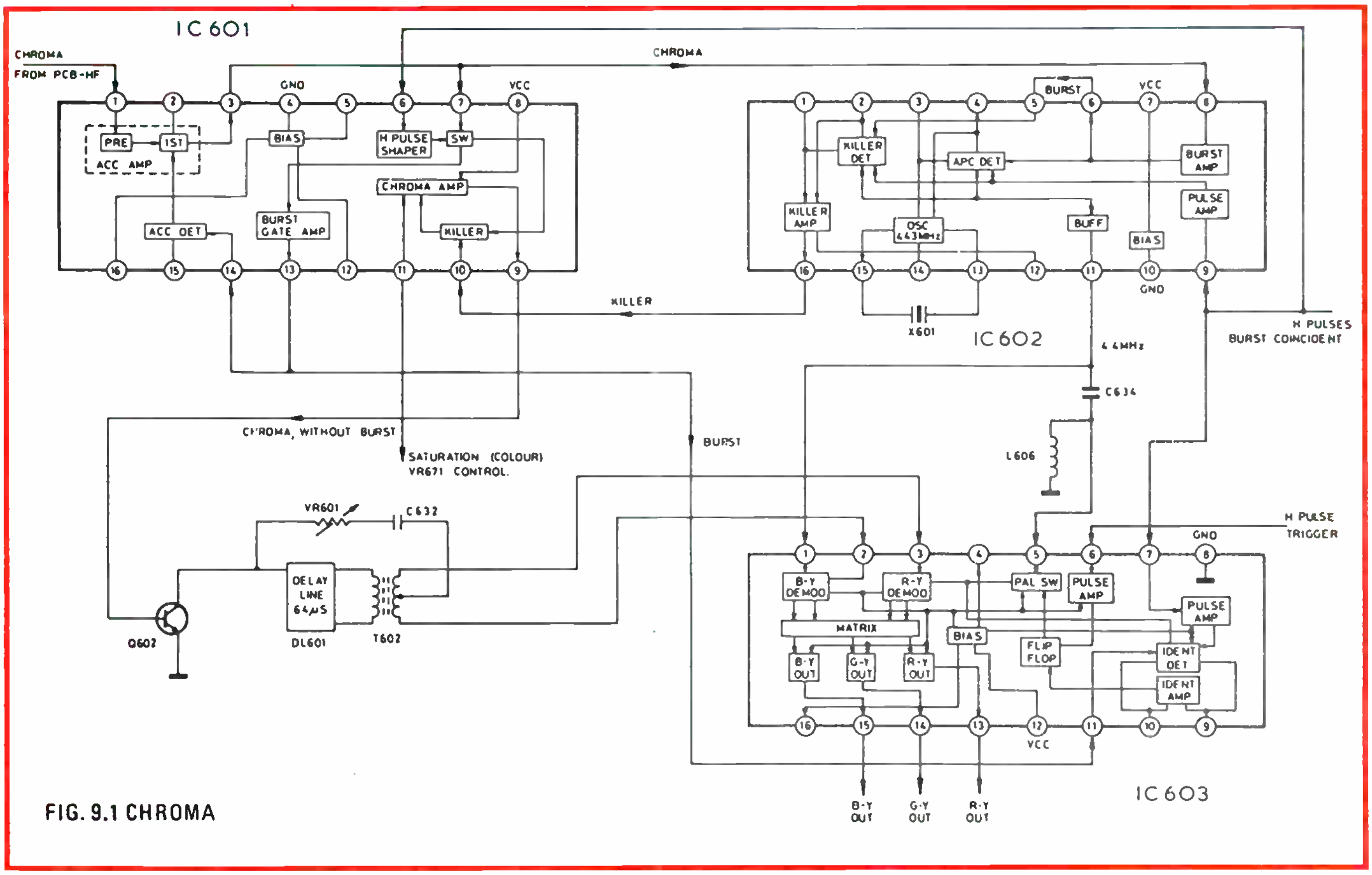


FIG. 9.1 CHROMA

Here's a block diagram of the Thorn's colour decoding circuitry from the service manual. It helps in understanding how things work, especially inside the IC's.

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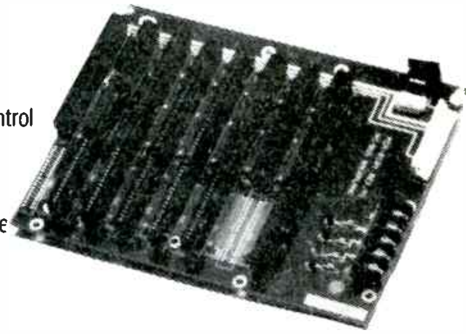

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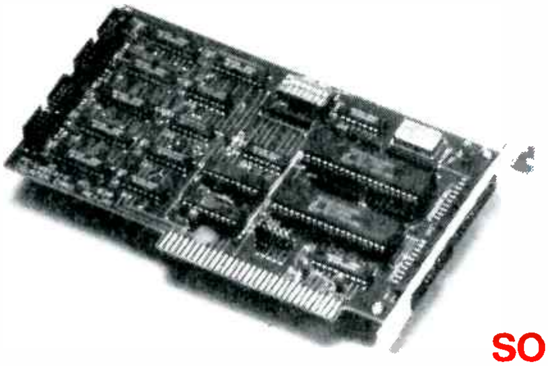

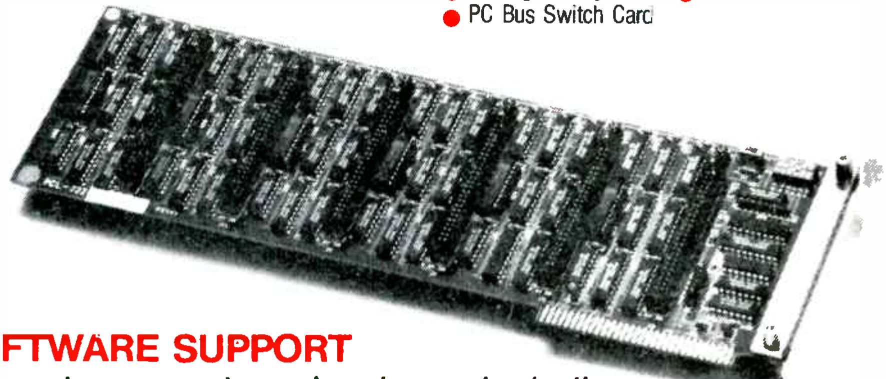

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Table of Voltages

PIN	IC601 Bandpass Amp.)		IC602 (S-C Osc, killer		IC603 (Demod-ulator)	
	A	B	A	B	A	B
1	2.06	2.07	11.30	13.00	4.40	5.90
2	1.97	1.92	13.50	12.70	2.42	2.73
3	0.01	(15.5)	12.10	12.50	2.42	2.73
4	GRND	0.01	12.10	12.50	2.42	2.73
5	2.27	2.34	2.50	2.44	4.47	5.00
6	0.63	0.64	4.12	3.12	0.05	0.05
7	1.63	1.66	15.30	15.50	0.64	0.64
8	15.30	15.50	2.46	2.42	GRND	0.01
9	11.90	12.38	0.63	0.64	2.80	12.17
10	1.77	(10.1)	GRND	0.01	10.30	12.24
11	6.76	8.40	5.62	4.60	2.42	2.74
12	15.30	15.50	1.63	1.70	15.30	15.50
13	10.10	9.90	0.00	(3.00)	10.40	9.93
14	0.01	(8.50)	14.90	15.10	10.40	10.00
15	7.30	7.86	15.00	15.20	10.40	9.82
16	8.40	8.57	1.77	(10.1)	4.47	5.02

In each case, column A shows specified voltages from the circuit diagram while column B shows the voltages measured in the fault condition. The voltages in brackets are those noted as significantly wrong.

capacitors. I have had a generally good run with small caps. They rarely fail in a way that is not immediately obvious. But then I recalled reading a video recorder service tip that recommended replacing all 'brown disc ceramic' caps, on one or other of the boards. The caps in this set weren't brown, but they *were* disc ceramics.

So on the basis that if I was going to replace everything, then these were as good a place as any to start, and I set about removing all the small ceramics around the bandpass amplifier. I planned to work around each chip in turn, until either the fault was solved or I ran out of patience.

It turned out that there were a dozen 10nF caps, and one 47nF cap associated with IC601. I replaced them all with brand new 'greencaps', then cleaned up the board and replaced it in the chassis.

And that was it!

When I switched on, the screen came up with quite reasonable colour. I had to reset the sub-colour preset and the front panel colour control, but after that I had a near-perfect picture. I let the set run for the rest of the day, but there was no sign of any loss of colour. I also rechecked the amplitude of the subcarrier oscillator, but found no improvement. I can only assume that the value assigned in the manual is wrong, or else it's variable and thus not very important.

So I can't tell you which of those 13 small caps was the faulty one. I suspect that it was one of those around the bandpass amplifier part of IC601. If the board had not been so awkward to remove and replace, I might have changed each one back, one at a time and thereby found the guilty party. But after spending so many hours taking pot-shots at individual components, I feel I was justified in using the duck hunter approach. Even if it does mean that I can't tell you precisely which pellet brought down the target!

Now, to round out this month's pages, here is a short story from one of our regular contributors. It's from L.K., of Daintree in North Queensland.

For a while I was wondering if I shouldn't pass this one over to my colleague Peter Lankshear who writes the 'Vintage Radio' column. The subject is relevant to his material, and may well answer a few problems for his readers. But then L.K. is a serviceman, and the story is about servicing, in a way. So here it is, on the Serviceman's page:

From time to time there are jobs which a serviceman tackles for no remuneration; sometimes voluntarily, and sometimes unwittingly. The former are usually done out of curiosity, amusement or necessity. The story that follows involved all three.

It started when a friend of mine, an auto electrician by trade, arrived at my home one wet Saturday afternoon with an old 6V6-G valve in his hand. I winced inwardly at the sight, but actually I should not have done so. He had helped me with a couple of favours some weeks previously, by way of overnight repairs to the service van, so this time it was my turn.

As a hobby, my friend had been restoring a vintage model Healing 'Golden Voice' console radio. It transpired that the task had been completed recently, and although the set operated quite well initially, the volume slowly decreased over time until it became barely audible.

Furthermore, he had correctly diagnosed the cause to be low emission of the old output pentode, now cradled carefully in his hand. His hope was that I might have "...an old one in the junk box?"

He might well have been right, but an extensive search failed to unearth one, or even a suitable substitute. What I did find, however, was a piece of homemade equipment that I used back in the black and white days for rejuvenating weak picture tubes. I had never before used it on normal valves of any kind, but curiosity began nagging at me. We discussed the possibilities over a cup of coffee. It was a rainy day, my friend felt he had nothing to lose, and I felt like 'having a go' — so that settled it.

These 'CRT rejuvenator' devices were at one time quite common about the trade (and still are, in a more elaborate form — Ed.), *and generally consisted of a filament transformer tapped at 6.3V, 7.5V and 9V, together with some form of HT supply around the 200V mark.*

Mine was constructed in an old wooden meter case, with a set of flyleads emanating from one side, terminated in an eight-pin CRT socket.

When fitted to the picture tube, all the elements were tied to the positive side of the HT supply through a 15 watt 240V lamp. The cathode of the tube was returned to the negative terminal.

The front panel was rather unimpressive, consisting simply of a filament voltage selector switch, an AC switch to the filament transformer only, and a means of viewing the lamp.

There were probably as many versions of this device as there were methods of using them, hence I make no claims for my own system other than to say that I used it often, with excellent results.

In operation, the HT supply remained on for the duration of the rejuvenation and the filament voltage turned on at the lowest tapping, while watching the lamp for any sign of redness.

Usually nothing happened and one then tried the 7.5V tap, or if necessary the 9V tap. At the first sign of a glow, the AC supply to the filament was cut until everything cooled down, then the whole process started over again. The object was to have the lamp glow on the 6.3V setting. At this point the low emission is

Continued on page 96

Fault of the Month

Philips CT6050 (CTO-S chassis)

SYMPTOM: No picture. Sound is OK, and the full EHT and focus supplies appear to be normal. All voltages on the base of the pix tube are present, although the output transistor collector voltages are higher than usual.

CURE: Replace R3050, a 2.7 ohm 1/4W fusible resistor off the line output transformer. The fault is really 'no vertical scan', but at normal brightness level the resulting horizontal line is not visible. This resistor feeds the 25V rail that runs the vertical stage; there is no apparent reason for it going open circuit.

This information is supplied by courtesy of the Tasmanian Branch of The Electronic Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015

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RITRONICS WHOLESALE
56 Renver Road Clayton
Phone (03) 543 2166 (3 lines)
Fax (03) 543 2648

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CPF CONTINUOUS POWER FILTER SPIKE ARRESTOR

The Fortron CPF Filtered Electronic Spike Protector provides a protective electronic barrier for microcomputers printers, telephone systems and modems electronic typewriters audio and stereo systems and other sensitive electronic equipment

The CPF provides protection from dangerous electrical spikes that can cause anything from obvious damage (like immediate equipment failure) to less obvious harm that can drastically shorten a system's life

CPF's superior circuitry design and semi conductor technology responds instantly to any potentially damaging over-voltage ensuring safe trouble free operation

Additionally CPF's filtering capability helps eliminate troublesome and annoying interference, general hash created by small motors fluorescent lamps, and the like that threaten the performance and shorten equipment life of unprotected electronic components

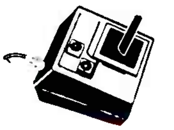
SPECIFICATIONS:
Electrical rating: 220-260 volts (AC) 50Hz 10 Amp
Spike/RFI Protection: 4 500 amps for 20m second pulses
Maximum clamping voltage: 275V differential mode

Cat.X10088 .... $69.95

DATALIFE DL-600 DATA CARTRIDGE

Stores up to 120 M/Byte

C12614 .... $59.00



JOYSTICK FOR IBM

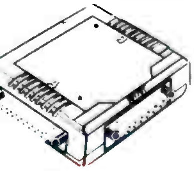
Features selectable "spring centring" or "free floating". Electrical trim adjustments on both axis. 360 degree cursor control

C14205...........$49.95

APPLE* COMPATIBLE JOYSTICK

Ideal for games or word processing. fits most 6502 "compatible" computers.

C14200.............$29.95



POCKET AUTO AB SWITCHES

- Pocket size, auto-scanning
- Allows 2 PCs to share one Printer

Serial model:
MS-201 - Host-powered
X19150.................$79.95
Parellel model: MP-201
Protocol transparent
X19155.................$89.95

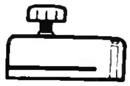
☆☆☆☆☆

RS232 BREAK OUT BOX

A simple way of monitoring RS232 interface lead activity Interface powered, pocket size for circuit testing, monitoring and patching 10 signal powered LED's and 2 spares 24 switches enables you to break out circuits or reconfigure and patch any or all the 24 active positions

SPECIFICATIONS:
Connectors: DB25 plug on 80mm ribbon cable and DB25 socket
Indicators: Tricolour LED's for TD RD, RTS, CTS, DSR, CD TC, RC, DTR, (E)TC
Jumper Wires: 20 tinned end pieces
Power: Interface power
Enclosure: Black, high impact plastic
Dimensions: 85 x 95 x 30mm

X15700 .... $99.95



DISK NOTCHER

Converts 5 1/4" single sided floppy disks to double sided, by placing an appropriate notch in the floppy disk jacket.

C21070................. $7.95

THE BUTTON SPIKE PROTECTOR

Surges and spikes are caused not only by lightning strikes and load switching but also by other equipment being switched on and off such as fluorescent lights electric motors fridge freezers air conditioners etc

For effective protection such spikes must be stopped before they reach your equipment Simply plug The Button into an outlet and it will protect all equipment plugged into adjacent outlets on the same branch circuit The Button employs unique metal oxide varister technology and will dissipate 150 joules of electrical energy (nearly twice that of comparable surge arresters)

SPECIFICATIONS:
Voltage 240V Nominal
Total Energy Rating 150 joules
Response Time 10ns
Protection Level 350V peak

$42.95

MAGIC STAGE

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

C21080 On special was $24.95
Now.......$14.95

SURGE BUSTER

6 PROTECTED POWER OUTLETS
Ideal for protecting personal computers, video equipment, colour TVs, amplifiers, tuners, graphic equalisers, CD players etc

SPECIFICATIONS:
- Electrical rating: 240V AC, 50Hz, 10A
- 3 x Metal Oxide Varistors (MOV)
- Maximum clamping Voltage: each MOV: 710 volts at 50 amps
- Response time: Less than 25 Nanoseconds.

X10086 .... $69.95

QuickShot joysticks

Quick Shot offers the most complete selection of video game controllers in the market. Models are available to suit all the most popular video game machines and just about any playing style.

QS-123 WARRIOR 5
IBM COMPATIBLE (15 PIN
C14208..........$59.95
APPLE & IBM COMPATIBLE (9 & 15 PIN CONNECTORS)
C14211..........$62.95

QS113PC IBM PACK INCLUDING JOYSTICK ADAPTOR CARD (15 PIN)
C14216..........$59.95

QS-123 PC IBM PACK INCLUDING JOYSTICK ADAPTOR CARD (15 PIN)
C14217..........$74.95

QS-129N/F SPACEAGE CONTROL NINTENDO & MULTISYSTEM COMPATIBLE (7 OR 9 PIN)
C14214..........$39.95

QS-130N/F DELUX DIGITAL NINTENDO & MULTISYSTEM COMPATIBLE (7 &9 PIN)
C14209..........$39.95

QS-131 NEW BASIC ATARI / COMMODORE -9 PIN
C14218..........$19.95

HS-3000 HANDY SCANNER INCLUDES FREE SOFTWARE! PC PAINT BRUSH & IMAGE TOOL

- Wide 4.13" (105mm) Scan width
- 100/200/300/400 switchable DPI resolution
- Four encoded modes: B/W and three half tone patterns.
- Thrity-two shades of grey.
- Built in scanner view window for accurate scanner placement.

X19945.................. $269

Only a few left!

GENI SCAN COLOUR SCANNER

The GS-C105 Colour scanner scans any colour or black & white image into your IBM PC AT, PS-2 or compatible system without loss of hue.

FREE SOFTWARE!
Draw shapes, modify objects alter colours & edit a palette of 256 colours using the commands on your pop-up menus. You can even design your own font type size.

- 105mm scan width, multi scan up to 300mm
- 64 shade levels

X19930..................$795

DUST COVER

Keep your computer and accessories free of dust and grime while not in use

XT* Cover Set
C21066......................$14.95
AT* Cover Set
C21068.................$16.95

HEAD CLEANER DISKS

It only takes a minute amount of dust, dirt or magnetic oxide particles on your drive heads to cause problems: errors, downtime or an expensive service call. Regular use of a head cleaner will keep your drive free of trouble causing dirt and help keep your system up and running. These disk cleaners are simple to use, and include cleaning solution and instructions.

- 3 1/2"
C12560................$6.95
- 5 1/4"
C12555 .... $6.95

HAVE THE CUTEST MOUSE IN THE HOUSE WITH THESE GREAT NEW PRODUCTS!

MOUSE COVER

Be the first in your office to have a mouse that every one will want use. This cute little mouse cover puts a bit of fun and colour onto your desk while keeping your mouse free of dust!

C21069.......................$7.95

MOUSE CLEANING KIT

Keep dust and dirt from damaging your mouse with this handy mouse cleaning kit. This special rounded tool will find its way into all the hard to get at places. The kit also comes with cleaning fluid and 5 soft cloths to keep your mouse spotless!

C21071................$9.95

MOUSE KIT

Everything you need to keep your mouse happy! You get a mouse pad, a mouse holder, a cleaning kit (previously described) and a cute little mouse cover.

C21072..................$16.95

MOUSE GIFT SET

Here it is! The ultimate mouse kit. You get all of the above products, the cute little mouse cover, the mouse cleaning kit, the mouse house and mouse pad all in a handy black case.

C21074..................$19.95

COMPUTER CLEANING KIT

To gain optimum performance and prevent damage to valuable disks, this cleaning kit has all you need to keep your computer in top notch performance. Anti-static cleaning pads, cleaning swabs, cleaning solution, 5 1/4" & 3 1/2" cleaning diskettes.

C21077..................$19.95

WE HAVE ENLARGED OUR RANGE OF COMPUTER PAPER!

Introducing ComPstat!

High quality 70 gsm, convieniently packed continuous fan- fold computer paper. Comes in packs of 250 or 500 sheets in two sizes. 279mm x 241mm and true A4. Very useful for photocopying computer print-outs without having white space on the top or bottom of the page.

279mm x 241mm
250 sheets
C21006...........$9.95
279mm x 241mm
500 sheets
C21007.........$16.95
True A4
296mm x 210mm
250 sheets
C21008.........$14.95
True A4
296mm x 210mm
500 sheets
C21009.........$19.95

KEYBOARD EXTENSION LEAD

5 Pin Din plug and socket

P19038................... $9.95

☆☆☆☆☆

ROD IRVING ELECTRONICS

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ROD IRVING ELECTRONICS

★★★GREAT RANGE! GREAT PRICE!★★★

MONITOR MOVER ARM
Position your monitor exactly where you want
- Maximise desk space!
- Solid steel structure
- Span 33cm
- Tray 30cm (tilting +/- 15)
- Desk clamp range 3cm -7.5cm
- Maximum load 50 kg

C21079................$199

FAX ROLLS

	1-9	10+
C20092	$9.95	$9.50
Size: 210 x 11.5 x 30m		
C20094	$9.95	$9.50
Size: 210 x 25.4 x 50m		
C20096	$19.95	$17.95
Size: 210 x 25.4 x 100m		
C20098	$9.95	$9.50
Size: 216 x 25.4 x 30m		
C20100	$11.95	$11.50
Size: 216 x 24.4 x50m		
C20102	$9.95	$9.50

RIBBONS
BARGAIN!

PRINTER RIBBONS TO SUIT:

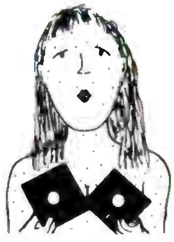
- CP80, SX80, DP80, BX100, BX100, MB100,

	1-9	10+
C22036	$19.95	$17.95
MX80, FX80, RX80, FX800, MX70, MX80, LX800.		
C22031	$16.95	$15.25
MX100, FX100, RX100, LQ1000		
C22002	$19.95	$17.95
LX80		
C22003	$12.95	$11.95
CITOH 8510 - 1550		
C22051	$13.95	$12.50

NATIONAL PANASONIC KXM110 PRINTER RIBBON
C22034..................$19.95

IBM PRINTER LEADS
- SUITS IBM* PC/XT, COMPATIBLES
- 25 PIN "D" PLUG (COMPUTER END) TO CENTRONICS 36 PIN PLUG.
- 1.8 meters
P19029.......................$14.95
- 3 metres
P19030.......................$19.95
- 10 metres
P19034.......................$39.95

ROD'S COMPUTER TIPS



HOW TO INSTALL YOUR PROTECTION
Before you catch a virus like this unfortunate girl, put on your write protects! It's simple! Here's how to do it.

3 1/2" DISK.
On a 3 1/2" disk you have to slide open the plastic tab to reveal the write protect hole.

5 1/4" DISK
On a 5 1/4" disk you have to cover up the notch as shown in the side of the disk with your protective device called a write protect tab. They usually come in black or silver. Transparent tabs should not be used because write protects work optically.
Regards
Rod irving.

CANON LASER CARTRIDGES
BRAND NEW CARTRIDGES

Why waste your precious time & money trying to get a quality print out from a "recharged" cartridge when you can buy a brand new Canon laser cartridge from Rod Irving for only $199.00!

EP CARTRIDGE FOR SIDE LOADING PRINTERS
C21107.......................... $179

EP-L CARTRIDGE FOR FRONT LOADING PRINTERS
C21109.......................... $179

EP-S CARTRIDGE FOR TOP LOADING PRINTERS
C21108.......................... $179

COMPUTER CASES
NEW TOWER CASE!
Give your computer that professional look.
Both for $339
X11105...................$199
Power supply to suit (220W)
X11102...................$199

MINI TOWE R CASE
200 x 415 x 330mm with 200w power supply
X11100.......................$325

RITRON EXECUTIIVE CASE
X11089.......................$119
P.S to suit X11089.......$149

TOP OF THE RANGE AT EXECUTIVE CASE
For 386 & 486 systems
Includes power supply
X11101.......................$320

POWER SUPPLIES
POWER SUPPLY FOR IBM*, PC/XT*, & COMPATIBLES
DC OUTPUT: +5/13A -5 0.5A +12V /4.5 -12 V 0.5A
X11096......................... $129

200W SWITCH MODE POWER SUPPLY FOR IBM*, AT* & COMPATIBLES
DC OUTPUT : +5/16A -5 0.5A +12V/4.5 -12V / 5A -12/0.5A
X11097.......................$149

UV EPROM ERASER
It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less time for less chips)
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased

Without timer
X14950....................$99
With built-in timer
X14955.................... $169

KEYBOARDS
IBM*, XT*, TYPE 84 KEY KEYBOARD
X12020.........................$109

IBM COMPATIBLE EXTENDED KEYBOARD (101 KEYS)
X12022.........................$109

101 KEY TRACKBALL KEYBOARD
Keyboard & mouse in one
X12030......................$199.95

KEYBOARD STORAGE DRAWER
C21083......................$84.95

MINI VACUUM CLEANER
C21087......................$14.95

KEYBOARD COVERS
C21089 84 KEY...........$4.50
C21088 101 KEY...........$5.95

DISK BOXES
100 x 5 1/4" ECLIPSE
C16042.......................$11.95
40 x 3 1/2" ECLIPSE
C16040.......................$8.99
120 x 3 1/2" LOCKABLE
C16039.......................$21.95
100 x 5 1/4" LOCKABLE
C16020.......................$13.95
50 x 5 1/4" LOCKABLE
C16025.......................$11.95
120 x 5 1/4" LOCKABLE
C16028.......................$19.95

PRINTER SWITCHES
RS232-2 WAY	$39
RS232-4 WAY	$69
RS232-X OVER	$69
RS232-2 WAY AUTO	$69
CENTRONICS 2 WAY	$49
CENTRONICS X OVER	$69
CENTRONICS 2way auto	$79
CENTRONICS 4 WAY	$69

PRINTER STANDS
ENCLOSED PRINTER STAND
C21055......................$39.00

DELUX PRINTER STAND
C21058......................$89.00

WIRE PRINTER STAND
C21054....80 column.........$24.95
C21056....132 Column........$34.95

MICE
WITTY MOUSE
EVER POPULAR, LOW BUDGET!
FREE MOUSE DRIVER & POP UP MENU SOFTWARE!
X19950 ....$49.95

QUICK MOUSE
Microsoft Compatible
FREE mouse house & mouse mat Plus FREE pop up menu software
X19955......................$69.95

SUPER BUS MOUSE 2
DESIGNED TO FIT THE PALM OF YOUR HAND! GREAT FOR SAVING A SERIAL PORT!
2 FREE TELEPAINT DISKS!
X19951........................$119

TOUCH MOUSE
"A Stationary Breakthrough"
Use your finger instead of your mouse. Great for saving space. Ideal for laptops
only 10 left
X19960 ..SAVE $30......$8

MICROSOFT MOUSE
The top of the range!
Supports hundreds of applications.
save $70
FREE MICROSOFT PAINTBRUSH SOFTWARE BRINGS YOUR COMPUTER TO LIFE.
X19958 ....$175

IBM* CARDS
XT HD CONTROLLER	$129
AT HD CONTROLLER	$149
RS232/SERIAL	
CLOCK	$49
MONO COLOUR CARD	$76
MULTI O/I	$99
VOICE MAIL	$199
PRINTER CARD	$29
EGA CARD	$149
DIAGNOSTIC	$795
TTL/PRINTER	$89
RAM 2M AT EXT/EXP	$225
8M AT EXT/EXP	$325
FAX CARD	$595
4 PORT SERIAL	$129
2 WAY FDD CONT (360K)	$39
RS232/SERIAL CARD	$39
GAMES CARD	$29
AT S/P/G 1 S/P/G	$43
AT S/P/G 2 S/P/G	$49
4 WAY FDD CONT. (360-1.44M)	$129
2 WAY FDD CONT. (360-1.44M)	$80
CLOCK CARD	$39
SMART DRIVE ADAPTER IDE/FDC	$49
SMART DRIVE ADAPTER IDE I O FDC	$89
VGA CARD 16 BIT NO RAM	$199
VGA CARD 16 BIT 250K	$229
VGA CARD 16 BIT 512K	$269
VGA CARD 16 BIT (1 MEG)	$299
VGA CARD 8 BIT 256K	$139

CHECK OUT OUR HUGE RANGE OF PRINTERS ON SPECIAL!

	Head	No.of col.	Draft Speed	No./ Fonts	Price
LX-400	9 pin	80	180cps	3	$279
LQ-400	24 pin	80	180cps	3	$479
LX-850	9 pin	80	180cps	3	$395
LQ-850	24 pin	80	264cps	3	$950
LQ-1050	24 pin	80	264cps	6	$1050
LQ-550	24 pin	80	150cps	3	$625
LQ-1010	24 pin	136	180cps	4	$795
OKI 172	9 pin	80	180cps	3	$275
OKI 380	24 pin	80	180cps	3	$650
200-GX*	9 pin	80	213cps	5 colour	$479
GSX 140*	24 pin	80	192cps	6 colour	$779

LASER PRINTERS
OL400 LASER PRINTER
4 PAGES / MIN 25 FONTS $1,795
OL800 LASER PRINTER
8 PAGES / MIN 36 FONTS........... $2,495
OL840 POSTCRIPT LASER PRINTER
8 PAGES / MIN 35 FONTS........ $4,295

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VIDEO ACCESSORIES

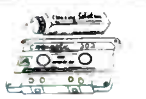
VHS VIDEO HEAD CLEANERS
New "wet ,dry, wet" system cleans and dries all parts which come into contact with the magnetic tape. Fluid is applied directly on to cloth cleaning tape prior to use. It uses clean tape for each cleaning operation. Low drag for use in sensitive mechanisims.
A11456........................$16.95

VIDEO / AUDIO TRANSMITTER
A small compact unit that allows transmission of video & audio signals (RF) to any TV set or VCR within range of 30 metres. Ideal for watching videos in the bedroom or kitchen without having to move the entire VCR or having long extention leads running through the house. Can also be used as a transmitter for a video camera. With power on/off switch audio and video leads and supplied with an AC adaptor.
A16150 Normally..$95.95
NOW ONLY.....$84.95

AUDIO ACCESSORIES

CRYSTAL LOCKED WIRELESS MICROPHONE AND RECIEVER
MICROPHONE SPECIFICATIONS:
Transmitting Frequency: 37 1MHz
Transmitting System: crystal oscillation
Microphone: Electret condenser
Power Supply: 9V battery
Range: 300 feet in open field
Dimensions: 185 x 27 x 38mm
Weight: 160 grams
RECIEVER SPECIFICATIONS:
Recieving Freq: 37 1MHz
Output Level: 30mV (maximum)
Recieving System: Super heterodyne crystal oscillation
Power Supply: 9V Battery or 9V DC power adapter
Volume control
Tuning LED
Dimensions: 115 x 32 x 44mm
Weight: 220 grams
Cat A10452 R.R.P. $113
Our price, $99

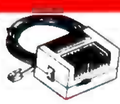
COMPACT DISC CASES
Packet of 3 standard replacement compact disk cases.
A10030........................$6.99



AUTOMATIC CASSETTE HEAD CLEANER
Cleans head (rec / pb) with mechanical action. Also cleans capstan and pinch roller at the same time
Includes bottle of cleaning fluid.
A10004........................$3.95

CASSETTE SALVAGE AND REPAIR KIT
(TA33)
Complete set of cassette parts. Also containing mylor splicing tape with splicing bar and razor blade.
A10009........................$3.95

TELEPHONE ACCESSORIES

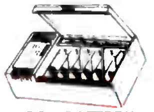


TELEPHONE EXTENSION BELL
Allows you to hear the phone ringing when you are outside.
Colour: cream.
5 metre length extension cord
Features US type plug.
Use with Y16025 US/ Australian adaptor.
Y16042........................$29.95

TELEPHONE EXTENSION CABLE WITH REEL
Allows 15 metres of telephone cable to be neatly wound in a portable storage container.
colour - cream.
Y16013........................$24.95

TELEPHONE BUG ALERT
Indicates if a third party is listening in to your telephone conversation
Green light indicates all is OK
Flashing red light indicates someone else is on the line
Complete with plug Aust/ socket for easy inline instalation.
Just mounts on to the side of the phone with double sided tape (sup.)
No batteries required, power is taken from phone line
Screwdriver supplied for adjusting and installing unit.
Y16019........................$34.95

ALUMINIUM TORCH
High strength corosion resistant aircraft grade
Durable anodised abrassion resistant finish
Non- slip knurled grip
Adjustable light beam angle
Keyring tail cap
Spare bulb -inside tail cap
mini size- 87mm long
A15066........................$9.95
pocket size- 150mm long
A15068........................$11.95



NBC-2 BATTERY CHARGER
Nickel cadmium battery charger for charging up to six batteries similtaneously.
Charges UM3, UM4, & UM5 nicads
Charging circuits are automatically selected depending on the physical size of the battery and the charger
Charging time 10 - 14hrs
240V AC mains operated
Requires NM4 or NM5 charging modules if UM4 or UM5 batteries are to be recharged.
M23523........$22.95

HEADPHONES

MINI STEREO EARPHONES
Impedance: 32 ohms
Sensitivity: 96dB
Freq. Response: 40 - 10,000 Hz
Cord length: 1.2m
A14006........................$4.95

POPULAR DELUXE HEADPHONES
These headphones have large soft ear cushions as well as having individual left and right channel volume controls.
A14005........................$34.95

INDOOR ANTENNAS

UHF/VHF/FM INDOOR TELESCOPIC ANTENNA
- High gain 75 ohm coaxial cable antenna with separate UHF & VHF dipoles
- Built In UHF/VHF mixer
- Frequency range 40-890MHz

L15033..............$24.95

INDOOR SPIRAL ANTENNA
- 300 ohm ribbon cable antenna
- Suits AM/FM tuners and portable TV's.
- 1 metre lead with 300 ohm spade terminals

L15040................$9.95

UHF/VHF/FM TUNABLE INDOOR ANTENNA
- 75 ohm coaxial cable antenna with separate UHF and VHF dipoles / receivers.
- Built in UHF/VHF mixer
- Frequency range: 40-890MHz

L15038..............$41.95

MIXERS

FIVE CHANNEL STEREO AUDIO MIXER
- Compact portable mixer with independant bass and treble controls and 2 power analogue output VU meters.
- 1 x low impedance microphone input
- 2 x stereo magnetic turntable inputs
- 2 x stereo line inputs
- Output sockets for both amplifer and tape deck.

A12013............$249.95

FOUR CHANNEL STEREO AUDIO MIXER
- Compact portable desk mount or panel mounting stereo mixer with 5 band graphic equalizer and twin LED display VU meters.
- 1 x low impedance microphone input switchable
- 3 x stereo magnetic turntable inputs switchable
- 3 x stereo line inputs-switchable
- Headphone monitoring on all channels
- 18 dB talk over switch
- Output sockets for both the amplifier and tape deck

A12012............$399.95

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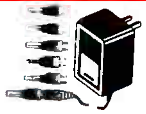

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When I Think Back...

by Neville Williams

Vintage Radio Receiver Design — 2: Batteries give way to mains operation

If the twenties saw the birth of radio broadcasting, no less importantly the end of the decade marked a quantum leap in receiver technology. From being the province of technicians, wireless sets became a piece of family furniture and, for urban listeners at least, the tedium and expense of batteries became a thing of the past.

As indicated in the last chapter, battery powered superheterodyne receivers made a noteworthy appearance on the market around 1925, setting new performance standards in terms of gain and selectivity — and to a degree, signal-to-noise ratio.

Their radically different circuit configuration and behaviour, however, prompted some buyer resistance in the marketplace, creating a demand for high performance receivers of less radical design.

For would-be purchasers, put off by the 'peculiarities' of 1926-vintage superheterodyne receivers, the obvious high-performance alternative was a conventional configuration, with at least two tuned radio frequency stages ahead of the detector and audio system — commonly described as a 'TRF' circuit.

Already a familiar term, 'TRF' acquired a somewhat broader connotation than in the days of the old regenerative 4-valvers (see previous chapter). In effect, it signified the alternative design approach to the superheterdyne principle. New receivers were either TRFs or superhets — a distinction that, as we shall see, carried over into the early 1930's.

In traditional form, with polished maple box and black bakelite panel, a typical TRF receiver with two RF stages called for three sets of coils, three separate variable capacitors and three separate tuning dials — one of each for the respective RF stages and the detector. To simplify tuning, the capacitors and coils would hopefully have been double-checked during manufacture, so that all three dials would end up at about the same reading for each individual station.

Some manufacturers went one better, by matching the tuned circuits well enough to allow the capacitors to be physically 'ganged' together and operated from a single tuning dial — a feature that became progressively more popular during the late 1920's (see Fig.1).

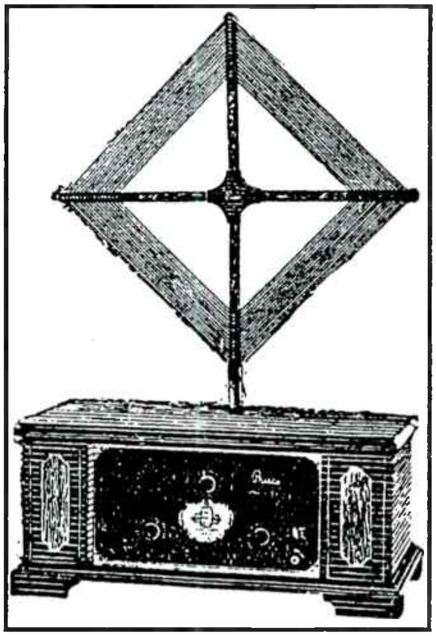


Fig.1: Announced in 'Wireless Weekly' for September 27, 1927, this 8-valve 'Priess De Luxe' receiver from Manufacturers Products boasted a frame aerial, single dial tuning and five RF stages, some untuned. The two-tone etched 'malloy' panel is said to give a 'refined appearance' and to combat possible hand capacitance effects.

Single dial tuning

In some cases the capacitors were lined up behind the dial, sharing a common shaft. In others, they were mechanically coupled by radial links, or by flexible concentric couplers (Fig.2). Yet another approach was to use a 'drum' dial mechanism, with two capacitors on either side, arranged with their axes parallel with the panel. With four capacitors, so driven, it was possible to accommodate three tuned RF amplifiers ahead of the detector.

In due course, component manufacturers progressed to the production of single-unit 2-gang, 3-gang and 4-gang tuning capacitors — even if these were not particularly rigid assemblies in the early stages.

But that was not the limit, with some receivers boasting five RF stages, some untuned (see Fig.1). Viewed from this remote point in time, one might be pardoned for wondering whether the untuned stages were always justified, or whether an important consideration was simply to add to the valve count to compete with 8-valve superheterodynes such as AWA's console model 'Super-8'.

As also indicated by Fig.1, some large TRF receivers were equipped with a panel-tuned frame aerial, offering the same directional properties as when used with a superhet.

As with simpler receivers having only a single RF stage, 'front-end' instability posed a considerable problem for the more ambitious TRFs. While due basically to the grid/plate capacitance within the triode RF amplifier valves, it was aggravated by the stray coupling be-

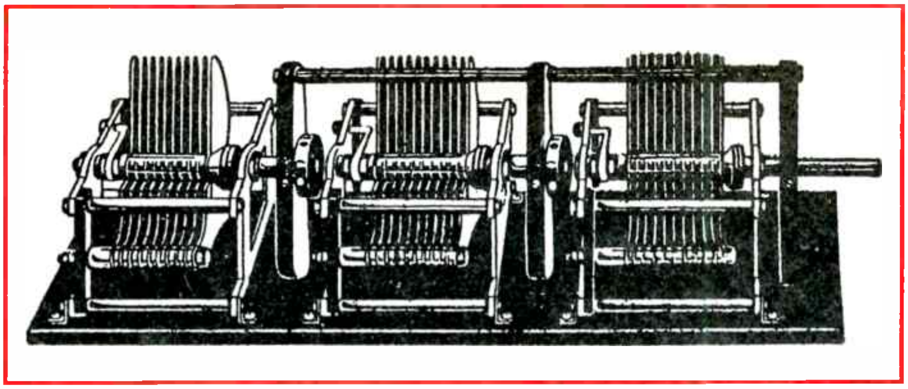


Fig.2: Typical ganged tuning condensers, as advertised by Murdochs, the one-time specialist mens store opposite the Sydney Town Hall. Prices for such assemblies varied with brand from about £3 to £6 — a week's wages, or more!

tween the multiple RF stages and particularly between the large, normally unshielded coils.

Attempts to combat the problem by using lower gain valves or deliberately reducing the 'Q' or goodness of the tuned circuits tended to limit the peak performance of the receiver. Alternatively, relying on filament rheostats to control the gain could prove confusing. In most cases, fitting a 'stabiliser' potentiometer, as explained in the last article, provided a more manageable method of control to meet particular situations.

The neutrodyne

Pending a fundamental cure for instability in the way of screen-grid valves (See *EA* June 1990, page 43), many designers resorted to the use of *neutralisation* — a technique that had been worked out in the early 1920's, but adopted only sparingly. (As reported in *The Australasian Wireless Review* dated August 1923, the 'Neutrodyne' principle was introduced 'recently' by Professor L.A. Hazeltine M.E., of the Stevens Institute of Technology, New York, to the Radio Club of America.)

In practice, the neutralising circuit took many forms, the most common being to tap and extend the winding supplying the anode of an RF amplifier such that the signal voltage at the lower end would be in opposite phase and, ideally, of equal amplitude to that at the anode. By connecting a small, adjustable capacitor between the lower end of the extended coil and the grid (Fig.3), it became possible to cancel the effect of the direct anode/grid capacitance.

Variations of the scheme included tapping and extending the grid winding instead, and returning the free end to anode via a neutralising capacitor.

Yet another approach involved phasing the interstage coupling transformers in such a way that the necessary neutralising voltage could be picked up from a convenient point in an adjacent stage.

Whatever the configuration, the purpose of a neutralising circuit was to introduce capacitive *negative* feedback around each RF stage, sufficient to exactly balance out the *positive* feedback resulting from the inherent anode-grid capacitance.

(At a time when positive and negative feedback, as such, were not part of the jargon, the failure of early experimenters to comprehend the idea is perhaps understandable!)

That aside, as applied to a generation of otherwise normal TRF receivers, Hazeltine's term 'neutrodyne' provided a measure of technical mystique which enabled them to compete to better advantage in the marketplace with 'superheterodynes'.

Over the years, the principle was applied to elaborate (e.g., 8-valve) receivers right down to simple — even reflex — designs with a single RF stage. In some cases, 'neutrodyne' was used purely as a descriptive term to indicate use of the technique; in others, it was featured on the front panel in the manner of a brandname. Neutrodynes, like superheterodynes, came in all shapes and sizes — some good, some very ordinary.

Adjustment procedure

Whether the average neutrodyne receiver operated to best advantage throughout its lifetime is another matter. Setting them up called for a critical adjustment procedure, which could all too easily be negated by well-intentioned but ill-informed experimenters.

Setting up typically involved tuning the receiver to a strong signal near the centre of the dial scale. Then, one by one, the RF amplifier stages would be disabled by disconnecting one filament supply lead or interrupting the connection within the socket with a scrap of cambric tubing. The valve itself would be left in position.

In the normal way, the signal would still be faintly audible, being fed through the disabled stage by the grid-plate capacitance of the inert valve and/or the neutralising circuit. The signal would normally increase as the neutralising capacitor was adjusted to either its maximum or minimum value, diminishing at some median setting.

The aim was to select the setting corresponding to minimum signal level, indicating that the grid-plate and neutralising capacitance were substantially cancelling each other in terms of signal transfer.

The routine would normally be followed for each separate RF stage. Other procedures may well have been specified for other circuit configurations, but it needs little effort to imagine how far astray the adjustments could have ended up at the hands of an owner/experimenter, curious to discover the effect of simply twiddling 'those curious little screw things'! (Fig.4)

Or, yet again, the effect of swapping valves around, or of substituting other

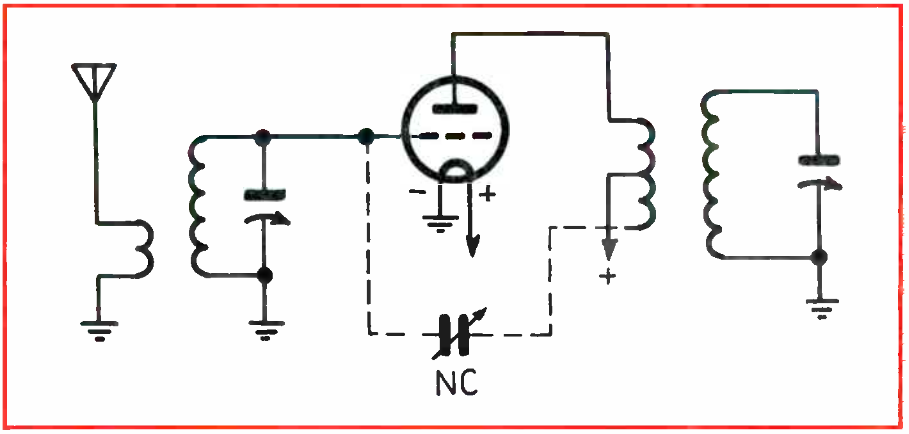


Fig.3: Perhaps the most common form of neutralising circuit, calling for an extended and centre-tapped anode feed coil.

[illegible]

types — without any thought to the fact that their grid-plate capacitance could be quite different from that of the valve for which the particular stage had been optimised.

Vintage receiver enthusiasts who may have occasion to restore a receiver using one or more neutralised RF stages should be aware of these considerations.

Why not mains power?

With its relatively uncomplicated controls, a receiver as illustrated in Fig.1 posed a standing invitation for any member of the family to switch on and listen through any program that happened to be on air. The one obvious deterrent was the knowledge that to do so would flatten the batteries that much sooner.

If only such receivers could be run from the AC power mains, like other domestic appliances. Unfortunately, it was easier said than done!

Of necessity, virtually all receivers produced up to about 1927 were designed around existing battery type valves which required the provision of pure DC voltages as under for the filament, the anode (or plate) and the grid:

- The 'A' or filament supply — 2, 3, 4, or 6 volts at up to 1.0 amp, or thereabouts.
- The 'B' or anode supply — nominally 22.5, 45, 67.5, 90 or 135 volts at up to about 20 milliamps.
- The 'C' or grid bias supply — typically in 1.5 volt steps up to minus 9 volts, with negligible actual current drain.

To obtain supply voltages of that order from the AC (alternating current) power mains required the use of a suitable step-down transformer, a rectifier to produce a unidirectional current, and a filter to smooth out the inherent ripple and ensure pure, hum-free DC (direct current).

Because of the relatively low anode current required by battery type valves, there was no particular problem in providing a suitable 'B' or high tension supply, such as the one pictured in Fig.5.

Of comparable dimensions to a couple of medium size B-batteries, a so called 'B-battery eliminator' could deliver a maximum supply voltage of around 130-150 volts, plus a selection of lower voltages corresponding nominally to those available from the intermediate tappings on ordinary B-batteries.

Perhaps it should be mentioned in passing that, while these intermediate voltages served the purpose, old-time experimenters were often puzzled because they appeared to be much lower than anticipated when measured on a voltmeter. The confusion was due to the fact that the low-resistance voltmeters of the day placed a heavy current load on the source being measured, reducing it to well below what it would have been when supplying the very modest drain of, say, a regenerative detector.

For safety's sake, commercial B-battery eliminators were designed to isolate the DC output circuitry completely from the mains potentials — although the isolation may not always have met the very strict specifications that currently apply to present-day mains-sourced supplies like battery chargers and plug-packs.

Curiously, an article on page 52 of *EA*'s 1927 *Wireless Weekly* reprint describes a home-made B-battery eliminator with no mains isolation transformer at all. While included, I understand, for its historical interest, readers should be warned NOT to attempt duplicating it, even for historical reasons. It could be positively dangerous to have lying around, because of the direct connection between B-minus and one side of the mains!

Some B-battery eliminators also provided a range of negative bias voltages, to obviate the need for a C-battery.

While this was technically easy enough to arrange, it was equally no big deal; C batteries were relatively inexpensive and, with virtually zero current drain, could be expected to last for their shelf life.

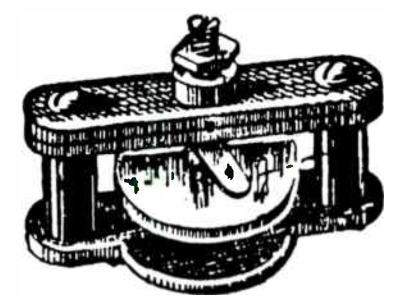


Fig.4: Pictured here about actual size, neutralising condensers (capacitors) offered an open invitation for experimenters to 'fiddle', often to no good purpose.

Filament supply

The real problem for all-mains operation was to supply the valve filaments. While it would have been no problem at all to step the mains voltage down to 2, 3, 4 or 6 volts, the filaments could not be supplied with raw AC for two main reasons:

Firstly, with the respective ends of the filament swinging plus and minus by the peak value of the AC waveform, the end effect would be rather like having a substantial 50Hz AC signal superimposed on the wanted program signal, causing a prominent 50Hz hum. This problem can be alleviated, but not eliminated, by earthing the filament circuit at an exact centre-tap rather than either end.

The second problem was that, by design, the filaments in battery valves were relatively small in diameter, to minimise the amount of current required to heat them to incandescence.

When fed with AC, the filament temperature tended to vary over each successive half-cycle and, with it, the electron emission. Therefore, quite apart from the spurious signal problem, as above, the emission — and basic efficiency — of the filament would be modulated at the half-cycle rate: 100Hz.

These days, with solid-state rectifiers and other technology, and with very high value electrolytic capacitors readily available, an adequately rectified and filtered A-supply would doubtless be practical — but back in the 1920's, rectifiers were clumsy and inefficient and capacitors larger than 4uF were hard to come by. The most practical answer was to rely on a conventional lead/acid battery or 'accumulator' to supply the filaments — kept 'topped up' by a small or 'trickle' charger connected permanently in circuit.

While this arrangement could be provided by the set owner using separate components, the battery service department of the Clyde Engineering Company, Sydney, made it a little less cumbersome with the self-contained unit illustrated in Fig.6.

Containing an isolating transformer, an electrolytic rectifier and either a 4-or 6-volt accumulator, it was self-regulating and could be left connected permanently to the power mains and the receiver. The only maintenance required was the occasional addition of distilled water to the cells and rectifier.

Because of the buffering effect of the storage battery, the DC output voltage varied little from the expected value and, according to the advertisement, mains hum was 'at all times negligible'.

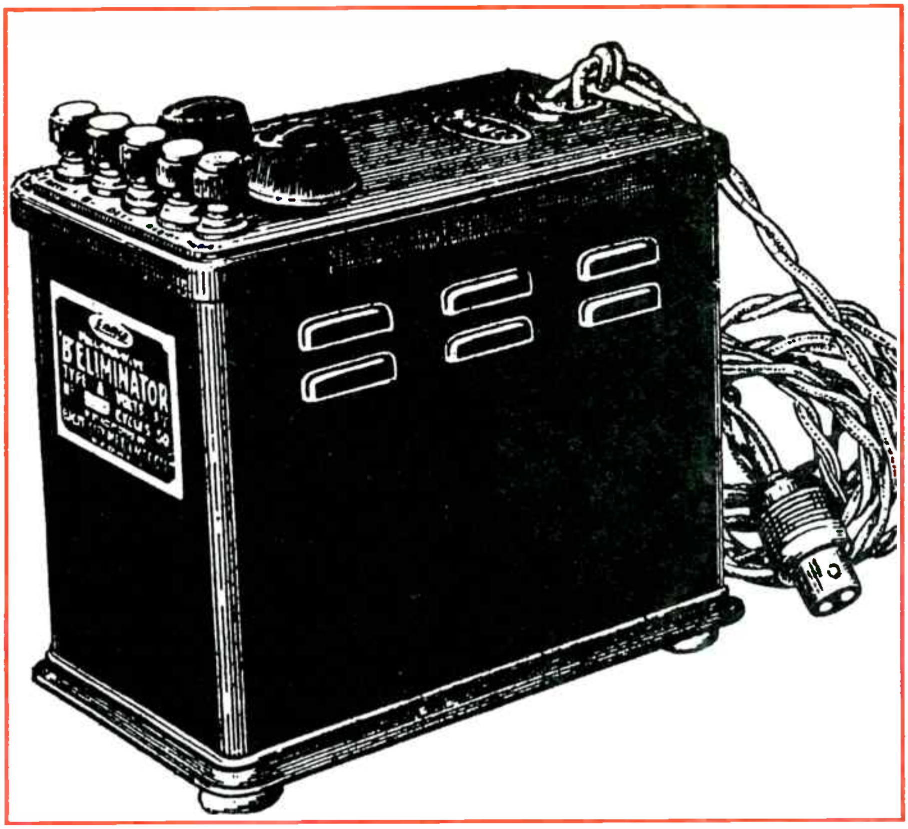


Fig.5: An Emmco B-battery eliminator, which was advertised for 10 guineas ($21) in 1927 — about three times the price of a set of B-batteries. The terminals and knobs on top provided a selection of semi-adjustable high tension voltages.

In an effort to find another solution to the filament supply problem, some designers adopted the idea of selecting valves with a similar, low filament current rating and wiring the filaments in series, thereby calling for a much higher voltage but lower current.

A valve which lent itself to this technique was the American type V99 or X99, with a filament rating of 3.0-3.3V at 60-63mA. While easing the filtering problem, however, the string of frail filaments proved rather vulnerable and the technique found only limited application.

Mains type valves

The salient point that emerged from all this was that battery valves and associated design parameters were not really compatible with mains operation, either technically or in terms of listener expectation in respect to sound output power.

There was an obvious need for valves which could operate with AC on the filament and at more generous anode voltage and current levels — beyond the economic limits of battery supply.

In fact, a solution to the AC filament problem had been identified back in 1921, by Messrs Freeman and Wade of Westinghouse. For the traditional filament, they substituted a narrow tube with an emissive surface, to serve as an electron source or *cathode*. Inside the tube, but insulated from it, they placed a heating element or *heater* which could be fed from a separate supply, most obviously low voltage AC from a step-down transformer winding (Fig.7).

Fig.6: This Australian 'Radio A-power Unit', advertised by Clyde Batteries in 1927 contained an isolating transformer, an electrolytic ('slop') rectifier and either a 4 or 6 volt battery. It was self-contained and self-regulating.

Being independent of the electron stream within the valve, the AC could not interact directly with the signal, while the thermal inertia of the heater/cathode assembly would be such as to obviate hum due to temperature variation at the half-cycle rate.

While it subsequently proved to be the logical answer to the problem, the idea was not exploited to any extent until around 1927. One can only assume that the difficulties of devising, patenting, producing and marketing the early generations of battery-based receivers were sufficient, in themselves, to inhibit any radical departure in valve and receiver design!

Even in 1926/7, when RCA released their first manifestly non-battery valve, they still passed over the indirectly heated option. Designated as type 226 (or 26) their first mains type valve was a clear derivative of their 'old faithful' 201-A.

Virtually identical in appearance and with very similar electrical characteristics, its one vital digression was a conventional directly heated filament rated at 1.5V and 1.05A.

The purpose of the stout, heavy-current filament was to provide sufficient thermal inertia to minimise the half-cycle temperature ripple. At the same time, assuming a centre-tap or 'balanced' earth return, the reduced filament voltage would hopefully reduce the level of AC hum injected into the grid bias/signal path.

So to mains power

The 226 undoubtedly maintained a degree of continuity between the design philosophy of battery powered receivers of the late '20s and their immediate mains powered derivatives — but with one important qualification. By careful null-balancing of the heater earthing, the 226 could indeed be used in all established roles — except that of detector, where the hum level proved totally unacceptable.

It was a limitation that forced manufacturers, at long last, to come up with mass produced valves having an indirectly heated cathode, the best known of which was the 227 (or 27). With a 5-pin base, it was still electrically similar to the ancient 01A — but it was essentially hum-free.

The 27, and valves like it, broke the intellectual log-jam preventing the development of true all-mains receivers. Designers soon expressed a preference for indirectly heated valves for all roles, giving rise to a demand for companion types with more generous performance

parameters than could be contemplated with a battery supply.

For their part, valve manufacturers, once they had come to grips with heater/cathode technology, foresaw the emergence of a whole new market area — requiring not just mains powered general-purpose triodes, but power output valves and sundry other types optimised for particular roles in a new generation of receivers.

In fact, the period from about 1928 onwards was marked by a procession of new valve types, as outlined in this 'Think Back' series for May and June 1990 under the sub-heading 'The rise and fall of thermionic valves or tubes'.

There were power output valves like the 45 and 47, rated to deliver 2 watts or thereabouts to the loudspeaker — ten times as much as available from even a loud battery set. There were rectifier valves like the 80, meant to be built right into a mains receiver and supply the necessary high tension voltage and current.

There were screened-grid, tetrode and pentode valves like the 24, 35, 57 and 58 designed for use as RF or superhet IF amplifiers, or for very high gain audio stages.

Thermionic diodes became commonplace, for use as detectors, and so too did complicated valves intended for use as frequency changers in superheterodyne receivers.

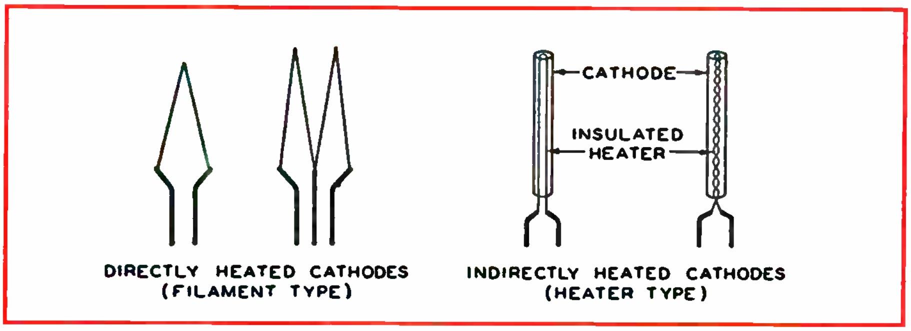


Fig.7: The indirectly heated cathode (right) was a virtual pre-requisite for AC mains powered receivers. First suggested in 1921, the idea was not adopted for mass-produced valves for another six odd years.

In many cases, new valves were introduced to meet urgent demands from the ever-expanding receiver market. In others, they were the result of on-going research in valve laboratories which resulted in new receiver design concepts. Ironically, progress in mains type valve and receiver design generated a demand for parallel technology in battery powered domestic and portable sets and automotive receivers. As a reminder of valves in those categories, readers may care to turn back to the articles mentioned above.

Assembly and wiring

This same period saw a complete revolution in the methodology of assembling and wiring domestic radio receivers.

Up to and beyond the mid 1920's, most receivers were constructed on a baseboard and panel, which slid into a table-top cabinet with lift-up lid. The major components were designed to mount on the baseboard or panel, with the incoming lead-ends being bent into an eyelet shape and clamped under flat-headed screw terminals or knurled nuts with a concave undersurface. It was very much the 'handyman' approach.

The done thing was to effect the interconnections with bare tinned copper busbar, of *square* cross section and about 1/16" (1.6mm) thick.

This was laid painstakingly in place and bent at strict right-angles, as appropriate, so that every run would be either exactly parallel to the panel and baseboard or at right-angles to them. The resulting 'geometric' style of wiring is well illustrated in Fig.8. Fairly ob-

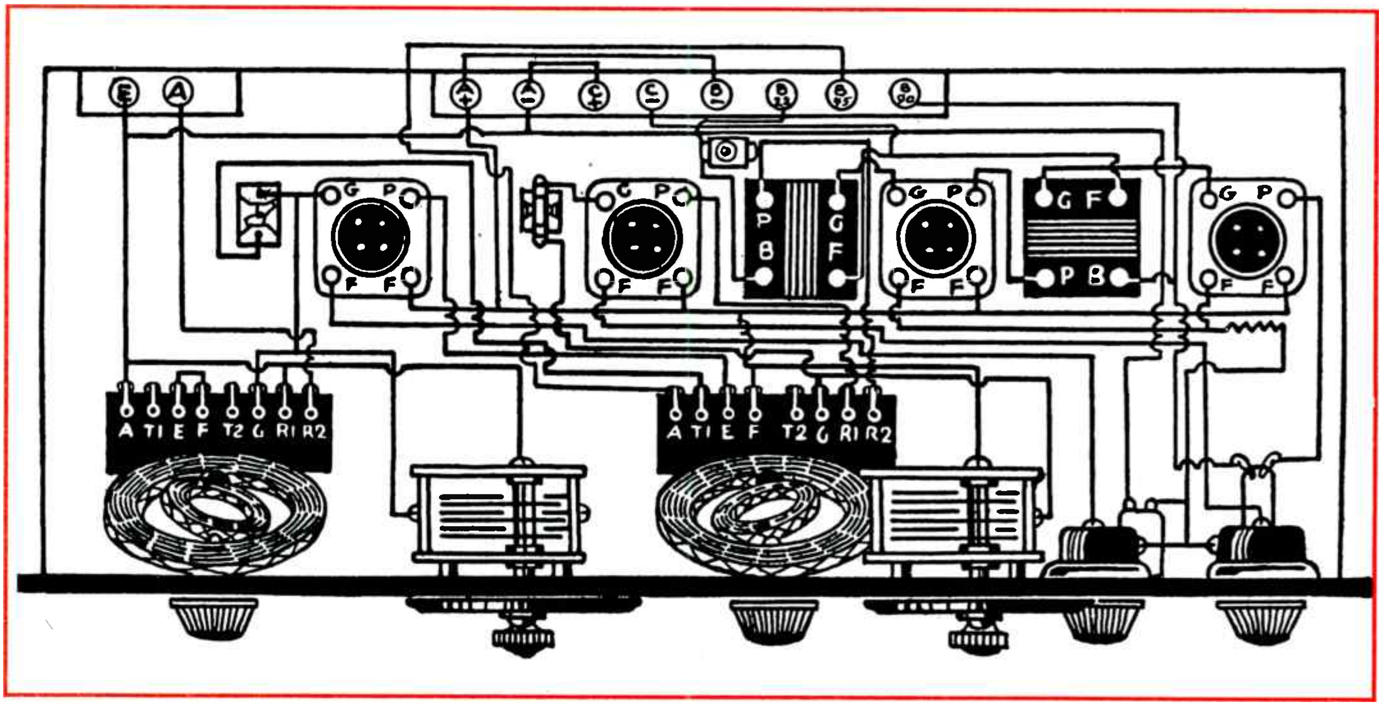


Fig.8: Originally from 'Wireless Weekly' for August 19, 1927, this shows the suggested wiring pattern for the 'Everyman's Four' receiver. To a handyman, ability to wire a receiver in the approved manner was as much an art form as his wife's embroidery!

viously, in the two-dimensional drawing, loops have to be used to indicate that various wires cross without touching. In the actual receiver, the busbars would be elevated one above the other, to provide the necessary clearance.

For proud owners of new receivers, the routine was to switch on and demonstrate to visitors how they worked, then explain the purpose of the various knobs, finally lifting the lid to display the working parts — the valves and, of course, the orderly wiring.

I remember my father, responding to an article in a magazine, preparing to make changes in the family Colmovox. He could have used any wire to hand, but that wasn't good enough. He had to equip himself with several lengths of square-section busbar and a pair of long, round-nosed pliers to form eyelets at the end of each run. The job done, it was difficult to tell that the original wiring had ever been tampered with.

In fact, as I recall mentioning elsewhere, he was so proud of his handiwork that he set about making a glass front-panel for the receiver so that visitors, listening to the sound, could also contemplate the internal works!

A different approach

In due course, however, the industry began to realise that fancy terminals and fussy wiring methods were tedious and costly, without adding anything to the actual performance of the receiver. If you have a copy of the *Wireless Weekly 1927* reprint, take a look at the layout diagrams on pages 35 and 36 for an 8-valve superheterodyne, and imagine the man-hours that would be involved in translating them into a multi-layered pattern of bare busbar.

So it was that geometrically arranged busbar gave place to insulated 'point-to-point' wiring, with tags and soldered joints taking over from terminals and eyelets.

The move to mains operation also had an important bearing on the transition. It was certainly not prudent to have exposed bare wiring or terminations carrying mains potentials, or even the 250-odd volts DC that was commonly applied to the anodes of mains type valves.

The end result was the almost universal adoption of inverted metal dish 'chassies', with the major components mounted on top and the point-to-point insulated wiring and small components underneath, well away from prying fingers.

Apart from safety, the format lent itself to familiar metal working techniques and to assembly line production. If the chassis needed to be made attractive to the prospective purchaser, the external components could be variously embellished with lacquer, enamel, electroplating and labels, all of which were variously exploited in typical Australian receivers.

That was about the way things were when I ceased to be an onlooker and took my first job in a radio factory. I must confess that, against a traditional battery set background, it came as something of a culture shock to learn that the attributes of a capable production wirer were accuracy, speed and the ability to make good soldered joints. Neatness didn't seem to count for much, apart from keeping leads reasonably short and reasonably firm.

After encountering a few early examples of 'new-age' mass-produced chassies, it became evident that, in the matter of neatness, some production supervisers and bench wirers had taken liberty for licence. On top, the chassis and other metalwork may have been 'prettied up' with gold coloured lacquer — but underneath, to compare the wiring with a proverbial 'rat's nest' would have been unfair to rodents!

How NOT to do it!

Leads ran hither and yon in all directions, trimmed to 'near enough' length, looped around to reach their destination and spot soldered to the appropriate lug. Overlaying the wiring was an assortment of resistors and capacitors, bridging from here to there and supported for the most part by their own roughly trimmed leads.

If that wasn't bad enough, much of the wiring had been done with stranded tinned copper wire, covered in a rubber which had gone 'gooey', interacting with the wire and solder to coat it with a chemical salt of some kind. For a technician, replacing leads or parts in that kind of environment was nothing short of a horror.

When I started at Reliance Radio, it was in a completely virgin situation: my first job, on the first day of a new factory, assembling and wiring the first batch of a completely new line of receivers.

Another novice wirer and I were given the circuit, the wherewithal and a laboratory prototype to follow, and it was more or less up to us to work out the details of how best to arrange the leads and minor components.

Fortunately, my new mate was also methodically inclined and, under the supervision of the designer, we worked out a common wiring routine: short, direct leads for the high frequency connections and methodically grouped runs for the supply leads, anchored to the chassis by clips or other means. A bare tinned copper busbar linked all the earth lugs under isolated mounting nuts, and provided a convenient anchorage for the various earth bypass capacitors.

Once devised, the wiring style was adopted for all models and, in later years, Reliance took to displaying their chassies in radio shows over a 45° mirror, with under-lighting to emphasise the orderly wiring.

In fact, there was more to all this than mere cosmetics. Manufacturers soon realised that underside wiring had to be kept clean and accessable for ease of service, and suitably anchored if it was to survive long delivery journeys by Australian road and rail transportation.

It was a lesson that had to be even more scrupulously applied later in the monochrome television era, with its greatly increased valve and parts count and more complex wiring.

In the next chapter, we will be looking at the evolution of typical mains type TRF and superheterodyne circuits.

(To be continued)

Circuit & Design Ideas

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

Remote IR tester

This circuit was developed to check whether an infra-red remote control transmitter is functioning or not.

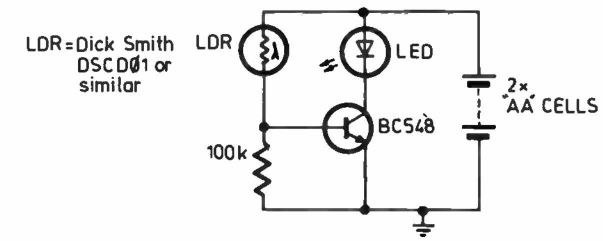
The unit's simplicity is mainly due to the use of a common light-dependent resistor. Whilst LDRs are normally used to detect visible light, they function just as well with incident infra-red energy, with the added bonus that their sensitivity is much greater than an infra-red diode or phototransistor.

This extra sensitivity allows the LDR to directly control the base current of a transistor as shown in the circuit.

As incident infra-red light increases, the resistance of the LDR falls, turning on the BC548, which then turns on the LED. Note that, depending on the type of LDR used, the 100k base resistor may need to be varied to extinguish the LED in the 'standby' mode.

With no incident light, the standby current is only a couple of microamps, and so a power switch is not required.

The prototype was built in the smallest 'jiffy box', with the LDR mounted at the end of a tube, which projected from one end of a jiffy box, in order to reduce the effect of the ambient light. Alternatively, the LDR could be mounted behind an infra-red filter. In operation, the unit detected infra-red emissions at a range of up to 12cm.

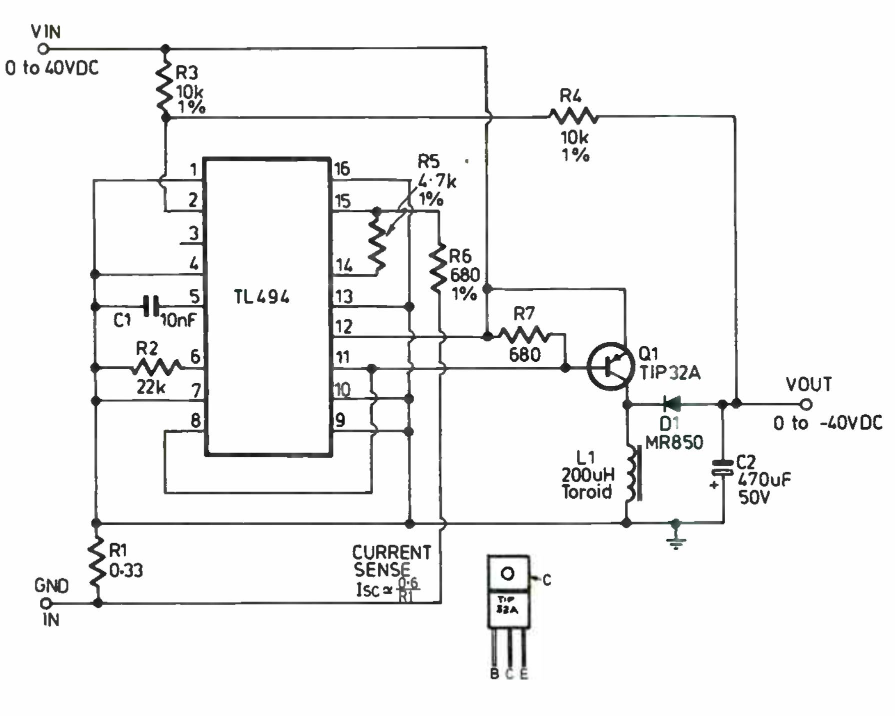


Grant Willis,
Port Lincoln, SA **$30**

0-40V voltage inverter/doubler

This inverter/doubler is basically a buck inverting circuit which provides an exactly complementary negative voltage to the positive supply voltage.

This is especially useful where split rail supplies are needed. When the circuit is used in the doubler mode, the output voltage is the circuit ground, thereby providing a voltage exactly double the input voltage. The operation of the circuit centres on the TL494 pulse width modulator chip. Resistors R3 and R4 provide the earth referenced divider to set the output voltage; R5 and R6 provide another earth referenced divider to sense and limit the circuit current.



Transistor Q1 is driven from the two output transistors of the chip, running in parallel. Q1 directly charges the field in coil L1 and then cuts off, allowing negative voltage from the field collapse to pass through D1 and be stored in C2.

Because the TIP32A is rated at 3A, R1 equals 0.33 ohms to give a maximum (short circuit) current of 2A.

Steve Garland,
Maroubra, NSW **$35**

Switching lamp dimmer

This circuit came about from the need to dim a lamp for reading at night while camping, without wasting battery power.

The circuit is a variable pulse-width dimmer using a 555 and MOSFET to keep things simple. As the on time of the MOSFET reduces and the off time increases, the lamp dims.

The interesting thing about this circuit is that the duty cycle (ratio of on to off time) of the 555 can be varied from about 5% to 95% in a nice linear fashion, without changing the frequency of operation.

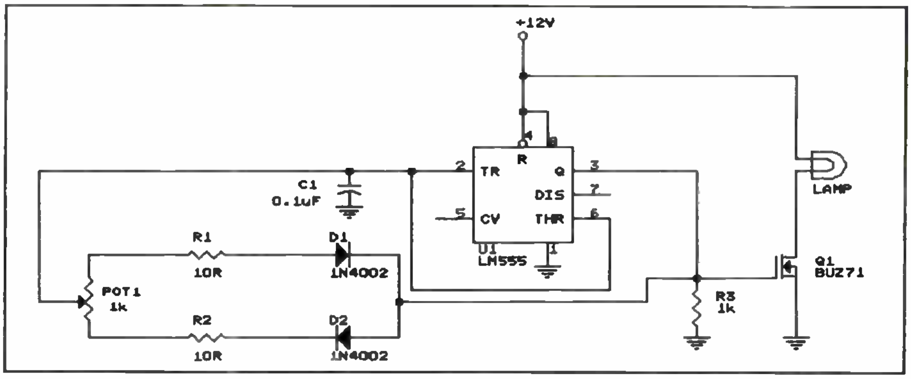
The trick to this is in D1, D2, R1, R2 and pot 1 which form a network to

charge C1 from pin 3 of the 555. As pin 3 goes high and low, C1 is charged by D2, R2 and the bottom half of pot 1, and then discharged by D1, R1 and the top half of the pot.

Now as the position of the wiper is changed the resistance used to charge/discharge C1 changes, ultimately changing the duty cycle.

Because the total resistance used to charge and discharge the capacitor is always the same (i.e., the value of the pot), the total time taken is the same so the frequency is constant.

Resistors R1 and R2 set the maximum and minimum duty cycle. If the on or off time is too short, then some radio interference can result. The lamp can be rated up to 21W without any problems although smaller lamps seem more efficient when dimmed.



You could also use this circuit to run 6V lamps from 12V.

Alex Eades,
Katoomba, NSW **$35**

'No battery' alternator start-up

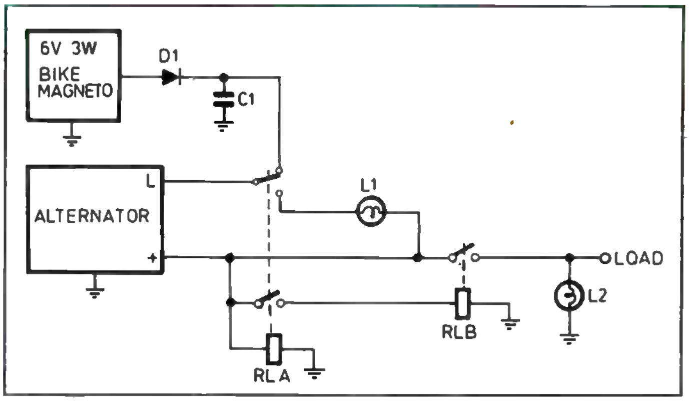
Want to take a 12V power supply out into the bush, or build a battery charger with a bit of oomph?

The answer is to run a car alternator from a stationary motor. But the problem with this arrangement is that you need to lug a battery around to initially power the alternator's rotor to get it started.

Instead of a battery, this circuit uses a bike magneto, driven by the belt between the motor and alternator, to produce sufficient current to start the alternator in a no-load situation.

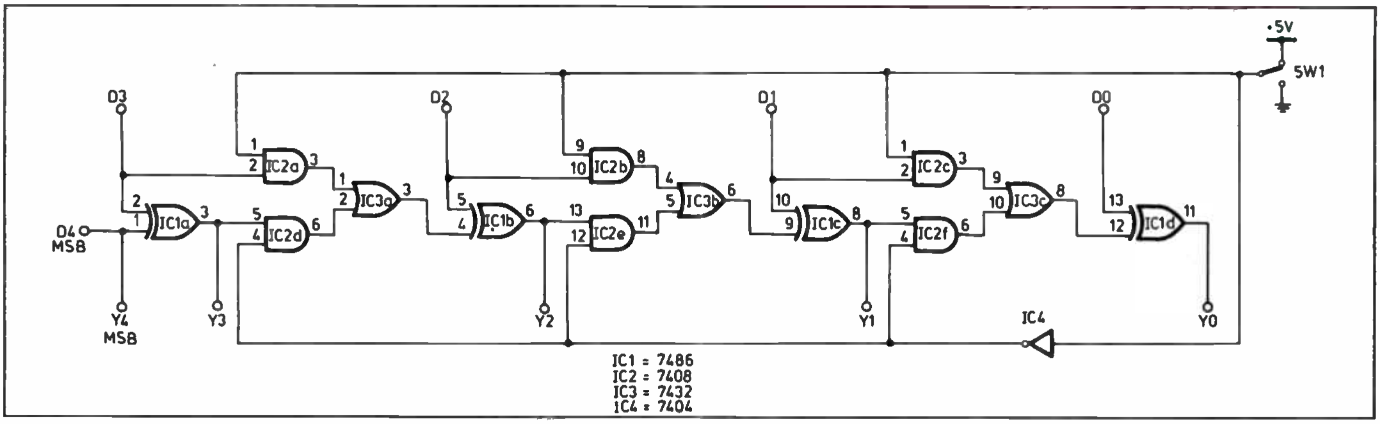
The magneto current is rectified and smoothed by D1/C1, then fed into the 'L' (lamp) input on the alternator. This starts the alternator current, which activates relay RLA.

The relay switch then provides the current, via a charge lamp L1 (the ignition lamp on the car dashboard), so the bike magneto can now be disconnected. Relay RLA also switches in the load relay RLB, which lights up lamp L2 and provides the 12V (unfiltered) supply.



My unit uses a 1hp motor which can drive my 55A alternator flat out.

Rob Morris,
Seaford, VIC **$35**



Binary-Gray-Binary code converter

There are a number of codes in use in digital systems. One such code is the Gray Code. This circuit converts either natural binary code to Gray code, or the reverse, Gray to binary. 'Exclusive-OR' gates are used to do the additions needed for the conversions, while 'and' and 'or' gates are used to activate different segments depending on the direction of the conversion.

To convert a 5 bit binary code (B_4-B_0) into Gray code (G_4-G_0), the relation connecting the bits is as follows: $G_4=B_4$; $G_3=B_4+B_3$; $G_2=B_3+B_2$; $G_1=B_2+B_1$; $G_0=B_1+B_0$.

The relation for the reverse conversion, namely Gray to binary code is: $B_4=G_4$; $B_3=B_4+G_3$; $B_2=B_3+G_2$; $B_1=B_2+G_1$; $B_0=B_1+G_0$.

The 5-bit input code is entered in D_4-D_0, while the output code is received at Y_4-Y_0. Switch S is high for binary-to-Gray conversion, and only the 'and' gates IC2a-IC2c are activated for IC1 to add the required binary bits. For the reverse Gray-to-binary conversion, switch S is low, and only the 'and' gates IC2d-IC2f now let IC1 add the binary to Gray bits. IC3a-IC3c are 'or' gates to join the two possible inputs to the adders. Notes that six AND gates are required. These are labelled IC2a-f. Since the 7408 contains only four AND gates, two of these chips are needed.

P.R. Narayana Swamy,
Kingswood, NSW **$35**

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NEW '91

Anti-static with Teflon tip	Cat T-2567	$14.95
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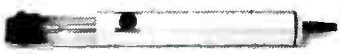

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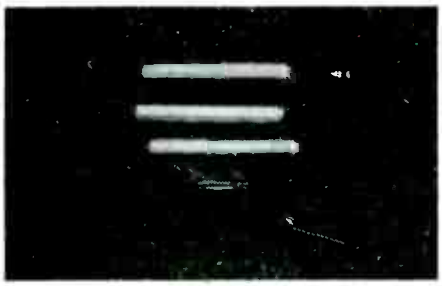

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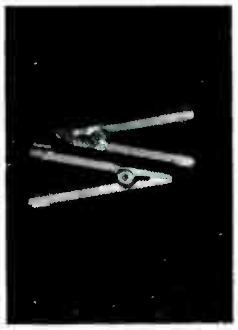

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B1152/PB

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TELEPHONE AMPLIFIER

This telephone monitoring system is battery operated and needs no electrical connection with your telephone. Simply attach the magnetic pick-up near the earpiece and friends or business associates will be able to hear conversations as they happen. This is a complete kit with pre-punched and silk screened front panel.

Cat K-3104

EA Nov '90

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CHROMAVOX

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Cat K-3162

EA January '90

SAVE $40 $99

6/12 VOLT BATTERY CHARGER

Unlike most simple battery chargers, this clever 6/12 volt SLA (sealed lead acid) battery charger continuously monitors the battery voltage, and then automatically adjusts the charge rate to suit. Apart from having four LED indicators and five switchable charge rates, our charger maintains the battery at a constant float voltage once it has been fully recharged. This means it can remain connected to the battery indefinitely and still keep it in peak condition! Short form kit with all components, hardware & front panel label.

Cat K-3220

$69.95

SILICON CHIP March '90

Case H-2812 & transformer M-2000 not included

DUAL TRACKING +/- 50V POWER SUPPLY

This switch mode power supply can really deliver the goods with variable output from 0 to 100 volts DC! Ideal for TV servicing.

- Current output is 1.7A @ 0-87V and 1A @ 100V
- Voltage is variable from 0-100V
- LED indicator for ripple exceeding 5mV p-p
- Short-circuit protected
- Pre-punched & screened front panel
- This kit is supplied complete

Cat K-3465

SILICON CHIP April '90

SAVE $30 $219

HURRY... LIMITED STOCK! TOUCH LAMP DIMMER

This unit can turn your light on and off or dim them just by touching the decorative plate. The unit is suitable for dimming incandescent lamps rated from 25 watts up to 300 watts total.

Cat K-3001

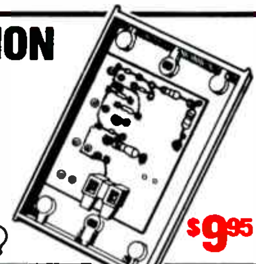
SILICON CHIP June '89

$29.95

TOUCH LAMP EXTENSION

Do you have two-way light switches in your home and would like them replaced with touch dimmers? We have just the thing! This extension touch plate is connected in parallel to the K-3001 main unit. Now you can switch your lights on and off or dim them from two locations.

Cat K-3002



SILICON CHIP July '89

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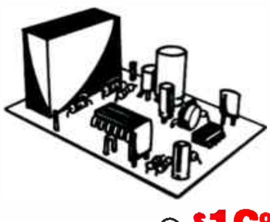
FLEXITIMER

We call this little gadget the 'Flexitimer' because it uses just a handful of components to accurately time intervals from just a few seconds to a whole day! It's relay can switch a number of different output devices and the circuit can be easily modified or incorporated into a much larger project. This is a short form kit with circuit board and components only.

Cat K-3595



EA March '91

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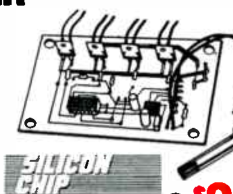
12/24V LIGHT CHASER

This simple circuit can produce some pretty impressive effects! It has four separate channels which can each power 36 watts of light bulbs ie : 12 x 3W. A single rotary control allows you to vary the flash rate from about a ¼ second up to 2 seconds. This is a full form kit containing all components, hardware & case plus LEDs for testing the channel outputs. Cat K-3163



SILICON CHIP April '91

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Take extreme care when working with this equipment.

Degree Of Simplicity — Simple — Intermediate — Detailed

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With true RMS!

If you've ever wished for an accurate digital meter with the readability of an analog meter then here is the solution — a digital multimeter combined with a full sized analog meter!

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- Resistance 200, 2k, 20k, 200k, 2M, 20M ohms
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PENCIL

Probe Type Digital Multimeter

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One of the handiest meters you could own! It features data hold, fixed and auto ranging, diode test, audible continuity check plus a full 3½ digit LCD display. Ideal for work on circuit boards!

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- ACV: 2, 20, 200, 500V
- AC/DC Current: 200mA
- Resistance: 200, 2K, 20K, 200K, 2M, 20M ohms
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- Soft carry pouch

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COMPUTER

Digital Multimeter with RS-232 Interface

A high quality performance multimeter that can find and hold minimum and maximum readings as well as measure relative offsets and handle currents up to a huge 20A (AC/DC). What's more, you can locate intermittent faults by monitoring and storing the output of your meter on computer. The meter has a 20 segment bar graph and comes with an RS-232 cable and computer program disk.

- DCV: 200mV, 2V, 20, 200, 1000
- ACV: 200mV, 2V, 20, 200, 750
- Current AC/DC: 2mA, 200, 20A
- Resistance: 200ohm, 2Kohm, 20, 200, 2Mohm, 20
- Capacitance: 2000pF, 200nF, 20uF
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- Diode and Continuity check
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Cat Q-1570

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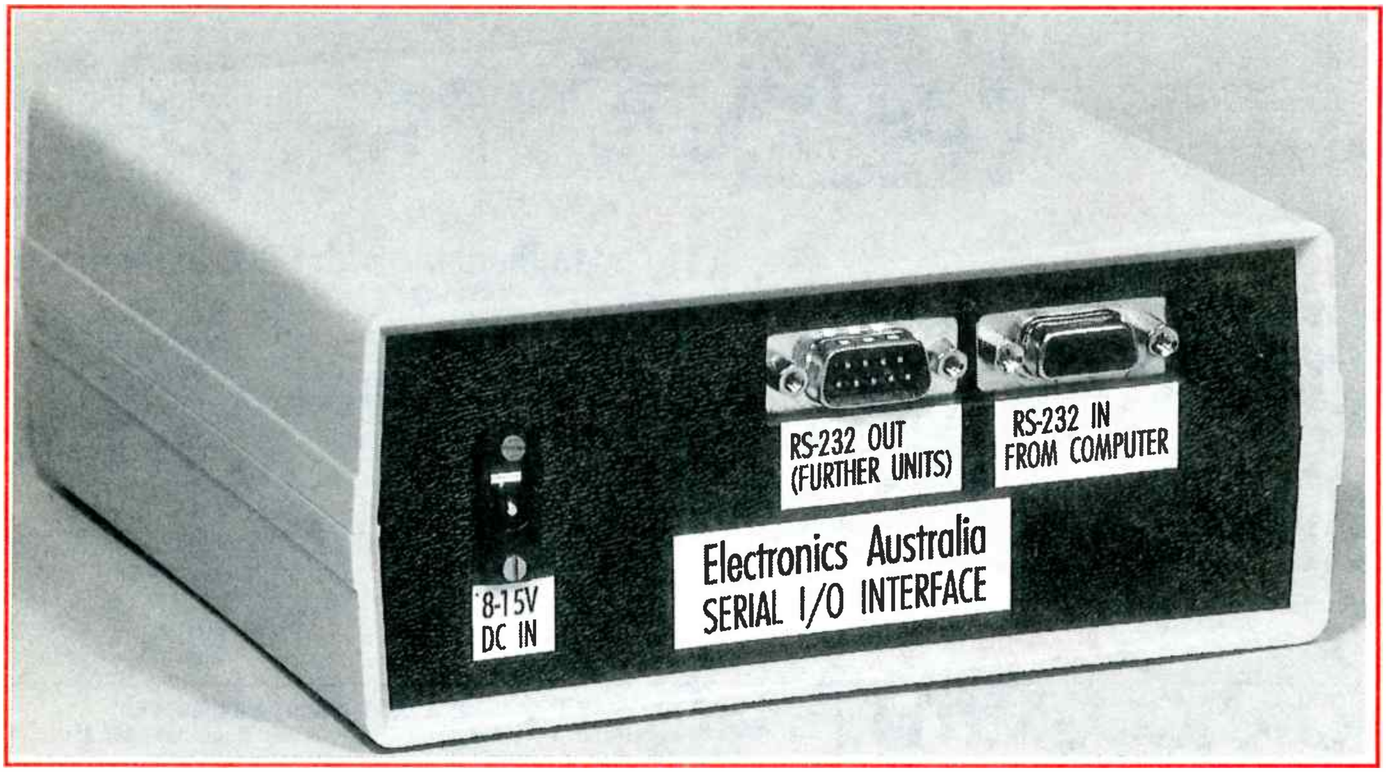
Construction Project:

IMPROVED SERIAL I/O INTERFACE FOR PCS - 1

Here's a new design for a flexible, low cost interface unit for use with any personal computer fitted with a standard RS-232C serial port. It provides eight digital inputs and the same number of outputs, and can be used as the basis for monitoring and controlling all kinds of things — from model train layouts and watering systems to security systems, stage lighting and machinery. A simple addressing system allows multiple units to be 'daisy chained' from a single RS-232C port, for expanding the number of inputs and outputs up to 64 of each.

by JIM ROWE



How would you like to be able to use your PC to control the stage lighting for the local school or dramatic society, allowing you to automate complex lighting changes and sequences (even fast ones) so they took place at the touch of a key? Or to control your model train layout, so you could run a variety of different train schedules just by playing the right 'program'? Or to control a water sprinkler system, with 'programs' that could easily be varied to suit the seasons? Or to hook it up to stepper motors on a metalworking lathe or milling machine, to experiment with computer numerical control (CNC)?

All of these applications — and a host of others — open up when you provide your PC with the flexible input/output or 'I/O' interface unit described here, together with whatever basic power driving and isolation circuitry may be needed.

This new I/O interface design provides your PC with a set of eight individually controllable digital (on/off) TTL output lines, capable of being used to drive relay and triac switches via simple driver circuits. It also provides a set of eight TTL input lines, which can be used to monitor a variety of things such as switch contacts or the output of various sensors, either directly or when necessary via opto-isolating stages.

Incidentally the new interface has been designed to mate with the relay driver, triac driver and opto-isolated input boards designed by Mark Cheeseman, in his earlier and somewhat

IMPROVED SERIAL I/O INTERFACE FOR PCS - 1

more complex 'Real World Interface' described in *EA*'s August, October and December 1988 and February 1989 issues. Mark's relay driver and input isolating boards will be re-described briefly in the second of these articles, along with a revised version of the triac driver board.

The new interface itself connects to the PC via a standard RS-232C serial port, which means that it's basically suitable for connecting to a very wide variety of computers — from high powered modern 386- and 486-based models right down to elderly 8-bit models like TRS-80's, Apple II's or Microbees that may have outlived their usefulness for traditional 'number crunching'.

As long as they have a standard RS-232C port, they can generally be used for this kind of monitoring and control work — which can give them a new lease of useful life!

An important aspect of the interface is that it has been designed to be 'addressable'. This means that more than one interface can be connected to a single RS-232C port, in order to expand the total number of inputs and outputs. In fact the basic interface is provided with both a main RS-232C input/output and a 'loop through' input/output, to make it easy for multiple units to be connected in 'daisy chain' fashion to a single computer port, using standard DB-9 cables.

The design provides eight different possible addresses, so that up to eight interfaces can be connected up to a single port on the PC. This give a potential of up to 64 different output lines, and the same number of inputs — more than enough for most basic monitoring and control jobs.

Another aspect of the interface worth noting is that it uses a crystal-locked baud rate generator, giving you the choice of communicating with the PC at any of six different standard preset rates: 9600, 4800, 2400, 1200, 600 or 300bps.

Like the unit's address, the baud rate is selected very simply using a hardware jumper or link, so that there is virtually no setting up or adjustment required before the interface is used.

The interface's ability to operate at up to 9600bps means that potentially the state of any output line can be changed, or the state of all eight input lines monitored, by the computer in only slightly more than a millisecond — 1.04ms, to be precise. This means that a lot of things can be turned on and off in

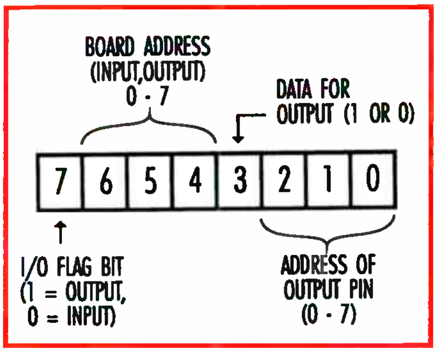


Fig.1: The format for the command bytes used by the computer to control the interface functions.

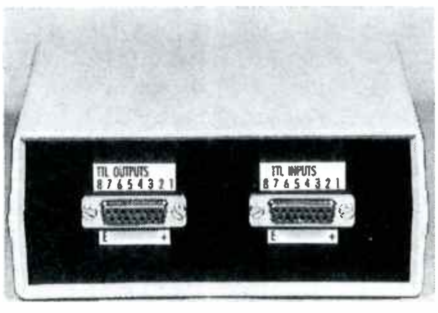
a second, if you wish, along with monitoring quite a few input lines.

You can even use the computer and interface combination as a high-tech programmable lamp flasher/light chaser, if you wish — if necessary, they can pulse lamps on and off so fast that you're scarcely aware that anything has happened!

With a little ingenuity and by reducing the effective number of devices that can be controlled by a single interface, you can even use the interface to control the speed of a motor, or the brightness of a lamp, over a range of output levels.

For example you can control the speed of two different motors, or the brightness of two different lamps, with each having 16 possible speeds or brightness levels. More about this also next month.

All of the components for the basic interface fit on a single small PC board, which fits inside a low-cost plastic case. Power is derived from a standard 8-15V DC 'plug pack' power supply, and because the interface itself draws only around 30mA, in many cases the same plug pack can also be used to supply the relay or triac driver circuitry, and/or the input isolating circuits. In some cases it may even be possible to power other



The rear of the prototype, which uses a pair of DB-15 connectors for the data outputs and inputs respectively.

interfaces from the same plug pack, where more than one are used.

In developing this design, the emphasis has been on providing a simple, low cost and easily built hardware configuration that should also give reliable and foolproof operation. At the same time, it has been designed for easy programming on the computer — in many cases, using nothing more than standard BASIC (although you can of course use a more flexible language like 'C' or assembler, if you wish). We'll look more into the programming side in the second of these articles, as well.

How it works

There are only eight ICs in the complete interface, as you can see from the schematic. At the heart is U1, a standard 'UART' or *universal asynchronous receiver/transmitter*, which handles the basic jobs of (a) receiving serial data bytes from the computer, and converting them into parallel form; and (b) taking parallel input data, and converting it into serial data bytes for transmission to the computer.

Like most standard UART devices, the AY-5-1015D (or IM6402) used here for U1 requires a local clock signal for both its receiver and transmitter sections, and both clock signals must be of a frequency corresponding to 16 times the desired baud rate.

In this case the clock signals are provided by U4, a 74HC4060 device which is designed to be used as both a crystal clock oscillator and a 14-stage binary divider chain, tapped at the fourth and later stage outputs. With a low cost 2.4576MHz crystal, as used here, U4's first six available outputs therefore provide a choice of 153.6kHz, 76.8kHz, 38.4kHz, 19.2kHz, 9600Hz and 4800Hz — corresponding to baud rates of 9600, 4800, 2400, 1200, 600 and 300bps respectively. The desired clock frequency is selected by jumper/link LK2, and fed to pins 17 (receive clock) and 40 (transmit clock) of U1.

Serial data passes between U1 and the computer via U5, a specialised RS-232C interfacing chip (MAX232 or TSC232). This has four buffers to perform level translation between the bipolar voltage levels used for RS-232C communications, and the unipolar TTL levels used by the UART chip.

It also has an inbuilt DC-DC converter system, which generates the +/-10V DC levels required for driving the RS-232C line, from the circuit's main +5V supply rail.

Serial RS-232C data arriving from the

computer via pin 3 of J1 passes through one of U5's receiving buffers, and then passes directly to pin 20, the serial data input of U1. It also passes out again via one of U5's transmitting buffers, to pin 3 of J2, where it can be sent on to other interfaces.

The serial output data from pin 25 of U1 passes through a more complex process on its way back to the computer, but only slightly so. This is because of the need to combine the output of this interface with that from any others which may be connected to the same RS-232C line, via J2.

Here the serial input data from pin 2 of J2 is fed through the second receiving buffer of U5, and then both it and the serial output data from U1 are fed to U7d, a 74HC00 two-input gate element wired here to perform an OR function. Data from either source is thus able to pass out through inverter U6f, the remaining transmit buffer of U5 and pin 2 of J1, back to the computer.

Most of the remaining circuitry is used to provide the interface's address selection, input/output logic and output data latching. To understand how this is done, it's important to realise that the interface as a whole is designed to respond to simple single-byte 'commands' sent to it from the computer.

If the command is to carry out an 'output' operation, which involves changing the state of one of its eight output data lines, this is done directly in response to the command byte itself; however if the command is to carry out an 'input' operation, the interface responds by transmitting the status of its eight input lines back to the computer, as a separate data byte.

Fig.1 shows the command byte format to which the interface is designed to respond. As you can see, all eight bits are used. These are split into four separate functional groups — two groups of three and two single bits. Of these, bit 7 the most significant bit is used to 'flag' whether the byte is requesting the interface to perform an output (1) or input (0) operation.

The three next most significant bits 4, 5 and 6 are then used to specify the address of the interface which is intended to respond to the command byte, in simple binary code. As there are three bits allocated for this, there are thus 2^3 or eight possible interface board addresses.

The four least significant bits 0-3 are used only for output command bytes, having no significance when an input command is specified. Bits 0-2 are used to specify the particular output line whose status is to be changed, again in simple binary code, while bit 3 is used to convey the actual data to be conveyed to the output line concerned. So to force the output line to a high level bit 3 is given a value of 1, while to force the line to a low level it is given a value of 0.

Returning to the schematic, we can see how the various operations are performed by the remaining circuitry. When the command byte from the computer is received by U1, its eight data bits appear on pins 5-12 — with the most significant bit appearing on pin 5, and the least significant on pin 12. So the 'interface address' bits 4, 5 and 6 appear on pins 8, 7 and 6 respectively, while the I/O flag bit appears on pin 5.

As you can see, the three address bits are fed to the inputs of U2, a 74HC138 three-bit binary decoder.

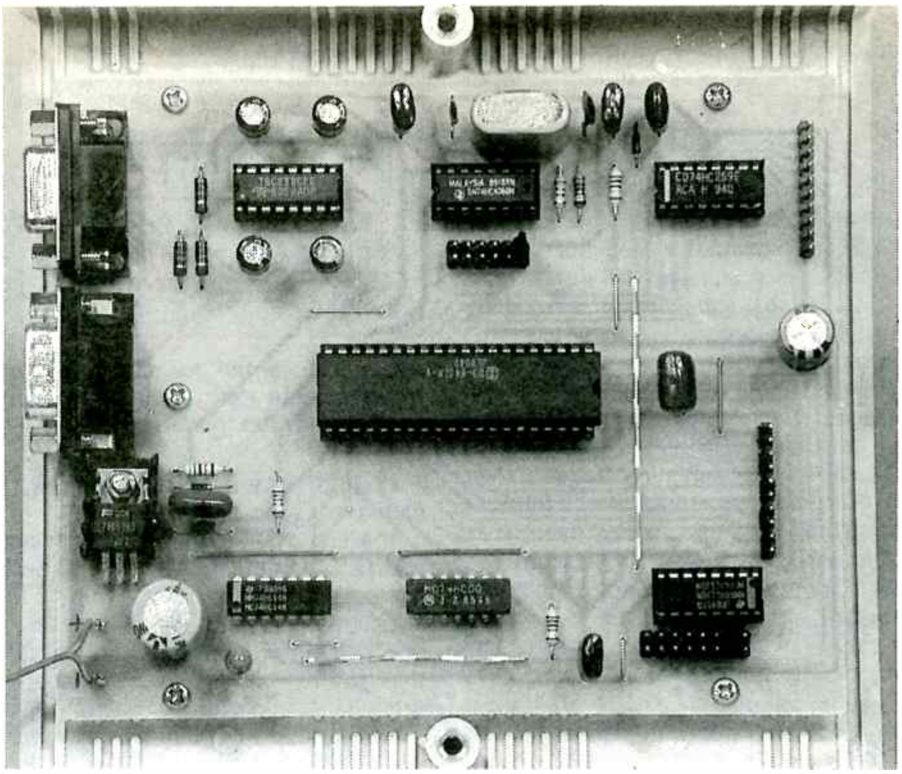
As soon as the command byte is received, and its eight bits are available in stable form at pins 5 to 12, the UART indicates the availability of the received data by changing the logic level on its 'data available' (DAV) pin 19, to a high (1). This rising edge is fed through a small R-C delay circuit, formed by R5 and C10, and then through Schmitt inverter U6d. The output of U6d is then fed back to the 'reset data available' (RDAV-bar) pin 18 of the UART, to reset it ready for the next byte. This feedback action results in the generation of a short negative-going pulse (about 25 microseconds long) at the output of U6d, about 75 microseconds after the arrival of each command byte.

And this pulse is fed to the G3-bar input of U2 (pin 4), which effectively switches it to one of its eight outputs, under the direction of the command byte's three address bits — fed to its A, B and C code inputs.

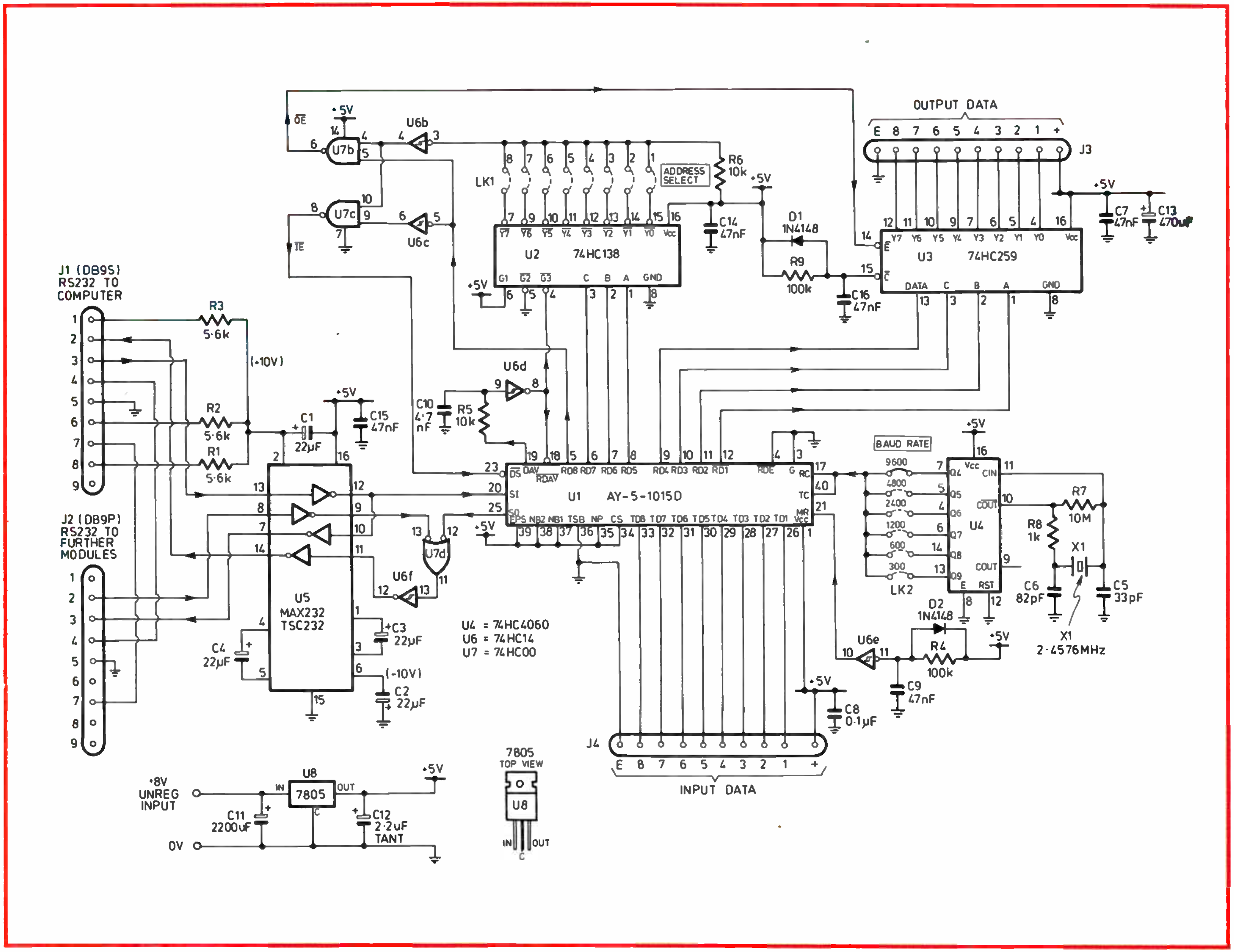
The nett result is that depending upon the address code specified in the command byte, the negative-going pulse from U6d appears on one of U2's active-low output pins, driving it low briefly. And the same action will take place in every interface that is connected to the RS-232C line, if more than one are connected.

But whether or not anything further happens on any particular interface depends upon the position of its address jumper/link, LK1. As you can see, this essentially connects only one of the outputs from U2 to the input of inverter U6b, which is normally pulled to logic 'high' level by resistor R6.

If the address code in the command byte from the computer does *not* correspond to the output of U2 which con-



Here's a top view of the completed interface PC board, showing the location of all components, links and connectors.



As you can see from this complete schematic, there isn't a great deal in the new interface. It uses only eight ICs, counting the voltage regulator U8. Heart of the unit is U1, a standard UART device

nects to U6b via LK1, then nothing further happens on the interface concerned.

But if the code *does* correspond to the output of U2 to which LK1 is connected, then the negative pulse generated by the arrival of the command byte is able to pass through to U6b on the interface concerned, pulling its input low for 25us. And accordingly the output of U6b, which is normally low, is driven high for the same period — potentially enabling the two NAND gates U7b and U7c.

Only one of these gates will in fact be enabled, however. This is because the second input of U7b is driven directly by the command byte's I/O flag bit (bit 7), from pin 5 of U1, while the second input of U7c is driven by the complement of the same bit, inverted by U6c.

So the output of only one of the two gates will go low, for the duration of the 25us pulse: U7b if the flag bit is a 1, signifying an 'output' command, or U7c if the flag bit is a 0 to signify an 'input' command. That's why the output line from U7b is labelled 'OE-bar' (output enable, active low), while that from U7c is labelled 'IE-bar' (input enable, active low).

The rest is quite straightforward. To execute an output command, the OE-bar pulse from U7b is fed to the active-low enable input of U3, a 74HC259 binary-addressable octal latch. Also connected to the A, B and C address inputs of U3 are bits 0, 1 and 2 of the command byte, from pins 12, 11 and 10 of U1, together with output data bit 4 from pin 9 of U1. As a result, the OE-bar pulse causes the value of the command byte's data bit to be latched into one of U3's eight latch flipflops, causing the corresponding output line to switch either high or low as desired.

For an input command the operation is even simpler. Here the IE-bar pulse is merely fed to the 'data strobe' (DS-bar) input of UART U1, triggering it into sampling the values on the eight input data lines, and transmitting them back to the computer. The software in the computer can therefore 'catch' the data byte that is sent back in response to the command byte, as this will represent the input data from the interface which was addressed.

As you can see this is a very simple system, which calls for a minimum of circuitry yet still allows us to independently control the state of any one of eight output lines, on up to eight different interface boards, from a single RS-232C port. We can also monitor the state of any set of eight input lines, again on up to eight interface boards.

And all of this can be done with quite simple software, too, as we'll see next month.

The remaining components shown in the schematic are used for either the power supply, or for reset circuitry to ensure that the interface operates correctly each time power is applied.

Inverter U6e is used to apply a negative-going pulse briefly to the active-low reset input of the UART (pin 21) when power is first applied, to initialise it correctly.

The duration of the reset pulse is determined by R4 and C9, with C9 initially holding the input of U6e at a logic 'low' level until the capacitor charges up via R4. Diode D2 is to discharge the capacitor when power is removed, to prevent damage to U6e.

A virtually identical reset circuit is connected to the active-low 'clear' input (pin 15) of output latch U3, to ensure that it powers up with all output lines at a predictable logic level — rather than at random levels. Here the components used are R9, C16 and D1.

As all of the ICs used in the interface operate from a single +5V supply rail, the power supply is very straightforward. U8 is a standard 7805 three-terminal linear regulator, which accepts the input from a standard unregulated 8-15V DC plug pack and provides a very stable +5V source.

The +5V line is also made available at both the output data and input data pin-strip connectors (J3 and J4), for use by the output driver and/or input isolating boards. As the interface ICs only draw about 30mA, while the 7805 can handle up to 1A, the current available for relay and triac driver boards will normally be limited only by the plug pack — typically around 300-500mA.

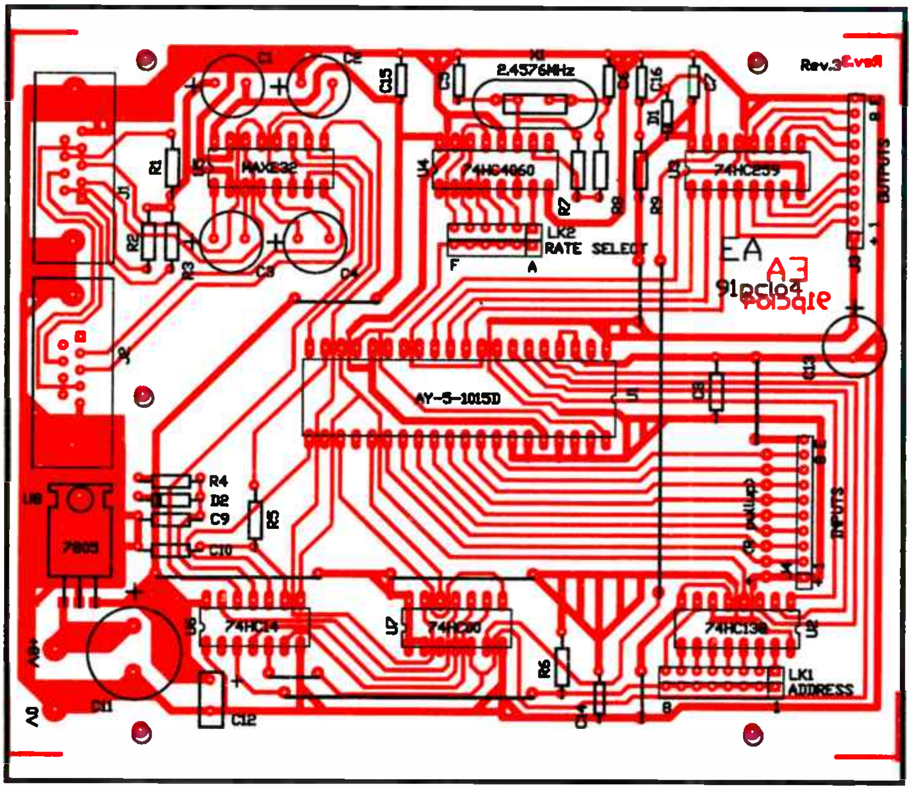
If you use a fairly husky plug pack, you may well be able to power more than one interface and driver board combination from it.

Construction

Virtually all of the circuitry for the basic interface fits on a small single-sided PC board, measuring 145 x 118mm and coded 91pcio4.

This is designed so that it can be housed by itself in a standard low cost plastic utility box, as shown in the pictures, or in a larger box along with the relay, triac driver or input isolating boards if you wish. The small box shown measures 155 x 160 x 65mm, and is currently sold by most suppliers for around $14.

There are only eight ICs involved in the circuit, plus a handful of other parts. The PCB has also been designed to



And here's the PCB overlay diagram, to guide you in wiring up the interface. Note that the board will take both sizes of crystal currently available.

make things easier for both assembly and setup, by taking advantage of some of the PCB-mounting connectors now available.

Thus both J1 the main RS-232C connector (a DB-9 socket) and J2 the 'loop through' RS-232C connector (a DB-9 plug) are PCB-mount types, while the board is designed to take 10-way PCB mount SIL pinstrips for the TTL output and input connections J3 and J4, to mate with push-on socket strips.

Similarly the board is also designed to take 0.1" spaced DIL pinstrips for links LK1 and LK2.

This allows both the interface address and the baud rate to be set up simply by pushing on a 'jumper shunt', of the type that is used for hardware programming on many PC cards.

Of course you don't *have* to use SIL connector strips for J3 and J4, or DIL strips for LK1 and LK2. You can elect to solder wires and links directly to the board, if you wish, to save money. However the connectors do make for a neater job, and will also make servicing a lot easier if it's ever needed.

Incidentally you may wonder why I have not designed the PCB to take, say, PCB-mounting DB-15 connectors for J3 and J4 — resulting in the need to use separate panel-mounting connectors when the interface is fitted in its own small case, as shown in the pictures.

This was done because I expect that many users will want to fit the board in a larger case, with the relay or triac driver and input isolating boards — in which case they would very likely be interconnected directly with short lengths of ribbon cable, and push-on IDC connectors.

Another small point to note is that the PCB also allows for fitting a set of pullup resistors to the input data lines, just near J4. If the input isolating board to be described next month, is used with the interface, these are not required; this is the reason for them not being shown on the schematic.

However if you don't use the isolating board and connect the data inputs directly to switches or relay contacts, the resistors may be required for reliable operation. Although the UART inputs have internal pullup resistors, these are fairly high in value.

If you need to fit the pullup resistors, they should be around 10k in value. The PCB has been designed to take an octal SIL resistor array if desired, instead of separate resistors; the positive pullup source is at the end nearer U2.

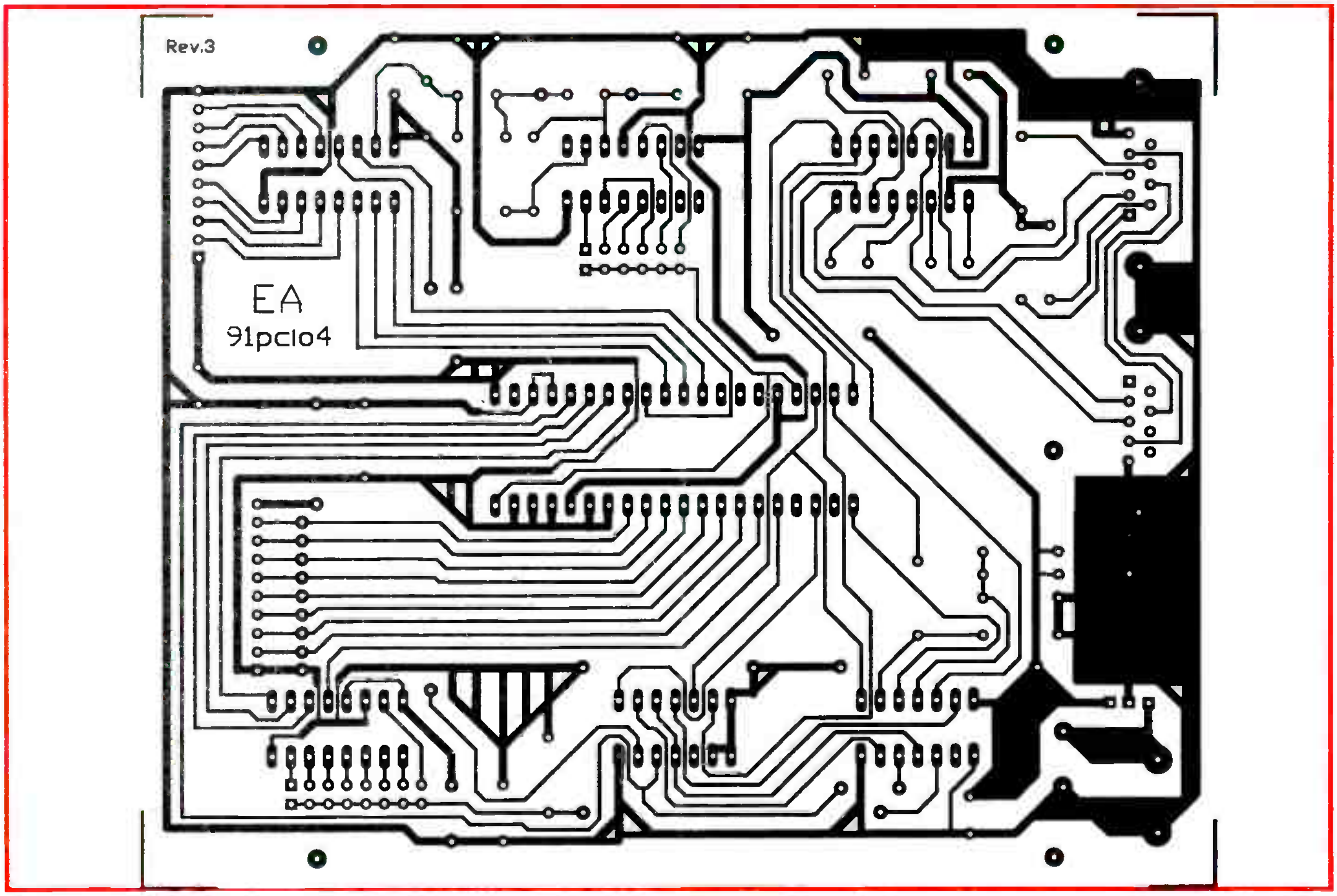
Assembling the components on the PC board should be very straightforward, using the overlay diagram and the pictures as a guide.

As usual, it's a good idea to check the PCB for solder plating bridges or slivers of copper shorting tracks, before you begin fitting any of the components. Then fit the nine wire links, to ensure that you don't forget them.

In most cases these should be from insulated hookup wire, although bare tinned copper wire is OK for those that are quite short. You might also care to fit a couple of PCB pins for the unregulated DC input connections near C11, to make it easier to make these connections later.

Then fit the resistors, the capacitors and the two diodes, taking care to form their leads so that they can mate with the PCB holes without strain. Make sure that the diodes and polarised capacitors are fitted with the correct orientation, of course.

These can probably best be followed by fitting the various connectors and pin strips — J1, J2, J3, J4 and LK1, LK2.



The PCB pattern is reproduced here actual size, for those that like to etch their own board.

Interface for PCs

Don't forget that the DB-9 *socket* is used for J1, and the DB-9 *plug* for J2.

Now you can add the quartz crystal. This can be of either the smaller or larger case types currently available, as pads have been provided for both 5mm and 12.5mm pin spacings.

The final step is to add the ICs. These can be soldered directly into the board if you wish, or via sockets in the case of U1-U7.

With the exception of U1 and U5 these are all fairly rugged and low cost 'HCMOS' devices, so soldering them in directly is not particularly risky provided you take the usual basic precautions of an earthed iron, etc.

However the UART (U1) is an N-channel device and rather more expensive, as is U5, so I'd recommend using a socket for these two at least. I elected to use sockets for all devices except U6 and U7 (and of course regulator U8), on the prototype units I've built to date.

Needless to say if you use sockets, these can be soldered into the board with no special precautions, before the ICs are added.

Regulator U8 is mounted horizontally, as you can see from the picture and overlay, fitting inside a small U-shaped finned heatsink. Both it and the heatsink are held in place with a single 3mm machine screw and nut, with the three IC pins bent down at right angles where they narrow in width, to mate with the holes in the PCB.

That's about it for the assembly of the basic interface board, apart from mounting it in a suitable case if you wish. Note that if you elect to fit it into the case used in the pictures, it mounts in what becomes the *top* of the case — which for some reason is the part provided with most of the internal mounting pillars, etc.

The only other thing is to arrange for the supply of 8-15V DC to the interface board, via the two pins near C11. Note that the positive input is the pin nearer to U8 — a mistake here could be rather expensive.

Setting it up

There's very little involved in setting up the interface, thanks to the simple circuitry and crystal-locked baud rate oscillator.

All you need to do is fit the jumper shunt (or link) for LK2 in the position corresponding to the baud rate you intend to use, and that for LK1 in the position which corresponds to the address you want to give the interface.

The setting you use for LK2 is fairly flexible. It depends mainly on the computer you're using, and how rapidly you want the interface to respond. In most cases it's probably easiest to set LK2 to position A, for the fastest speed of 9600bps — assuming that your computer's serial port and software can operate happily at this speed.

Then the interface will be capable of operating as fast as you're likely to want — while still being quite happy to handle only the odd byte each way, for jobs needing only leisurely exchange of data.

The main reasons why you might want to use one of the lower data rates are if your computer's port can't handle the higher rates, or you want to connect the interface to it via a very long cable. Here you may find that a lower baud rate will give more reliable operation, due to the lower sensitivity to signal degradation from the long cable.

The various positions of LK2 correspond to decreasing baud rates, moving from A (9600bps) down to F (300bps). Note that if you're going to be using more than one interface on the line, they'll all have to be set for the same baud rate.

The computer's port will also have to be set for the same rate, of course, no matter how many interfaces you're using. With an IBM-type PC this can be done by your software, but with older machines it may involve setting a DIP switch or jumper shunt.

Which address you set up for the interface using the LK1 jumper/link is largely up to you, and the number of interfaces you plan to connect up. If you're only using one interface, you can pick any of the eight addresses you fancy — this will only determine which address you have to specify in your software, to communicate with it.

The same thing tends to apply when you're using more than one interface, except that here you must give each interface a different address — otherwise the software won't be able to separately control their outputs, or monitor their inputs.

It's probably easiest to give your first interface the address of '1', the second '2' and so on. Then you won't have to open up boxes later on, to discover which address you gave them, or keep trying different address codes in the software to see which interface responds!

As predicted earlier, we'll look at the interface's matching relay driver, triac driver and input isolating boards in the second of these articles. I'll also give you some simple programs to get you going on checking out the interface and using it for controlling and monitoring. ■

PARTS LIST

1 PCB, 145 x 118mm, code 91pcio4
1 Case, 155 x 160 x 65mm (optional)
1 2.4576MHz crystal

Semiconductors

D1,D2	1N4148 diode
U1	AY-5-1015D or D3-6402R-9 UART
U2	74HC138 octal decoder
U3	74HC259 binary decoded octal latch
U4	74HC4060 oscillator/divider
U5	MAX232 or TSC232 serial transceiver
U6	74HC14 hex Schmitter inverter
U7	74HC00 quad NAND gate
U8	7805 5V regulator (TO-220)

Resistors

(All 1/4W 5%)

R1-3	5.6k
R4,R9	100k
R5,R6	10k
R7	10M
R8	1k

Capacitors

C1-4	22uF 16VW electro (PCB mount)
C5	33pF NPO ceramic
C6	82pF NPO ceramic
C7,C9,C14,C15,C16	47nF metallised polyester
C8,	0.1uF metallised polyester
C10	4.7nF metallised polyester
C11	2200uF 25VW electro (PCB mount)
C12	2.2uF 10VW tantalum (PCB mount)
C13	470uF 10VW electro (PCB mount)

Miscellaneous

1 x DB-9 socket, PCB mounting;
1 x DB-9 plug, PCB mounting;
1 x 6-way DIL pin strip;
1 x 8-way DIL pin strip;
2 x jumper shunts, to suit DIL pin strips;
2 x 10-way SIL pin strips;
2 x 10way DIL connectors, to suit if desired);
1 x small TO-220 heatsink bracket, for U8;
1 x 3mm x 10mm machine screw and 3mm nut, for mounting U8 and heatsink;
1 x 40-pin DIL IC socket,
1 x 16-pin DIL IC socket;
3 x 15-pin, 2 x 14-pin DIL IC sockets (optional);
1 x small DC power connector; hookup wire for PCB links;
2 x DB-15 sockets (panel mount — optional).

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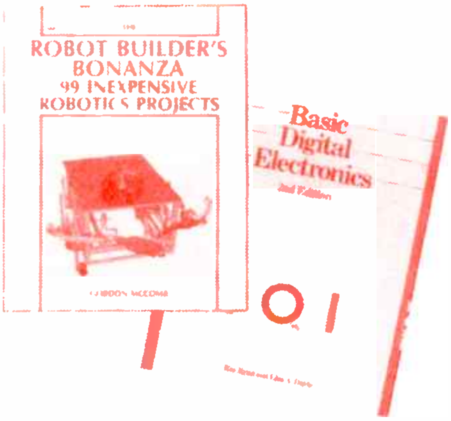

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JAYCAR - No 1 for BARGAINS

WIRE ON SMALL REELS

You know the scenario! You buy a few metres of cable and by the time you get round to using it, it's all messed up and it takes you twice as long because half the time is spent on untangling it. It's not only frustrating - it can damage the cable. Jaycar has now solved your problem! Our most popular cables are on small reels.

LIGHT DUTY SPEAKER CABLE
14/0.14mm Cat. WB-1703 30 metre roll NORMAL PRICE 30¢ metre
$7.50 SAVE $1.50

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NEW

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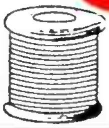
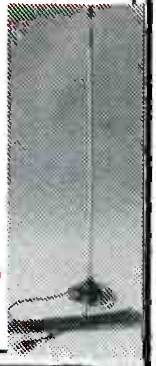
NORMAL PRICE 80¢ metre
$17.95
SAVE $6.05



CB ANTENNA WITH MAGNETIC BASE BARGAIN

Buy a spare at this silly low price.
Consists of a mini antenna which is only 470mm (about 18") tall which is top adjusted and a quality magnetic base with 5 feet of cable and a CB plug.
We've had reports that this antenna is as good as a 4 foot helical - but you be the judge. You would expect to pay around $35 - $40 for this, but not from Jaycar.
Limited quantity.
Cat. DC-2020
NEW
ONLY
$19.95



UNBELIEVABLE CAR ALARM SENSATION

Jaycar has purchased an importers entire stock of two models of "Vandalert" remote controlled car alarms. We can offer these far below normal prices. Quantities are limited, so be quick. Check out the features.

VANDALERT V40

The V40 is a remote controlled car alarm. It is supplied with two individually coded key fob transmitter keys.
The electronics and siren are housed in a die cast metal box (not plastic) and it has a master bypass keyswitch mounted in the siren (ideal if you lose your keys and can't turn the alarm off remotely).
Also included is an ultrasonic interior sensor. Everything you need to install the alarm is supplied - instructions, cable quick connectors, cable ties, door/bonnet switch and all wiring harnesses, as well as two alarm stickers.
FEATURES INCLUDE:
- Two remote key fob controllers
- Current sensing system
- Ultrasonic sensor supplied
- Ignition kill
- Inbuilt adjustable shock sensor
- Audible arm and disarm
- Master bypass keyswitch
- Won't alarm when ignition is on
- Die cast aluminium box/built-in siren

WAS SELLING FOR OVER $300
V40
Cat. LA-8940
ONLY
$129.50

NEW

VANDALERT V80

The V80 has all the features of the V40 plus the following:
- Battery back-up
- Cooling fan overide
- 12V 5A output when alarmed is triggered to power additional siren, lights, etc.
- Extra module supplied to flash car indicators when alarm is turned on and off.

Cat. LA-8950 **ONLY $169.50**

MINIATURE SPEAKERS

In keeping with Jaycar's philosophy of "Electronics for the hobbyist" we proudly announce two new miniature speakers. Up till now the smallest speaker available to the hobbyist has been the old 57mm size. We now have 40mm and 27mm Mylar cone 8Ω speakers. Their reproduction quality is excellent, and they are not expensive. 10+ LESS 10%

27mm Cat. AS-3002 **$2.50 ea**
40mm Cat. AS-3004 **$2.50 ea**

NEW

DIGITAL BLOOD PRESSURE METER

Oscillometric method

Keep an eye on your blood pressure at home with this easy to use digital electronic blood pressure meter. It uses the highly accurate oscillometric method to give systolic and diastolic pressure as well as pulse. Features include
- Easy operation

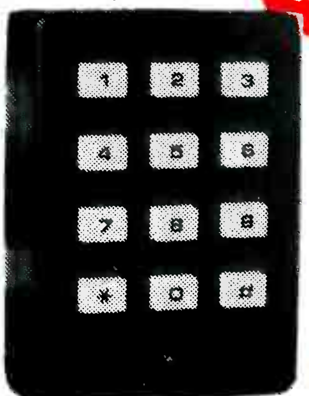
Designed for quick and simple one-touch operation
- High accuracy

High precision with oscillometric method and artifect reject algorithm
- Memory

Convenient memory function for previous reading
Supplied complete with comprehensive instructions, case and batteries (4-AA).
Cat. QM-7250
$99.95
NEW

FAKE CAR ALARM

Save your car for less than $5!
Were selling for $19.95!
It's a black box with 12 digits on the top and a flashing LED.
It looks very similar to the controller on a very expensive car alarm (the one that guarantees your car won't be stolen.)
So, with this sitting on your dash, would be thieves will think you have a high quality alarm, and move on.
Can be used on its own, or to complement any existing alarm system.
Use on cars, around the home, on boats, etc. Easy to install, size 70 x 50mm, sticky tape already supplied on back. Includes alarm sticker. Requires 2 x AAA batteries (not included) Cat. SB-2375 $1.95 for two.
Cat. LA-5105
ONLY $4.95
SAVE 75% over 1988 price



NEW

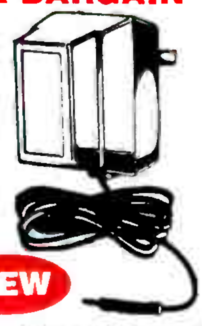
Wholesale enquiries contact Bruce Routley (02) 747 2022

PIEZO SIREN BARGAIN

Limited quantity, grab one while they last. Black in colour, supplied with mounting bracket and connecting cable. Size 100mm H (from mnt brk to top) length 80mm, width 80mm.
SPECS
Operating voltage 12V DC
Resonant Freq 3kHz
Sound Output 120dB
Current Drain 300mA
Cat. LA-5258
ONLY
$19.95
NEW

PLUG PACK BARGAIN

240V mains to 15V AC 100mA. Supplied with 2 metre cable to a 2.1mm DC plug.
Cat. MP-3022
NORMAL PRICE is $9.95
STOCK UP NOW
ONLY
$4.95
SAVE 50%
NEW



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CALL MARK HARRIS OR BRUCE ROUTLEY NOW ON (02) 747 2022




JAYCAR - No 1 for HOBBYISTS

BUTANE MINI TOOL

At last a low cost quality, portable butane powered flame torch. Ideal for the hobbyist and professional. Adjustable flame, completely portable, up to 90 minutes use per fill, adjustable temperature control, mini size, uses standard butane gas lighter fuel. Ideal for shrinking heatshrink tubing.
Cat. TS-1410

ONLY $12.95

SOLDERING OPTION
Cat. TS-1412 **$9.95**

6-12V DC BUZZER BARGAIN

PC mount - pins are 15mm apart. Also includes mounting holes for panel mounting. Operates anywhere from 6 to 12 volts DC. Size 28mm diameter, 35mm mounting holes, 14mm high excluding pins
Cat. AB-3460

CRAZY PRICE
1-9 $2.95
10-99 $2.00
100 up $1.50

PIEZO BUZZER

Top quality buzzer. Operates from 3-16V DC. Typical frequency 3700Hz. Current draw 5mA. Sound pressure level 91dB. Size 17mm(H), 23mm dia, mounting hole dia 28mm.
Cat. AB-3462
$3.95

NEW

ULTRASONICS FOR CAR ALARMS

NEW

Don't miss this. Don't pay $79 to add ultrasonics to your car alarm. We've got top quality 3 wire units for only $39.95. With this in your car you will have added protection against illegal entry from movement as well as broken windows. Limited quantity.
Cat LA-8960
ONLY $39.95

LOUD PC MOUNT BUZZER

Top quality 96dB PC mount buzzer. Model AI-550KA. Limited qty. Pin spacing 15mm, Supply volts 3-15V DC, current draw 6mA, frequency 2800Hz. Size 15mm (H), dia 23mm.
Cat. AB-3458
$4.95

REUSABLE PCB CLEANING SOLVENT

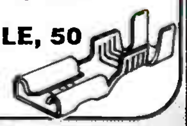
NEW

Hycasol is supplied in a bottle instead of the usual environmentally unsound spray can. It contains 500ml which is 2 1/2 times the amount of the spray can. To use simply pour contents into a glass or metal container, brush on circuit board and return to bottle after use. Can be re-used many times. PCB's should be cleaned. Hycasol will dissolve flux residues and grime leaving the track work and board absolutely clean. Cat. NA-1050 **$16.95**

SPADE LUG MADNESS

Stock up now. This bargain won't last long. Standard QC - 6.3mm spade lugs.

50 MALE, 50 FEMALE, 50 PLASTIC COVERS
Cat. PT-4510 **$8.95**



HOBBY BOX

Quality ABS black plastic box. Ideal for use in cars as can be supplied with underdash mounting bracket. It may look familiar to many people as it's a radar detector enclosure. The front panel has a square hole and the rear panel has some odd shaped holes, but cables can be run through and in a car they won't be seen anyway. Dimensions 39(H) x 125(W) x 127(D)mm. Available two ways:

Box A includes top, bottom, front and rear panel, mounting bracket and two thumb screws.
Cat HB-5942 **$5.95**

Box B includes top, bottom, front and rear panels only.
Cat HB-5940 **$2.95**

NEW

TOP QUALITY CAR ALARM TAMPER (PIN) SWITCHES

Spring loaded switch for mounting in car doors, boot etc for alarms. Top quality stainless steel. Will last a lifetime. Two sizes.

NEW

Short - overall length 38mm, pin travel 6mm.
Cat LE-8780
$3.95

Long - overall length 53mm, pin travel 12mm.
Cat LE-8785
$3.95

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We're even open extended hours
FRIDAY NIGHT TILL 8.30pm
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CIGARETTE LIGHTER POWER LEAD BARGAIN

Ideal for running a 12 volt appliance from your cigarette lighter. Consists of a fused cigarette lighter plug with 1.4mt of cable terminated to a 2.5mm DC plug. Includes 2A fuse.
Cat PP-2008
ONLY
$3.95

NEW

12V FUSED LEAD

NEW

It's a 1.4mt length of twin fig 8 polarised cable with a line fuse holder and a 2A 3AG fuse. Ideal for running a 12V piece of equipment from the car, with the added bonus of being fused. A fuseholder on a 300mm single wire without a fuse sells for $1.10. So stock up now!
Cat SZ-2014 **ONLY $1 each**

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363 HUME HIGHWAY
Cnr MEREDITH STREET
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Phone 709 2822
Ample parking at rear

PROFESSIONAL RACK ENCLOSURES NOW AVAILABLE

NEW

See catalogue for full details

1 UNIT	**$89**	Cat. HB-5120
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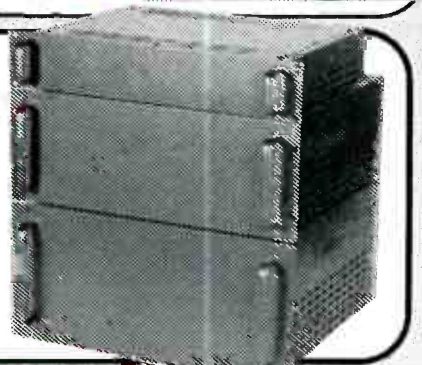
4 UNIT	**$139**	Cat. HB-5135
5 UNIT	**$149**	Cat. HB-5140



CAR CIGARETTE LIGHTER PLUG MADNESS

We're overstocked. Prices include tax. Cat. PP-2000

NORMALLY $1.20 ea
NOW ONLY 1-9 60¢
10-99 45¢
100 up 30¢








JAYCAR - No 1 for NEW PRODUCTS

EDUCATIONAL SOLAR ENERGY KIT

Ideal for students or anybody who wants to learn about solar energy. This kit shows you how to make a solar system.

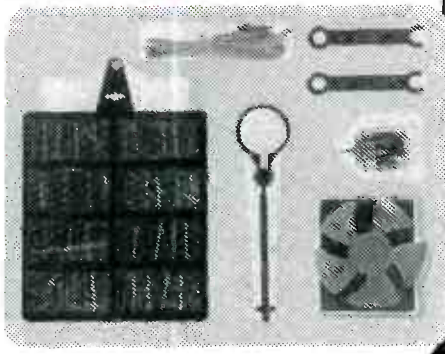
- make a solar circuit
- make an electrical circuit
- learn how to increase voltage
- learn how to increase current
- learn how to make a solar panel
- use solar power to produce energy for a radio, calculator, battery charger and 1.5V cassette player.

Cat. KJ-6692

$24.95

NEW

The kit includes 8 solar cells, which fit into a plastic housing and can be connected up in either series and parallel, a motor and mounting bracket, a fan, tool for connecting solar cells and a 10 page booklet explaining the why's and how's of solar energy.



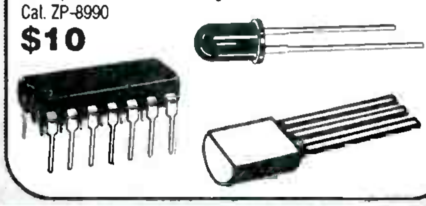
SEMICONDUCTOR PACK

Available once again

Pack contains 100 pieces. May include transistors, diodes, IC's, computer chips, RAM, TTL, CMOS, etc. We cannot guarantee that all items above will be included but we can guarantee at least 100 brand new prime spec semis and $10 will represent an absolute bargain.

Cat. ZP-8990

$10



JAYCAR WILL NOT BE UNDERSOLD ON GOODS OF THE SAME QUALITY

BEGINNERS GUIDE TO THE IBM PC

By Bruce Collins

This book assumes that you have very little or no knowledge of using a computer. It will take your hand and guide you through the computer maze. By the last chapter, you will certainly know your way around your new IBM compatible or genuine computer. The book covers such topics as:- what is a computer?, format and copy commands, disk drives, DOS commands, software generally, computer add ons, maintenance and a lot more.

NEW

An ideal book for a computer novice. Softcover, 69 pages, 210 x 140mm.

Cat. BC-1120 **$9.95**

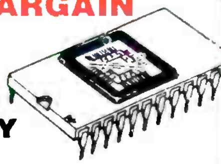
27C64 BARGAIN

64k CMOS EPROM

Cat. ZZ-8465

NORMALLY $9.50

JUNE BARGAIN $3.95



NEW SEMICONDUCTORS

Cat	Description	Price
ZK-8870	MC145436 DTMF Decoder	$9.95
ZC-4514	4514 4-16 Decoder	$3.95
ZC-4043	4043 Quad RS latch	$2.20
ZK-8860	DAC 0800	$4.75
ZS-5323	74LS323 Shift register	$8.95

NEW

LOWER PRICES ON HIGH BRIGHTNESS LED's

all 5mm round styles - **500mCd RED WATER CLEAR**

Cat. ZD-1792 **NOW ONLY $1 ea**

1000mCd RED WATER CLEAR

Cat. ZD-1793 **NOW ONLY $2 ea**

3000mCd RED WATER CLEAR

Cat. ZD-1796 **NOW ONLY $3.25 ea**

160mCd YELLOW WATER CLEAR

Cat. ZD-1795 **NOW ONLY 50¢ ea**

80mCd GREEN WATER CLEAR

Cat. ZD-1794 **NOW ONLY 50¢ ea**

BUY10 - SAVE10%

REED RELAY PRICES SLASHED

We are sick and tired of paying too much for reed relays through local suppliers, so we have done something about it. These new ones are directly imported by Jaycar. Check out the low prices. These are NOT DIL mount.

5 VOLT SPST
WAS $5.25
NOW $2.75
Cat. SY-4036

12 VOLT SPST
WAS $5.95
NOW $2.95
Cat. SY-4038

METEX DIGITAL MULTIMETER WITH COMPUTER INTERFACE

Yes, the Metex M3650CR will interface with your computer via RS-232. Connecting lead and software disk supplied. Monitor store and print out the output of the DMM on computer. It will take readings over time and find and hold mimimum and maximum readings.

PLUS:

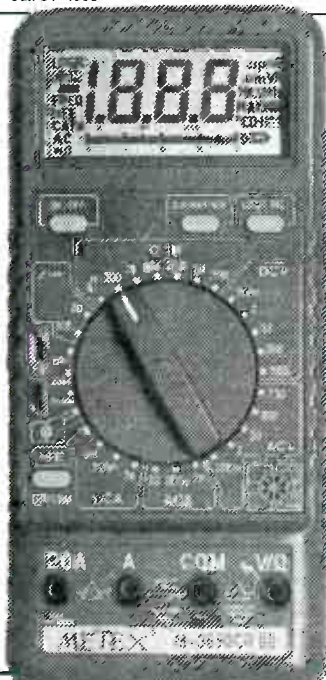
- **Bargraph**
- **Frequency**
- **Transistor**
- **Logic**
- **Relative offset**
- **3.5 digit**
- **20 Amp current**
- **Carry case**
- **Overload indicator**
- **Data hold**
- **Mimimum/maximum hold**
- **Diode and continuity**
- **Range selector beeper**

NEW

$199.50 Cat. QM-1450

SPECIFICATIONS

Function	Range	Resolution
DC Voltage	200mV	100µV
	2V	1mV
	20V	10mV
	200V	100mV
	1000V	1V
AC Voltage	200mV	100µV
	2V	1mV
	20V	10mV
	200V	100mV
	750V	1V
DC Current	2mA	1µA
	200mA	100µA
	20A	10mA
AC Current	2mA	1µA
	200mA	100µA
	20A	10mA
Resistance	200Ω	0.1Ω
	2kΩ	1Ω
	20kΩ	10Ω
	200kΩ	100Ω
	2MΩ	1kΩ
	20MΩ	10kΩ
Capacitance	2000pF	1pF
	200nF	100pF
	20µF	10µF
Frequency	20kHz	10Hz
	200kHz	100Hz



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Construction Project:

FAN SPEED CONTROLLER

Get ready for next summer by building our fan speed controller. It can control virtually any type of fan over a speed range from 'just turning' to maximum, allowing you to adjust the fan to suit the conditions. So throw away those paper weights, and tame that bargain-priced fan with three speeds — all too fast!

by PETER PHILLIPS

Publishing a fan speed controller in the middle of winter may seem slightly non-seasonal, but readers might recall the heat of last summer and the problems of buying a fan to cool those summer days.

Perhaps you were successful at buying one, such as a floor standing type fitted with three speeds: fast, too fast and 'gale force'. Or maybe you have an exhaust fan fitted in the home office, to keep a bit of air flowing while you work. The problem here is similar: the fan often only has two speeds — off and 'flat out'.

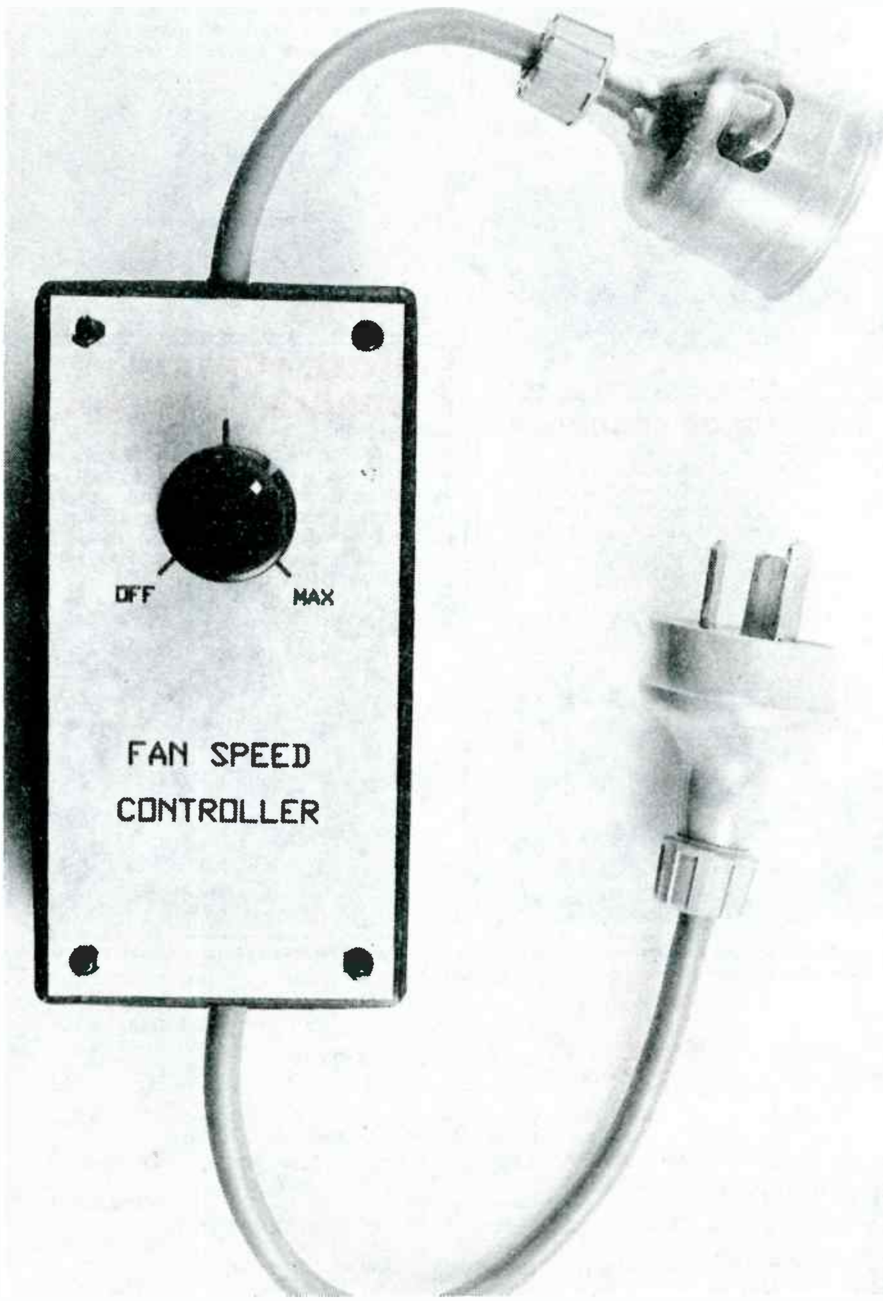
Faced with the latter problem, I decided some time ago to see how a light dimmer would work with the exhaust fan fitted in my workshop. It worked, but for about one day...

I would probably not have bothered further, if the need to tame one of those cheap floor standing fans had not arisen during the summer months. These fans are very common and usually feature a shaded pole motor, a three-speed controller and some sort of oscillating mechanism.

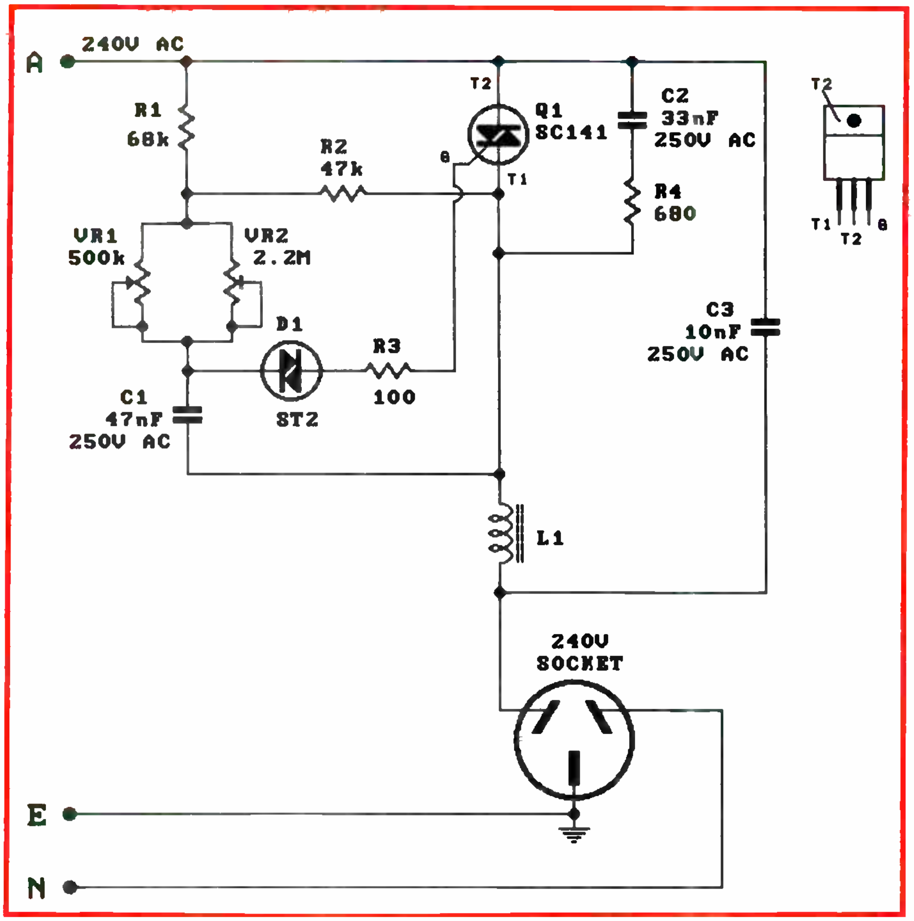
However, the lowest speed in a fan of this type has to be one that ensures reliable starting of the motor if that speed is selected at switch on. The problem is, once the fan gets going, the slow speed is usually faster than you want — as in most cases all that's needed is a bit of air movement, with the fan running silently and gently in the background.

Sound familiar? With our simple fan speed controller, you can end these problems and enjoy a zephyr rather than suffering a hurricane.

The project uses a phase-controlled triac, with a circuit much the same as a light dimmer. In fact it could be used as a light dimmer, although that is not really its intended use. We housed the prototype in a medium sized jiffy box, with a three pin plug and a three pin



FAN SPEED CONTROLLER



The circuit diagram of the controller. The triac is phase controlled by VR1 and Cl, and VR2 adjusts the circuit so the triac is off when VR1 is at maximum resistance. A symmetrical diac is used in the triac trigger circuit

socket on the end of leads coming from the box. This way, you simply plug the controller into a power point and plug the fan into the socket from the controller. There is no need for an on-off switch as, assuming everything is correctly adjusted, the triac will turn off completely when the pot is turned fully anticlockwise.

The PCB holding everything is small enough to fit in a wall cavity behind a standard size mounting plate, allowing the unit to be used to control the speed of an exhaust fan. In this instance an on-off switch should be added, perhaps on an adjacent plate as there is no room for the controller and an on-off switch on the same plate unless you resort to some creative construction.

Although we haven't tested it with a ceiling fan, there is no reason why the controller cannot be used with this type of fan. After all, the motor is the same type as for any other fan, except for the lower speed of rotation.

On the topic of use, the unit is intended only for small motors, up to 100W or so. While it may control heavier loads, it has only been tested with domestic fans fitted with a small shaded-pole motor. It has not been tried with squirrel cage motors or universal motors. It should definitely NOT be used with fan heaters, as the load will exceed the capabilities of the triac and its heatsink.

The unit has RFI suppression and generates an insignificant amount of RF noise, due in part to the relatively low current taken by an average fan motor.

The worst-case fault condition is a dead short in the triac, which will cause the fan to run at full speed. For this reason, if the unit is used with a ceiling fan or an exhaust fan, an on- off switch is required. There is no need for this switch when the unit is controlling a floor standing fan, as these generally have their own on-off switch, and the controller can be unplugged from the power point if a problem arises anyway.

The circuit

The circuit is very standard, although we started with the intention of using proportional control to obtain switching at the zero crossings. This system has the advantage of generating very little radio frequency interference (RFI), as the triac switches when the current is passing through zero. However, it seemed overkill for a low power load with inherently small RFI generation.

Resistors R1 and R2 form a voltage divider and supply the phase control network with a reduced voltage. If the unit is connected to 240V and a load, these resistors will conduct current even when the triac is off, dissipating something less than 1W of heat. For this reason, these resistors need to be rated at 0.5W.

Phase control is provided by the variable resistors and capacitor C1. The operation is typical in that C1 charges at a rate determined by the setting of VR1. When the charge voltage equals 30V or so, diac D1 will trigger and a pulse of current flows in the gate circuit of the triac, triggering it into conduction.

If VR1 is set to zero resistance, C1 will charge quickly and the triac will switch on very early in the half cycle. The triac then turns off when the current falls below its holding current.

This sequence is repeated during the next half cycle, as unlike an SCR a triac conducts both ways and responds to both positive and negative trigger pulses. Again the setting of VR1 determines when the triac is triggered, and the conduction point will be the same on both halves of the cycle.

The diac used in the circuit is a symmetrical type, with equal switching voltages for both polarities. Most light dimmers have an asymmetrical diac, to minimise the effect of *hysteresis* in which the control has different characteristics depending on the direction of adjustment.

When a symmetrical diac is used in a light dimmer, the lights will suddenly come on when the control is moved from its off position. Once the lights come on, they can then be dimmed further by moving the control back towards the off position. An asymmetrical diac overcomes this effect and the control becomes equal for both directions of rotation of the control.

However it is an advantage to *have* the 'snap on' effect with a fan speed controller, as this gives more reliable starting of the motor. In fact, the control will appear to be equal in both directions when the unit is used with a fan, but the hysteresis effect will be apparent when it is driving an incandescent lamp.

The snubber network of C2 and R4 across the triac helps eliminate false triggering due to spikes on the supply. Capacitor C2 bypasses the spikes and the series resistor R4 limits the discharge

current of the capacitor when the triac switches on.

RFI suppression is provided by C3 and L1, although experiments have shown that for small fans, these components are not essential as the amount of RFI produced by the circuit is relatively small. However, for best RFI rejection they should be fitted. The trimpot VR2 allows the unit to be adjusted so that when VR1 is at maximum resistance, the triac is fully off. This adjustment is fairly important, because of the lack of an on-off switch.

Note that all capacitors are rated at 240V AC, although C1 could have a lower voltage rating due to R1 and R2 preventing the voltage across this capacitor from reaching 240V. However it is better to be sure!

On the question of safety, it can be seen that if the triac became a short circuit, full voltage would be applied to the appliance connected to the unit. This would simply result in full power to the appliance, with no other ill effects.

But you may notice that the layout diagram shows the earth lead connected to the body of the pot. This is a basic safety consideration, and if the pot has a plastic shaft fitted with a plastic knob, earthing the pot is probably not required.

When the pot case is earthed, a very worst case scenario could be a short-circuit between all three terminals of the triac, giving breakdown of the diac and a possible track to earth caused by internal breakdown of the pot.

Under these rather improbable conditions, R3 becomes the only resistance between the active and the earth connection to the case of the pot.

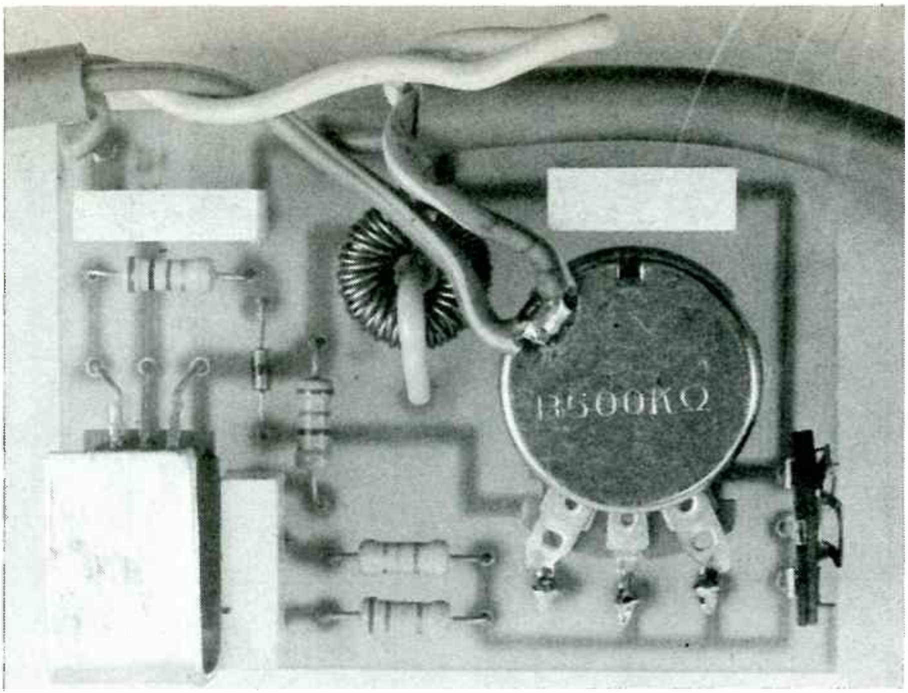
The instantaneous power dissipation would be substantial and R3 or the diac would quickly blow into an open circuit. If not, the fuse in the switchboard would blow.

For these reasons, an internal fuse has not been fitted, although some readers may prefer not to earth the pot at all as this prevents a voltage differential between the pot wafer and its enclosure.

In any case, fit a plastic knob to the shaft of the pot and cover any exposed metal parts external to the front cover, to prevent them being contacted by anyone.

Construction

The PCB holds everything, including the potentiometer. As the photos show, the pot also serves as the means of holding the PCB inside the plastic case, and a hole to suit the pot needs to be drilled in the PCB. The pads for the mains leads should be drilled to give a 2mm hole to accept the conductors.



This shot shows the PCB and how the plug and socket wiring were attached. The heatsink was made from a piece of aluminium measuring 55mm by 15mm and insulated from the triac with a TO-220 insulator.

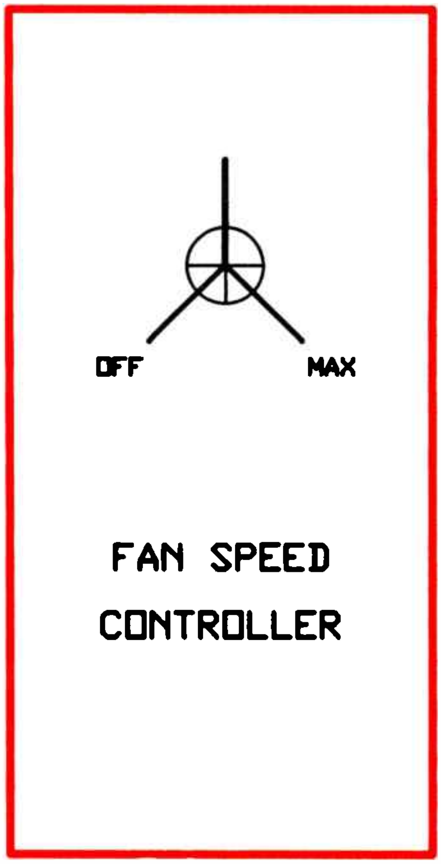
Once the PCB is drilled, fit the capacitors and the resistors. Most 240V AC rated capacitors have a lead spacing of 6mm, but pads for 4mm spaced leadouts have also been provided to suit all types.

Although not absolutely essential if the unit is controlling a small exhaust fan, a heatsink should be fitted to the triac. In the prototype, we used a piece of aluminium (55mm x 15mm) bent as shown in the photos.

Being dead scared of 240V, we used a TO-220 mica (or mylar) insulator between the heatsink and the triac, as the tab of the triac will be at mains potential. A 4mm nylon nut and bolt should be used to hold the triac to the PCB, with the bolt head on the track side of the board.

The inductor in the prototype was wound on an iron powder toroid available from Dick Smith Electronics (Cat. L-1439). Use a 1.5m length of enamel coated winding wire with a gauge of around 0.5mm to give approximately 40 turns. The toroid is held to the PCB with a piece of insulated copper wire fitted as shown in the layout diagram.

Other types of inductors can be used, providing they have a suitable gauge of wire for the winding and a ferrite (or iron powder) core. Or maybe you have a faulty light dimmer you can cannibalise, as the inductor used in these will suit admirably. The pot is connected to the



This front panel design is for a jiffy box and will help locate where to drill the hole in the lid for the pot.

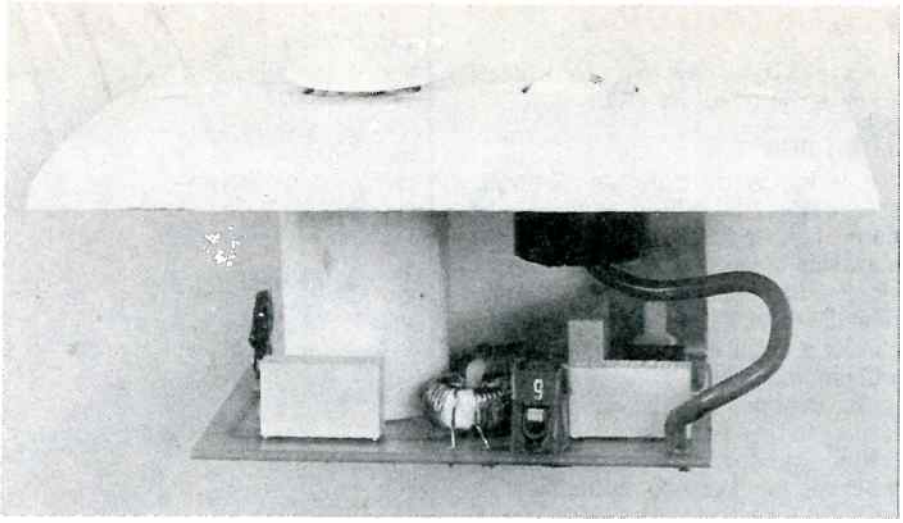


Fig.1: By using parts from an old light dimmer, the PCB can be fitted to a standard size wall plate for use with an exhaust fan.

PCB with short pieces of wire that extend from the pot terminals to the PCB. Fit the trimpot so the movable contact faces away from the pot, to minimise the chances of contact between the two.

Finally, the mains wiring can be installed. If you are using the unit with a floor standing fan, connect a three pin plug to one end of a length of three core flex, and a three pin cord extension socket to the other. Then remove around 85mm of sheath from the centre of the length of flex to expose the inner cores.

Cut the active lead (brown wire) and solder it to the pads as shown in the layout diagram. Just make sure the active from the plug connects to the correct pad, identified on the PCB as AC IN. If you decide to earth the case of the pot, strip about 10mm of insulation from the earth conductor and solder the uncut copper conductors to the case of the pot.

Testing & adjustment

Because most of the circuitry is at mains potential, there are two basic precautions required. The first is not to touch any part of the board when power is applied, and the second is to test the board in such a way that it can't blow any fuses.

To do this, I use a short extension lead with a 240V lamp socket permanently connected in series with the active conductor. With this technique, the first test is to connect the board (with load) to the mains via the test lead fitted with a 40W lamp.

The protection lamp will light at full brilliance if there is a short between active and neutral, although this is rather unlikely unless you've made a drastic wiring error.

With VR2 set midway, by operating VR1 you should be able to vary the brilliance of both the series-connected protection lamp and the lamp serving as a load.

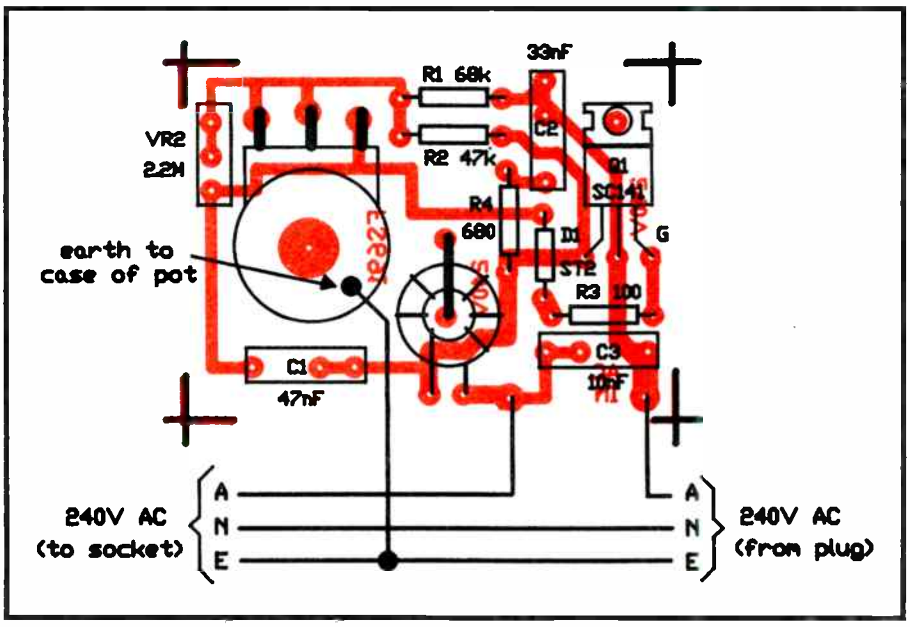
If all is well, connect the board directly to the mains, as now you need to adjust VR2. There are numerous ways to get the correct setting, but the simplest method is to use a portable AM radio to determine when the triac has stopped conducting.

Place the radio close to the board, so it picks up the RFI being generated by the circuit. You will need to have the radio fairly close (within 50mm or so), and tuned to the lower end of the dial.

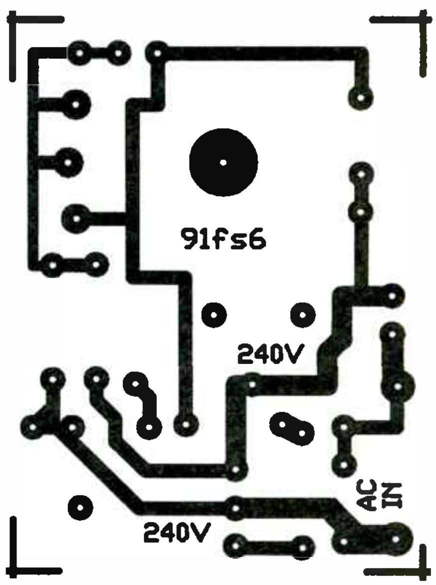
The correct adjustment of VR2 will cause the triac to stop conducting when the main pot (VR1) is moved from maximum to minimum.

Don't try adjusting VR2 with the pot already at the off position, as the hysteresis effect will cause conduction of the triac the next time the pot is moved away from, then back to the off position.

The radio will serve as a better indicator than the lamp as to whether the triac is conducting or not.



The layout diagram of the PCB. The pot is earthed only if there is exposed metal when the unit is fitted to the case. All resistors are 1/2W rated, and all capacitors are 240V AC rated.



The PCB pattern for those who can make their own.

Fan Controller

Naturally, use an insulated screwdriver to adjust VR2!

The case

It is important to use an all-plastic case to house the PCB. In particular, the lid of the case MUST be plastic as the track side of the PCB is fitted relatively close to the underside of the lid. Apart from the shock hazard, if the PCB tracks contact a metal lid, destruction of both will probably result.

The artwork for the lid can be used to identify where the hole for the pot is drilled, although this is not critical, providing the board fits inside the case when the lid is attached.

The pot should be attached to the PCB with a nut, then the whole assembly fitted to the lid with another nut holding the pot. The head of the screw holding the triac in position will serve as a spacer at the other end of the PCB.

If the threaded section of the pot is not long enough, you'll need to file the head of the bolt holding the triac and also some of the solder connections on the PCB. Then attach the board to the lid without fitting a nut to the pot first.

File exit holes for the flex in the sides of the box, so that when the lid is fitted to the box, the bottom of the lid clamps the flex. Otherwise, clamp the flex somehow to prevent it being pulled from its connections if stress is applied to the flex.

For fixed fans

If the unit is being used to control a ceiling fan or an exhaust fan, the completed board could be fitted to a standard size mounting plate as shown in the photo of Fig.1.

We used the case from an old light dimmer unit and a miniature 500k pot from the junk box. It is also likely that the pot from a light dimmer will have the correct value, assuming the pot itself isn't faulty.

With careful disassembly of the dimmer, you might be able to get an arrangement similar to that shown in the photo, but one that also includes a pot from the old dimmer.

Notice that the case from the dimmer unit spaces the PCB sufficiently from the plate to allow a 240V switch mechanism to be fitted. Although not shown in the photo, a cover made from suitable insulating material should be constructed to wrap around the assembly before it is fitted in the wall cavity.

To allow the unit to be connected to the existing fan wiring, we fitted a PCB-mount single screw connector to the board. Also a wire from the AC IN pad to the common of the switch mechanism is required. The loop terminal on the switch can be used to terminate the neutral wires, and the active to the fan connects to the PCB mount connector. The incoming active connects to the switch, therefore ensuring the switch breaks the active *before* it connects to the PCB.

If the pot is fitted so there is no exposed metal, earthing the pot is not required.

As a final point, don't assume the triac has stopped conducting if the fan is not turning. It could be that there is insufficient output to start the motor, but enough power to eventually heat the windings and possibly burn out the motor. Because an exhaust fan cannot always be seen behind its grill, it is best to turn it off with the switch rather than rely on the triac being turned off. ■

PARTS LIST

Resistors

All 1/2W, 5%:
R1 68k
R2 47k
R3 100
R4 680

Variable resistors

VR1 500k linear panel mount
VR2 2.2M trimpot, vertical mount

Capacitors

All 250V AC mains rated, PCB mount:

C1 47nF 250V AC
C2 33nF 250V AC
C3 10nF 250V AC

Semiconductors

Q1 Triac, type SC141D/BT137 or equivalent
D1 Diac, type ST2 (or BR100-03) or equivalent

Miscellaneous

PCB 73mm x 53mm coded 91FS6; medium sized zippy box 41 x 68 x 130mm, plastic lid; toroid (iron powder) 15mm OD, 8mm ID (DSE L-1439 or similar), 1.5m enamel coated winding wire, 0.5mm; heatsink, aluminium 55mm x 15mm; TO-220 insulator; 4mm nylon nut and bolt; plastic knob to suit pot; three core flex, three pin plug top and extension socket

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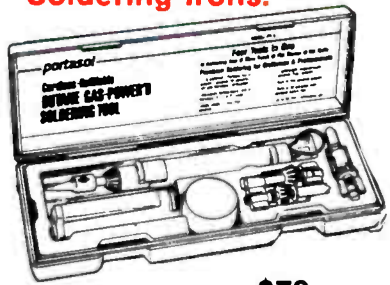

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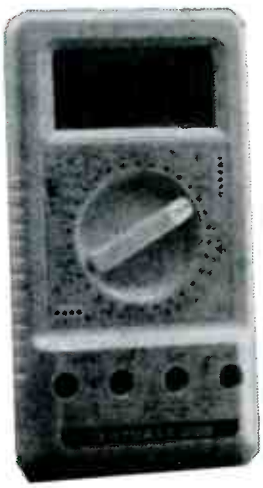

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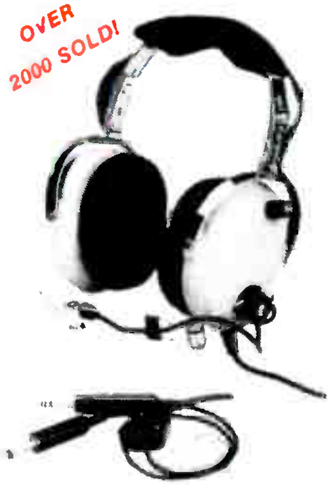

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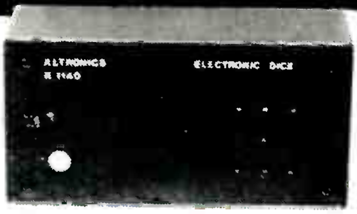

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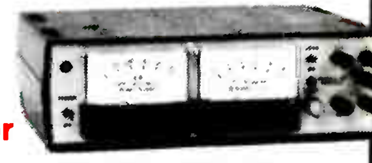

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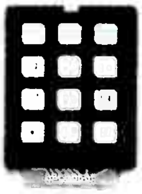

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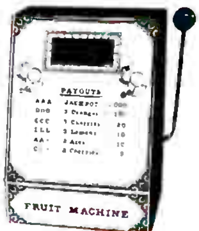

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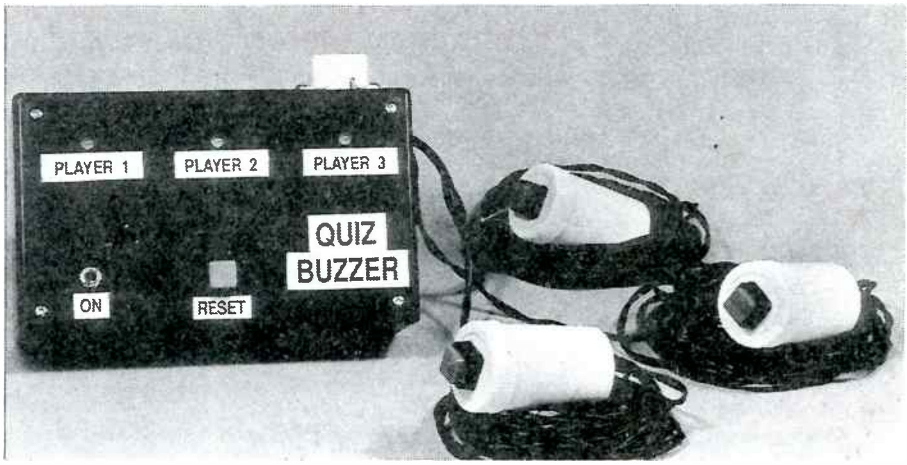
Construction Project for Newcomers:

Simple Quiz Buzzer

Want to play a quiz game like Channel 9's 'Sale of the Century'? This simple project for newcomers, especially our younger experimenters, will let two to five players play the game. Only the first person to push his or her button can sound the buzzer and turn on his or her light. The other players' buttons cannot work until the master 'reset' switch clears the circuit for the next game.

by PETER MURTAGH

As well as showing you how to construct this simple circuit — and having a lot of fun using it — this project will help you learn some basic electronics at the same time. For this reason, the circuit is built out of ordinary electronic components like transistors, diodes and resistors. This way you can see exactly what you are building. We could have designed this project out of integrated circuits, but if we had, then you wouldn't be able to learn as much about electronics.



To simplify the circuit and its explanation, we will start by talking about each 'game unit'. Each of these units provides the electronics needed for one player. So you need to build as many game units as you want players to join in your game. (After building them, you join the units together, adding the common items: reset switch, buzzer, battery and on/off switch.)

If you look at the circuit diagram, you will see that there are four input diodes connected to the 'logic gate' section. Because the number of diodes is one less than the number of players, this means that the circuit as shown can accommodate up to five players — to extend beyond five, you will need to increase the number of diodes at the logic input stage on *each* unit. We built our game for three players, so our units only have two diodes.

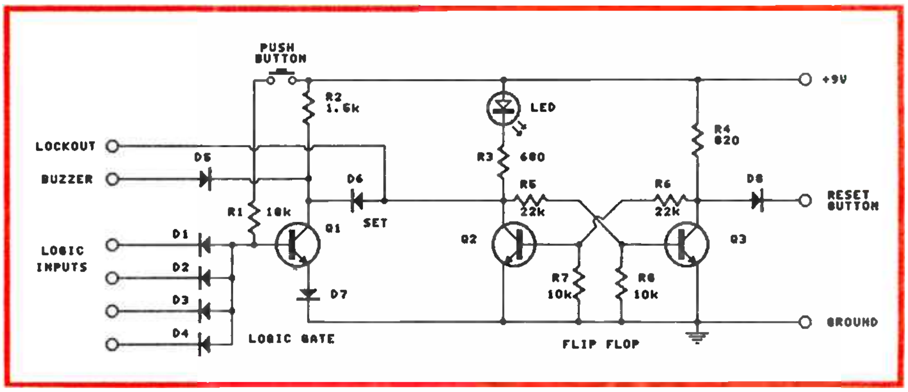
Some theory

At the heart of each unit is a flip-flop. Flip-flops, in their simplest form, consist of two transistors connected together in such a way that only one of the transistors can be turned on at a time. So if you turn the 'off' one on, this turns the 'on' one off.

Transistors are members of the group of semi-conductors. This means that they are made of material part way between ordinary conductors and insulators. They can be turned on (and conduct at various levels), or turned off (and not conduct). In this circuit we are using our transistors as switches — they are either turned fully on or off — and not as amplifiers which increase the signal current.

To switch on the transistor, you apply a small current between its base and emitter. This causes a larger current to flow through the collector-emitter junction. With NPN transistors, like the BC548s used in this project, a voltage difference of about +0.7V is needed between the base and the emitter to turn the transistor on. If the voltage applied is lower, then it will not turn it on.

This 0.7V value is the typical voltage drop across any silicon diode. The reason that it is also the value to turn on a transistor is because a transistor is effectively made up of two diodes joined back-to-back. But, unlike the diode which maintains its 0.7V voltage difference when conducting, the collector-emitter voltage drop across a switched-on transistor can fall to about 0.3V because the base current 'saturates' the transistor, making it a better conductor.



The circuit diagram for each player. While the board allows up to five players, we built ours for only three. So diodes D3 and D4 were not used.

Simple Quiz Buzzer

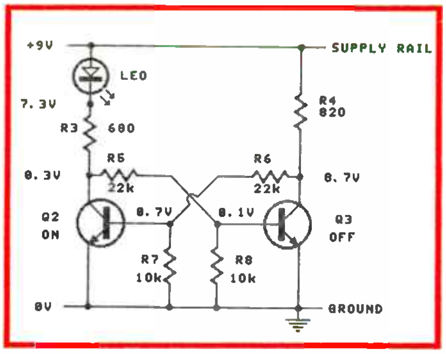


Fig.1: Approximate flip-flop voltages when the LED is on.

In a flip-flop circuit, its state can be changed in two ways. The 'off' transistor can be *turned on* with a high voltage, or the 'on' transistor can be *turned off* with a low one. In this circuit, all switching of the flip-flops is done by turning them off — we found this method to be more reliable. Also, the negative switching voltage is applied to the collector of the transistor, not directly to its base. This was done to get a lower voltage at the base to ensure that it always turned off: 0.7V applied at the collector drops to 0.3V at the base (explanation later). Let's see how all this theory applies to our circuit. Note that transistors Q2 and Q3 form our flip-flop.

How does it work?

When you first switch on, connecting the battery to the circuit, the Light Emitting Diode (LED) in each unit will glow. This means that transistor Q2 is turned on. Current from the positive supply rail flows through the LED and resistor R3; most then goes through the transistor Q2 to the ground wire, but a small current also flows through R5 and R8.

Refer to Fig.1 to see a summary of the various (approximate) voltage levels:

The 9V total drops across the LED, resistor R3 and the transistor in stages of about 1.7V, 7.0V and 0.3V respectively. This means that the voltage at the collector of Q2 is low, as it is only 0.3V above ground voltage. This 0.3V also causes the small current to flow through R5 and R8 which form a voltage divider. Because R5 (22k) is roughly twice as big as R8 (10k), the voltage drop across R5 is twice as big as that across R8. Hence the voltage at the base of Q3 is only 0.1V. This low voltage, caused by switching Q2 on, switches Q3 off.

Now Q3, being off, has a high collector voltage (8.7V), which results in a high enough voltage at the base of Q2 to keep it switched on. The actual value is determined by the potential divider made up of resistors R4, R6, and R7 in parallel with the base-emitter junction of the switched-on Q2.

Reset button

When the 'reset' button is pressed, Q3's collector is connected to ground via diode D8. The voltages at its collector and the base of Q2 now become 0.7V (the D8 voltage drop) and 0.3V respectively. The base of Q2 has gone low, so Q2 turns off. Because its collector voltage now goes high, so does the base voltage at Q3; this turns Q3 on.

You can see why the arrangement is called a flip-flop: the two transistors have turned on/off and off/on. Pressing the reset button sets up the flip-flops to start the game — all players' lights are off. The game can now begin!

Setting the flip-flop

When a player's push-button is pressed, this activates the 'set' routine. This does exactly the same as pushing the 'reset' button, but this time to the opposite transistor. The 'set' turns Q3 off

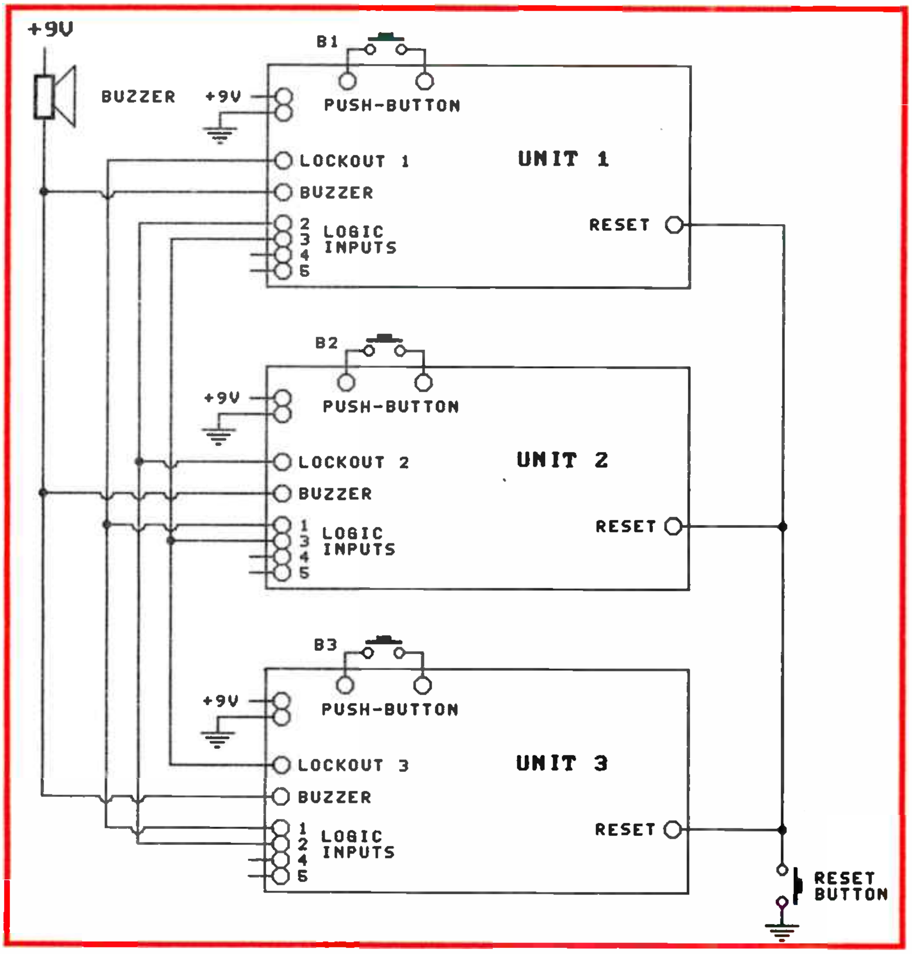


Fig.2: The wiring between the three game units. The lockout wire from each unit loops to a logic input of all the other units. The loops between the '+9V' and 'ground' points are not shown.

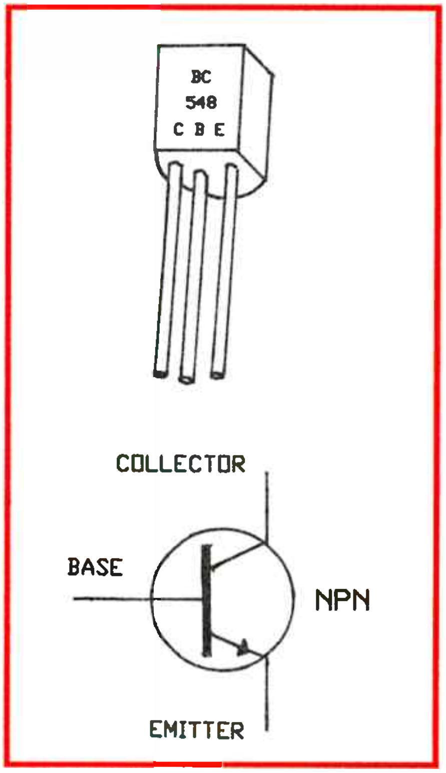


Fig.3: The pin arrangement for the NPN BC548 transistors.

and Q2 on, and so lights the LED. The push-button actually performs the 'set' routine by turning on transistor Q1, which connects its low collector voltage via D6 to the collector of Q2 and then through to the base of Q3 to turn Q3 off.

However, the circuit must allow this flipping to happen only for the *first* player to push a button. To achieve this blocking-out of the slow players, we use a 'logic gate' made up of diodes D1-D4, D7 and transistor Q1. The diodes bring signals from each player and isolate each signal from the others. The role of the transistor is mainly to stop each flip-flop interfering with the others. Our first model didn't have this isolating transistor, and we found that turning the first flip-flop on also turned others on. And you can't have two winners now, can you?

So the first player to press his or her button, 'sets' their flip-flop. While the button is kept depressed to keep Q1 on, current can also flow through the buzzer, diode D5, transistor Q1 and the diode D7. This sounds the winning signal.

Once the button is released, Q1 turns off and so does the buzzer; but the flip-flop remains flipped, which means that the LED stays on until the reset button is pushed.

Lockout signal

But how do we stop Q1 turning on if someone else has already pressed their button? We do this by interconnecting the various units as shown in Fig.2, so that a low lockout-voltage from the winner is used to lock out the others.

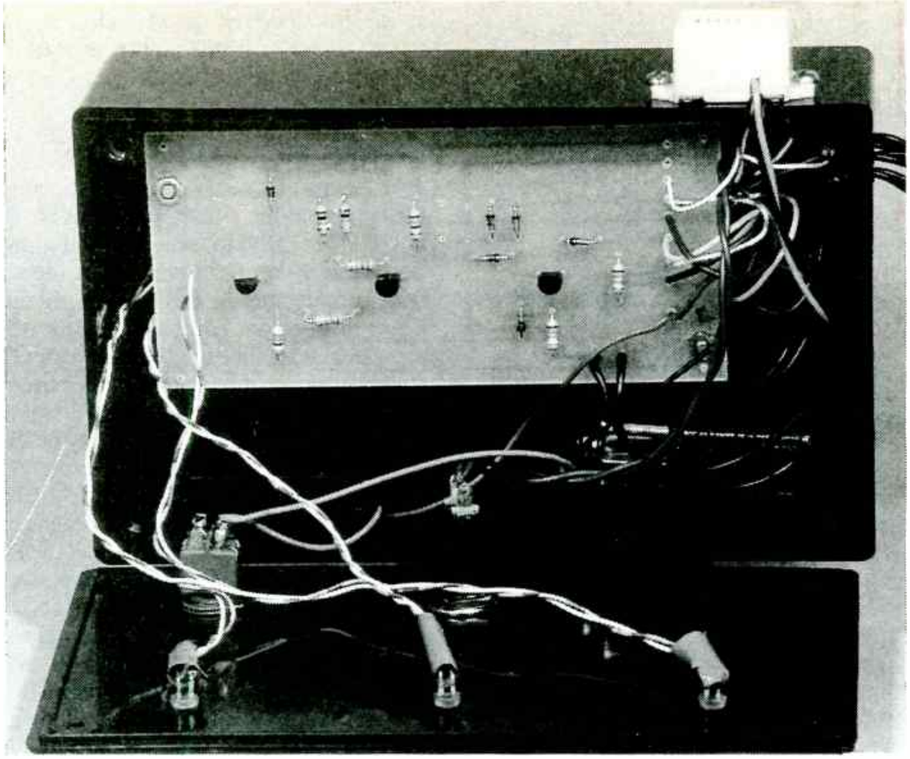
Before any of the players pushes a button, the lockout voltage coming from all their Q2 collectors is high. Suppose player No.1 is the first to push his or her button. Transistor Q1 can be turned on, because all the other players' lockout voltages are high — they reverse bias *all* the input logic diodes and have no effect on the Q1 base voltage of player 1's circuit.

But suppose button No.2 has been pressed before button No.1. The lockout voltage supplied to diode D1 on No.1's game unit drops to almost zero. When button No.1 is pressed, the Q1 base voltage can only rise to about 0.6V, because the current can now flow to ground via the input diode and No.2's switched-on Q2 transistor. The base voltage remains low, so Q1 does *not* turn on. The same thing happens if any other unit's button has been pressed before No.1's.

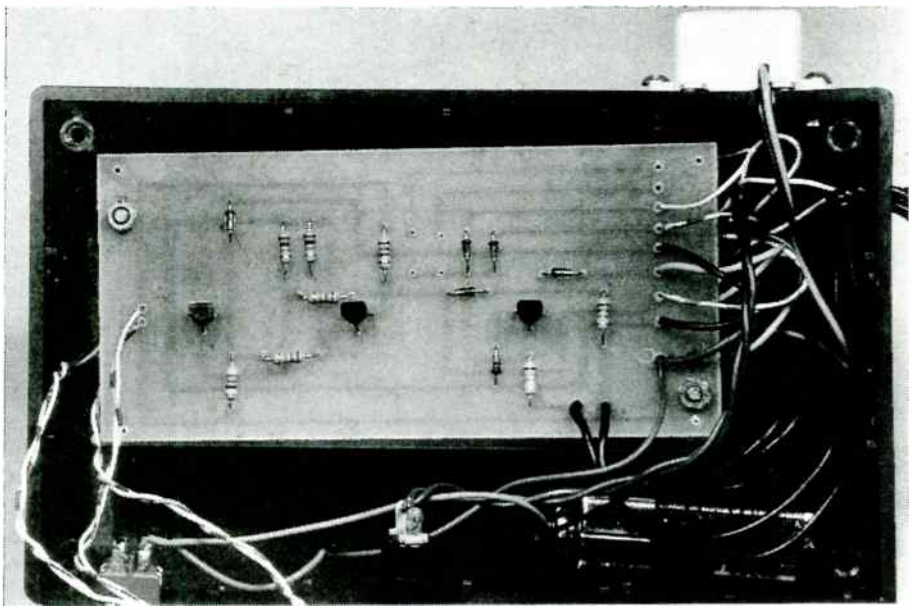
So all the input logic diodes on any unit must be reverse-biased (the lockout voltages from all other units must be high) for that unit's Q1 to be able to be turned on.

Only the first player to push a button can turn his or her transistor Q1 on (and sound the buzzer and flip their flip-flop). The buzzer tells you that there is a winner and the LED tells you which player it is.

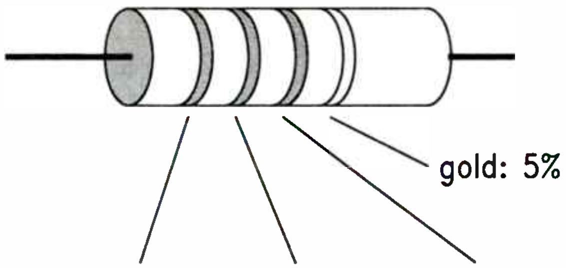
The reason for the extra diode D7 is to make absolutely sure that there is only one winner. Without it, the Q1 base voltage for the second player to push the button is 0.6V. This is a bit too close to 0.7V for comfort. Before adding D7 to our game unit, when we pushed the second button, the second LED gave off a faint glow, because the second Q1 transistor was being slightly turned on. But with D7 added, the 0.6V is shared between the transistor and diode. The



Inside the box: the wires at the left go to the LEDs on the front panel, those at the right loop between the three PCBs.



The 'sandwich' of the three PCBs, bolted together and fastened to the base of the zippy box. Note the groove at the top right for the buzzer leads.



680	blue	grey	brown
820	grey	red	brown
1.5k	brown	green	red
10k	brown	black	orange
18k	brown	grey	orange
22k	red	red	orange

***Fig.4:** This table gives the three code band colours on all the resistors used in our circuit. The gold band means all values are accurate to within +/-5%.*

RESISTOR COLOUR CODE

black	0	Band 1 colour:
brown	1	first number
red	2	
orange	3	Band 2 colour:
yellow	4	second number
green	5	
blue	6	Band 3 colour:
purple	7	number of zeros
grey	8	
white	9	

***Fig.5:** This table shows the general resistor colour code.*

voltage between Q1's base and emitter is now only about 0.3V, so the transistor cannot turn on.

Construction

If you want to build a very neat, protected model, then you will make up a number of printed circuit boards from the pattern provided and enclose all the units inside a container like a zippy box. Mount the LEDs on top of the box and run leads out to the players' push buttons.

However, if you want to save money and keep the cost to the bare minimum, then the printed circuit board and the commercial box are not essential. But we would suggest that you do use some some form of container, just to keep all the parts together and to give some form of protection. Fig.3 shows you how to identify the three leads on the BC548 transistor — collector, base and emitter.

On the printed circuit board, the transistor leads are inserted with the flat face of the transistor towards you; that is, the collectors are all on the left hand side (the side of all the inputs to the board).

Fig.4 shows the resistor colour code, and the colour bands on the resistors used in this circuit.

There are several alternatives to the printed circuit board. You can use strip board (a laminated board with a matrix of holes drilled into several parallel copper strips), matrix board (a board full of suitably spaced holes), or a piece of masonite or plywood. With the strip board, you can solder the components on to the copper and break the copper strips by drilling or cutting with a sharp knife.

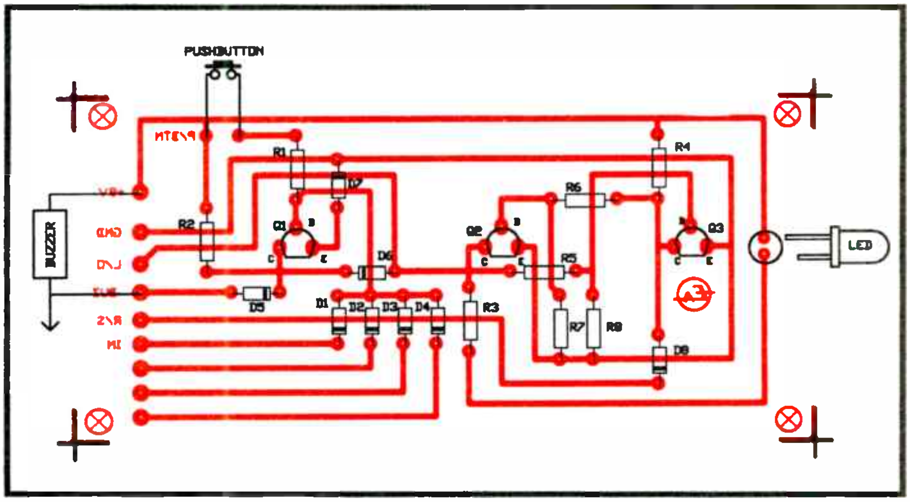
For the masonite approach, place the circuit board pattern on top, mark the positions of all the holes, then drill them. Place the components through the holes and twist the relevant leads together. To replace a longer track, use a piece of bridging wire.

You can just twist the wires and leads together, but we recommend that you also solder them to make sure that you have good, permanent electrical contact.

Whatever method you decide to use, be careful when bending the leads on the electronic components. It is far better to hold each lead with a pair of pliers, and then bend the lead around the pliers. This avoids damage to the join between lead and component.

Make the length such that both leads pass directly down through their holes and the components sit neatly on the board.

When soldering everything together follow the normal rule: solder the least sensitive components first, so that the more sensitive are less likely to be heat damaged. So solder the resistors first, then the diodes and finally the transistors. Also, if you have not had much experience with soldering, use



The PCB overlay diagram. Note that diodes D3 and D4 were not needed for our three-player version of the quiz buzzer.

Quiz Buzzer

a heat-sink to stop the component becoming overheated. The easiest way to do this is to grip the component lead with a pair of pliers. Because the grip is between the solder point and the component, the metal of the pliers will 'soak up' much of the heat.

If you find that you don't have enough hands to do all this, stretch an elastic band around the handles of the pliers.

This will keep them pressed against the lead. But position everything so that the weight of the pliers is not pulling too hard on the component.

Remember that you need to make up as many units as you want players in your game. Refer again to Fig.2 to show how to make the inter-connections between the units for three players. If you have more than three boards, then you shouldn't find it difficult to extend the idea.

Just remember that the lockout from each unit must be connected to one logic input on each of the other boards (but of course not to its own board). It doesn't matter which of the various input diodes on each board it connects to, but you are less likely to make a mistake if you use the following pattern.

Start with lockout 1; run a lead to the first diode of unit 1, then loop to the first diode of unit 3.

Next connect lockout 2 to the first unused diode of unit 1 (No.1) and the first unused on unit 3 (No.2). Finally, lockout 3 goes to diode 2 on both units 1 and 2.

Provided that you do not intend to solder the LEDs directly onto their boards, you can save space by stacking the units side-by-side or on top of each other. But space them so that there is no pressure on the transistors.

An easy way to do this is to use plastic wall plugs and drill them out to take a 1/8" bolt. The bolts will fasten the boards together and fix them to the base of your container. Even though there are markings for four bolts on the PCB, we ended up using only two bolts — more than enough. Our bolts were 1-1/2" long, with countersunk heads.

The spacers were cut to about 10mm. But don't cut these spacers until you have finished your soldering — make them as small as possible, but with nothing touching between layers.

A smaller spacer keeps the bottom board raised from the box. Remember to leave enough room beside the boards for your battery.

Again, instead of using the bolts, you can save money by placing a layer of insulating foam between each board and holding them all together with a couple of elastic bands!

Seeing that all the players will not want to sit on top of each other, run leads from the box to the players' push buttons.

Tie a knot in the leads on the inside of the box before soldering these leads to the boards. Then an accidental tug will only pull the box along the table and not tear the leads off the board.

Mount each player's push-button in a small plastic container like those used for 35mm film or for medicines. Again, tie a knot in the leads inside the container, before soldering the leads to the push-button.

Fix the button to the lid, then screw the lid back on. This will twist the leads, so either twist them in the opposite direction beforehand to compensate, or make the lead entry hole in the container large enough to allow the leads to turn as the lid is screwed on.

The overlay diagram shows where to connect the buzzer. Of course you only need one buzzer. The arrow shows where to extend the loop which goes to the 'buz' connection on all the other units. (See Fig.2 for more wiring details).

If you use the compact electronic buzzer which we did, it must be connected with the right polarity: the red wire goes to the +9V terminal and the black wire to the 'buz' inputs. We bolted our buzzer to the outside of the box with short 1/8" bolts.

An on/off switch is recommended, as the unit draws about 30 milliamps even when no lights are on. This will quickly flatten your battery. We placed it between the positive terminal of the battery and +9V point on the top board.

To decorate our unit, we used double-sided tape to stick on labels. The tape was also used to fasten the battery to the bottom of the box, in a location where nothing was mounted above it.

So there you are. A very easy-to-build project which should provide a lot of fun, and hopefully teach beginners a bit about electronics.

If you are still at school, why not build the buzzer and ask your teacher to use it in the classroom? The quiz could be about language vocab, science formulae, spelling... The list of uses is endless. What an encouragement to learn your homework! ■

PARTS LIST (to make three units)

1 plastic case, 50 x 90 x 150mm
1 9V battery
1 electronic buzzer
1 SPST on/off switch
2 1-1/2 x 1/8" countersunk bolts, connecting wire, plastic spacers

Resistors:

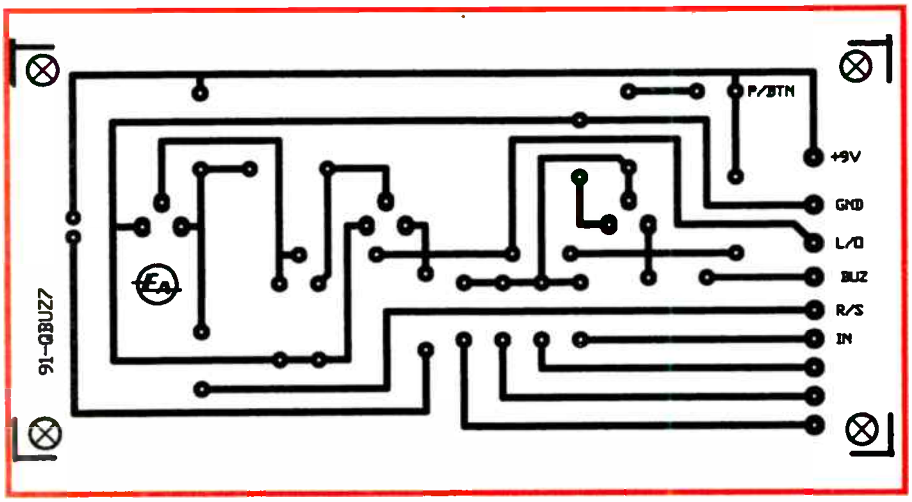
All 1/4W, 5%:
3 680 R3
3 820 R4
3 1.5k R2
6 10k R7,R8
3 18k R1
6 22k R5,R6

Semiconductors:

18 1N4148 diodes
9 BC548 NPN transistors

Miscellaneous:

4 pushbuttons
3 mounting tubes
3 LEDs



A full size reproduction of the PCB artwork for those who wish to make their own boards. The same pattern was used three times to make the three boards used in our three player version of the quiz buzzer.

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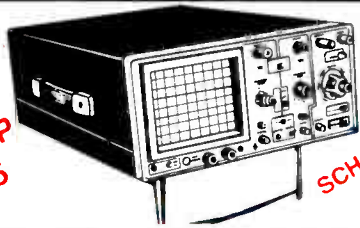

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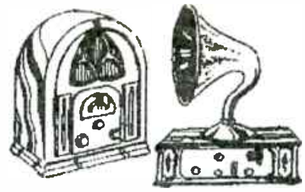
Vintage Radio

by PETER LANKSHEAR



The story of 'Reflexes'

This month's column is not about rubber hammers and kneecaps, but a technology that persisted throughout the history of valve radio, and one that was exploited to its greatest extent in Australia.

With semiconductors available today at only a few cents apiece, it is difficult to appreciate just how expensive amplification was in the early days of radio. Not only valves, but every milliampere-hour of precious battery power cost a lot of money. Any way to economise was well received.

During World War 1, much research went into triode valve applications. One US Navy worker, W.H. Priess, patented the concept of passing a signal twice through the one valve — once at RF and then, after detection, at audio frequencies. Provided that there was no overloading, with 'reflexing' (as it was called) one valve could, theoretically, do the work of two.

There seems to have been little immediate interest, but with the advent of broadcasting, reflexing became an attractive proposition to manufacturers and experimenters. Notable 1922 models were Marconi's two valve V2, and De Forest's D7 with three valves. Similarly many enthusiasts used their one precious valve as an RF amplifier feeding a crystal detector and then reflexed the audio back to the grid of the valve to again amplify the signal. Any problems like erratic operation and distortion were of little consequence.

Early superhet use

An early 'high tech' application of reflexing was in Edwin Armstrong's first generation of RCA superheterodynes, in 1924. To keep the number of valves to a minimum, the first valve was used as an RF amplifier, and then again as the first IF stage operating at about 50kHz.

After 1925, as valves became cheaper, and users became more critical of its complications and limitations, reflexing was generally abandoned. But during 1932, the 6B7 and 2B7 double-diode-pentodes, and the 6F7 triode-pentode appeared. Each had a general purpose pentode suitable for both RF and AF amplification. The triode of the 6F7 was suitable as a detector or audio amplifier, and the diodes in the other valves were for detection and AGC.

The arrival of these multifunction valves coincided with a boom in 'midget' radios, and an increasing demand for car radios. Economies in space and battery consumption became important, providing an incentive to resurrect reflexing.

From late 1933 the Americans, especially RCA, made some use of the 6B7 in car radios as a reflexed IF and transformer-coupled audio amplifier, with the one valve providing IF and AF amplification, diode detection and AGC. This was an effective system, but a problem was that it was practically impossible to make an inexpensive wide range audio coupling transformer with sufficient inductance for pentodes such as the 6B7. The result was a restricted audio response — acceptable enough in a car, but inadequate for a domestic receiver.

With its pentode section used as an RF or IF amplifier and the triode as an audio amplifier or detector, the 6F7 soon became a popular alternative to reflexing for economical and compact receivers — typical Australian examples being the 1933 Healing 44F and Stromberg Carl-

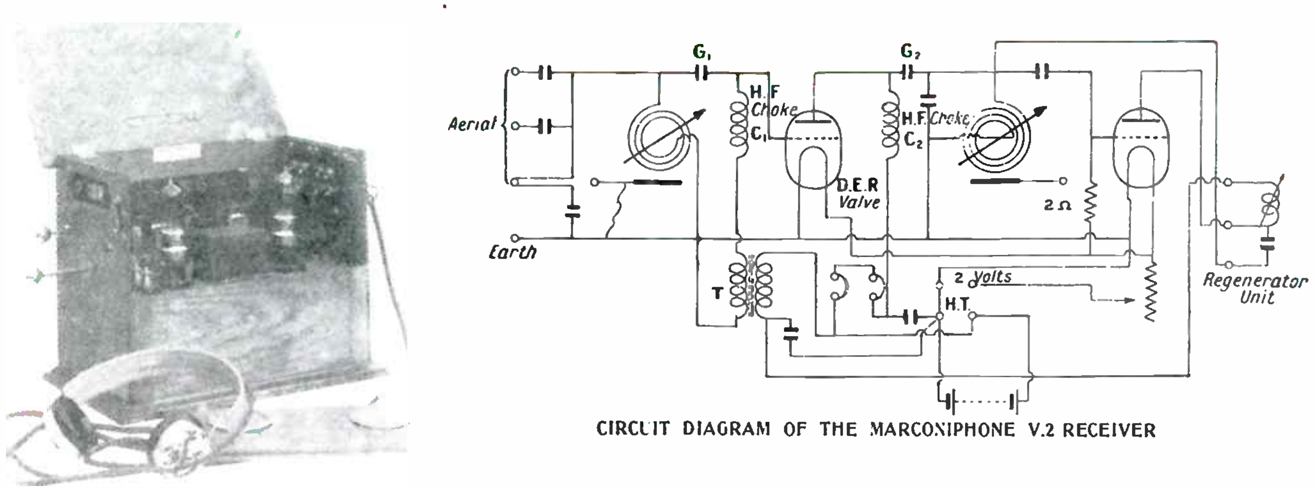


Fig.1: One of the earliest British receivers made commercially was the 1922 Marconi 'V22', a reflex with the first valve combining the functions of RF and AF amplifier. Marconi used plug-in 'pancake' coils, tuned by adjustable copper 'spades'.

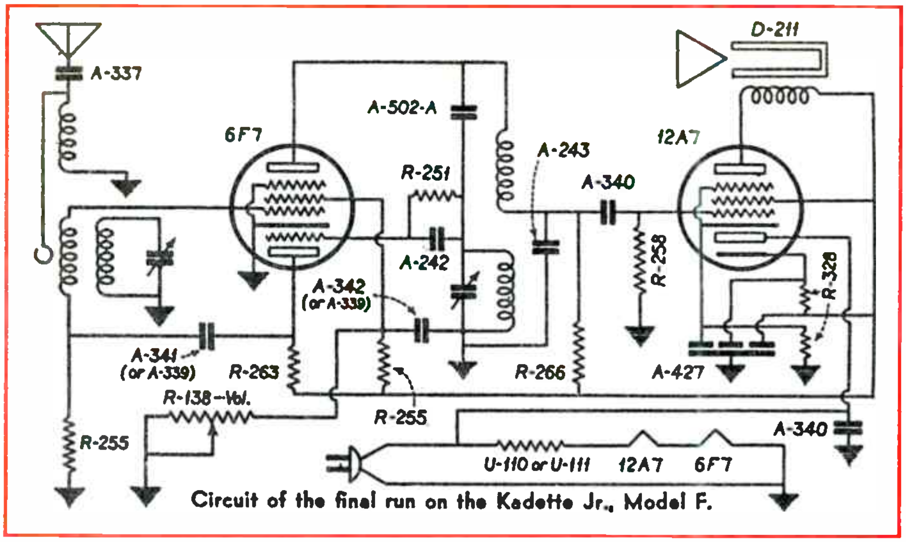


Fig.2: Using two double valves and a classic example of reflexing from 1933, the International Kadette Jr was a 'midget' which could be fitted into an overcoat pocket. The pentode section of the 6F7 was both RF and AF amp, with volume controlled by varying its screen voltage. The triode section of the same valve was used as a grid-leak detector. Note the absence of a power transformer.

son 564. Some writers confused this with reflexing, but the concept was quite different — multiple valves within the one envelope, rather than multiple use of a single valve.

However the American firm International *did* reflex the 6F7 in their unique 1933 'Kadette' TRF series. Claimed as 'The World's Smallest Radio' (for 'World' read 'America'), a Kadette could be fitted into an overcoat pocket. They had only two valves, combining the functions of RF amplifier, grid leak detector, two AF stages and mains rectifier!

Emerson and RCA made some small reflexed domestic superheterodynes in the mid 1930's, but they resorted to a resistive audio load for the 6B7. This compromise improved the audio performance, but created a serious limitation for IF/AF reflexing that was never fully overcome.

Limitations

There is insufficient space here to cover all aspects of reflex design. Readers interested in a full discussion are referred to the classic *Radiotron Designer's Handbook*, where an entire chapter was devoted to reflexing.

Briefly, to obtain a reasonable audio gain, the anode load resistor of the reflexed amplifier needed be of the order of 50k to 100k ohms. At the same time, for an acceptable IF performance, at least 100 volts were needed at the anode. With HT supplies normally around 250V, the maximum current through the anode resistor was therefore restricted to less than 2mA — inadequate for good IF amplifier performance.

If AGC was used, there was 'play through', or significant audio output even with the volume control at zero. As the control was advanced, there was a 'minimum volume' effect accompanied by distortion. As a compromise, some receivers did not use AGC, but had the manual volume control ahead of the IF amplifier.

Other problems included distortion at high modulation levels, and total receiver gain was significantly less than with the use an extra valve in a conventional receiver.

In Europe, where signal strengths were high, a less complex system became popular for economical receivers. Many European output pentodes, such as the PENA4, AL3, and EL3 had very high mutual conductances — typically 9mA/V, compared with the 2.5mA/V of the standard 2A5, 42 and 6F6 pentodes available in the US. With an efficient IF amplifier it was possible to eliminate the audio voltage amplifier, by driving these high gain valves directly from a diode detector.

The EL3 even had diodes incorporated, to become the EBL1 for this service. Unfortunately the EBL1 was a very tall valve, limiting its use in compact receivers.

Some early Australian sets such as the 1933 Astor OX, and a few New Zealand 'Ultimate' sets, did use this arrangement but their use of the insensitive American pentodes was a serious limitation. Later, the *Radio & Hobbies* 'Little General', using the higher gain beam tetrode 6V6G, was quite successful in good reception areas.

By 1937 reflexing had been pretty well abandoned in America, but not so in this part of the World. New Zealand's Ultimate produced a small four-valve reflex during the period 1937-39, but Australia became the real stronghold of reflexing.

The great Aussie reflex

The second generation of reflexing was to be taken up enthusiastically in Australia — particularly by AWA, who in 1934 introduced the first of their reflexed Radiolettes, the model 27.

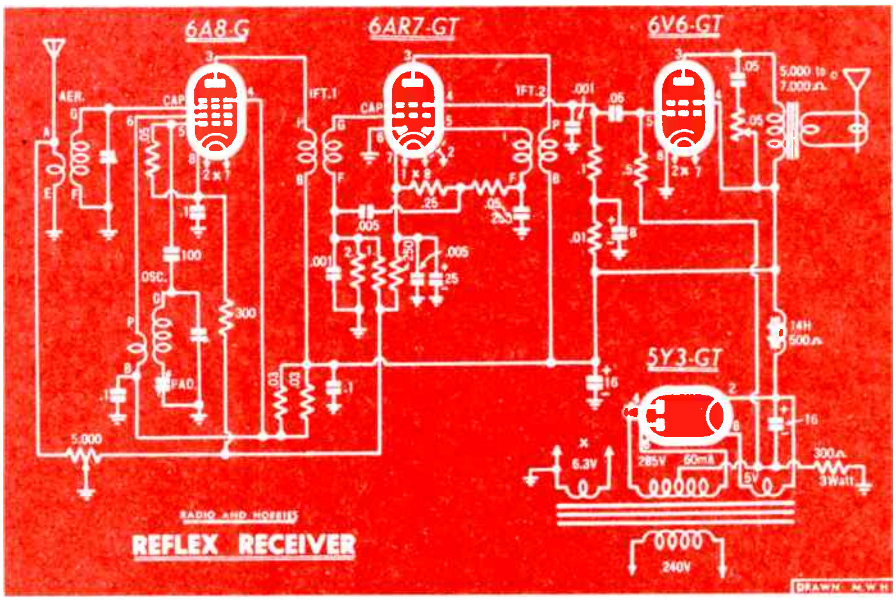


Fig.3: This 1952 'Radio & Hobbies' design represents the final development of the Australian reflex, with the screen grid of the 6AR7-GT IF valve acting as the audio stage anode. Breakthrough and low level distortion could be avoided only by using a manual gain control.

Despite the shortcomings of reflexing, the little five valve Radiolettes proved to be very popular with the public, although less so with servicemen!

With more gain than a straight five-valve receiver, their extra sensitivity could be useful. Shortwave models were added to the range in 1936. Other firms too found a demand for reflexes. The 1938 *Australian Official Radio Service Manual* lists eight different brands of reflex receiver, including battery powered versions.

For about 15 years Australia persisted with the reflex. AWV even developed valves more suited to reflexing than the semi variable-mu 6B7 and its octal equivalent, the 6B8G. There was an extended-cutoff and better shielded version, the 6B7S, and later in octal form, the 6G8G. Then in 1949 came the unique lead shielded 6AR7GT, with more than double the transconductance of the 6B7.

An interesting but late improvement came in November 1947, from a *Radio & Hobbies* reader, S.L. Marsh of Belmore in NSW. By using the screen grid of the reflexed valve as a triode anode at audio frequencies, the pentode anode could be run at full current and voltage.

This idea was taken up by *Radio & Hobbies*, who in October 1950 produced the circuit shown in Fig.3. But having no AGC, it was still a compromise.

Solid state reflexing

By now the valve reflex receiver had reached the limit of development. Miniature valves were becoming available,

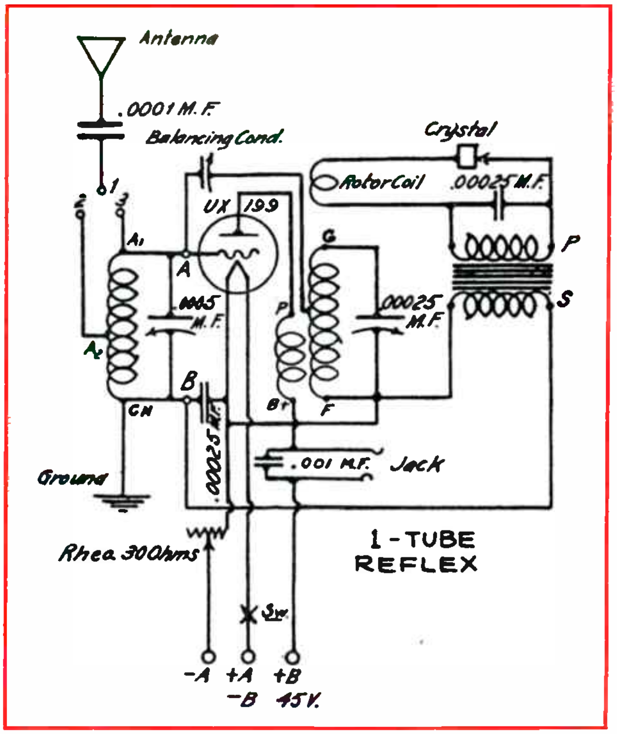
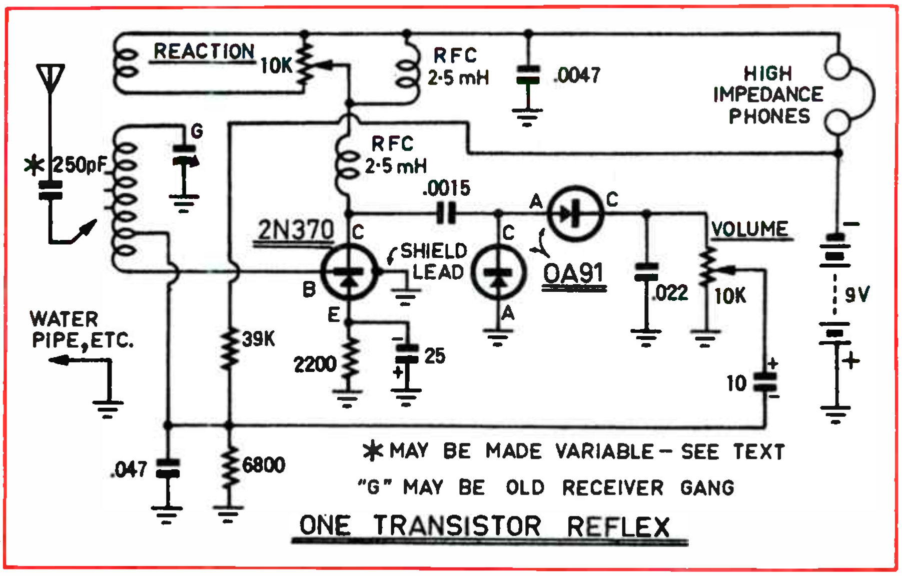


Fig.4: The wheel goes full circle! At right is the National one valve reflex for hobbyists, dating from 1925, while below is its solid state equivalent, described 37 years later by Jim Rowe in the then 'Radio, TV and Hobbies'.



and the minimal cost savings of reflexing were not worthwhile.

But even in electronics, history has a habit of repeating itself. Experimenters were naturally excited by the arrival of the first RF transistors, but they were very expensive. In June 1963, *Radio & Hobbies* published a very full description (by Jim Rowe, now *EA*'s Managing Editor) of a single high frequency transistor reflexed receiver with RF regeneration and crystal diode detection — the solid state equivalent of the reflexed single valve circuits of 40 years before.

Finally, a successful and unusual example of reflexing came in the mid 1960's, from none other than Philips, in their F2 television chassis. The 5.5MHz sound IF signal was boosted by the transformerless 'Hi-Z' valve audio output stage, prior to conventional amplification and limiting by a single AF124 transistor IF stage.

This novel system worked quite well, as the IF signal was insignificant in an amplifier capable of several watts, and the frequency modulated IF signal was completely unaffected by the presence of audio frequencies.

Today, with amplification so cheap, reflexing is completely unwarranted and we are unlikely to ever again see this remarkable and sometimes frustrating technology, which has nevertheless left a legacy of receivers of considerable interest to the vintage radio enthusiast. ■

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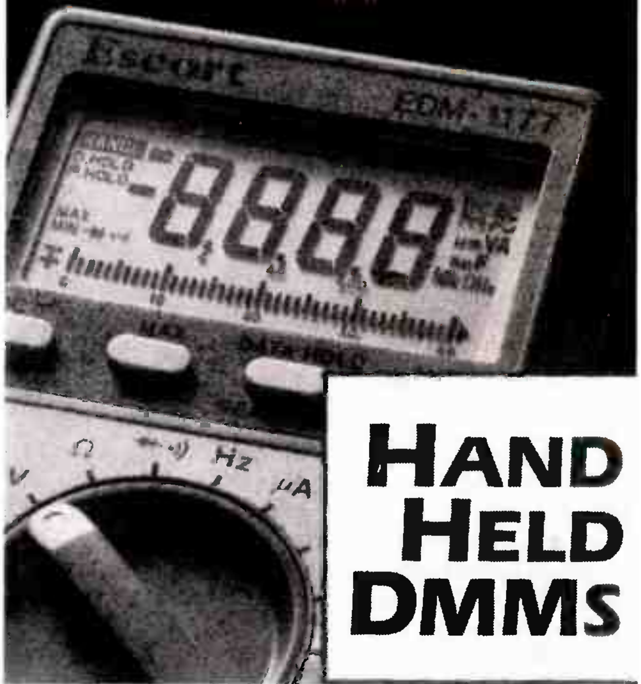

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SHORTWAVE LISTENING

by Arthur Cushen, MBE

Preserving radio's past

As new listeners find interest in the shortwave bands, they often ask what will happen to their collection of verifications in the future, with the establishment of an Archives Section in New Zealand, and collections in Australia, the retaining of this valuable material is assured.

Broadcasting in both countries had its beginnings in the 1920's and the early pioneers of radio listening often collected historic material, which was destroyed when they passed on. It has become apparent in radio listening, just as in any other pastime, that the past must be preserved. In New Zealand in 1971, an Archives collection was established which would be the first in the world to preserve radio listening material. For some years, the material was stored at Radio New Zealand Archives in Timaru. When it was decided to move the Sound Archives of Radio New Zealand to Christchurch, the Oamaru branch of the New Zealand Radio DX League decided to retrieve the material from the project they initiated some 20 years ago. Considerable activity has taken place in putting the thousands of station details onto computer — and the massive amount of material dates back to 1928.

Naturally, with the passage of time, papers are becoming fragile, so they are being housed in acid-proof compartments. The papers are being photocopied to provide access for those wishing to read radio history in the making. Wax lined boxes and steel cabinets have been provided to the Oamaru group as they continue to read and file material on computer.

It is planned that this type of nostalgic radio material will be available on display in the future, so radio listeners have been encouraged to try and keep their own material in presentable form. The writer has over 9000 vertifications, some 3000 on mediumwave and 6000 on shortwave. Hence the storage problem becomes acute. The Archives Section is also retaining past radio receivers and radio publications. But it is not holding schedules, station promotions and the like, because of the tremendous amount of space which would be required. It is hoped that in future any radio listener with a collection of cards and letters will not allow them to be destroyed, but will remember that there are facilities available for their safe storage.

At the National Convention of the Association of North American Radio Clubs in Montreal in 1986, the writer stressed the need to preserve the history of North American Radio. To do this, the Committee for the Preservation of Radio Verifications was established. The CPRV group has been able to store its material at the Christian Science Monitor buildings in Boston, and have some 30,000 stations already listed on computer. To further promote the historic value of the collection, from time to time, they issue photocopies of some of the older verifications. These reprints in DX magazines enable the new listener to look back into the history of radio broadcasting. Similarly in Australia, the various radio clubs and

AROUND THE WORLD

ALASKA: KNLS Anchor Point broadcasts in English 0800-0900UTC on 11715Khz; 1500-1600 9615kHz; 1800-1900 11945kHz; 2000-2100 11910kHz.

BULGARIA: Radio Sofia, up to September, when the country returns to standard time. English broadcasts are 0630-0700 11765, 15160 and 17825kHz; 1830-1900 9700, 11660, 15330kHz; 2030-2100 9700, 11660, 15330kHz; 2130-2230 11680, 15330kHz.

DUBAI: Dubai Radio UAE is best received in English 0330-0400 11945, 13675, 15400 and 15435kHz, while a later broadcast is on 1600-1645 11795, 13675, 15320, 15400, 21605 and 21675kHz.

LATVIA: Radio Riga International has two English broadcasts, firstly on Saturday 1830-1900UTC on 5934kHz and repeated Sunday 0700-0730 on the same frequency. This new service in English from Latvia was received very well in the 0700 transmission, but the broadcast at 1830 suffers severe co-channel interference.

SEYCHELLES: FEBA is heard with Gospel broadcasts on 15250kHz opening at 0330 with sign on and is preceded by an interval signal. The programme can be in one of three languages, which are broadcast alternatively to East Africa.

SOUTH AFRICA: Radio South Africa, Johannesburg is heard at 0355 on 15365kHz opening with a transmission at 0358 in French on 15365kHz. Later at 0455 on 11925kHz a broadcast in Portuguese is heard from Radio South Africa. Since the External Service now broadcasts for reception in Africa, signals from South Africa have been more difficult to receive. This follows the cancellation of transmissions to Europe, North and South America.

VIETNAM: The voice of Vietnam Hanoi is heard in English at 2030 on 12020kHz. Other frequencies used are 9840 and 15010kHz. At 1100 a further English half hour programme is noted, and on this occasion 9840kHz gave the best reception.

YUGOSLAVIA: Radio Belgrade has a broadcast to Europe and Africa 1930-2000 and this programme in English has provided excellent reception in the Pacific on 15165kHz. The frequency of 15165kHz has some sideband interference from Radio Australia from 1955, while 17840kHz is a clearer signal.

radio amateur organisations are also caring for memorabilia of the past.

Latin American reception

As we move towards winter listening, signals from Central and South America are being received at increased strength in the tropical bands — that is, 60 and 90 metres, 4750-5050kHz and 3200-3400kHz.

In recent months Paul Edwards of Wellington, New Zealand has been touring South America. He has visited radio stations which he has heard back home, getting them to verify his reports, or thanking them for past kindness in confirming his reception. He found there are two main problems with Latin American stations: a poor mail service and the fact that few of the staff speak English (a report in Spanish is essential). There is a problem with sending return postage, as international reply coupons are not valid in many countries. Mint stamps of the country to which the report is being sent seems to be the obvious answer. When such stamps are not available, listeners can send a selection of Australian or New Zealand postage stamps — this is often sufficient compensation for the station to pay for postage. Recently a further problem has arisen due to the high cost of hydro-power. Some countries operating on both medium and shortwave have turned off their shortwave transmitters.

A station which has returned to shortwave is Radio Nacional Espejo, Casilla 352, Quito in Ecuador. This can now be heard on 4860kHz with 1000W. The station is keen to receive reception reports from distant countries and reports in Spanish covering programme information, in particular, the names of commercials and music. In the past they received about 20 letters a month, but since upgrading their shortwave facilities they are expecting many more reports from overseas listeners.

Recently Richard MacVicar visited Radio Nacional Espejo and he is also planning to call on other stations in the Quito area. Listeners of his programme, DX Party Line, each Saturday at 0735 and repeated at 1005UTC on 9745 and 19925kHz, can learn a lot about Latin American Radio reception. ■

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

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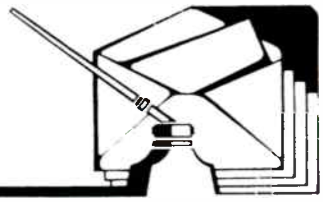
Information centre



Conducted by Peter Phillips

From one thing to another

A very belated warning, another interesting reason for tuneable hum and various letters seeking answers make up our lot this month. There's even a bit of criticism thrown in...

One of the great challenges of electronics is being able to achieve a desired outcome at low cost. Many disposals firms earn quite a nice income from electronics enthusiasts, and the benefits flow both ways.

For example, some years ago I bought 20 printed circuit boards stocked with a mixture of components. The all up cost was $10, and for this I ended up with 200 sensitive gate SCRs, hundreds of 0.1uF capacitors and a miscellany of other components.

Believe it or not, all components have now found their way into various 'inventions'. Even some of the edge connectors from the PCBs have been used in other projects.

Another useful outcome of being electrically inclined is the ability to incorporate useful systems around the house.

I bet most readers have some kind of intercom or communications system, that would cost a mint to purchase and install if they couldn't do it themselves.

One of this month's contributors mentions a bus system he has installed in his house, for general use by the family. What a good idea!

Maybe other readers have done something similar. It occurs to me that this could be an interesting area to explore, and I therefore invite readers to write in describing things of this nature. And don't just stop at systems.

Maybe you've been able to adapt parts of an old record player to make an automatic dishwasher, or something equally intriguing. Our role in this column is information, and sharing ideas is all part of the fun.

So moving right along, our first letter has the belated warning mentioned in the introduction, and belated it is...

Transformers

Transformers have been a topic of discussion in recent months, and the following letter concerns 'improper' use of a transformer in a project published by *ETI* in January 1983. I have to say I agree with the correspondent, who also has a few other comments about the article describing the project, which was for an amplifier design based on work by Professor E. Cherry. The amplifier's fine, it's the implementation that worries our writer, who is also the secretary of the IREE Brisbane Audio Group:

This letter has to be an excellent example of dangerous procrastination, so I am contrite in advance.

Back in January 1983, ETI published a project for a 60W NDFL amplifier, which works well despite certain mechanical aspects concerning mounting of the output transistors. However our main cause of concern is the recommended power supply.

The supply uses a Ferguson PF4361/1 transformer, and the article suggests using the secondary winding to buck the primary to allow the derivation of exactly +/-45V DC. This means there will be 240V connected to the secondary winding. Thus, if the other 15V winding is used, there will be a very low level of isolation between the 240V mains and the low voltage section of the circuit. Definitely lower than the SAA rules might allow!

We were somewhat aghast that such an arrangement was suggested in the magazine, and I wrote to Ferguson who responded stating that they 'do not recommend the mixing of the 15V windings between input and output'. They also stated the connection is incorrect anyway, in that the output voltage would be increased rather than lowered.

The letter also contained a reference to AS3159 and AS3126 and the delightfully woolly sort of mumbo-jumbo relating to the use of equipment by skilled and unskilled people. I have always been intrigued by the implied assertion that unskilled people are more at risk than skilled people in certain circumstances. Do those who have passed 'whatever exam' develop an invisible dielectric that prevents electrocution in times of carelessness?

All in all, the project had some undesirable, nay dangerous elements, and it amazed us that it appeared in that form. You might like to publish a warning. Now why haven't I written sooner? ...'dunno' is the answer. Put it down to apathy, procrastination, laziness... (R.G., Chapel Hill Qld).

There is not much I can add, as R.G. has said it all. Looking at the original article, the phasings of the windings effectively subtract, giving an increase instead of the required reduction. But mixing primary and secondary windings is certainly not good practice (unless the transformer is specially designed to allow this to be done safely), and a warning is the least we can do.

The issue of skilled versus unskilled users is probably more arguable, in that a skilled person is likely to have less 'times of carelessness', brought on by an educated fear of the mains. For this reason, we try to use plugpack type transformers where possible, or to include detailed warnings concerning connection to the mains. But thanks R.G. — a case of better late than never!

Car radio antenna

These days quite a few people are likely to have a set-up similar to that of our next correspondent:

3 [illegible]

[illegible]

[illegible]

time, the circuit of Fig.1 might be a easier solution. This circuit uses a 7805, which is certainly readily available.

Any voltage regulator can have its output voltage increased by adding resistors R1 and R2 as shown in this circuit. However, while there is a mathematical relationship to calculate the

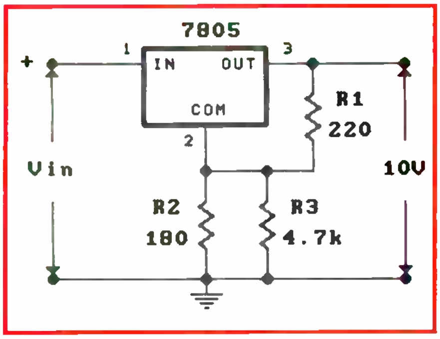


Fig.1: Our suggested circuit for using a readily available three terminal regulator to produce 10V.

values, in many cases the results will give non-standard resistance values. The circuit shown gives the required 10V output, and if R3 is omitted, the output will be around 10.2V.

As for any three terminal regulator, a bypass capacitor should be connected between the input and ground terminals next to the regulator. Hope this helps you, R.B.

The March What??

If I had to pick the most contentious item in the magazine, I'd choose the What?? questions. The questions and their solutions generate a lot of mail, usually complimentary, occasionally critical. The next letter falls into the latter category.

Presumably you will again (as in April) claim '...except that what I MEANT was...' when I point out that your '6V light globe' answer to your March What?? is undesirably skimpy in that a wide range of possible 6V globes will not give the resistance readings shown in the question.

Firstly, the 6V globe must have a metal filament. A carbon filament lamp (admittedly rare) measured under the question's test conditions would show a lower resistance on the meter's Rx1 range than on the Rx10 range (lower current) as, unlike metal, carbon filaments have a negative temperature coefficient of resistance — so that their resistance reduces as the current increases.

Your answer is also incomplete, failing to mention the possibility of a positive temperature coefficient thermistor, or of a low-rating fuse using one of the rarer metal alloys with a high PTC. In fact, a whole range of devices could be concocted to satisfy the test conditions — for instance a relay with a 5.4 ohm resistor or auxilliary winding switched across its 15 ohm coil by its normally open contacts, or one with a 4 ohm coil, in series with a 9 ohm resistor or second winding shorted out by its normally closed contacts. Similar results could be obtained from a silicon controlled switch with resistors.

Of course, this may open the question as to what was meant by 'device'. Perhaps you MEANT 'component' to rule out some of the foregoing possibilities. And why a '6V' light globe? Different multimeters will pass different values of current on their ohms ranges, giving different resistance readings.

I admire your efforts to keep people thinking about the subtleties of electronics, but PLEASE try to be more rigorous. I am sure there are others besides me who like to see generalised answers to ill-defined questions and exact answers to tight ones. Both can be interesting. (G.W., Florey ACT).

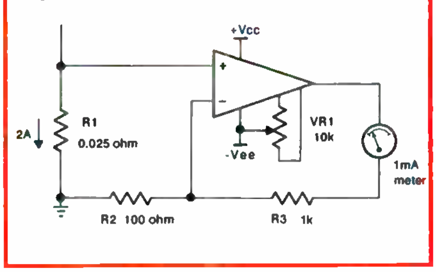
Fair enough, G.W. Certainly there are many possible answers to the question, but all the letters I have received on this question give the answer as simply a 'light globe'. I think most people were aware that defining the voltage of the globe was not part of the deal, and accepted the answer as being reasonable.

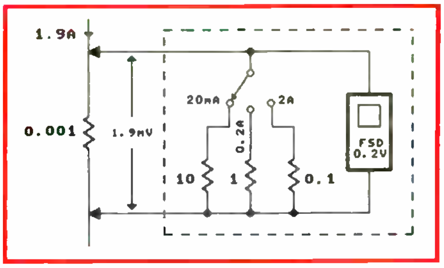
In fact, I suppose that had I given a general answer, someone else may have written saying that some light globes would give the same readings for both scales. Still, your point is taken.

What??

The question this month also includes a meter, and has an exact answer. For the circuit shown in Fig.2, determine the current flowing in the 1mA meter movement. Assume an ideal op amp, that has been adjusted for zero offset.

Fig.2:





Answer to June's What??

The circuit shown above is the arrangement required in which the ammeter is connected across a 0.001 ohm resistor. The question really tests whether you understand how ammeters work. A digital ammeter is a high resistance voltmeter measuring a voltage drop across a known resistor, usually called a *shunt*. Changing the shunt resistor changes the current required to produce the required voltage, and the range switch therefore selects different shunts and moves the decimal point.

Put another way, an ammeter is a very low resistance voltmeter, and changing the range merely changes the input resistance — but not the full scale deflection voltage. Because the ammeter is now connected to a load with an extremely low resistance (0.001 ohms), the input resistance of the meter is of no consequence and changing the range simply moves the decimal point without changing the absolute value of the display. Thanks to Mr Soong for another interesting question. ■

NOTES AND ERRATA

High Security IR Remote Control Switch (April 1991): In the circuit schematic on page 56, the connections for the input and output pins of supply regulator IC4 are reversed, both in terms of pin number and function. The input is pin 1, and should be shown connected to +12V, while the +5V output appears on pin 3. The regulator is shown correctly in the PCB overlay on page 58, but on this diagram capacitor C4 is shown with the polarity reversed. Also capacitor C11 is not shown on the schematic; it is in fact connected from the +5V rail to earth, near IC2. The schematic should also show pins 4, 6, 9, 10 and 11 of IC3 as being connected to earth, as well as to each other.

Wideband Discone Antenna (Radio Experimenter's Handbook, Volume 2: The hub kit mentioned in this article is available from Stead and Baker (Ashpoint Foundry), PO Box 91, Camperdown NSW 2050; phone (02) 519 7480 or (02) 516 1296. ■

EA with ETI marketplace

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THE SERVICEMAN

Continued from page 40

cured, and the tube should perform like new.

On this particular occasion we set up the experiment on the kitchen table (ignoring the disapproving looks from Mrs L.K.), and connected the 6V6-G to the socket with jumper leads. The valve responded very quickly to the treatment, for in only a few minutes I felt confident in pronouncing the job a success. But proof of the pudding came about an hour later, when a phone call confirmed that the old radio had "...never sounded better!" So for those enthusiasts doing a restoration and finding themselves stuck in this manner, I can only suggest 'Give it a go!'

For low power valves, and also for mini series types, it may be wise to use a higher ohmage load than the one I have described. The characteristics of an incandescent lamp are ideal for this application, since the resistance will increase with temperature (brightness) — thereby offering a fair degree of protection over that from a pure resistance.

So there! That answers a question that's been in my mind for years. In fact, ever since I first boosted a picture tube. I have often wondered if an ordinary valve would respond to rejuvenation in the same way as a picture tube does.

The question arose because I was a young teenager during the last war and, with my father away overseas, I spent a lot of time with a favourite uncle. Uncle Norm was a representative for a company called 'Valve Life', and he spent much of his time visiting the few radio shops that still had any stock, to collect old valves for rejuvenation.

During the war, valves for domestic use were simply not available, so the only way to keep the old radios going was per medium of 'rejuvenators' like my uncle. I never did see the factory where the rejuvenation was done, so I have no idea of just what went on there. But L.K.'s story fills in a lot of the missing detail. One thing I do recall about that period was that the rejuvenation sometimes didn't work, or even destroyed the valve. That accounts for why we spent so many Saturday mornings haunting the auction sales, buying up old radios for the replacement valves they contained.

L.K.'s story has certainly kicked around a few memories for me. I hope you found it as interesting as I did. And that's it, for this month. ■

Amateur Radio News

Progress with MWRS 6m repeater

The latest copy of Manly Warringah Radio Society's *Newsletter* to reach our office reports that the Society's 6m repeater project is progressing rapidly.

An updated repeater licence (VK2RMB) has been received from DoTC, covering the new 6m repeater as well as the existing 2m and 70cm units. Meanwhile the digital repeater controller has been acquired and demonstrated by Phil VK2BDF, and the transmitter and receiver units which were kindly donated by Laurence Adney VK2ZLA have been converted from the commercial 70MHz band to 52MHz.

Following tests carried out to find the optimum designs and locations for the transmit and receive antennas, both will be using separate Rx/Tx J-poles, one on each of the Society's towers to provide physical separation. The transmitter will be housed in the clubrooms, while the receiver will be remotely located in a weatherproof enclosure atop the 110' tower. If major desensitising of the receiver occurs, greater antenna separation or filtering will be investigated.

The MWRS can be contacted either via its repeaters, or by writing to PO Box 186, Brookvale 2100.

Callsign mixup

Thanks to the use of computer databases by both the DoTC and the WIA, the current *1991 Amateur Call Book* is apparently the most accurate produced to date. But a few errors still crept in, as they do with any human enterprise.

Ironically, one of these involved *EA*'s own editor, Jim Rowe. When the *Call Book* was published, a number of readers rang up to point out that Jim's callsign VK2ZLO, which he has held for over 22 years (since late 1969), was listed as belonging to a C.V. Day, at a totally different address.

Enquiries to both the DoTC and the WIA revealed that a year or two ago, the former's computer system had allowed the re-issueing of this and a few other 'already issued' callsigns, creating double-holder situations. When this was eventually discovered, those who had been allocated the callsigns most recently were given new calls. However, when the information in DoTC's database was supplied to the WIA for use in the new callbook, an 'operator error' ensured that in the case of callsign VK2ZLO, the licence holder details were still shown incorrectly!

As the WIA's general manager and secretary, Bill Roper VK2ARZ, commented, "Why is it that if we are going to have an error in the *Call Book*, it has to involve one of the highest profile amateurs in Australia?".

VK2RSY 10m beacon heard in Canada

According to a recent news broadcast by the WIA's NSW Division, a Canadian amateur reported that VK2RSY's 10m beacon on 28.262MHz was heard in VE7 at the beginning of April, on an otherwise 'dead' band — despite there having been a solar flare the previous day.

Apparently the beacon is often received from far afield, and is also frequently reported as 'the only signal heard'. As the WIA broadcast suggested, this *might* mean that 'everyone was too busy listening to call CQ'. However it might alternatively suggest that there isn't enough activity on the band, world wide. As the WIA points out, if amateurs don't make it evident that they're using the band, there are various other spectrum users who will. ■

Another shot taken at this year's Gosford Field Day, showing Julie VK2XBR with his satellite decoder.

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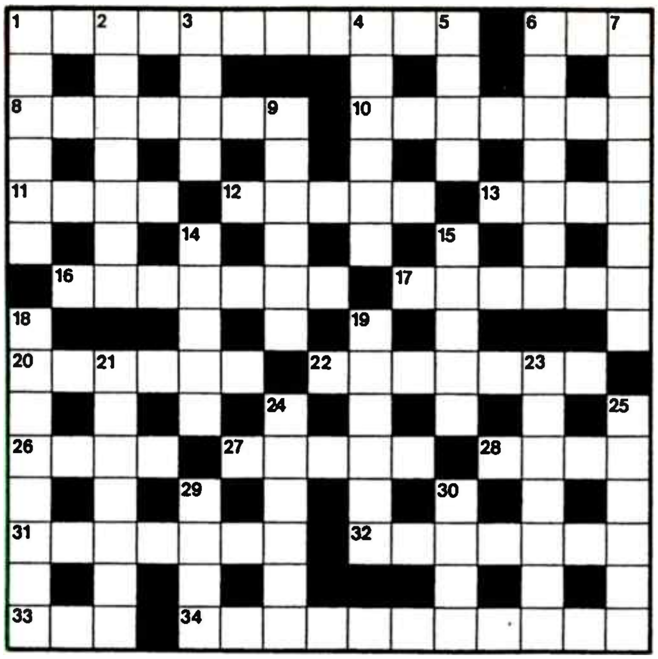
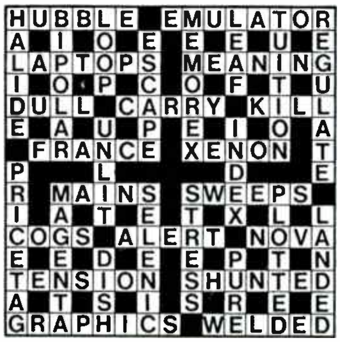
EA CROSSWORD



ACROSS

1. Desk for computer, etc. (11)
6. The phase alternation system for television. (3)
8. Solidifying. (7)
10. SI units. (7)
11. Earth leakage circuit breaker. (1,1,1,1)
12. Computer accessory. (5)
13. Reduce sound level. (4)
16. Remove component from circuit board. (7)
17. Seismologists study waves in this. (6)
20. Edward ----, developer of atomic fusion process. (6)
22. Conic section. (7)
26. Kirchhoff formulated these. (4)
27. Physical effect with units of 10 across. (5)
28. First name of Gagarin, the first orbiting cosmonaut. (4)
31. Sampled a range of frequencies, etc. (7)
32. Said of aircraft that evade radar. (7)
33. Special broadcasting service. (1,1,1)
34. Quality of exertion on article. (11)

SOLUTION TO JUNE



DOWN

1. Flat part of security system. (6)
2. Network in optical device.(7)
3. Conducting phenomenon, the --- effect. (4)
4. Charge particles. (6)
5. Up-to-date information. (4)
6. Result of using multiplier. (7)
7. One tuned to audio. (8)
9. Neutral terriotry. (6)
14. Representation; imitation. (5)
15. Brand of calculator, etc. (5)
18. Makes useful. (8)
19. Thin pieces. (6)
21. Type of filter. (3-4)
23. Suppressing circuit. (7)
24. Fuse and fasten. (6)
25. Defeat, serve, or is antenna in position? (4,2)
29. Symptom of TV video problem. (4)
30. Intermediate part of r.m.s. (4)

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

July 1941

Radio eye spots raiders: An astounding device which detects the approach of aircraft and ships is given credit for helping to defeat the German aerial invasion of England last autumn.

It is a system of radio location. Any solid object in the path of these waves, whether a ship or plane, sends back a reflection, and the system is not affected by fog, cloud, or darkness, but keeps watch 24 hours every day throughout the year. The invention is so secret that even in the Services it is known only by three letters.

100 miles for ninepence: A range of well over 100 miles on one charging of batteries, costing in Adelaide 9d at night electric power rates and 2s at day rates, with a top speed of 500mph and average speed of 30mph, are claimed for a new five-seater electric car invented by Mr John Bowker. His backers say that, as an alternative to petrol, the electric car is far superior to producer gas.

The experimental car has done 6000 miles in the past 12 months and a recent film showed this car on a journey to Mount Lofty summit (2300 feet), which was claimed to be a world record climb for an electric car.

July 1966

Machines or shelves: The state of near-saturation in consumer products is forcing the Australian electronics industry to get up off its haunches in a bid to survive. In some directions, the changing attitudes are to the good. Considerable pressure, for example, has been brought to bear upon the Federal Government and its instrumentalities to make full use of local technology, instead of simply buying from overseas sources.

For decades, publicity has been largely confined to advertisements extolling the virtues of consumer products. Engineering achievements have received scant mention. Also, there is a tendency to import an increasing number of sub-assemblies, generally for reasons of convenience, and to integrate them with local components.

Nuclear powered weather buoy: The weather station, NOMAD is powered from batteries kept charged by a SNAP-7D nuclear generator. Three series-connected, 4V nickel-cadmium batteries are charged by the 50W SNAP, a thermoelectric generator operated by heat from the nuclear source.

The station keys a pulse-modulated transmitter operating at 5340kc and a power of about 4kW. This signal can be received reliably over a distance of about 800 miles.

Electronic circuitry: Standard Telecommunication Laboratories in use in advanced electronic circuitry. Using a point electrode and a very low input energy of 24V, the research team has maintained a spark gap of a few microns.

The performance achieved with this machine is claimed to be comparable with that of electron and laser beams, also used on thin film machining work. ■

Electronics Australia with eti

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DEVELOPMENT OF A 386SX SBC FOR INDUSTRY USE

PC-BASED CIRCUIT SIMULATORS: IsSPICE

Schematic capture and SPICE input file preparation using SPICENet

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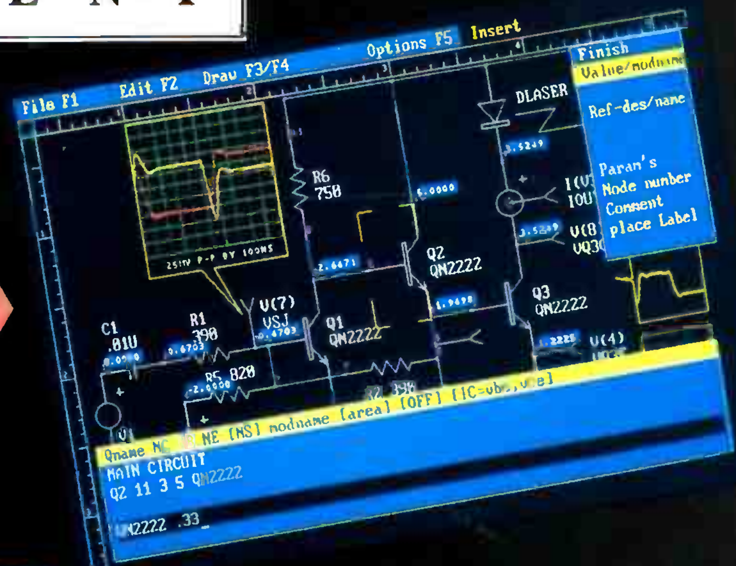


Professional Electronics

NEWS HIGHLIGHTS

UNI OF NSW GETS NEW OPTOELECTRONICS LAB

A $250,000 optoelectronics teaching laboratory officially opened in the School of Physics at UNSW.

The laboratory, which received financial support from the NSW Education and Training Foundation and the University, and support from other partners including Alcatel, Telecom and the CSIRO, will provide students with 'hands-on' training in relevant technologies.

The Director of the Laboratory, Dr Michael Gal, said the facility has been equipped with some of the most up-to-date instruments available and students will be experimenting with state-of-the-art technologies and techniques.

"The past 25 years have seen a revolution in the field of optics which was sparked off by the invention of the laser, optical fibres and semiconductor optical devices," Dr Gal said.

"This resulted in the development of a whole new range of industrial applications which have taken optics from the research laboratory to the workplace and the home."

Dr Gal said the School of Physics at UNSW has been offering final year students training in the applications of optical and laser technologies for the past six years.

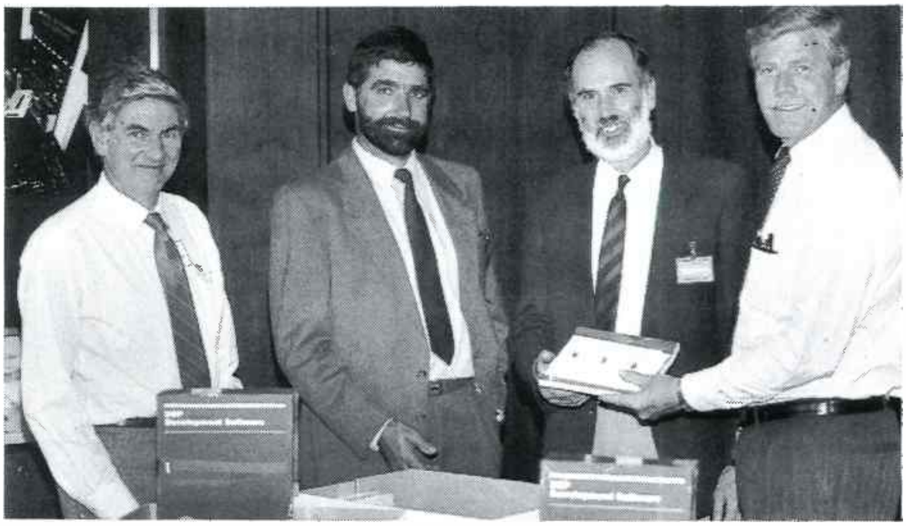
"The content of the courses has been directed towards perceived industry needs," he said. "However, there has been a lack of practical optoelectronic training in this important area."

"The optoelectronics laboratory is now a compulsory final year physics program to ensure that all graduating physics majors get a chance to work and learn about optoelectronics."

MOTOROLA GIFT TO SWINBURNE INSTITUTE

Motorola Communications Australasia has donated a 'truckload' of advanced communications equipment and materials to Melbourne's Swinburne Institute of Technology.

The equipment presented to Swinburne includes semiconductors, data books and educational work stations on Digital Signal Processing (DSP). All of the equipment is based on Motorola manufactured components.



Swinburne senior lecturer Mr Bill Lavery describes DSP as 'the microprocessor of communications'.

"The techniques of DSP allow us to receive electronic signals of many kinds and process them to extract useful information about the source of those signals," Mr Lavery said.

"DSP really is the heart of the so-called 'cleverness' in modern communication systems," Mr Lavery said. "As such, it's extremely valuable for us to be able to give students real, practical experience of DSP techniques. Before Motorola's assistance, we were largely confined to textbook learning in this area."

"This month we have been given literally a truckload of valuable components and systems which will enable us to go beyond the theoretical and actually let our students develop their own DSP applications."

NEWS HIGHLIGHTS

NEW LINE, AUTOMATED ALIGNMENT AT MELCOA TV ASSEMBLY PLANT

Responding to increased competition in the local colour TV market, local Panasonic set manufacturer Melcoa has installed a new assembly line at its plant in Penrith, NSW.

A heavy investment has also been made to improve quality and productivity. The combination of robotics and computer programming at alignment and final adjustment stage for example, will ensure that there is no variation in picture colour between each set.

Some 85% of all insertion is done by Panasert robots, installing around four million components per month. The factory is now capable of producing up to 9000 units per month.

As renovation work coincided with the factory's 23rd anniversary, a number of special guests were invited to inspect the new facilities. Representing Panasonic parent company, MEI, was managing director of MEI's television division, Toshikatsu Yanawaki.

With him on a tour of the factory were David Bedall, Minister for Small Business and Customs, Ross Free, Member for Lindsay, and Morihiro Sato, Panasonic managing director.

Hosting the tour, which was followed by an afternoon tea for staff, was Melcoa managing director Alex Ogata, gm manufacturing, Ross Henderson, and gm engineering, Scott Yamaguchi.

Addressing staff at the function, Mr Yamawaki said he was concerned at the increasing number of imports to Australia so to respond to this, his company took the initiative to refurbish the Melcoa factory.

Mr Yamawaki said that despite his concern he was confident Panasonic produced a competitive product as a result of a strong production base backed up by leading technology.

In fact, the company's newest model television in Japan, due for release in Australia later this year, has been such a success that production cannot keep up with orders.

Turning to the Japanese market, Mr Yamawaki said big screen TV's, 29" and 33", were the biggest sellers accounting for 50 percent of that market.

Colour television manufacturing was also heading rapidly towards more sophistication including multiplex, satellite, digital and high definition.

"Television is a product we can expect to keep developing and advancing," said Mr Yamawaki.

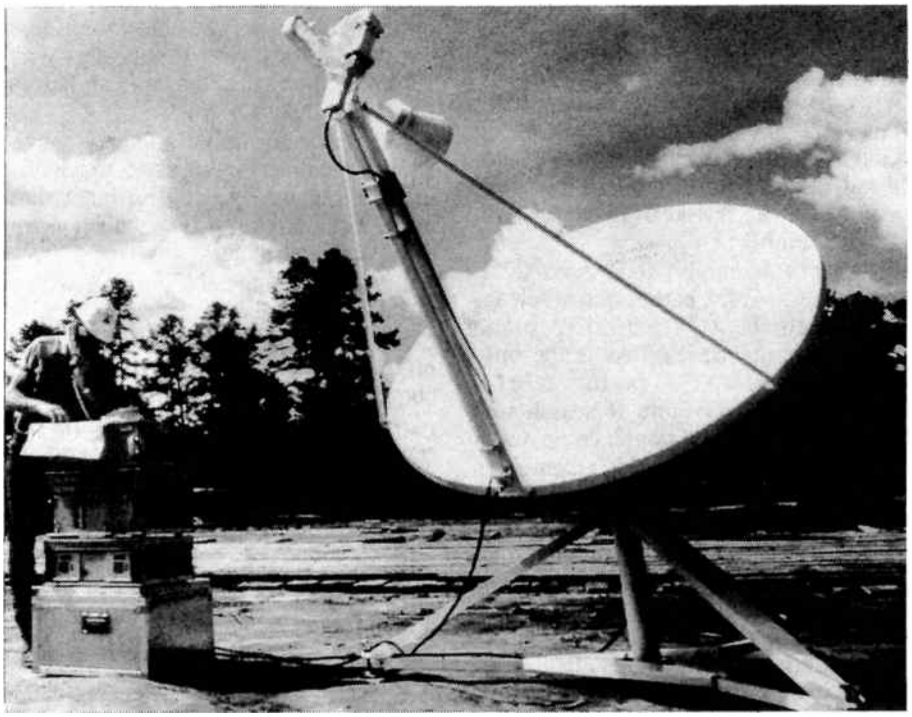
'FLYAWAY' TERMINAL FOR SATELLITE COMMS

Scientific-Atlanta has designed and developed a new KU-band Flyaway earth station ideal for use with the latest Aussat satellites.

The 1.8m Flyaway terminal, an earth station providing satellite telephone telecommunications from the most remote locations, is ideally suitable for mining crews in remote areas and for media news crews covering disaster.

The portable unit has a complete earth station for both circular and linear polarised satellites, is packaged for travel in rugged protective cases. All cases meet the weight and size restrictions defined for checkable luggage on commercial airline flights. Within an hour of site arrival, two people can completely assemble the equipment and establish voice channels to the larger fixed stations of telecommunications authorities within the same country or directly to other countries.

Features of the 1.8m Flyaway antenna include offset feed design for superior RF performance; mounting rails for antenna-mounted 10 watt LPA; and a tripod mount design for easy levelling on rough surfaces.



NEWS HIGHLIGHTS

LATEST TRENDS AT ELENEX '91

The latest trends and innovations in electrical and electronic products will be on display at ELENEX AUSTRALIA, from 10.00am to 6.00pm Sunday 30 June to Wednesday 3 July 1991, at the Sydney Exhibition Centre, Darling Harbour.

ELENEX AUSTRALIA will showcase hundreds of electronic and electrical products and provide a perfect opportunity for industry members to keep up to date with the latest technology available from Australia and around the world. This year's show will comprise around 130 exhibitors from Australia and overseas. The United Kingdom will again participate on a national stand comprising 15-20 companies. Taiwan has also taken space in the exhibition.

Meltec will exhibit their revolutionary, ozone friendly, batch aqueous cleaning system (BACS), used to clean printed circuit boards. This is the only closed-loop BACS in the world. Australian Optical Fibre Research will display a working example of a wave division multiplexor, which combines the outputs of a red and green laser, transmitting it and then separating it via a coupler at the end of the circuit. Other interesting displays will include BDL Cable and Electrical's new rubber sheathed electrical cables for use underwater, and AF Bambach's display of glass insulated, high temperature, electrical cable which endures temperatures of over 900° without breaking down.

A conference entitled ELECON 91 — ELECTRONICS THE NEXT DECADE will be staged concurrently with ELENEX AUSTRALIA from Monday to Wednesday 1-3 July. ELECON 91 is being organised by CIMA Electronics, a company which specialises in design and development of electronics and microelectronics and technology transfer. ELECON 91 will cover topics such as: Design for Manufacturability, Surface Mount Technology, Semiconductor Technology, Quality Assurance, Achieving Standards, Optoelectronic Devices, Voice and Data Systems, Sensor Technology, Integrated Circuit Design, Project, System and Logistics management and marketing issues.

Speakers from Australia and overseas will take part in 10 90-minute sessions.

Visitors to ELENEX AUSTRALIA can also see the latest in robotic and automation technology at the adjoining AUTOMATE AUSTRALIA exhibition.

US BUYING AGENCY OPENS

American Purchasing Agents (APA) specialises in obtaining American made products for their Australian customers. There are no minimum quantities and express delivery can be easily arranged.

While based in Melbourne, APA also has an office in the USA which locates and ships the products and expedites orders, pays the suppliers and ships the products direct to the Australian customers. Customers need only deal with APA's Melbourne office and can pay in Australian dollars.

APA offers Australian companies a viable alternative to the established distributor system. When a distributor runs out of stock he can create a real crisis for some of his customers.

APA provides these companies with a means of obtaining an emergency shipment to keep production moving. This might include raw materials, product components, spare parts, in fact any supplies. APA's service enables the American supplier to handle the order as he would any other domestic order. While most suppliers accept small orders for delivery within their home market, they will not accept small export orders because of the extra effort and costs associated with export documentation, organising freight forwarders, ensuring payment, etc.

Further information is available from APA at 65 Littlewood Street, Hampton 3188 or phone (03) 598 8314.

SOANAR NOW SOLE DISTRIBUTOR FOR NEC

In a major restructuring of its sales operations NEC Australia has dissolved its component division and appointed Soanar the sole Australian agent for all NEC components.

NEC semiconductors, passive components and relays will now be available only from Soanar's network of branches throughout Australia. In effect, Soanar will become the 'NEC Component House' in Australia, reporting directly to NEC Electronics in Hong Kong.

In this capacity Soanar will be able to provide all the technical information and assistance that may be required by Application and Design Engineers.

NEWS BRIEFS

- This year's ***PC91*** and ***Communications and Office Technology 91*** shows will both be held at the Royal Exhibition Building, Melbourne from 11-14 August. PC91 is the 17th Australian Personal Computer Show.
- ***RF Devices*** has been appointed Australian agent for Narda Microwave, part of the Loral group of companies.
- ***Priority Electronics*** has been appointed exclusive distributor for the Unitrode range of semiconductors.
- A branch office has been opened in Canberra for the Australian owned ***Pericomp Computers***, distributor for the American ALR PC, and other computer peripherals.
- Three Australians have been appointed to the board of directors of ***Hitachi Data Systems***. Greg Gardiner, formerly of John Fairfax, is chairman; Fred Mackay, formerly of the Queensland Electricity Generating Board, is a non-executive director; while Cliff Stratton has been promoted from regional director to managing director.
- William Harold Clough has been appointed to the board of ***IBM Australia***. Mr Clough was formerly chairman and chief executive officer of the West Australian construction company, Clough Limited.
- ***Bosch Australia*** has a new managing director, Hans Hugendubel, who has come from the parent company in Stuttgart, Germany to replace Werner Maas. Mr Maas has retired after almost 36 years with Bosch.
- After caretaking the position for six months, Mr Glen Stanford has been appointed as national sales and marketing manager of ***TDK Australia***.
- The Moorebank site of ***MM Cables*** has been officially certified by Telecom Australia as having a quality system complying to AS3902. This means the site is authorised to sign product quality release documents on Telecom's behalf.
- Dr Robert Ward has been appointed as chief defence scientist for the ***Defence, Science and Technology Organisation***. The organisation develops technologies in areas such as communications and aerospace which have significant commercial potential.

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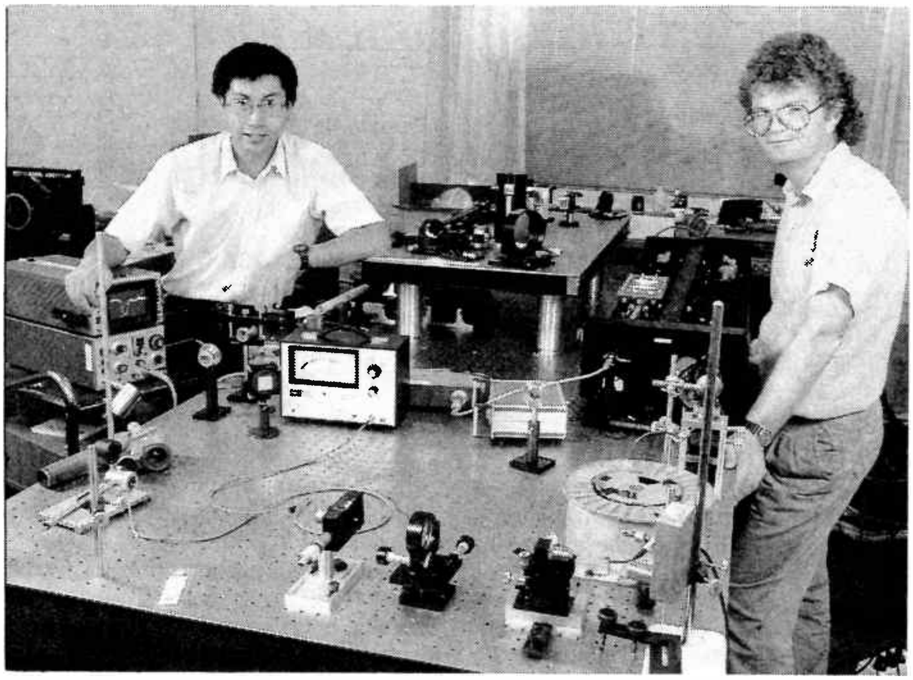
HIGH POWERED LASER FOR ANU



One of the most powerful lasers in the world is now being assembled in the Laser Physics Centre at the Australian National University's Research School of Physical Sciences. The new machine has been made possible by a recent grant from the ANU's Large Equipment Committee.

The new laser is a very stable mode-locked neodymium-doped yttrium-lithium-fluoride laser, which will be used in conjunction with existing equipment to generate high intensity beams of coherent laser light with more than two terawatts (two million megawatts) of peak power.

By way of comparison, one of the world's major laser research centres, the Lawrence Livermore National Laboratories in the USA, has a 10-15 terawatt machine.

The Head of the Laser Physics Centre, Dr Barry Luther-Davies, said that the ANU machine would eventually have almost the same power as the Livermore laser once an ingenious technique for increasing the laser's power, developed at the ANU, was introduced.

The technique was successfully tested by PhD student, Mr Yanjie Wang of RSPhysSE, at the University of Rochester, USA, late last year.

Dr Luther-Davies said the method was a very cost effective way of boosting beam power, and also had the desirable effect of simultaneously reducing the laser pulse duration.

Essentially, the researchers have found a physical mechanism which causes an increase in beam power when the frequency of the laser is doubled in a crystal. The ANU idea is an extension of a technique called 'frequency-doubling' which adds two infrared photons to produce one frequency-doubled green photon.

According to Dr Luther-Davies, theory and experiment have confirmed that by using the new method, laser power could be boosted by a factor of five, to 10 million megawatts.

The trick the ANU researchers are using is to split the infrared light beam into separate pulses, which travel at different speeds when they are shone into a large potassium dihydrogen phosphate (KDP) crystal. The slowest pulse is sent through the crystal first, followed by the faster wave, which is deliberately delayed so it catches up and eventually 'overtakes' the slower wave.

Both waves are required for 'frequency doubling' which occurs preferentially when the product of the two wave intensities is highest.

As one wave overtakes the other that optimum time sweeps through both pulses and transfers all the infrared laser energy into a shorter, frequency doubled, green light pulse.

LAUNCH OF INMARSAT-C SYSTEM

The much heralded Inmarsat-C satellite communication system has now entered full commercial service. The eagerly awaited transition from a pre-operational to a fully commerical service started in January this year when the coast earth station (CES) at Perth, Western Australia, came on-stream to handle Inmarsat-C traffic in the Pacific Ocean Region. Within days it had been joined by CESs at Pleumeur Bodou in France and Blaavand in Denmark, both operating to the Atlantic Ocean Region (East).

A typical Inmarsat-C terminal, from Thrane and Thrane.

At the beginning of February, the Singapore CES also started commercial operations in the POR. In April, the Norwegian CES at Eik began operations in the Indian Ocean Region and the service is due to be extended to the Atlantic Ocean Region (West) this month (July). A further 12 CESs are scheduled to come on stream during the course of 1991.

Just days after the launch, the system was reported to be carrying thousands of messages to and from ships every day.

Speaking of the new service's inauguration, Inmarsat director general Olof Lundberg said, "the opening of the first Inmarsat-C land earth station in Perth is the start of a revolution in communications."

He went on, "it marks the commencement of a service that will allow anyone with a small low-cost terminal, no matter how remote, to communicate anywhere in the world."

Inmarsat-C will make its major impact through the compact size and low cost of the user terminals.

Already, 11 different units are available from nine manufacturers. Most are no bigger than a car radio and some retail for as little as US$3500. ■

PC-based Circuit Simulators - 2:

IsSPICE Version 1.41

In this second article in our three-part series looking at circuit simulator packages designed to run on personal computers, we look at Intusoft's IsSPICE (Version 1.41) and the complementary programs which go with it to form that firm's ICAPS/2 package. Although currently not as well known as PSPICE, it offers many worthwhile features at a significantly lower price.

by JIM ROWE

Hopefully there's no need for a general introductory preamble this time around, as we discussed the basic concept of computer simulation of electronic circuits in the first of these articles. We also covered the development of SPICE, the world's best-known simulator — firstly for mainframe computers, in the 1970's, and then more recently for personal computers.

This month we're taking a look at a second PC-based SPICE simulator, which comes from another Californian firm: Intusoft. This simulator is called *IsSPICE*, and the particular version we'll be discussing is Version 1.41. This is the 'basic' version of *IsSPICE*, which runs on virtually any model of IBM-compatible PC (e.g., XT, AT, 386 or 486) but only uses 640K base memory and cannot take advantage of the 'protected' mode offered by the 286 and later processors. As a result it is limited to simulations on circuits with up to around 200 components.

Intusoft has other (higher priced) versions of *IsSPICE* which can take advantage of protected mode and extended memory, and as a result can cope with almost unlimited circuit size: roughly 1000 components per megabyte of extended memory. These also run rather faster than Version 1.41 — about three times faster, in fact.

As the name suggests *IsSPICE/286* runs on the 286, while *IsSPICE/386SX* and *IsSPICE/386* run on the 'SX' and 'DX' versions of the 386 respectively, with a minimum of 1MB and 2MB of extended RAM in each case. I gather that there's also a special version for the 486, although this doesn't seem to be available in Australia as yet.

Incidentally these 'higher' versions of *IsSPICE* are claimed to offer the fastest PC-based SPICE simulation currently available. At the same time it should be pointed out that *all* PC-based versions of *IsSPICE* require the use of an appropriate floating-point coprocessor chip, to suit the processor in use. This includes *IsSPICE Version 1.41*.

I mention this not as a criticism, by the way, but just to clarify the situation. Circuit simulators by their very nature have to perform a great deal of floating-point calculation, and their operation can thus benefit from a coprocessor to a rather greater extent than with many other kinds of software. In fact with virtually all of the PC-based simulators, use of a coprocessor becomes more or less essential, when you're simulating anything other than a really small and simple circuit. Otherwise the simulation can take a surprisingly long time...

So the only real difference here is that you need a coprocessor even to try out *IsSPICE 1.41*, whereas at least you can run the evaluation version of *PSPICE* on a computer which doesn't have one.

By the way, Intusoft also has a version of *IsSPICE* which runs on the Apple Macintosh. And unlike the PC versions, *IsSPICE/MAC* is available in both 'coprocessor' and 'no coprocessor' forms — so Mac users actually *do* have the opportunity to try it out without investing in a coprocessor.

Background

Intusoft was founded in 1985 by Lawrence Meares, its current president, and Charles Hymowitz who is now the vice-president. Based in San Pedro, California, the firm puts a significant amount of effort on improving the performance of its products, and in the past six years has made many upgrades to its *IsSPICE*-based packages. The founders themselves are engineers and programmers, and have personally authored much of the *IsSPICE* documentation and support literature — including *Simulating with SPICE*, an introductory textbook that Intusoft supplies with all of its packages; a further book of applications material, titled *SPICE Applications Handbook Vol.1*; and a steady stream of newsletters and applications notes.

The current version 1.41 of the base level *IsSPICE* dates from July 1988, when it replaced the firm's original version 1.0. Since then it has been upgraded a number of times, as have the other programs which form part of Intusoft's *ICAPS* packages.

Like other PC-based versions of SPICE, *IsSPICE* is based on Berkeley *SPICE2*, or more specifically 'SPICE 2G.6'. In its literature Intusoft describes it as an 'enhanced' version, but stresses that it is still fully compatible with the original.

Version 1.41 provides all main simulation options: AC, DC, Transient, Noise, Fourier, Sensitivity and Distortion analysis — the last of which is not available with *PSPICE*, you may recall. The provision of distortion analysis seems to be a result of the effort that Intusoft has put into improving the program's numerical exception processing, to prevent 'real indefinite errors' from occurring during distortion analysis. Another enhancement is that there is now 6-digit precision for the X-axis variable, instead of the original four digits.

Like *PSPICE* and the original *SPICE2*, *IsSPICE* itself is still essentially a rather unfriendly noninteractive file-to-file processor. It simply takes a text

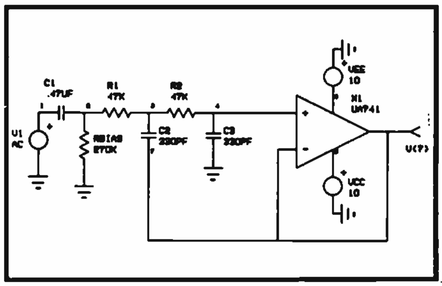


Fig.1: The schematic of a simple low-pass filter, as drawn by SPICENet.

[illegible]

format input 'circuit' file containing a netlist description of your circuit, plus control statements, and processes this to produce another text format output file with the simulation results data added. All you get while the simulation is actually running is a rather bald status/output screen, and if there's a problem of some kind the simulation is in many cases either truncated or simply aborted, after a cryptic error message is placed in the output file. More about this later.

The input file must be created separately, and if you want the simulation results in a more convenient form than the 'laundry list' provided in the output file, this too must be performed separately. Here's where the other 'companion' programs come in, of course.

In the case of *IsSPICE*, the most basic and virtually essential companion program is *PreSPICE*. Described as a 'circuit analysis pre-processor', this provides an extensive library of component and subcircuit models (none of them encrypted, incidentally), a full-screen ASCII text editor to allow editing or examination of the SPICE input and output files, plus facilities to enhance the basic *IsSPICE* operation with Monte Carlo analysis, parameter sweeping, optimisation of component values and parameter passing for nonlinear and linear equation-based modelling. It also provides a set of 'generic' macro models which allow the user to create models for specific devices using data sheet parameters.

While you can certainly run simulations with just the combination of *IsSPICE* and *PreSPICE*, most modern users would find this approach both archaic and unacceptable. At the very least they'd want to add *IntuSCOPE*, described as a 'data analysis and SPICE post-processing tool', which can operate on the output text file produced by *IsSPICE* (or any other PC- based SPICE, for that matter) and allow you to produce graphical displays and printouts of response curves, waveforms and so on.

IntuSCOPE is effectively an interactive 'software digital oscilloscope', and is thus functionally similar to the *PROBE.EXE* program available for *PSPICE*. However the current and latest version of *IntuSCOPE* (Version 3.11) has a fully graphical multi-windowing user interface, which is very similar indeed to Microsoft's *Windows 3.0*. Like the latter it is mouse driven via pull-down menues and on-screen 'radio buttons', although it can also be operated from the keyboard if desired.

As well as allowing you to 'see' the results of your simulation in much more convenient (and efficient) graphical form, *IntuSCOPE* also provides an impressive array of post- processing tools. These include the ability to perform integration, differentiation, FFT (Fast Fourier Transform), IFFT, polynomial regression, and waveform measurements and calculations such as RMS, peak-to-peak, minimum and maximum, and so on. It also allows you to move cursors along a waveform, and make both absolute and relative measurements — just as on a hardware DSO.

```
    lpfilter
*SPICE_NET
*INCLUDE NONLIN.LIB
.AC DEC 10 1HZ 10KHZ
.PRINT AC V(7) VDB(7)
.NOISE V(7) V1 10
C1 1 2 .47UF
RBIAS 2 0 270K
R1 2 3 47K
C2 3 7 330PF
R2 3 4 47K
C3 4 0 330PF
X1 7 4 7 5 6 UA741
VEE 0 6 10
VCC 5 0 10
V1 1 0 AC 2
.END
```

Fig.2: The basic SPICE input file for the LP filter, as produced by SPICENet.

Further features of *IntuSCOPE* worth noting include automatic scaling for waveform plots, the ability to change both X and Y scaling manually (including options of selecting the number of decades, for the X axis of semi-log plots), and the ability to support a wide range of printers and plotters. It can also provide plot files in a number of standard graphics-file formats, for porting over into most standard drawing, CAD and desktop publishing packages.

Intusoft also provides another main 'companion' program for *IsSPICE*, and one that has no current equivalent in the *PSPICE* stable. This is *SPICENet*, which provides a complete schematic entry facility — so now you can actually draw your circuit's schematic, and have a SPICE netlist created for you in the process.

Like most modern schematic capture packages, the current version of *SPICENet* (V2.00) has an essentially graphical user interface, with easy to use pull-down menues and mouse operation. However it also has a keyboard 'short-cut' system for experienced users, based on one- or two-keystroke codes. And of course as part of using it to draw your schematic, it assembles the corresponding SPICE netlist.

In fact as well as automatically providing node numbers and component reference designations, it also guides you, quietly and semi-transparently, in adding either simulator control statements or pre-processor directives to your netlist, to produce (ultimately) the full SPICE circuit file.

After laying out your basic schematic, you are guided into supplying values and 'labels' for the various components, supply sources, signal sources and so on. As part of this process, you are also effectively supplying the values and parameters for the corresponding netlist definitions and statements. Labelling a 'test point' automatically generates the appropriate .PRINT statement, for example (to program *IsSPICE* to generate the desired output variable data); similarly placing and then labelling a complex component like a transistor, or a subcircuit like a 741 op-amp automatically generates an *INCLUDE XXX.LIB directive, so that *PreSPICE* can call up the appropriate library and insert the necessary device model data or subcircuit file module.

Finally you are also guided into adding the necessary SPICE control statements, to ensure that the simulation performs the analyses you want — such as .DC, .AC, .NOISE, .DISTO, .TRAN and .FOUR.

It's really the addition of *IntuSCOPE* and *SPICENet* that provides *IsSPICE* with the kind of user interface that most people expect nowadays. Without them, you're almost back in the 1960's mainframe computer era, with batch processing and decks of punched cards; in fact if you look through the simulator's output text file, there are often explicit references to punched cards!

By the way, this is again not a criticism of *IsSPICE* alone; it applies equally to *PSPICE*, and probably to other PC-based versions of SPICE as well. And of course the fact is that Intusoft has indeed provided *IsSPICE* with both a graphical output processing tool and a custom-designed schematic entry/netlist generator, the latter in particular representing a big step forward compared with other PC-based competitors — including *PSPICE*.

That said, it's worth mentioning here that both *IntuSCOPE* and *SPICENet* are fully compatible with the Berkeley SPICE 2G.6 standard, so that they're also capable of being used with other PC-based SPICE packages. And as it happens, Intusoft and its distributors will sell them separately, as well as in ICAPS packages... (Nudge, wink!)

The remaining programs available to go with *IsSPICE* are *ICAPS.EXE*, the program 'shell' that is used to tie the various other programs together when they're bought as an integrated package, and *SPICEMod* — a program which is

IsSPICE 1.41

used to allow the user to create their own device and subcircuit models.

Hardware requirements

The hardware requirements to run the base level *IsSPICE* (V1.41) simulator itself are quite modest: an XT, AT, 386 or 486 machine with matching coprocessor, 640K of RAM and a hard disk. As the simulator displays only a text-format status screen, it works with virtually any graphics adaptor and monitor. The higher level versions of the simulator are not a great deal more demanding, requiring only their appropriate processor and coprocessor combination, and a suitable amount of additional extended memory. *IsSPICE/286* and *IsSPICE/386-X* both need at least 1MB of extended RAM, while *IsSPICE/386* needs at least 2MB.

The same general hardware configuration is required for both the *PreSPICE*, *ICAPS.EXE* and *SPICEMod* programs, because these too are essentially only text orientated.

But in order to run *SPICENet*, you need to have at least an HGA (Hercules) monochrome graphics adaptor — or preferably a CGA, EGA or VGA colour adaptor with matching monitor. You really also need a Microsoft or compatible mouse, with matching software driver, and DOS 2.00 or later. And finally in order to run *IntuSCOPE*, with its even greater dependence on and use of graphics, you need at least an EGA adaptor or better with matching monitor with mouse/driver and DOS 3.1 or later.

Using IsSPICE

The Australian distributor for Intusoft is Speaker Technologies, whose principal Peter Stein very kindly loaned us a complete *ICAPS/2* package to try out for a few months. Peter even came down from his rural headquarters in Dyers Crossing, in Northern NSW, to deliver it himself and give us a quick introductory demo.

As it happened, a few weeks passed before I was able to spend any time with the program. And in the meantime, the original 286- based machine on which it had been installed for Peter's demo had been moved to another department (after the *ICAPS* programs had been duly wiped). This was because my own office machine had at last been upgraded to one using a 386SX, to give me more satisfactory operation when using *Ventura Publisher*.

Unfortunately the new machine is not fitted with a 387SX coprocessor, so I was forced to try out the *ICAPS* package

```
    lpfilter
*SPICE_NET
*INCLUDE NONLIN.LIB
.SUBCKT UA741 2    3  6   7  4
*              - IN + OUT VCC VEE
*
QNI1 10 2 13 QNI1
QNI2 12 3 13 QNI2
.MODEL QNI1 NPN(NF=1.5 BF=111 IS=8E-16 CJE=3PF)
.MODEL QNI2 NPN(NF=1.5 BF=144 IS=8.3E-16 CJE=3PF)
Q3 13 14 4 QN741
IBE 4 14 185NA
CCM 13 4 2.5PF
RCM 13 4 10MEG
RC1 11 10 1K
RC2 11 12 1K
CBF 10 12 55PF
D1 7 11 D741
RP 7 4 10K
GA 0 15 12 10 .9MMBO
GCM 0 15 13 0 6.3NMBOS
R2 15 0 100K
D2 15 0 D741 OFF
D3 0 15 D741 OFF
C2 15 16 30PF
GB 16 0 15 0 12.5
RO2 16 0 1000
D4 16 17 D741P OFF
EP 17 0 7 0 -1.8 1
D5 18 16 D741P OFF
EN 0 18 0 4 -2.3 1
.MODEL D741P D(RS=1M)
D6 19 16 D741
D7 16 20 D741
IRO 20 19 170UA
RRO 16 21 1MEG
Q4 7 19 21 QNO
Q5 4 20 21 QPO
.MODEL QNO NPN(BF=150 CJC=3P IS=1E-14)
.MODEL QPO PNP(BF=150 CJC=3P IS=1E-14)
L1 21 6 30UHY
RL1 21 6 1K
.MODEL D741 D(CJO=3PF)
.MODEL QN741 NPN
.ENDS
.AC DEC 10 1HZ 10KHZ
.PRINT AC V(7) VDB(7)
.NOISE V(7) V1 10
C1 1 2 .47UF
RBIAS 2 0 270K
R1 2 3 47K
C2 3 7 330PF
R2 3 4 47K
C3 4 0 330PF
X1 7 4 7 5 6 UA741
VEE 0 6 10
VCC 5 0 10
V1 1 0 AC 2
.END
```

Fig.3: After passing the LP filter's circuit file through PreSPICE, the 741 model data has been added.

on my own home machine — another 286-based model running at 12MHz. Not that this is normally fitted with a coprocessor, either (I haven't at this stage invested in one, because they've been rather pricey) — but I was able to borrow the 287 chip back from the firm's machine, and instal it temporarily in the home machine.

So to cut the story short, the nett result was that my trying out of *IsSPICE V1.41* and the rest of the programs had to be done on a fairly modest 286/287/12MHz machine, albeit with VGA level colour graphics. And although this was exactly the kind of machine that Peter Stein had kindly installed it on for me, I had to go through the installation all over again.

Of course that's not such a bad idea; installation is part of the story, when you're evaluating any software package. All the same, I wasn't looking forward to the job, as there are quite a few disks involved in the various programs and it had all looked rather daunting when Peter had done it the first time. But happily just before I had to tackle the installation, a small package arrived. The *IntuSCOPE* program version originally provided (V2.11) had just been upgraded to V3.11, and with the upgrade disk there was also a new SETUP disk with a program which can integrate the installation of any or all of the *IsSPICE* programs (each of which previously had separate installing programs of their own). There was also a new 80-page book titled *PC Installation and Tutorial Guide*, to provide further guidance, and a new perfect-bound *IntuSCOPE User's Guide* of around 250 or so pages (not cumulatively numbered).

Using the new SETUP program and *Guide*, the job of installation turns out to be a lot simpler and easier than before. Within about 45 minutes I had completed the job, and had fired up the *ICAPS* shell to start the evaluation.

As with *PSPICE*, I elected to work through the tutorial material provided with the *IsSPICE* programs, to get a good feel for both the programs themselves and the documentation. In this case Intusoft provides a set of five 'hands on' tutorials, four of which are in the new *Installation and Tutorial Guide* book while the fifth is in the *SPICENet* manual. The latter deals with the use of *SPICENet*, as you'd expect, while the others cover basic use of *ICAPS*, the text editor and *IsSPICE* for a simple circuit example (1), running a simulation of a more elaborate circuit (2), using *IntuSCOPE* to produce waveforms and make measurements from an output file (3), and Monte Carlo analysis (5).

These all turned out to be well written and easy to follow, and certainly do give you a good introduction to the various programs and their capabilities.

The *PC Introduction and Tutorial Guide* also provides a helpful introduction to Intusoft's new windowing user interface, as used on the latest version of *IntuSCOPE*.

After working through the Intusoft tutorials, I then tried feeding in and running simulations on a few circuits of my own — including the same simple active low-pass filter circuit, using a 741 op-amp, that I had tried previously on *PSPICE*. This allowed me to compare the ease and convenience of using the two, fairly directly.

Of course the major difference between the two is apparent right from the start. Instead of having to prepare the netlist and input circuit file yourself, using a text editor, with *IsSPICE* you can draw your schematic directly and have *SPICENet* do most of the work. Not only does this generate the netlist and circuit file, but *SPICENet* will also let you print out the schematic on paper or port it into other software.

The schematic for the little LP filter circuit is shown in Fig.1, exactly as printed out from *SPICENet* on an HP-compatible laser printer. The corresponding netlist/circuit file produced

[illegible]

by *SPICENet* at the same time is shown in Fig.2, ready to go into *PreSPICE*, while Fig.3 shows the expanded file after *PreSPICE* had added the 741 op-amp's subcircuit module from its NONLIN.LIB model library, ready to be crunched by *IsSPICE*.

It's very nice to be able to draw your schematic, and have the basic SPICE netlist/circuit file generated in the process — not totally automatically, to be sure, but at least with a minimum of effort and hassle.

Is this really such a big point? Yes, I believe it is. Academics and other theoretical boffins may be able to think of circuits in terms of netlists, but I suspect that most of us who work with electronics in a practical way are much better able to visualise a circuit's configuration and operation when we can see a schematic. I know I always can, and I did find it rather irritating with *PSPICE* to have to draw out my circuit, either on paper or using *PROTEL Schematic*, and then painstakingly translate it into a SPICE netlist and add the right control statements, using a text editor or word processor — SPICE reference manual in hand.

No doubt those boffins who work with SPICE every day wouldn't find this a problem at all, but for we ordinary mortals working in the real world, it all seems a bit tedious and unnecessary to have to translate our circuits into this rather arcane lingo. In order to be really useful as a design tool, surely a circuit simulator should be able to understand *our* way of describing and visualising circuits — we shouldn't have to adapt to what *it* finds convenient.

This might have been OK back in the pioneering computer era of the 1960's, but in 1991 we've come to expect something better...

Mind you, even with *SPICENet* helping you it isn't all absolutely plain sailing. When I first drew my active LP filter schematic, and ran the resulting input file through *PreSPICE* and *IsSPICE*, the simulation aborted almost immediately after it began with a terse 'JOB ABORTED' message. This was puzzling, because the same circuit and almost identical input file had run quite happily with *PSPICE*.

Intrigued, I went into the *PreSPICE* text editor and started to wade down through *IsSPICE's* simulation output file. Here in the tabular simulation output data I started to find all kinds of weird voltages for some of the circuit nodes — like -251.1248V, in a circuit running from balanced 10V rails!

Finally I found the two cryptic lines:

ERROR: NO CONVERGENCE IN DC ANALYSIS

*****JOB ABORTED

Hmmm — what could be so wrong, to result in *IsSPICE* not even being able to calculate the circuit's quiescent DC operating point?

Then the penny dropped. Here I should note that the schematic for the filter shown in Fig.1 is actually the final version; the first time round, it looked slightly different.

When I had added the 741 op-amp 'subcircuit' into the schematic, *SPICENet* had plonked its symbol on the screen with the negative input uppermost; because I wanted it with the positive input uppermost, I had used the appropriate '-' key to flip it around. This was fine and gave the schematic configuration I wanted, but unknown to me there was a hidden trap: in flipping the symbol over, I had also flipped the 741's two supply rail pins. The Vcc (+) pin was now the one on the *bottom* of the symbol, while the Vee pin was on the top.

Of course I didn't realise this at the time, because for some inexplicable reason the two supply pins on *SPICENet*'s 741 symbol aren't identified with any markings or labels. So when I went ahead and added a pair of 10V DC voltage sources, to represent the Vcc and Vee supply rails, I simply connected the positive Vcc generator to the top pin in the conventional way, and the negative

[illegible]

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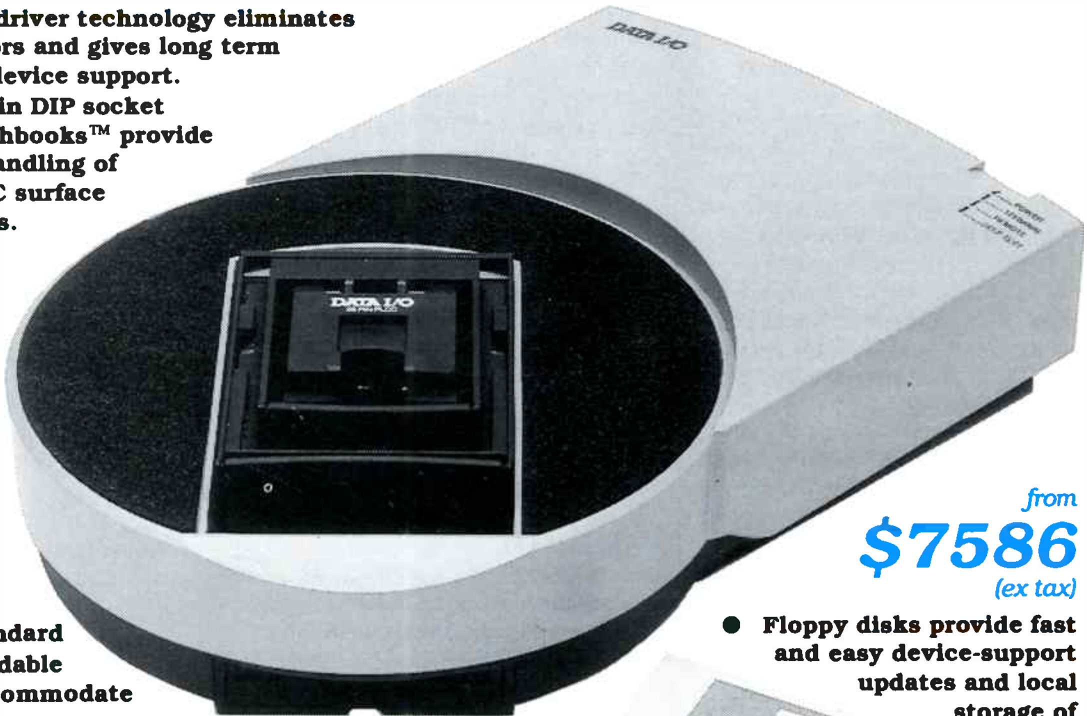

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Device Type	Library	Devices Included
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Memory	E/EEPROM All	All EPROMs and EEPROMs
Memory	PROM All	All bipolar and CMOS PROMs
Microcontrollers	E-micros All	All microcontrollers with on-board EPROMs
Logic	PLD 24	All PLDs up to 24 pin
Logic	PLD 28	All PLDs up to 28 pin
Logic	PLD 44	All PLDs up to 44 pin

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Vee generator to the bottom pin. No wonder *IsSPICE* couldn't calculate a sensible quiescent DC operating point for the resulting circuit model — I had inadvertently hooked up the power supplies to the 741 with reversed polarity!

Presumably *IsSPICE*'s mathematical model of the 741 was effectively melted, which was frustrating at the time until I twigged onto the cause. But I suppose it's still better than burning out a *real* op-amp...

Of course it wouldn't have been nearly as easy to make this kind of silly mistake if *SPICENet* had the supply pins properly identified on its 741 symbol. Hopefully Intusoft's programmers will fix things like this when they're doing the program's next upgrade. As you can see, all that was involved in fixing the problem was to swap around the Vcc and Vee generators to the 'correct' pins on the device symbol. Although it then looked a bit odd, the simulation proceeded without a hitch.

As a comparison, the basic DC, AC and noise calculations for this circuit took *IsSPICE* just over 34 seconds, whereas the evaluation version of *PSPICE* had taken around 2.5 minutes for the same thing, running again on a 286-based machine running at 12MHz. I suspect that this impressive speedup of about five times is due more to the fact that here *IsSPICE* was able to take advantage of the 80287 coprocessor, rather than it being dramatically faster than *PSPICE*. When the latter was being tested, I didn't have access to the 80287. It's likely that if I had, *PSPICE* too would have shown a similar speedup.

But back to *IsSPICE* and the LP filter simulation. After running the simulation, I did use the text editor to run quickly through *IsPICE*'s output file (here 12 pages long). This was mainly out of curiousity, of course — unless you're a SPICE expert or boffin, the output file is of little immediate or practical use. It's really only of much interest when the simulation aborts — for searching to find the SPICE error message!

As with virtually every other circuit example, once you've managed to get *IsSPICE* to perform the simulation successfully it's then a matter of quickly firing up *IntuSCOPE*, to look at the results in concise graphical form — waveforms, response plots or whatever.

IntuSCOPE turns out to be a nice program to drive, thanks to its very *Windows*-like graphical interface and interactive mouse-and-menues operation. Certainly rather more 'friendly' than the comparable *PROBE* program which is available for *PSPICE*, I have to admit, although there's still a number of areas where its operation still seems to fall rather short of the intuitive ideal.

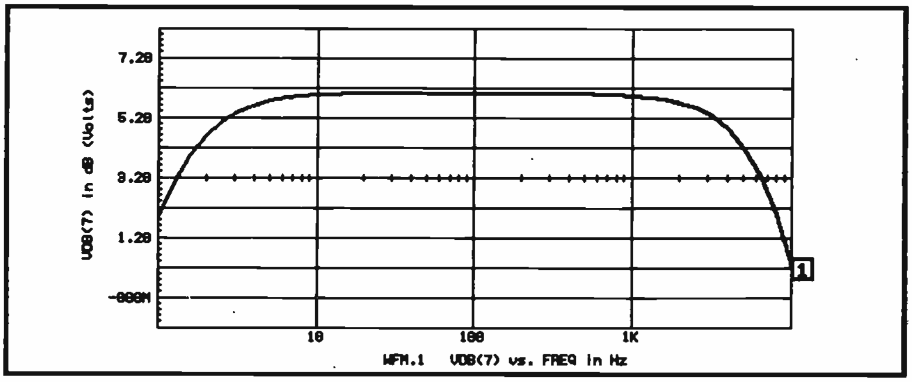


Fig.4: Here's a plot of the low-pass filter's frequency response, as produced by IntuSCOPE from the output simulation data from IsSPICE.

For example it was fairly easy to get a display or printout of my LP filter's frequency response with a dB scaling, either directly from the data provided by *IsSPICE* in response to the .PRINT VDB(7) statement (shown in Fig.4), or by having *IntuSCOPE*'s inbuilt 'calculator' convert the straight V(7) voltage data into dB. But I still haven't worked out how to get *IntuSCOPE* to shift the 0dB reference level to the curve's plateau, so that you can quickly spot the -3dB points, etc.

Similarly there were a few other areas which I found confusing initially, like *IntuSCOPE*'s different kinds of file saving: you can save a graph one way, via 'Save Graph' in the File menu, but that kind of saving is not the one you use for graphs that are to be ported back into *SPICENet*, for pasting into your schematic. To do the latter, you need to use 'Save WFM', which for some strange reason is in the Calculator menu...

Still, on the whole *IntuSCOPE* is fairly friendly, and offers a lot of powerful features for manipulating the SPICE output data and presenting it in more useful form.

Summary

From my experience so far with *IsSPICE Version 1.41* and its companion programs, my impression is that the overall *ICAPS/2* package is rather more friendly and easy to use than MicroSim's product. Intusoft has obviously made worthwhile progress towards bringing SPICE into the 1990's.

Mind you, there are still quite a few areas where I believe further improvement is required. In many ways *IsSPICE* and the other programs in *ICAPS/2* are still not what I would call a truly 'integrated' package — they're more a suite of programs which can pass data between each other.

The various programs are still very different in terms of 'operational vintage', too. In fact they almost run the gamut of 30 years — from *IsSPICE* itself, still essentially back in the non-interactive 1960's, through the totally text-orientated text file editor, to the gradually more interactive and graphical *ICAPS.EXE*, *SPICENet* and finally *IntuSCOPE*. Even those that accept mouse input have little differences between the way this is done — which is initially confusing, and later irritating.

I must say that Intusoft's documentation is pretty patchy, too. The later manuals are quite helpful, but those that are a bit older (like *Simulating with SPICE*) seem rather jumbled and in need of a fairly major revision.

But despite these criticisms, there's no doubt that *IsSPICE* stacks up very well in relative terms, when you consider its price. The basic *IsSPICE V1.41* program alone is only $149, while *PreSPICE* with the model libraries and Monte Carlo option is available for a further $325. Even adding *IntuSCOPE* ($510) brings the price up to only $984 — less than a third that of the equivalent *PSPICE* suite. And adding the schematic capture/netlist assembly facilities of *SPICENet* only bumps up the price by a further $485, to a total of $1469. This is surely very reasonable for a complete functional suite to perform SPICE simulation, considering what used to be required!

Incidentally the Macintosh version of IsSPICE sells for $304, which is also the price for the 'hotter' MS-DOS version *IsSPICE/286*, while the super-hot *IsSPICE/386* will set you back $627.

For further information on any of the Intusoft products, contact Speaker Technologies, PO Box 50, Dyers Crossing 2429 or phone (065) 50 2254. ■

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Fluorescent one-liners

Babcock Display USA has released the VF0120 series Azure Vacuum Fluorescent Subsystem with one line of 20 characters, with character heights of 5mm, 9mm and 15mm.

The VF120 series accepts baud rates of 1200 to 9600 and brightness of 175fL. It operates on a single +5V DC power supply. The VF0 120 can use several fonts, including 96 standard ASC11, ECMA, Katakana, scientific and European characters. Built in are dimming, several scrolling entry modes and blinking characters. The subsystem accepts TTL-level parallel or serial-ASC11 data.

For further information circle 272 on the reader services coupon, or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 784 4066.

Auto-balance Dolby sound

Analog Devices has introduced the SSM-2125, Dolby Pro-logic Surround Sound Decoder which fully integrates an auto-balance function. In fact, the SSM-2125 combines all the core functions of a complete Dolby Pro-logic system on a single chip — including active decoding matrix, centre mode control, noise generator and auto-balance.

Auto-balance provides dynamic correction of left-right input signal-level imbalances, eliminating the need for manual user adjustments and improving centre-channel dialogue separation. The decoder's on-board auto-balance function alone replaces a cumbersome discrete circuit composed of up to 24 active and passive components. In all, the complete SSM-2125 integrates up to 30 operational amplifiers and 10 voltage-controlled amplifiers. A user-selectable Pro-logic bypass mode provides a high-fidelity two-channel signal path without the need for external relays, while thin-film resistors and laser trimming eliminates the need for external gain and offset trimming circuitry.

With over 100dB dynamic range and 0.015% THD, the SSM-2125's 18-bit equivalent audio performance rivals that of compact disc and digital audio tape. Furthermore, separation between any two channels is typically 35dB.

For more information, circle 276 on the reader services coupon, or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

Programmable delay line

Dallas Semiconductor has introduced a series of four programmable 8-bit silicon delay lines. Designated the DS1020, the series can be programmed using a three wire serial or 8-bit parallel port and offers delay values that can be varied over 256 equal steps.

The DS1020 is available in models with 0.25ns, 0.5ns, 1ns, and 2ns steps, with the fastest model offering a maximum delay of 73.5ns and the slowest model 520ns. All models have an inherent (step zero) minimum delay of 10ns. After the user-determined delay, the input logic level is reproduced at the output without inversion. The DS1020 is TTL and CMOS compatible, and is capable of driving 10 74LS chips. Type load and features both rising and falling edge accuracy.

For more information, circle 275 on the reader services coupon, or contact Veltek, 22 Harker Street, Burwood 3125; phone (02) 808 7511.

New DSPs

Texas Instruments has released several new Digital Signal Processing (DSP) chips which make it possible for DSPs to be cost competitive in applications that

have historically been filled by 16-bit microcontrollers, while offering five to ten times the performance of competitive microcontrollers.

Already, DSP has proven itself in both high performance and high volume applications like cellular telephones; fax, dictation and answering machines; and compact disk players; even in computers, combining text and graphics functions with sound and live motion images for multimedia operation. Cost decreases and faster design cycle times are making DSPs an affordable option for cost-sensitive, mainstream systems requiring added horsepower. DSP costs are tied to performance, largely determined by the application's sample rate; the signal's bandwidth. Very low

Solid State Update

bandwidth signals, around one kilohertz, are appropriate for digital control applications, while speech applications require about four kilohertz. For audio, the need jumps to 25kHz; radio extends to the megahertz range.

For more information, circle 271 on the reader services coupon or contact Texas Instruments, 6 Talavera Road, North Ryde 2113; phone (02) 887 1122.

8K x 9-bit FIFO/rate buffer

Dallas Semiconductor has added to its range of first-in-first-out memory with the DS2013, an 8K x 9-bit FIFO featuring asynchronous read/write operations. It offers full, empty and half full flags, and unlimited expansion capability in both word size and depth.

The main application of the DS2013 is as a rate buffer, sourcing and absorbing data at different rates. The full and empty flags are provided to prevent data overflow and underflow. A half full flag is available in the single device and width expansion configurations. The data is loaded and emptied on a first-in-first-out basis, and the latency of the retrieval of data is approximately one load cycle (write). The writes and reads are internally sequential, thereby requiring no address information. The ninth bit is provided by support control or parity functions.

For more information circle 278 on the reader services coupon or contact Veltek, 22 Harker Street, Burwood 3125; phone (03) 808 7511.

Analog multiplier

Analog Devices' monolithic AD734 is a high accuracy and low distortion analog multiplier/divider. Operating with a small signal and full-power bandwidth of 10MHz, the multiplier/divider offers a slew rate of 450V/µs, a signal-to-noise ratio of 94dB, and a guaranteed conversion accuracy of 0.25% for high grade devices — a 4x improvement over competitive solutions.

As a four quadrant multiplier, the AD734 can function as an oscillator, filter or voltage-controlled amplifier. When connected as a two-quadrant divider, the device can function as an automatic gain control (AGC) amplifier or an RMS-DC converter. Direct-divide mode also allows users to optimise dynamic range for varying input signal spans. Applications for the AD734 multiplier/divider include audio systems, sonar, analytical instrumentation, and RF and IF signal processing. A wide 40MHz input bandwidth and low distortion make the AD734 well suited as a demodulator or mixer in heterodyne receivers: the third order intercept point is +43dBm while the 1dB compression point is +18.6dBm for an 8.46V signal across 1k. Third order intermodulation distortion (IMD) is a very good -75dB.

The AD734 performs the mathematical function W = XY/U, where X,Y and U are fully differential analog input signals. In most applications no external components are required for operation. In multiplier mode the denominator voltage U can be derived internally from a 10V buried zener reference. As a two-quadrant divider U is an external input variable and the AD734 functions with a 1000:1 denominator range and a gain-bandwidth product of 200MHz.

For more information, circle 273 on the reader services coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

Micropower CMOS op-amps

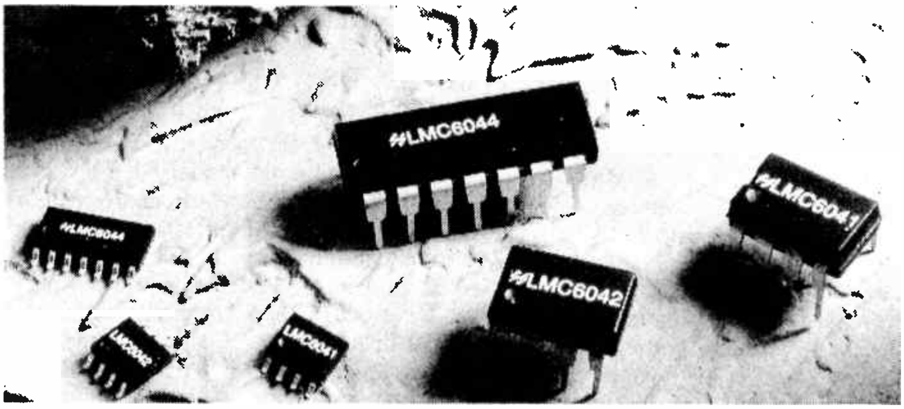
An ultra-low supply current of 10-microamps, coupled with full rail-to-rail output swing, are the hallmarks of the new LMC6041 family of micropower CMOS operational amplifiers from National Semiconductor.

These high-performance op-amps are ideal for use in systems requiring very low power consumption such as battery-powered instruments and hand-held meters.

This family also features a low-input bias current of 2fA (femto-amps), which allows for higher system sensitivity in end-applications such as electrometer amps, and fire and smoke detectors. An input common mode range that includes a negative rail, combined with the rail-to-rail output gives the widest possible signal range in single-supply applications including barcode readers, remote environmental sensors, and photodiode and infrared detectors.

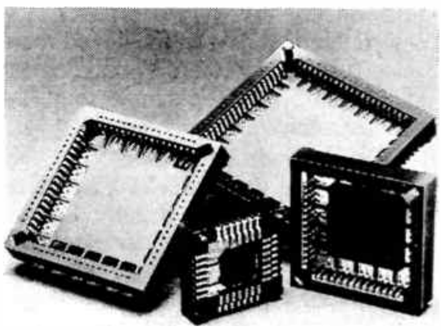
Available as single, dual or quad, these devices also feature insensitivity to latch-up, high output drive, and require no external pull-down resistors for swing to ground.

For more information circle 277 on the reader services coupon or contact National Semiconductors, 16 Business Park Drive, Monash Business Park, Nottinghill 3168; phone (03) 558 9999.



Surface mount PLCC socket

Samtec has released a new surface mount PLCC socket with the same PCB footprint as the chip carrier itself. The socket's liquid crystal polymer body permits high temperature VP and IR soldering, and its open construction allows full visual inspection of every solder fillet. An optional dual-polarisation pin system has one full round and one split pin to assure proper orientation and easy assembly. Precision stamped solder tails have a special 'micro-slot' in the tail for added adhesion of solder paste, and after reflow, superior mechanical strength for high stress surface mount applications. The contact



design places downward pressure on the PLCC so it remains in the socket. Samtec PLCC Series sockets are available for chip carriers with 28, 32, 44, 52, 68 and 84 leads.

For more information circle 274 on the reader services coupon, or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970. ■

Data Acquisition Feature:

The Datataker 600 digital data logger

Melbourne firm Data Electronics has been making microprocessor-based data logging units since 1983, and has chalked up impressive sales not only within Australia, but also and perhaps more importantly overseas. Here's a look at their latest top-of-the-line logger, the model 600, which uses an innovative removable battery-backed SRAM memory card.

by JIM ROWE

The first Australian designed and manufactured digital data logger produced by Data Electronics was the Datataker 100, a compact low cost unit designed primarily for laboratory and research applications. Still available, it provides for up to 46 analog inputs and also has 17 digital ports which can be configured for either input or output.

Features of the 100 which contributed to its rapid user acceptance included low power consumption and an inbuilt back-up battery, which allowed it to be operated from sources such as solar and wind generators; inbuilt scaling and linearisation for a wide range of common temperature sensors; communication via a standard RS232/RS422/RS423 serial interface, for both programming and retrieval of data — either by direct connection or remotely via a modem; and an inbuilt firmware interpreter that allowed the unit to be programmed relatively easily from either a computer or 'dumb' terminal, using simple English-like commands.

Following on from the model 100, the firm developed the model 200, a similar but larger unit designed more for industrial applications. This is also still available, providing 50 analog inputs, up to 64 digital inputs and 21 digital outputs, and enhanced support for all common sensors and transducers.

The model 200 has become widely used for industrial monitoring, data acquisition and energy management. For example Datataker 200's have been installed by the Department of Housing and Construction at all three of Australia's Antarctic bases, to monitor all building services.

More recently, Data Electronics has developed three further Datataker models again: the model 50, a low cost unit which can be configured for up to five differential or 10 single-ended analog/digital inputs, five TTL/CMOS digital inputs and five digital outputs; the model 500, a larger unit with up to 10 differential or 30 single-ended inputs, four TTL/CMOS digital inputs and four digital outputs, and the ability for up to 32 loggers to be connected via an RS485 'twisted wire' bus, to form a local network; and the model 600, which provides all of the features and facilities of the 500 plus an inbuilt 'mini console' with a 2-line-by-16-character LCD display, three alert LEDs and five control buttons.

All three of the new models also provide an important additional data memory facility. In addition to the 64K bytes of internal battery-backed RAM for data storage, they have a socket which accepts the new JEIDA/PCMCIA credit-card sized battery-backed-SRAM cards.

These are currently available with storage capacities ranging from 32K bytes up to 1MB, providing very compact storage for anywhere between 10,000 and 330,000 readings.

As well as simply expanding the raw data storage capacity of the new loggers, the memory cards also provide a very convenient medium for transport of the logged data back to the host computer. So if a logger is to be operated remotely, at a site which makes it difficult to retrieve data via the RS-232C serial port even using a laptop PC, the data can be retrieved simply by unplugging a 'full' memory card and plugging in a fresh one. There is no disturbance to data logging when this is done, as the logger simply uses its own internal memory as a temporary buffer until the new card is plugged in.

Back at the host computer, data from the card can be retrieved simply using the Datataker Memory Card Reader.

The memory card can also be used to load a new logging program or 'schedule' into the logger, as an alternative to feeding it in via the RS-232C serial port — again a handy feature, where a logger is located at a remote site with restricted access.

Model 600 features

Described modestly by Data Electronics as 'the ultimate data logger' (how will they describe next year's model?), the new model 600 Datataker is nonetheless very impressive in terms of its features and facilities. The unit's 30 analog input channels can be configured either for separate single-ended use, or combined in trios for differential inputs — so you can have anything from 10 differential inputs to 30 single-ended inputs, or a multitude of intermediate combinations (such as 5 differential and 15 single ended).

Each input can be software configured to suit any common scientific or industrial sensor or transducer, without any additional hardware.

The range includes standard type B, C, D, E, G, J, K, N, R, S and T thermocouples; platinum and nickel RTD's (resistive temperature detectors); thermistors; temperature sensor ICs such as the AD590, LM335, LM35 and LM34; 4-20mA current loop sensors; analog voltages, currents or resistances, with auto ranging over three decades; and

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[illegible] digital data logger

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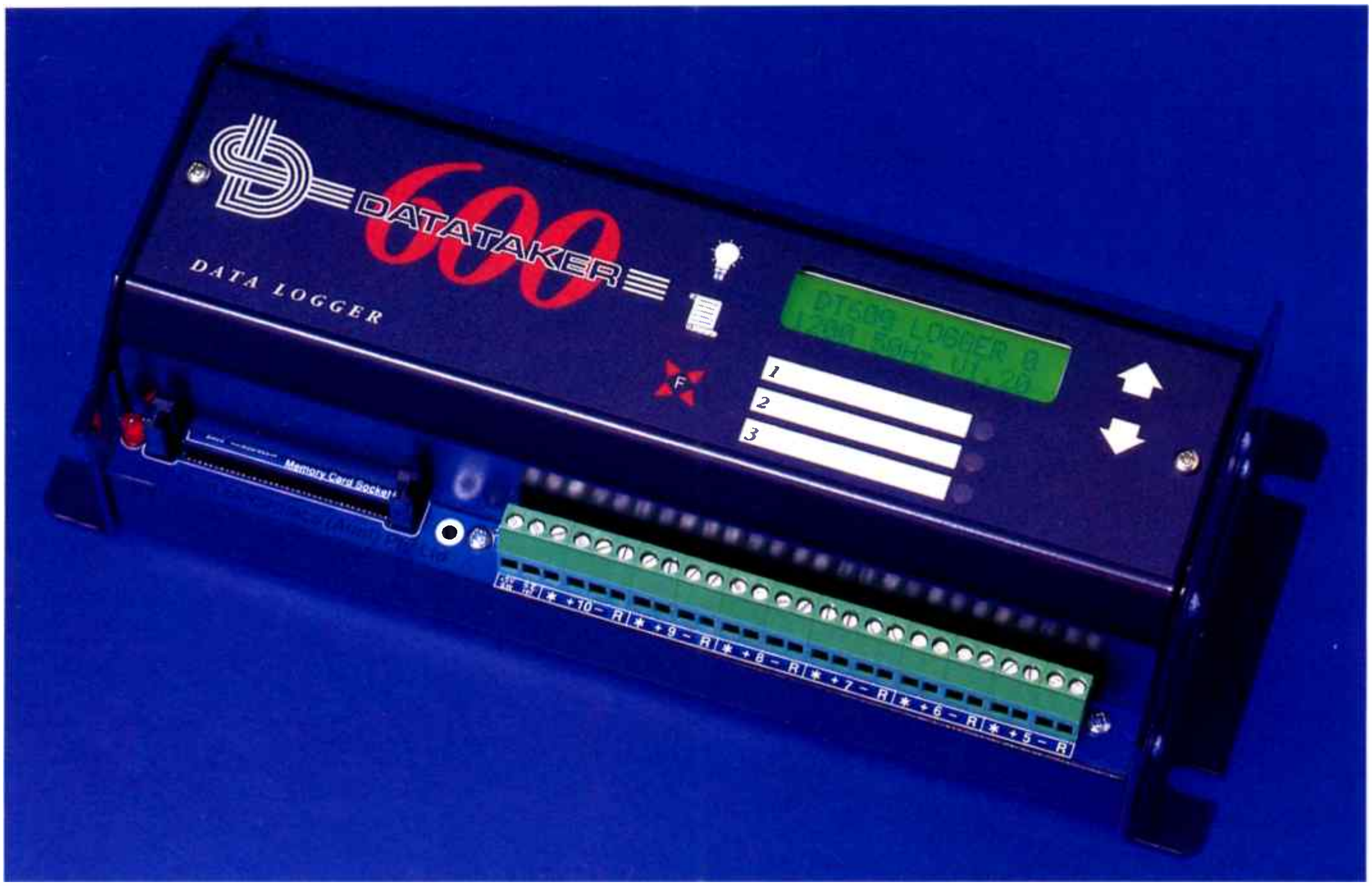

digital sensors. The unit is autocalibrating for all common temperature sensors, with an inbuilt thermocouple reference junction which is automatically calibrated against an LM35 temperature reference.

The output of other sensors can be linearised and calibrated via the software, using up to 20 fifth-order polynomials with definable factors, and 20 linear spans, again with definable factors.

The sampling resolution is 15 bits plus sign bit, with an accuracy of better than 0.15% and a linearity of better than 0.05%. Sampling is at 25 samples/second, and for differential input configurations the common mode rejection is better than 90dB within a +/-3.5V DC range. Series mode line rejection is better than 35dB.

Any of the analog inputs can also be used as a digital input, with adjustable threshold. When configured in this way they can also be used for frequency measurement (40Hz to 500kHz), or period measurement (2us to 25ms).

In addition to the analog input channels, the 600 also provides four 1-bit digital 'ports', which can each be configured as either inputs or outputs (in both cases TTL/CMOS compatible). As inputs they can be used for monitoring digital type sensors and switches, while as outputs they can be used to drive things like alarm flashers, sirens or emergency control relays.

There are also three further 'counter' input channels, which accept pulses at up to 1kHz (optionally 1MHz) and each provides an internal 16-bit presettable counting register.

Incidentally the basic 10/30 analog input capacity of the 600 can also be expanded with up to four external expansion modules, each of which provides 20/60 channels.

The 600's firmware provides for five separate 'schedules' to scan the input channels — one for immediate single scanning, and the other four for programmed repetitive scanning.

Timed scanning for the latter schedules can be programmed to occur as frequently as every second, down to as slowly as once every few months, while event-triggered scanning can be programmed to respond to any digital input or counter registration.

Quite apart from simple scanning of designated inputs, the 600 can also be programmed to manipulate and reduce ('boil down') the raw data obtained, to allow it to be both stored more efficiently, and analysed more conveniently.

The inbuilt firmware provides for averaging, calculation of standard deviation, integration, recording of maxima and minima readings (with optional time stamping), difference calculation and cross-channel expression evaluation with arithmetic, logical and relational operators, trigonometric, logarithmic and standard intrinsic functions.

In addition, it can be programmed to detect up to 120 different 'alarm' situations, where designated input values cross defined setpoints either singly, or in combination, and then in the event of these situations either set or clear digital outputs, return a text message to the host computer or carry out other actions. It's very powerful and flexible...

The model 600 can operate from an external power supply of either 7-13V AC or 10-18V DC, with its internal 1.2Ah rechargeable gel cell battery providing backup for between 10 hours and 65 days depending upon the scanning schedules (which determine current drain). A larger 17Ah battery can be provided, to multiply these backup times by around 10 times.

An interesting point is that when it's operating from the backup battery without an external power source, the 600 automatically drops into a very low-drain 'sleep' mode, in between scans. The drain in sleep mode is only around

Datataker 600

350uA, which prolongs battery life considerably.

As noted earlier, an RS-232C/423 serial port is provided for communications with the host computer or an intermediary laptop — either directly, or via a modem, etc. The baud rate is selectable by DIP switches, for either 4800, 2400, 1200 or 300bps.

Alternatively, as noted earlier programs can be fed to the 600 from its host computer, or logged data retrieved from it, via the SRAM memory cards.

In either case no special software is required, as all communications with the Datataker are essentially in plain ASCII text string format. This means that almost any standard communications software package can be used to 'talk' to the logger, although Data Electronics has written a special package called *Decipher* which is custom-designed for the job.

The programming language used for the 600 (and indeed for all of the other Datataker models) is in a concise, although somewhat terse, descriptive language. A sample scanning command would have the format:

R10M D T 1V 2R 3F 4TN LOGON

where 'R10M' means repeat the following scan every 10 minutes; 'D' and 'T' mean record the date and time; '1V' means scan input channel 1, and record its value in volts; '2R' means scan input 2, and record its value in ohms; '3F' means scan channel 3, and record the input signal frequency; '4TN' means scan channel 4 and record its value as a temperature, as measured by a type N thermocouple; and finally 'LOGON' means log all of the scanned data to the memory.

As you can see it's quite logical, although the fact that the Datataker can perform such a variety of functions and be configured in so many ways means that the programming can get quite involved.

Along with the basic scanning commands there are commands to control counter/timer channel status, specify logical/arithmetic/relational data reduction, specify or request information on logger configurations, modes and stored/active schedules, and so on.

The format used for the logged data is of course determined by the commands sent to it, but is again basically just a series of text strings. For example the sample scanning command just given would tend to generate data in the format:

```
Date 03/07/1991
Time 09:00:00
1V 1254.1 mV
2R 543.27 ohms
3F 2450.6 Hz
4TN 847.3 Deg C

Date 03/07/1991
Time 09:10:00
1V 1254.6 mV
2R 543.21 ohms
3F 2457.3 Hz 4TN 845.9 Deg C
```

and so on. If desired, the logger can easily be programmed to add more wordy descriptions to each reading.

The data format is in fact quite compatible with many spreadsheet packages like *Lotus 123* and Microsoft *Excel*, as well as with more specialised software such as *Labview*, *Labtech Notebook* and *Labtech Control*. So it's quite easily transformed into charts and other graphical representations.

Trying one out

Data Electronics very kindly made a sample Datataker 600 available to us for evaluation, complete with a copy of its custom *Decipher* software package, and we were accordingly able to put it through its paces.

The unit came complete with a small 12V/300mA DC plug-pack supply, to keep the battery topped up. We hooked up a few thermocouples and small power supplies (acting as substitutes for test voltages) to its inputs, and also connected its RS-232C comms port to an IBM-compatible PC (a 386SX clone, actually), using the DB-9 cable able supplied.

Then we fired up *Decipher*, which has a semi-graphical user interface, and proceeded to try a bit of elementary data logging.

It took us a while to get the hang of Data Electronics' programming language, but this probably reflects more on our lack of familiarity with data logging than on any possible deficiencies in the language itself. Before long we were confidently sending little logging 'schedules' to the 600, querying its status, and getting back the expected data.

Overall, our impressions from this 'hands on' trial are that the Datataker 600 is indeed a most impressive unit, with the power, flexibility and ease of use to make it suitable for a very wide range of data logging applications.

Quoted price of the basic Datataker 600 unit, including internal memory for 16,000 readings, inbuilt 1.2Ah battery, AC mains adaptor, IBM RS-232C cable and user manual is $3500, with *Decipher Plus* available for a further $495.

The firm can also supply memory cards and readers, larger batteries, industrial and portable protective enclosures, thermocouple wire and of course the other (lower cost) models in the Datataker range.

For further information circle 201 on the reader service card, or contact Data Electronics, 46 Wadhurst Drive, Boronia, Victoria 3155; phone (03) 801 1277. ■

About data logging

There are many areas in industry and science where a number of physical quantities need to be measured regularly, and the measurements recorded each time to produce a 'log of events' or database, to allow later reference and/or analysis. Examples are 'logging' the critical temperatures, pressures and rates of flow for an industrial process, or the soil moisture and air temperature readings for a study of plant growth, or the levels of certain toxic chemicals in a river, for a pollution monitoring project.

For many years, this kind of data logging was performed using analog chart recorders — based on either a heavy-duty moving coil meter movement with an ink pen attached to the pointer, or a motor-driven plotter using potentiometric nulling, and in either case recording the data as a graph on either a linear or circular paper chart. However during the last decade or so, digital technology has gradually taken over.

A digital data logger is essentially a dedicated microcontroller, programmed to accept inputs from a number of sources. These can include DC or AC voltages or currents, where these are directly available; derived signals such as readings from counters and timers; simple digital 'state' signals from switches and sensors; and signals from transducers such as tachometers, pressure transducers, flowmeter heads, strain gauges, auto-balancing bridges, thermistors, thermocouples and 'RTDs' (resistive temperature detectors).

Generally the logger is programmed to 'scan' or monitor these inputs sequentially, either at predetermined intervals (in response to an inbuilt real-time clock) or in response to a 'trigger' event — such as the value of one or more of the input quantities moving above or below a preset value, or outside a preset range.

All of the input values may be recorded after each measurement scan, along with the date, time and any other relevant reference information such as ambient temperature, relative humidity, etc. The resulting measurement log is stored either on a magnetic medium (e.g., floppy disk or tape), or in a semiconductor memory, and thus made available for further reference and analysis — in most cases, via a separate computer system.

[illegible]

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Rob Evans E.A. May 91

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- Water resistant
- Data hold
- Memory offset

Ranges
Vdc 200mV, 2V, 20V, 200V, 1000V
Vac 200mV, 2V, 20V, 200V, 750V
Adc 200µA, 2mA, 20mA, 200mA, 2A, 20A
Aac 200µA, 2mA, 20mA, 200mA, 2A, 20A
Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
$166.80

Model 98
- 3 1/2 digit plus 41 segment analog bar graph
- Autoranging or manual selection
- 8 Functions - Vdc, Vac, Adc, Aac, Ohms, Diode, Frequency, Capacitance
- Data hold
- Memory offset

Ranges
Vdc 200mV, 2V, 20V, 200V, 1000V
Vac 200mV, 2V, 20V, 200V, 750V
Adc 200µA, 2mA, 20mA, 200mA, 2A, 20A
Aac 200µA, 2mA, 20mA, 200mA, 2A, 20A
Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
Frequency 2kHz, 20kHz, 200kHz
Capacitance 2nF, 20nF, 200nF, 2µF, 20µF
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Industrial 386SX SBC is made in Australia

Local firm JED Microprocessors has just produced a compact single-board computer for industrial 'embedded' applications, which is based on the 80386SX processor and designed to be fully software compatible with the IBM PC-AT machine. This makes for very easy development of applications software.

by ED SCHOELL
Managing Director, JED Microprocessors

To most people, the word 'computer' calls up a vision of a box in a room or on a desk being used by an operator sitting at a keyboard, looking at a screen and waiting for a printout. However in today's world many, many more computers are embedded inside hardware applications — all the way from musical birthday cards to complex scientific instruments and industrial controllers.

While there may not be a manufacturing industry in Australia building computerised birthday cards, there certainly is an active industry, even in these difficult economic times, designing and manufacturing industrial controllers.

This market is spread Australia-wide, and usually consists of smaller companies with vertical market and design experience in specific sectors (e.g., coal mining, environmental and weather monitoring, batching and weighing). This market is proving quite resilient and needs easy-to-apply hardware which can be programmed quickly, preferably in an efficient high-level language, because of the usually small number (1 to 1000) of units produced with a common program.

Board requirements for this market require PROM code storage ability, high reliability (without fans and filters), low power consumption (often from batteries), compact size and mechanical convenience (i.e., stacking expansion rather than boards at right angles). Added to this is the need for PC compatibility, for reasons of user familiarity, code and compiler reuseability — and the low cost of compilers, operating systems and associated software in the first place. The other obvious requirement for boards in this market is logic I/O functions, so the board can interact with the world around it.

With many years of experience in this applications area, we at JED Microprocessors perceived a market niche which defined the board described below. Market research defined the need for AT-style performance as the mininum requirement. But the architectural enhancements of the 80386 offered better memory and multi-tasking control, so an 80386SX was the logical choice for the 'engine'.

This, then, is the basic concept of the new JED 386SX Industrial AT single-board computer (SBC) — a fast, embeddable board designed to provide users in this marketplace with a complete high-performance system on one board. It is designed for applications where PC power and performance are needed in a small system, which also follows PC standards implicitly as far as the programmer is concerned. It also offers rugged hardware suitable for operation in difficult environments or remote sites.

The new single-board machine continues the JED tradition. JED boards all use low power consumption CMOS technology, with many interfaces provided on board; PROM-based program storage on board; options of CMOS battery-backed data storage on board; and bus-compatible interfacing to add-on cards. It also has over 80 logical I/O lines.

The board is shown in the photo. It measures only 280 x 135mm (11" x 5.3") and draws less than *four watts* from a single 5 volt power supply!

The board uses a 386SX CPU — a processor in the Intel 8086/186/-286/386/486 family which is a 32-bit machine inside, but has a 16-bit system bus. It has all of the multi-tasking and other extra features of the 386, allowing use with new operating systems and system software designed for the 386, as well as offering full PC XT/AT compatibility.

The CPU is used with the Intel/VLSI 'Topcat' chip-set to produce a system which is 16-bit AT bus compatible. It runs with either a 16MHz or a 20MHz system clock and an 8MHz AT bus clock. The Topcat chip-set is one of the most integrated ones available, with bus drivers for the slot-bus on the chip-set.

Using a 'chip-set' is the only reasonable way to generate a system of this complexity in Australia without enormous expense and complexity. The two 160-pin Topcat chips replace over 100 conventional chips, saving power, design time and prototyping time and making it feasible to design a computer of this complexity for the 'niche' market we defined above, in Australia.

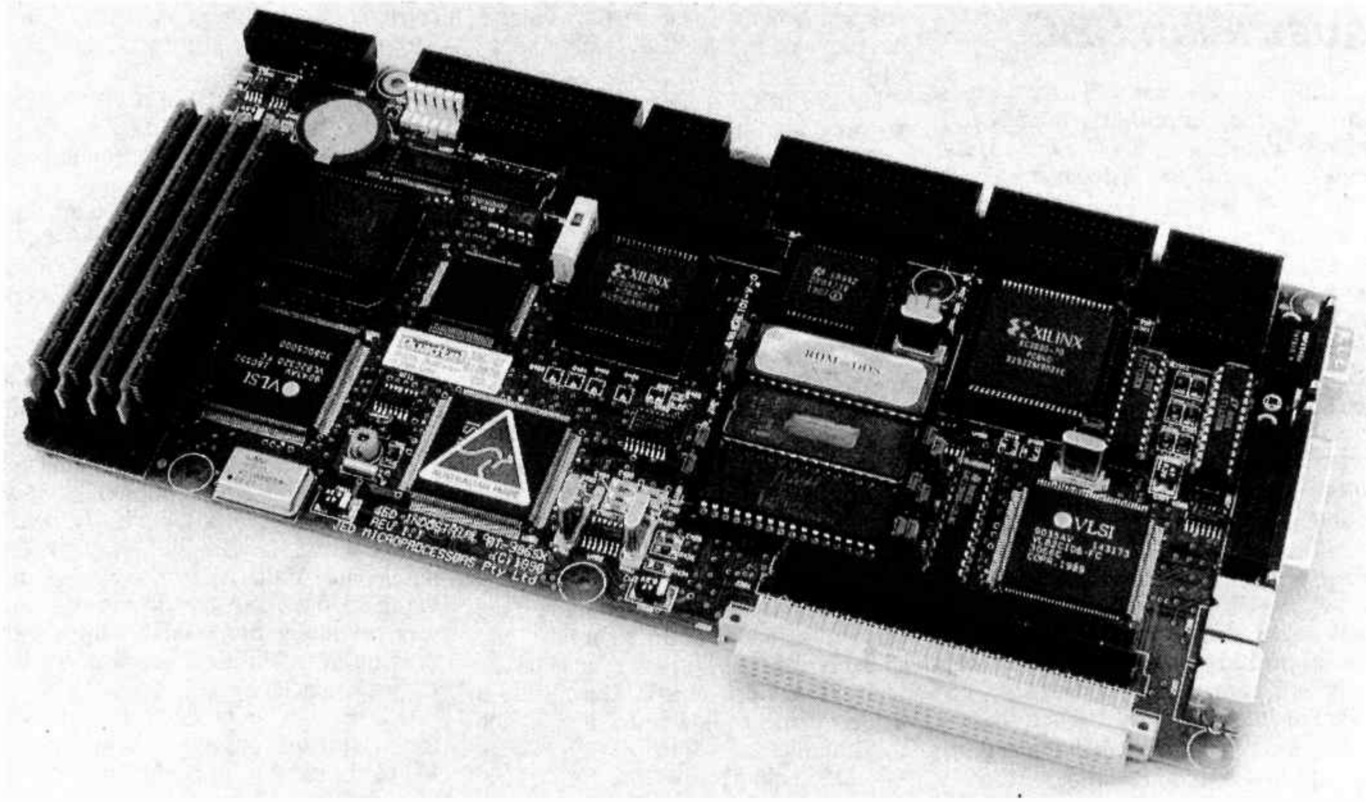
Gate arrays

The JED design uses two Xilinx gate arrays for other complex logic functions. This again allows the equivalent of many packages to fit into a small, low-power package, without expensive masking charges and the risk of costly design errors causing discarding of faulty chips.

A 387SX maths co-processor in a PLCC socket is an option for maths-intensive applications.

Up to 16M bytes of dynamic RAM in SIMM packages can be placed on the board, and is supported directly by the Topcat chip-set.

Industrial 386SX SBC is made in Australia



Three different SIMM sizes can be used (256K, 1M and 4M byte), allowing RAM sizes of 512K, or 1, 2, 4, 8 or 16 megabytes to be installed. EMS (LIM-4) and extended memory control is handled by the chip-set, as is shadowing of the main and video BIOS's into high speed 16-bit RAM, and interleaving of banks. Fast 80ns RAMs are used for zero wait-state performance.

As well as three 32-pin PROM/RAM sockets on the board, a memory expansion connector allows piggy-back memory boards to be added, forming a 'second storey' with up to 16MB of PROM disk (or a mixture of RAM, PROM and flash memory).

The PROM-disk BIOS configures EPROM memory to appear as a read-only drive-C for programs (and the CONFIG.SYS and AUTOEXEC.BAT files). All RAM is configured as a read/write drive-D for data files. This allows easy development using a hard disk with standard DOS compilers, for subsequent transfer to solid-state-disk without modification.

PROM or RAM credit-card memory card devices can also connect into this memory expansion header, and appropriate decode and address lines allow a small system front-panel-mounted connector to interface to 34-way, 68-way, and any other format card defined in the future.

For high-reliability semiconductor-based memory applications, this system provides all that is needed, either on the CPU board, or on the piggy-back second layer memory board.

One of the gate arrays contains the majority of the 'glue' functions needed to interface memory and I/O sections of the board. This produces chip decodes for three 32- pin PROM or RAM sockets and provides paging and control, allowing these sockets to act as a PROM/RAM disks. One socket contains the CPU BIOS, the VGA BIOS and any other BIOS programs the system needs. It also contains the pattern to set up the gate array logic to the correct interconnection pattern.

The sockets are wired to accept EPROMs up to 1MB, static RAMs up to 128KB (or larger) and pseudo-static RAMs up to 512KB. The RAMs can be battery backed. A watchdog and power monitoring chip aids system security. Two sockets can also be equipped with 12-volt 'flash' EPROMs, allowing on-board programming and downloading of software to the board in remote sites, via a modem with automatic loading into flash EEPROM.

A rechargeable lithium battery, with on-board recharger, is provided so that the system clock (in the Topcat chip-set) and the backed-up memory chips are kept alive. (A special line from the battery-backed power supply system provides a power line, even when the system power is switched off, for these battery-backed devices, so the on-board lithium cell is only needed when the power is unplugged or the system is in transit.)

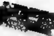
Disk system support

The board has an Integrated Drive Electronics (IDE) buffered hard disk interface for drive capacities from 20MB up to 350MB (3.5"). These drives are available at a reasonable cost from a number of manufacturers, and the power supply to these drives is controlled.

Suitable ranges of drives with low power consumption, good rugged mechanics (designed for laptops) and voice-coil speed in a small package are made by Conner and Quantum. They do not require air-flow cooling, which fits into the concept of this low-power CPU board mounted in a sealed box with no air flow, even in high temperature environments.

A National Semiconductor DP8473 floppy disk interface chip covers 360KB to 1.44MB drives. The cable to the drives can accommodate three floppy drives of various densities. Again, the drives can be powered down when not in use.

The board is supplied with a Quadtel BIOS in PROM. This BIOS is designed to support the feature registers of the Topcat chip-set, and in extensive testing we have found perfect compatibility



with all the software we have tested. This includes compilers, debuggers, Microsoft's *Windows 3*, *PCAD* and *Maxroute* CAD packages, just to name a few.

To the BIOS PROM we have grafted in the Trident VGA BIOS of which JED is also a licencee, and we use a EPLD on the board to map these into the correct BIOS spaces. Thus the stackable video, network and other cards which would normally have PROM BIOS extensions on their boards are all grouped into one PROM on the main board and are mapped into their BIOS extension areas automatically.

The board can be supplied with ROM-DOS, an operating system with support for solid state disk, or it can run under MS-DOS, DR-DOS, and Windows, as well as a variety of multi-tasking 386-mode operating systems and laboratory or scientific packages needing the task switching facilities provided in a 386.

Two serial ports, a parallel printer port, the AT keyboard and PS2 mouse controllers and several system decoder outputs are provided in one VLSI/Intel 'combo' chip.

LT1133 (RS232) drivers on the board are provided for serial interfacing, and a TTL/CMOS level serial connector allows users to add opto-isolated RS485, fibre-optic or other drivers off-board for long-distance industrial communications.

In industrial interfacing to remote serial I/O, we feel strongly that opto-isolation of the communications lines is essential, and for years have been providing small interface boxes for this function (the JED STD-990 and STD-995). This port on the board extends opto-isolation to the system with a small opto-isolator which mounts on the back of a panel connector.

An XT-bus expansion connector allows piggy-back (stackable) interface cards to be added at the right-hand end of the board. The first ones designed are both VGA video boards. One, using a Trident chip set allows 1024 by 768 line maximum capacity (16 colour), 800 by 600 (256 colour) as well as CGA, Hercules, EGA and normal VGA (in 16 and 256 colour modes). It supports the VESA standards.

The second one uses a new Western Digital controller, allowing for VGA-resolution LCD and EL (electroluminescent) display technologies.

JED plans to develop other boards for this connector: Ethernet, IEEE-488, extra UARTs or SDLC I/O cards can also go here, as well as custom-designed I/O boards.

Expansion modes

A high-reliability 96-pin DIN 41632 connector is included to provide AT bus slot expansion. A 96-pin DIN standard known as the PC/96 is followed on this connector, but this is electrically compatible with a standard AT bus. (This 96-pin version of the AT bus, as defined in the IEEE P996 ISA bus documentation, was originally proposed by Intel and used on Intel Multibus II boards as the P2/aPC connector.)

JED intends to produce a family of cards using this bus as a high-reliability I/O card family, with analog and digital I/O cards on a Eurocard format. Extra custom single interface cards can also be mounted alongside with a 90° DIN connector.

Some 83 I/O lines (beside the PC parallel printer port) are provided on the board. I/O interfaces from the memory paging gate array are pinned out via two connectors, one as a 26-pin I/O (with twin 8-bit ports with strobes) and one as the JBUS I/O expansion system.

The I/O can connect to the DataSafe device from JED, a 25 x 50 x 100mm diecast metal box containing up to 256KB of CMOS battery-backed RAM, and usable as a portable data storage device for retrieving data from data- loggers, etc.

The J-Bus interface port allows a family of DIN-rail printed circuit boards with industrial screw-terminal analog and digital power I/O to be addressed directly from the 386-SX board.

Re-wireable I/O gate array

A Xilinx RAM-based gate array wired to three more 26-pin I/O headers allows 56 I/O lines to be customised as I/O ports, with bit addressability, strobes, latches, up-down counters, encoder phase detectors or whatever takes your imagination. The configuration can be loaded from disk or PROM, and a custom design service for the I/O is available from JED. Links are provided to allow logic inside the gate array to interact with the interrupt and DMA systems of the system.

JED and the birth of an Australian PC...

JED Microprocessors began in 1976 as a part-time activity of owners and directors Junette and Edwin Schoell, working in their house in Boronia on the side of the Dandenong Ranges, about 30km east of Melbourne. Edwin ran the Applications Engineering department of National Semiconductor, and JED was started to design, and offer as kits, a range of 6" by 8" microprocessor boards using the 16-bit PACE microprocessor. (National encouraged this activity as a means of getting more users for their chips.)

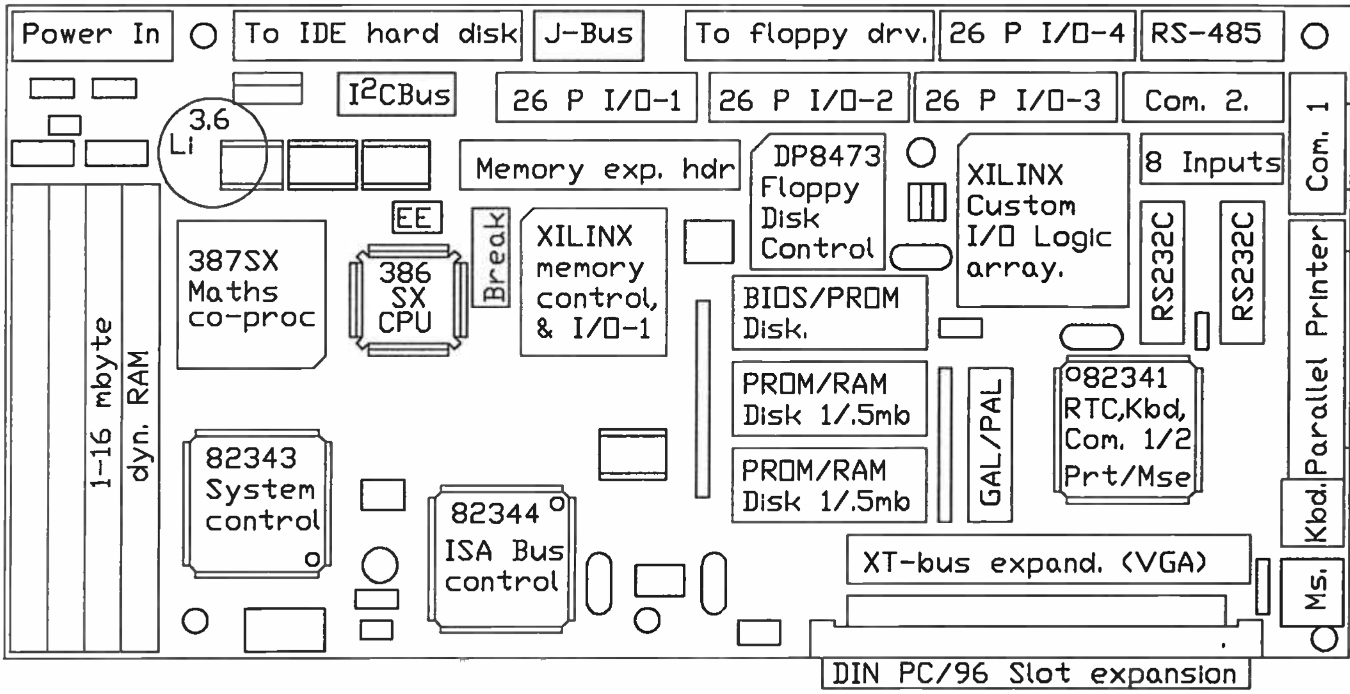
Edwin's background in electronics began with reading *EA*'s predecessor *Radio and Hobbies*, and making a 'Transporta 4' four-transistor radio, as a primary school student in 1957. Short-wave radio followed, with *EA* projects winning prizes in the Adelaide JAYCEE Science Fair, leading to an amateur radio licence (VK5ZTS & VK5NZ), and a degree in Electronics Engineering from the South Australian Institute of Technology, granted in 1967.

After joining Hawker Siddeley Electronics he working in the United Kingdom, on the design team of an early industrial control computer in 1968 and 1969, which was used in an RAAF project. Back home, he built the digital telemetry sections of the AMSAT-Australis 8 Satellite, and moved to National Semiconductor in 1972, specialising in microprocessor and microcomputer design and applications.

JED manufactured an STD-bus board based on the INS 8073 (Tiny-BASIC) in 1981, and sales of this popular board launched the company full time in 1984. A similar CMOS Z80-code computer (also STD-bus) released in 1984 and revised in 1989 now has 2,500 systems installed, and JED has grown to 16 staff with an office/factory in central Boronia.

Chris Mason, a graduate from Melbourne University in 1975 and fellow staff member at National, spent four years with Terran Computers, Melbourne, designing PC-compatible computers. Chris joined JED in March 1990, and the first JED 386-SX was sent to a customer just one year later.

The schematic of the new JED PC was designed on-screen using PCAD, and laid out interactively using Maxroute (a $9,500 package) running on a Terran 486 machine. PCB layout took 110 hours of CPU time, and the first prototype was on a two-sided PCB using .004" design rules. This was made in Australia by Lintek in Canberra, using a unique plating-up process. However because of noise problems when running external TTL-logic boards on the PC96 bus, it was decided to do the production revision in 6-layer, adding a ground and a VCC plane in the centre, and to use .008" design rules. This board runs faultlessly, and only had a couple of very minor changes. Thus only two revisions got us to production of an exciting Australian product.



Here is the layout of the JED 80386 single board industrial PC, showing the main components and connectors.

Gate arrays with up to 9,000 gates can fit into this socket. Thus a great deal of digital I/O is available on the main board, *without* having to add bus expansion and extra I/O boards.

Power for these (and other) I/O connectors which have 5 volts on them is protected by an on-board circuit-breaker, protecting the board from external shorts.

As well, an I^2C port on the board allows remote LCD displays, analog inputs, and remote functions on panels, etc. (The I^2C concept originated with Philips, and we use their chips for these functions.)

Cases, power supplies, etc.

A range of power supplies to suit are being produced by JED, and run from 10 to 60 volt DC inputs, or 24 or 240/110 volt AC inputs. Applications where vehicle power (12 or 24 volts), external battery power (12, 24 or 48 volts) or solar panels are all suitable power sources. As mentioned above, the board draws only 4 watts!

All of these power supply options come with integral battery backup and charger, and various isolation options. The battery charger modules and regulator modules are designed to drop into customers' systems easily, and are able to supply controlled power to other sections of a total system as well as the JED CPU board.

One option, interfaced to an I^2C interface from the CPU board, is remote clock and power control inside the power supply, allowing automatic start-up of the power supply (and hence, the computer) at pre-programmed times.

We anticipate that most users will be buying the systems as boards to embed in their own cases and then burying them inside their own equipment. However pre-packaged systems will be available from JED, for customers who do not want to do their own case or system manufacture.

Ideas for JED produced cases include 19" rack versions and a compact bookshelf design for laboratory or office users.

The JED 386SX AT has various options, and starts at $1,080 in small quantities, which includes 2MB of 80 nanosecond RAM.

JED Microprocessors is located at Office 7 & 8, 5-7 Chandler Road, Boronia, Victoria 3155; phone (03) 762 3588, or fax (03) 762 9639. ■

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New Products for Data Acquisition

Intelligent RS232 card

Priority Electronics has released the PCL-744, an intelligent eight port RS-232 interface card.

It has been designed for industrial applications where a PC has to communicate with multiple stations or PLCs through RS-232 interfaces.

Each PCL-744 is equipped with a V20 8MHz CPU that handles system setup and interface activities. This means that typical communication problems experienced by non-intelligent interfaces such as losing data or overloading the CPU, can be avoided.

In addition, the PCL-744 features complete modem flow control signals such as RTS, CTS, DSR, DTS and DCD. Up to four PCL-744s can be installed to attain 32 concurrent ports on one system.

Installation and application is made simple with easy to operate DOS device drivers supplied with each PCL-744.

These include high level language interfaces for Turbo C, Microsoft C, Quick, BASIC, CLIPPER and Turbo PASCAL, as well as assembly language.

For further information circle 204 on the reader service coupon or contact Priority Electronics, 7/23 Melrose Street, Sandringham 3191: phone (03) 521 0266.

VGA colour frame grabber

Capable of capturing five frames per second in 256 colour VGA resolution, the OC-20 from Boston Technology is a full size PC/XT/AT card which will store the captured image in PC-Paintbrush, Page Maker, Ventura Publisher, ColoRIX, Halo, Autodesk-Animator (GIF) and Pizazz Plus formats.

The OC-20 card can capture at resolutions from 320 x 200 x 4 bit up to 640 x 480 x 12 bits.

It can show live grey-scale pictures directly on your monitor for framing, focusing and selecting images, before grabbing, without the need of an extra

Data acquisition card for AT's

National Instruments Corporation has announced its highest performance, multifunction analog, digital and timing I/O board for PC AT and compatible computers and EISA personal computers. The AT-MIO-16F-5 doubles the sampling rate of the company's popular AT-MIO-16 board and adds advanced analog performance through self-calibration, dithering, deeper FIFOs, larger channel-gain memory and analog output via DMA.

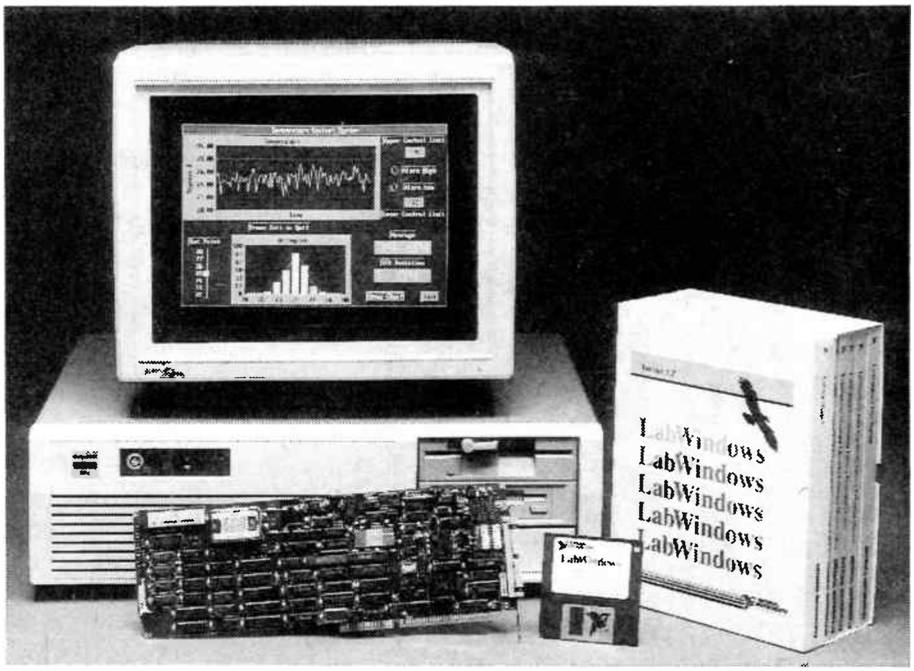
When programmed with the company's DOS *LabDriver* or *LabWindows 2.0* software, the board equips a PC AT for automating process monitoring and control, instrumentation and electronic test applications.

The AT-MIO-16F-5 has 16 single-ended or eight differential analog input channels with 12-bit resolution; two analog output channels with 12-bit resolution; eight TTL digital I/O lines; three 16-bit counter/timer channels; and 16-bit DMA with single and dual DMA channel modes.

It also samples analog signals at 200k samples/sec, and transfers the data directly to memory using DMA. Where most boards cannot maintain their sampling rate when using higher gains, the AT-MIO-16F-5 continues to deliver 200kSa/s performance at all gains, even when sampling multiple channels.

All analog input functionality of the AT-MIO-16F-5 is software-configurable. Software is used to select between single-ended or differential input mode; gains of 0.5, 1, 2, 5, 10, 20, 50 or 100; ranges of 0 to 10V or -5V to +5V; internal or external A/D timing, sampling rate; and pretrigger or post-trigger acquisition modes.

For further information circle 202 on the reader services coupon or contact Elmeasco Instruments, 18 Hilly Street, Mortlake 2137; phone (02) 736 2888.



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READER INFO NO. 25

monitor. The only connection needed is a video cable from any video source, providing a standard composite sync signal to the card via an RCA phone jack. Menu driven software is supplied with the OC-20 and allows you to set the colour, resolution, brightness, contrast and disk operation.

Also supplied is a driver, compatible with the OC-20 Kernel System, and various other programming utilities for building your own OC-20 software. The OC-20 is available in PAL or NTSC versions.

For further information circle 205 on the reader service coupon or contact Boston Technology, PO Box 415, Milsons Point 2061; phone (02) 955 4765.

High speed A/D board

The new PC-430 board from Datel is a very high speed A/D converter and digital signal processor, sampling at up to 4MHz, intended for use with PC/AT computers.

There are four analog input channels that are multiplexed through a sampling A/D converter, sectioned as a pluggable analog module. Simultaneous sampling and hold allows four inputs to be sampled at the same time without skew, then sequentially digitised.

Coprocessing is achieved using Texas Instrument's TI320C30 digital signal processor, to perform mathematical operations on incoming data.

This allows A/D data streams to be preprocessed, before being saved 'seamless' to mass storage.

An FIFO memory coordinates the precise timing of the A/D converter with the block transfer timing of the bus. The PC-430 has applications where rapid sampling and preprocessing of continuous analog data is required.

Noise filtering, waveform distortion analysis, high speed mapping and imaging, biomedical signal sampling and array processing are all fields for use for this device.

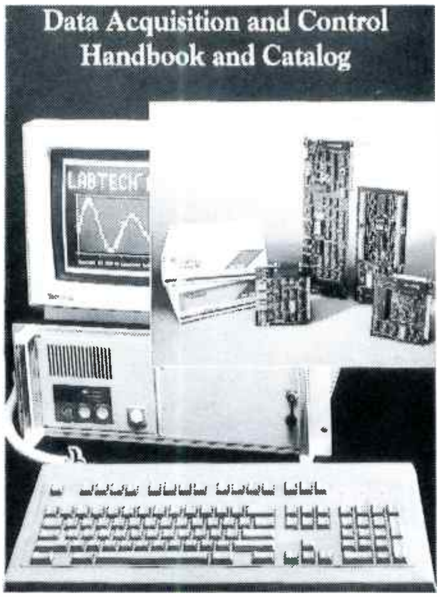
For further information circle 206 on the reader service coupon or contact Quiptek Australia, PO Box 335, Black Rock 3193; phone (03) 532 1328.

Data acquisition, control catalog

Novatech Controls has released a new handbook and catalog covering a broad range of industrial and control hardware and software.

A guide on how to select and use this type of equipment is included, as well as literature on industrial computers, industrial keyboards and data acquisition and control boards and modules.

For a free catalog contact Novatech Controls, PO Box 240, Port Melbourne 3207; phone (03) 645 2377.



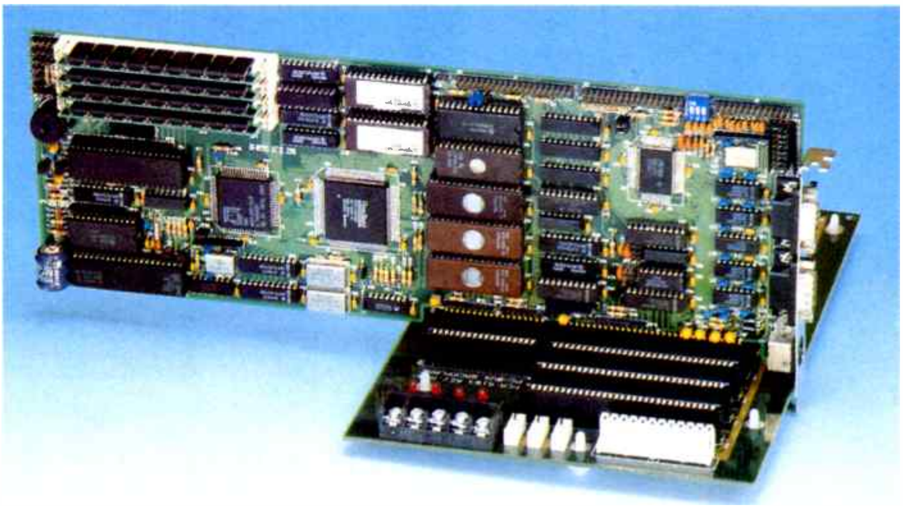
286-based SBC has REM disk

The PCA-6126 16MHz 80286 CPU card offers the features of an all-in-one package with CPU, RAM, disk controller, serial/parallel ports, ROM disk and 'watch dog' timer all on one full-size card. The six-layer CPU card can be plugged into the passive backplane of a chassis, converting it into an IBM PC/AT compatible system. Its highly condensed features make it suitable for commercial and industrial applications where the number of available slots is limited.

The PCA-6126 uses CMOS devices for a low power consumption of +5V at 1.5A, with a wide operating temperature range of 0 to 60°. The card has a built-in IDE (AT-Bus) hard disk interface to support two hard drives and a built in floppy disk controller to support two floppy drives.

The main feature of the card is the exclusive onboard ROM disk and watch dog timer. The ROM disk emulates a 360KB write-protected disk in drive A, and the watch dog timer ensures that the CPU is reset when program executions fail.

For further information circle 203 on the reader service coupon or contact Priority Electronics, 7/23 Melrose Street, Sandringham 3191; phone (03) 521 0266.



Budget digital scope card

Boston Technology's Compuscope LITE is a high speed data acquisition card for the PC/XT/AT which captures and stores analog data.

Two channels are provided at 8-bit resolution, capable of 40 million samples/sec on channel A, or 20 million samples/sec on each channel, with 7MHz full power bandwidth. Trigger source can be from channel A or B, external or from keyboard, with capability post-, mid- or pre-triggering on positive or negative slope. A test output is also provided, being between 0 or 0.9V square wave at 100kHz. Output of the data can be on printer or disk, in binary or ASCII files.

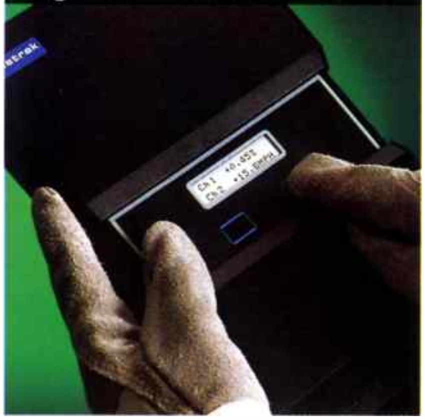
Compuscope LITE comes with oscilloscope software and driver for most popular compilers, as well as optional software modules for doing mathematical analysis of data.

For more information, circle 207 on the reader services coupon, or contact Boston Technology, PO Box 415, Milsons Point 2061; (02) 955 4765. ■

Utility,

Process Control,

Agriculture,



Pollution,

much, much, more.

HOW TO PUT THE SOLUTION TO ALL YOUR DATA COLLECTION NEEDS AT YOUR FINGERTIPS

No matter what application you've got your hand in, the new Rustrak Ranger II™ can record all your data for six months and longer. We don't mean just some things; we mean **all** of your data, up to 8 channels worth, from signal inputs such as temperature, voltage, current, process variables, pH, rpm and a long list of others. Add to this accessibility of 4 math channels and you get the advantage of computing your exact requirements.

rustrak

The Ranger II is a paperless recorder which records, reports and analyzes. After your data is collected, it is quickly transferred through a built-in RS-232 serial port to your PC. Then Pronto software – included **free** with every data logger – is used for plotting, analyzing, hard copy reporting and storage of your data.

While the Ranger II is sophisticated enough to handle any data collection need, it is also simple to use. Install the correct input module, turn the Ranger II on, press one button and the self-configuring Ranger II does the rest.

With a choice of storage modes, the Ranger II offers more compatibility with your needs than any other data logger. Here are some features:

Rustrak Ranger Data Logger

- Battery back-up of configuration and data storage
- 16 character two line LCD prompts operator and displays measurements
- Intelligent self-identifying input modules
- Transportable memory modules allow continuous recording
- Down-load to computer direct or via modem

Pronto Application Software

- Hercules, CGA, EGA and VGA compatible
- Comprehensive analysis tools
- Keyboard or mouse operation
- View up to 9 graphs at the same time
- Supports laser, letter and draft printers
- Print full page graphs
- User accessible notebook

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READER INFO NO. 26

Silicon Valley NEWSLETTER

TI challenges Hyatt's micro patent

If Gilbert Hyatt wanted to avoid going to battle with the likes of Intel and Motorola over the microprocessor patent he was awarded last July, he has run out of luck.

Texas Instruments, which also holds a patent for the invention of the microprocessor as well as the microcontroller, said its engineer Gary Boone was definitely the first to put an entire computer onto a single chip and wants Hyatt's patent voided. TI said it will challenge Hyatt's patent and has filed the necessary documents to do so with the US Patent & Trademark Office.

The Patent Office said it will immediately begin a two year trial-like procedure known as an 'interference', to determine who is the rightful owner of the microprocessor patent.

In filing its challenge, TI focused only on the issue of the 'computer-on-a-chip', or microcontroller, which is also covered under the Hyatt patent. It did not challenge the microprocessor part of the patent. Microprocessors only contain a computer's central processing unit, not any of the memory and other circuitry commonly found in microcontrollers.

Industry analysts said TI may have concluded that the microcontroller portion of the Hyatt patent may be too weak to withstand a serious challenge.

Analysts also expect the issue to become even more complicated if Intel were to join TI in challenging the Hyatt patent, in order to protect its microprocessor patent.

For his part, Hyatt said he is confident his patent will prevail. "It is a wide-open ballgame. All the facts have to be proven, and we are prepared to re-establish my position."

Sun pranksters strike again

For the seventh year in a row, Sun Microsystems employees pulled off headline grabbing April Fool's pranks on two of the company's top executives. This year, even Apple chief John Sculley was targetted by the Sun jokers.

Starflight Space Technologies is a small machine shop turned space headquarters in Santa Clara, founded by 33 year old ex-Varian engineer Mark Goldsborough. Currently it's developing this 14 foot low cost 'Orion' launch vehicle, for launching satellites and other payloads into space.

Top engineering staffs at both Apple and Sun collaborated on setting up simultaneous meetings with their chief executives to discuss 'new product developments and strategies.' But when Sculley arrived at the meeting, he faced a group of masked engineers from Sun who proceeded to give a presentation of some ludicrous suggestions for future Macintosh products.

Similarly, Scott McNealy got an earful of awkward proposals for new SparcStation systems from the Apple staff. Afterwards, the two meetings hooked up via satellite videoteleconference systems and shared a laugh.

Meanwhile, Sun vice president Wayne Rosing found himself under eight foot of ocean water and surrounded by real seven foot sharks, introducing Sun's 'SharkStation-1'.

Rosing, who had been a mastermind of several past April Fools pranks was lured to a local zoo by his wife, where he learned he himself, was now the target of an April Fools joke. Rosing agreed to put on the scuba gear and pose behind his desk set up in front of the glass window of the fish tank. With several imposing, but harmless sharks swimming around him, Rosing placed himself at his desk, and scribbled out the message: "These guys (sharks) are pretty tame compared to the sharks I have to work with."

Sun has been getting national attention with its series of ever more elaborate April 1 pranks, which included:

1990: Scott McNealy found a 60-foot wooden arrow stuck through his office, a response to McNealy's call a few months earlier to 'place all the wood behind one arrowhead'.

1989: An entire Sun office building was wrapped in a plastic fumigation tent, with a note attached saying the 'bugs were being removed' from a new product.

1988: McNealy, an avid golfer, arrived in his office to find it transformed into a golf hole, including sand traps, water hazards, putting green, hole and pin. The same day, vice president Bernard Peuto found his office turned into a tropical bird sanctuary, including peacocks, ducks, parakeets and a rooster.

1987: Co-founder William Joy found his new Ferrari in the middle of the company pond, seemingly floating on its surface, thanks to a submerged platform.

1986: Vice president Eric Schmidt's entire office, including his computer, telephone and fax machine, was moved to a platform in the middle of the pond, with only a tiny rubber raft to get to work.

Tongue controller for the disabled

Zorcom of Los Altos has developed a remote control device that fits inside a one ounce customised mouthpiece and allows the user to control virtually any electrical appliance, by pushing tiny buttons with the tip of his or her tongue.

The device was invented by Dan For-

tune working out of his Los Altos garage, the traditional spawning ground of most of Silicon Valley's electronics industry.

The system has particular broad range applications in the world of the physically disabled. People who are paralysed from the neck down will be able to function with unprecedented efficiency in their home, using the Zorcom device.

The tongue, despite its size and bulky shape, is an extremely sensitive and precise part of the body. Even though the nine or so buttons on the device are only 1/8" in diameter and spaced only about 1/4" apart, the tongue can easily address the correct button.

In addition to the mouthpiece, the Zorcom system comes with a receiver and transmitter unit that also lets the user know what state a certain button is in at any time. This is important when controlling such devices as personal computers, with keyboards with up to 50 or 60 keys.

Fortune said the Zorcom system will initially be marketed at about US$1500. But he expects the price to come down sharply as volume picks up.

Judge allows Semi-Gas sale

Hopes of keeping tiny chip equipment maker Semi-Gas out of Japanese hands have been dashed, when a federal judge refused to act on a request by the US Department of Justice to order an injunction against the sale.

The ruling clears the way for Japan's Nippon Sansa and Semi-Gas' US parent Hercules to complete the US$25 million sale of the company, which makes gas containment equipment used in the semiconductor industry.

The sale has been the focus of an intense campaign by US industry and government officials to keep the company in US hands. While small in size, Semi-Gas dominates the field for gas containment systems. Among other things, it plays a critical part in the development of advanced semiconductor manufacturing technology at the Sematech research consortium. Because the latter only allows participation of companies that are US owned, Sematech will have to cancel Semi-Gas as a member, a move that could bring its research operation to a halt until a replacement company has been selected or similar technology developed inhouse.

In his ruling, Judge Clifford Green denied the Justice Department's request for a temporary injunction on the grounds that the Justice Department had not adequately shown how the combination of Semi-Gas and Matheson would result in an unlawful market concentration of gas cabinets.

Earlier, the anti-trust division of the Department had concluded that the combining of the world's two leading suppliers of such cabinets would substantially increase Semi-Gas' dominance of its market. The government pointed out that Nippon Sansa already owns Matheson Gas Products, Semi-Gas's nearest competitor in the US, a violation of US anti-trust law.

US is 'struggling' in many high-tech areas

The United States has lost its leadership position in high technology and regaining that position would be critical to the future vitality of the US economy, according to a report from the Council on Competitiveness.

The CoC, a non-profit organisation made up of top business, education and labour leaders, said that in two-thirds of the 94 technology areas investigated in the report, the US continues to be a world leader or at least competes effectively with other countries. But in another 30 or so markets, the US has fallen so far behind foreign competitors, that US companies are no longer a factor in world markets or would not be able to play a major role for at least the next five years.

Among other things, the report said the US still maintains world leadership in microprocessors, software and computer graphics. But in other areas, such as scientific instruments and semiconductor manufacturing equipment, the US in in serious trouble with many of the typically small US vendors facing an uncertain future in the face of their foreign competitors, most of whom belong to large, well-financed conglomerates.

In some areas, like silicon wafer production, consumer electronics and robotics, the US has virtually been wiped off the map. Areas in which the US now maintains only a 'weak' position include display materials and systems and memory chips, two critical components in the building of the next generation of HDTV 's.

"America's once commanding lead in the critical technologies that drive economic growth and national security is being seriously challenged by foreign competitors," the CoC report states. "Even American success stories in chemicals, computers and aerospace have foreign competition close on their heels."

In 17 areas of technology the CoC report identified as 'critical', US companies were ranked as 'weak' or 'losing' in 12, and considered strong in only two — microprocessors and magnetic data storage.

Cypress in 'hot water' over pollution flap

Cypress Semiconductor of San Jose has made headlines in California for the success of its water conservation programme, in light of the five year drought that is plaguing California. In fact, so successful has its programme been, that the Santa Clara Water District built a major water conservation print media campaign around it, including posters with pictures and statement from Cypress president, T.J. Rodgers.

But now, Rodgers has been dealt an environmental black eye, when the San Jose Water Pollution Control Agency placed Cypress on a list of 13 Silicon Valley electronics companies that are the city's worst industrial water polluters. Cypress was cited as 'significant violator' of water pollution control laws.

Among other things, the Agency issued Cypress a citation for dumping industrial waste water with unacceptable high levels of copper and lead pollutants into the San Jose sewage system.

"I'll be darned. We sure can pick 'em," said one Water District official when learning about Cypress' pollution citation.

Apparently Rodgers owed his selection as the valley's premier water conservation spokesman more to his firm's public relations agency than to its actual water conservation programme. PRx, one of Silicon Valley's largest high-tech oriented PR and advertising agencies, also handles the water conservation campaign for the San Jose Water District. In an effort to generate some very valuable exposure for Mr Rodgers and Cypress, PRx decided to build the water conservation campaign around the Cypress conservation programme.

In the water conservation campaign, Rodgers proudly states how Cypress conserves water by "each day treating and recycling thousands of gallons of water through special ozoniation waste treatment equipment." But some of that same 'special equipment' was installed at Cypress only after the company was forced to purchase it by the city of San Jose, in order to deal with the water pollution it was causing. Also Cypress dragged its feet in installing the $250,000 purification system for nearly a year. ■

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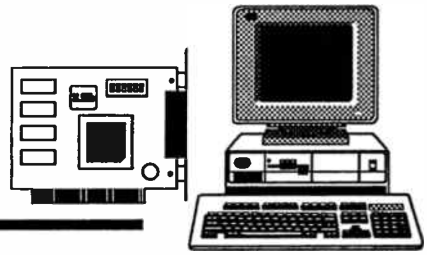
Computer News and New Products



Active tracking line filters

Local manufacturer Precision Power Products is now making three-phase models of the internationally patented 'Islatrol' active tracking power line filters in Australia, under licence.

These filters are installed on premises to suppress electrical spikes and disturbances which can severely disrupt production equipment. This import replacement exercise has resulted in cost reductions of up to 59% on larger filters.

Precision's Australian-made range of active tracking power line filters now consists of 17 models from 1A to 100A, priced from $328 to $5930.

For further information circle 170 on the reader service coupon or contact Precision Power Products, 12 The Corso, Norman Park 4170; phone (07) 395 7433.

I/O cards with lifetime guarantee

Interworld Electronics has introduced the Performance Series range of plug-in cards for PC/XT/AT and compatibles, from Industrial Computer Source (ICS). The Performance Series range includes analog to digital, digital to analog, digital I/O, counter/timer and serial communications cards in a variety of resolutions, speeds and number of channels.

The cards are so reliable that they come with the industry's first 'lifetime guarantee'. Under normal usage, as long as you don't beat them with a hammer, short them to high voltage or leave them to be destroyed by the elements in a hurricane, Interworld will repair or replace them for as long as the user requires.

The Performance series cards include 24, 48, 72 and 120 buffered digital I/O cards; 8 relay, 8 isolated input board; 5 channel counter/timer board, 8 and 12-bit data acquisition boards with sampling rates up to 100kHz; 2 and 6 channel D/A boards; watchdog timer card; RS-422/485 serial port cards.

For further information circle 171 on the reader service coupon or contact Interworld Electronics & Computer Industries, 16 Eskay Road, Oakleigh South 3167; phone (03) 563 7066.

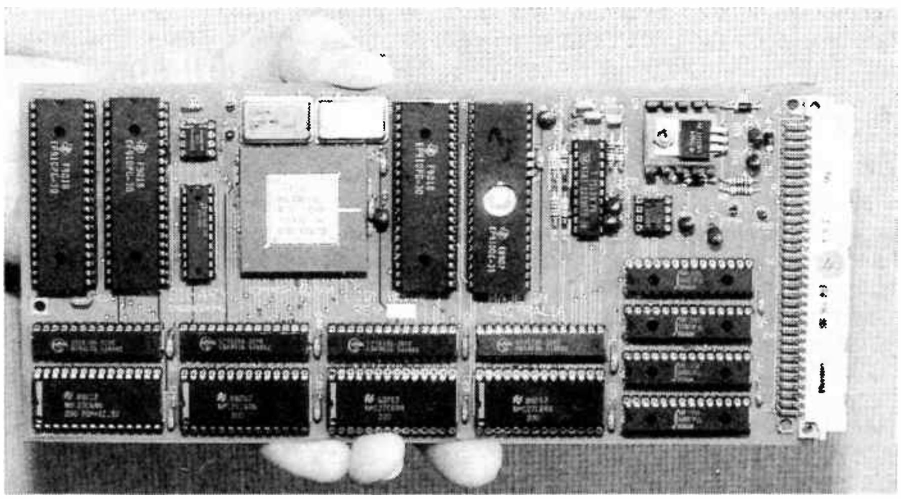
Fully duplex voice codec

Sydney-based automatic testing equipment manufacturer Binary Engineering has released what is believed to be the world's first fully duplex, 4.8kbps, single DSP voice codec.

The codec is capable of compressing speech to a 4.8kbps data stream for transmission, and decoding an incoming 4.8kbps data stream to produce good quality speech.

Incorporating an AT&T WE-DSP32C digital signal processor, the codec is mounted on a 100mm by 220mm half Eurocard PC board and uses a proprietary code excited linear predictive speech compression algorithm. Applications for this type of product include multiplexing multiple voice channels onto existing data channels, multiplexing voice and data onto data networks, good quality voice communications via satellite channels and cellular telephone networks, encryption telephony, voice mail and voice logging.

For more information, circle 166 on the reader services coupon, or contact Binary Engineering, PO Box 995, Brookvale 2100; phone (02) 938 5344.



EE Designer CAD upgrade

At the instigation of Visionics International, Haliplex is offering to 'trade-in' users' current CAD packages for the latest version of EE Designer — for the price of its standard 12 month maintenance agreement.

Packages targeted by the offer are CadStar, Pads, PCad, Protel, SATCAM, and EED2. The offer is open until July and is limited to one trade-in per company/user.

The RRP of EED3/E (Extended) Version 1.6/2.4 is $7993.00. The cost of 12 months' maintenance, which incorporates unlimited 'On-Line Assistance' and two substantial software updates is $1333.00, reducing after the first year.

For more information, circle 162 on the reader services coupon, or contact Haliplex, 5/1 James Street, Bayswater 3153; phone (03) 720 3799.

Low cost relay card

Boston Technology's PC-63 is a low cost, low power 16-channel relay card for any PC/XT/AT personal computer needing a control itnerface for external devices.

The card uses 16 reed relays for the 16 channels, with 16 LEDs indicating the channel status. These are also used for diagnostics purposes. The relays are arranged in two ports, with 8 relays on each port, and are controlled with specific bit patterns to each port on the PC data bus. The card also has a DIP switch selectable base address to avoid bus clashes. Since reed relays are used, the maximum power each channel can handle is 10W, with a maximum voltage rating of 150V and maximum current of 1A.

The PC-63 is supplied with demonstration software for testing and showing the card's features, and full source code is provided.

For more information, circle 164 on the reader services coupon, or contact Boston Technology, PO Box 415, Milsons Point 2061; phone (02) 955 4765.

IBM releases 486SX model

IBM Australia/New Zealand has announced its first computers to incorporate Intel Corporation's newest microprocessor, the low cost, entry level i486 SX chip.

The systems incorporate full 32-bit, 20MHz processors that have 32-bit data paths, but do not have an integrated maths co-processor.

As with other i486 processors, the new 486SX chips also include an 8 kilobyte internal cache. IBM offers the new PS/2 maths co-processor 487SX-20MHz, as an upgrade option for customers requiring this function.

As with other members of the Model 90 and Model 95 families, the 486SX systems include the processor-complex-card design. This full-size card resides in a dedicated slot on the system board and houses the microprocessor, the memory controller and the micro channel bus control. Through this design, these 20MHz systems can be upgraded easily to tap into current and future i486 technologies by installing a new processor-complex card.

For more information, circle 165 on the reader services coupon, or contact IBM Australia, PO Box 400, Pennant Hills 2120; phone (02) 634 9111.

Palmtop PC has Lotus 123 inbuilt

Hewlett-Packard and Lotus have introduced the HP95LX, the first palmtop PC to combine personal computer power with the full capabilities of Lotus 1-2-3, all built into a 312-gram device the size of a handheld calculator. The HP 95LX also is designed to work as an extension of desktop and laptop PCs.

Jointly developed by HP and Lotus, the HP 95LX will be manufactured and marketed by HP for a list price of $1075.

Advanced modular-design techniques have allowed the system's entire microprocessor-electronics to be housed on a single applications-specific, integrated circuit (ASIC). The HP 95LX also includes the first built-in implementation of Microsoft Corp's MS-DOS ROM (Version 3.22) operating system, executed from ROM.

In addition, the system's plug-in application card slot supports the Japanese Electronics Industry Development Association (JEIDA) 4.0 and Personal Computer Memory Card International Association (PCMCIA) 1.0 standards.

For more information, ring Hewlett-Packard on (008) 033 821.

Book size PC

Melbourne based computer supplier Dynamic Component Sales has released a fully featured book size PC.

The PC 'Booky' is about one fifth the size of normal desktops, which gives users a major saving in desk space without sacrificing the PC's features or functionality. Users can have the benefit

COMPUTER PRODUCTS

of the machine in the office and the convenience of taking it home — Booky will fit in a briefcase.

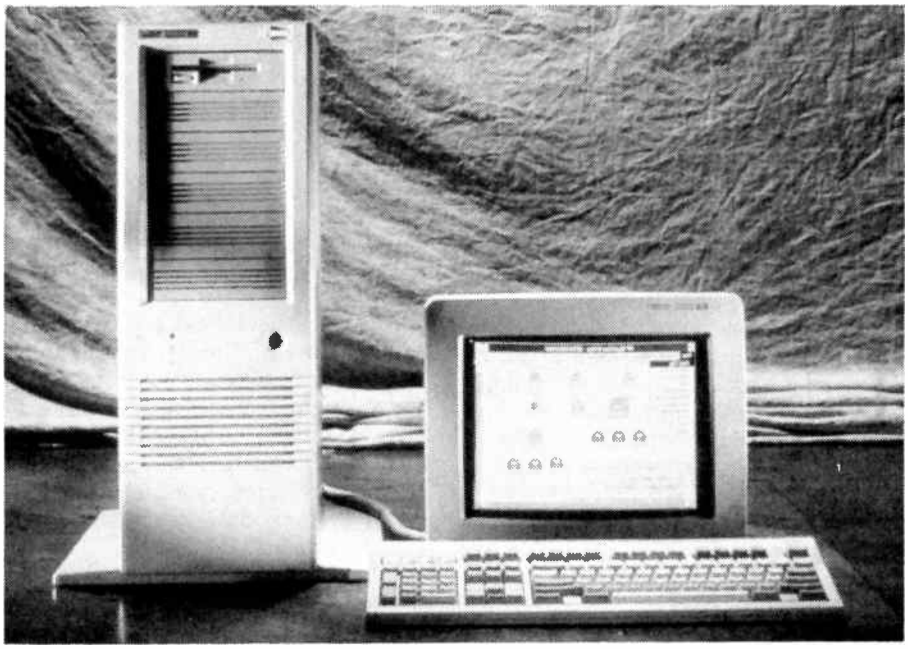
'Booky' is a 16MHz, 80C286-based PC that includes a 40MB hard disk, 3.5" floppy disk, 1MB of RAM (2MB optional), 102 key keyboard, two serial ports and one parallel port, and supports VGA colour and an 80287 coprocessor. The system measures 240 x 185 x 45mm and weighs only 1.45kg.

For more information, circle 161 on the reader services coupon or contact Dynamic Component Sales, 17 Heatherdale Road, Ringwood 3134; phone (03) 873 4755.

Solid state disk drive

The DS2262 Megastore Stik is an extremely compact solid state mass storage device that provides up to 32 megabits of non-volatile DRAM for data storage. The DRAM and internal control functions are accessed using a 3-wire serial interface (CLK, D/Q, RST) which can hook directly to the serial port of popular micro-processor/microcontroller devices such as the DS5000T/2250T time microcontroller family. An external backup supply such as a 6 volt battery can be attached to enable DRAM data retention, creating in effect a 'solid state disk drive'. An internal circuit monitors the main and 5 volt supply. Upon its failure, the DRAM is write protected and the backup supply switched on. With an inexpensive 1300MA hr lithium battery, a DS2262 with 4 megabits can provide up to 3 weeks of continuous non-volatile operation. The DS2262 is available with 4, 8, 16 and 32 megabits and mates with JEDEC standard 30-pin SIMM edge connectors. All necessary DRAM timing and refresh duties are performed automatically.

For more information, circle 163 on the reader service card, or contact Veltek, 22 Harker Street, Burwood 3125; phone (03) 808 7511.



HP i486 PC runs at 33MHz

Hewlett-Packard has introduced its first 33MHz PC, an enhanced version of its existing i486-based PC, and a mass-storage subsystem to complement the two computers. The base-model HP Vectra 486/33T PC combines an i486 microprocessor operating at 33MHz; eight 32-bit EISA expansion slots; an HP custom memory controller with 128KB external-memory cache and burst-mode support; 4MB of zero-wait-state main memory (expandable to 64MB); a Weitek 4167 coprocessor.

HP's SCSI-2 mass storage subsystem provides excellent expandability and connectivity, suitable for LAN and multiuser-serve applications.

The subsystem opens the door to a broad range of SCSI peripherals, including conventional and digital audio tape (DAT) backup devices, CD-ROM drives and erasable optical-disk drives.

Up to seven devices can be supported by a single host-bus adaptor and multiple adaptors also may be used.

For more information, ring Hewlett-Packard on 008 033 821. ■

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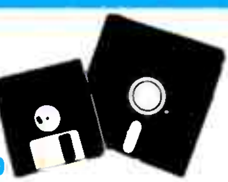

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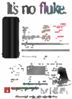
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I have a good quality AM/FM car radio which I have built into a case with its own power supply. Because I want to use it in the house, I need to connect external aerials, one for AM and one for FM.

Consequently I would like to know the approximate impedance of the aerials that a car radio is designed to work with. (D.A., Findon SA).

Using a car radio as a conventional radio has a number of advantages, such as pushbutton tuning and the benefits of the increased sensitivity usually inherent in the design. Unlike most domestic receivers, a car radio relies on an external antenna, usually mounted somewhere on the vehicle. The antenna then connects to the radio via a length of coaxial cable.

I cannot find any information concerning impedance, though if I had to guess, I'd choose either 50 or 75 ohms, unbalanced. However, I'm not even sure if impedance is a factor, although any antenna has an impedance. Not being an expert in antenna design, my advice in this instance would be to construct an antenna that has similar characteristics to a car aerial.

For example, a car aerial is fixed to what amounts to an earth plane, and the length of connecting coaxial cable should be kept as short as possible. Most car radios have a trimmer capacitor that 'tunes' the antenna, and the optimum antenna installation is one that allows this capacitor to peak the sensitivity. The easiest way might be to use a car aerial, and I have used such a system for many years in my own home workshop.

Tuneable Hum

Last month I presented a number of letters from readers offering solutions to the tuneable hum being experienced by J.M., from Aldinga Beach in SA. The next letter is on the same topic, although the situation may not apply to J.M. However, the cause is interesting as it shows what can happen when conductors, diodes and a strong RF signal get together:

I had a similar situation to J.M. some time ago concerning tuneable hum, in that most of the stronger AM stations were accompanied by a very loud buzz, mainly on 3LO (774kHz) and 3AK (1503kHz). The problem only affected radios inside the house, although it would affect a car radio as the car came up the drive.

I live within 4km of the major cluster of six of Melbourne's commercial AM radio transmitters and within 20km of the ABC transmitters. In my home I have installed an unshielded 6-wire bus with at least one skirting board appearance on a 5-pin DIN socket in every room. This, by the way has been very useful for temporary connections of intercoms, speakers, headphones, play telephones etc. One pair of this bus has been set aside for a permanent low power 12V DC supply for battery charging, powering toys and so on. The 12V supply is simply a full wave bridge on the secondary of a small transformer, with a 2000uF filter capacitor.

The problem was brought to a head when a permanent load (feed for a masthead amplifier via a zener diode and limiting resistor) was connected to the 12V supply. The supply bus, about 18m long and with several stubs, was picking up a lot of RF, about 20V in fact. It seems the RF was sufficient to bias the diodes, and the nett effect was that the amount of DC coming through was affected by the RF. This meant that the voltage on the 12V bus was effectively a 100Hz modulated version of the total RF field being picked up by the bus.

This new signal was then radiated from the bus throughout the house, and when a strong station was selected on a radio, the modified signal was also strong enough to give the original program along with a very annoying buzz, almost as loud as the original (1dB S/N measured on 3LO).

Two things cured the problem, but the greatest benefit was derived by bypassing at least one of the diodes in the bridge with a 0.022uF capacitor. The other was to RF ground the 12V supply at the output of the bridge rectifier. I wonder if J.M. may have also inadvertently brought the problem on himself in a similar manner. (G.G., Greensborough Vic).

Quite a few of we 'electronics bods' are likely to have installed a similar system to that described by G.G. I have a ridiculously complicated intercom system in my house, where the on-off switch at each station actually switches the 12V DC supply to the intercom amplifiers. I know of quite a few people who have installed a general purpose bus system in their house, and over the years the use of such a bus changes as the family grows up.

While problems may not occur if you live some distance from established RF sources, there's no guarantee that such a source won't start up some time in the future. So from G.G.'s letter and all the others I've presented, it seems that an important thing to remember is that diodes and RF can produce tuneable hum.

The next letter is on a slightly related topic, and asks for information that I don't think anyone knows the answer to.

Overhead power lines

I have read recently of suggestions that living near an overhead power line is a possible health hazard. I'm referring only to the 330kV lines that form the grid system, and not to the power lines one sees in the streets. As I live very close to a tower that supports overhead 330kV lines, I wonder if you have any information about the effects from these lines. (G.N., Padstow NSW).

I too have read about the research being conducted, and it seems that the findings are rather inconclusive. From what I've read, the recommendations are that authorities should locate new 330kV lines away from built-up areas. However, no conclusive findings on the effects of exposure to a strong electromagnetic field were presented. But I stress, that's what I read, and maybe I haven't read the right documentation.

I can recall one interesting effect, in which a colleague found that his heart pacemaker became erratic when he entered the switch yard of a power station. However, I doubt that the electromagnetic field from the overhead lines would be as strong as that from a transformer.

Maybe other readers have more information, as this is an interesting topic — particularly for those living near such a line.

10V regulator?

The next letter is from a reader who is 'getting into' electronics. I won't present the whole letter, but the writer asks an interesting question:

I notice that in the Circuit and Design Ideas section in the February 1991 edition of EA that a 10V regulator, type 7810 is used in the mains frequency indicator circuit on page 81. I have looked through a number of catalogues from parts suppliers but cannot find such a regulator.

Because I would like to use a 10V regulator rather than a 12V regulator to power a small DC motor, I wonder if you could advise me where I can obtain such a device. (R.B., Doveton Vic).

While I wouldn't go so far as to say there is no such device, I too cannot find it listed in any of the databooks or catalogues I have. While there may be a 7810 somewhere out there, in the mean-