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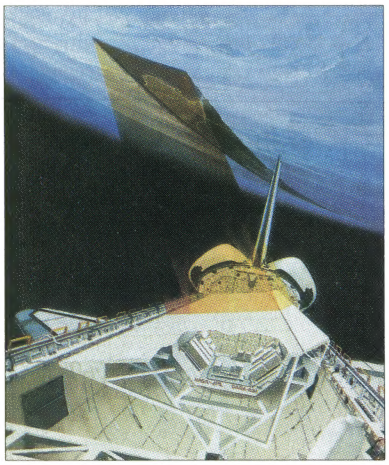
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Volume 56, No.11
November 1994

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Scanning the earth by radar



Earlier this year, NASA tested its Spaceborne Radar Laboratory in orbit aboard shuttle Endeavour. It provided the first opportunity to observe the earth simultaneously on multiple wavelengths, as Kate Doolan explains starting on page 26...



This month's special feature on the Sunshine State starts on page 67...

On the cover

When Tom Moffat visited Tasmanian firm Branch and Associates, to learn more about the firm's new Fander-1 educational robots, he couldn't resist taking this shot of a group of finished robots, 'marching forward' into the future. See Tom's story on the new robots, starting inside on page 20...

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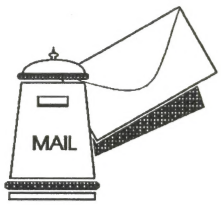
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LETTERS TO THE EDITOR



SMA responds

I would like to take the opportunity to provide some information to your readers on reforms being introduced by the Spectrum Management Agency (SMA), particularly those resulting from the recent inquiry into the apparatus licence system. My letter is prompted by the comments made in your August edition (Letter to the Editor, Mr Paris Cockinos).

The inquiry was undertaken by the SMA in response to a Ministerial direction, as the Government was concerned that while the existing apparatus licence system works reasonably well, it may not prove as adequate in the future given the increasingly rapid advances in new technology and service delivery. The aim of the apparatus licence system inquiry was to develop a simplified, more efficient and more flexible system, particularly with regard to setting licence fees, consistent with our legislated objectives.

As part of the inquiry process the SMA prepared a discussion paper, intended to focus the inquiry and provoke rational debate, and conducted a series of public information seminars to respond directly to user queries. The views of spectrum users (large and small) and other interested parties were subsequently expressed in over 420 written submissions. A report was then provided to the Minister for Communications and the Arts outlining the outcomes of the inquiry, including a number of proposals for reform which the SMA is now moving to implement or to further refine.

These proposals include a reduced number of new licence types (to replace the existing 104 categories) based on International Telecommunication Union service definitions; the transfer of apparatus licences between parties, direct charges for certain SMA services on a cost recovery basis, and licence fees based on spectrum management costs attributable to a licensee and the amount and location of spectrum access.

It is understandable that people may be concerned about the level of fees to emerge from this approach. The SMA is currently working through the likely structure of new fees including comparisons between existing fees, and expects to publish further information in October or November.

Another outcome of the inquiry has been the introduction of class licences for CB radio and 27MHz handphone services. A class licence authorises any person to operate in accordance with the licence conditions, without the requirement for an individual licence or to pay a licence fee. Revenue forgone by the introduction of class licences will not be recovered from other licensees.

In addition to the apparatus and class licence systems, the SMA may authorise use of radio communications under a new system, known as spectrum licensing. This system is yet to be implemented. Unlike apparatus licences, which authorise operation of specific equipment for a particular purpose, spectrum licences authorise the operation of any equipment within a defined spectrum access (frequency and geographic boundaries) in accordance with the licence conditions. Spectrum licences are tradeable, in whole or part, and third party use may be authorised.

Mr Cockinos makes reference in his letter to the SMA's intention to use auctions to allocate spectrum licences, and the potential impact this may have on smaller users and communications companies. In fact, the legislation allows for spectrum licences to be allocated by various means, including over the counter (on a first-come, first-served basis), by auction or tender. Apparatus licensees in bands to be converted to spectrum licensing would automatically be offered spectrum licences, with no lesser access than they would have under an apparatus licence. Special provisions would exist to continue to provide for public and community services. Auctions or tenders will probably be used to allocate spectrum licences, and where the spectrum is likely to be subject to high demand. Where this is not the case, an over the counter allocation will be used.

A discussion paper on the implementation of spectrum licensing will be released for comment towards to the end of October. Government policy is to introduce spectrum licensing selectively and the SMA expects that the majority of licences will remain under the apparatus licence system for some time.

As Mr Cockinos mentions in his letter, it is also intended to introduce a system

of accreditation of persons to perform a number of functions such as frequency assignment or service planning. Persons seeking accreditation would have to meet and then continue to satisfy the requirements established by the SMA for their work to be accepted. A number of inquiries have already been made to the SMA from persons with communications experience who are interested in accreditation. Work is underway to establish a sound and reputable system of accreditation.

Should any of your readers have any concerns or queries they are encouraged to get in contact with their nearest SMA office to obtain copies of the two papers I have mentioned or to raise any related questions.

Roger Smith,
Acting Spectrum Manager,
Spectrum Management Agency,
Belconnen, ACT.

AOCP reviews

Some of your readers may not be aware that the syllabuses for both AOCP/AOLCP and NAOCP examinations are currently under review.

A small group of volunteers has been working with me for some time on the review and extension of the examination question banks and on the updating of the syllabuses. Drafts of the revised AOCP/AOLCP syllabus have been circuited to each WIA Division and to a few other interested parties for comment. It is expected that the NAOCP revision will be circulated similarly very shortly, and that further consultation with the SMA will follow.

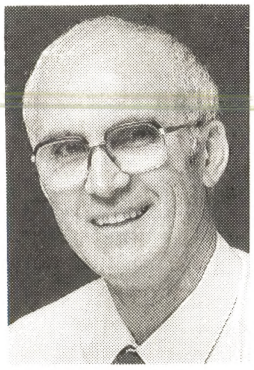
No changes to the present examination question bank or proceedings will be made until all the revisions are finalised and approved by the SMA. There will of course be a period of overlap to allow for candidates affected by the changes. A similar revision of the Regulations question bank will take place when the new regulations are finalised.

If any of your readers wish to comment to me on any of the syllabuses, they may reach me through the WIA Federal Office.

Brenda M. Edmonds, VK3KT,
WIA Federal Education Coordinator,
PO Box 2175,
Caulfield Junction, Vic.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



Robots, orbiting radars, earthquakes and bulletin boards...

Whatever your particular interests within the wider sphere of electronics, we have plenty to appeal to you this month.

For a start, there's a special feature on many of the things that are happening in Queensland's industry — and you'll see that quite a lot *is* happening in the 'Sunshine State', as it happens. Our thanks to Queensland representative Graham Smith, and all of the people in the industry up there who helped him gather the 'raw material' for this feature.

We also have a very interesting story by Tom Moffat, on the new 'Fander-1' educational robots now emerging from another Australian state: the Apple Isle. When we heard of the new robots we were able to arrange for Tom to visit the factory, and as usual he reports on his visit in eminently enjoyable fashion.

Also competing for your attention is Louis Challis, eager to tell you about his recent trip to Japan, where — among other things — he was able to tour the earthquake research lab at Kajima Corporation's Technical Research Institute. The tour included a 'hands-on' demo of some recent notable 'quakes, while standing on the Institute's massive shaker table — it can shake a 30-ton building model with forces of up to 2G!

Then again, if space technology is more your interest, we have an interesting story from Kate Doolan on NASA's test earlier this year of its Spaceborne Radar Laboratory SRL-1. With a mass of over 10 tonnes, SRL-1 orbited the Earth in shuttle *Endeavour* and demonstrated the effectiveness of using dual-polarity and multiple wavelength radar to provide high resolution images of our own planet. Impressive stuff!

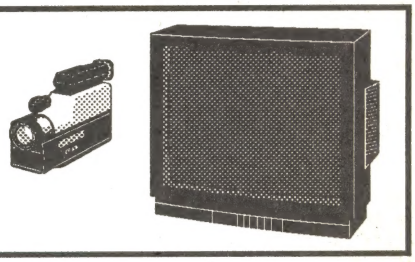
Of course we have all of our usual features and departments as well. Neville Williams writes about the career of Harry Mauger, who spent many years in the Australian sound recording industry, while in the Vintage Radio columns Peter Lankshear tells the story of the famous Browning-Drake receiver, and how it came into existence. Nick de Vries also takes us deep into the bowels of an infra-red exhaust gas analyser, to see how they work.

For those who like to give practical expression to their electronics knowledge, as usual we have a selection of construction projects. Peter Phillips presents some simple but proven circuits for driving stepper motors, while I'm presenting a little co-axial cable tester which uses only a handful of parts, but lets you check cables almost literally 'in a flash'. There's also a couple more modules for radio control enthusiasts, a low cost interface for using an old PC as a programmable logic controller, and a new high-efficiency solar battery charging circuit.

Make sure you don't miss Tom Moffat's Madhouse piece this month, either. It's on BBS's, the Internet, electronic mail and media hype about the 'information superhighway' — and as usual, Tom not only puts it all into sensible perspective, but also manages to be entertaining at the same time...

Jim Rowe

What's New in VIDEO and AUDIO



New Onkyo A/V surround receiver

The new Onkyo TX-SV717PRO A/V Surround Receiver is claimed to represent a breakthrough in affordable audio excellence, delivering professional A/V surround sound facilities at a down to earth price.

The TX-SV717PRO delivers impeccably clean power to make home theatre come alive, with 110 watts RMS into eight ohms per channel in stereo mode, 85 watts RMS to the front left, centre and right channels and 30 watts RMS to each of the rear channels in surround mode.

And, in place of inexpensive hybrid IC amplifiers found in less quality units, each of the five channels in the TX-SV717PRO is powered by completely discrete amplifier blocks, with individual components (no ICs) to produce 'dynamic, transparently clear sound' from any source.

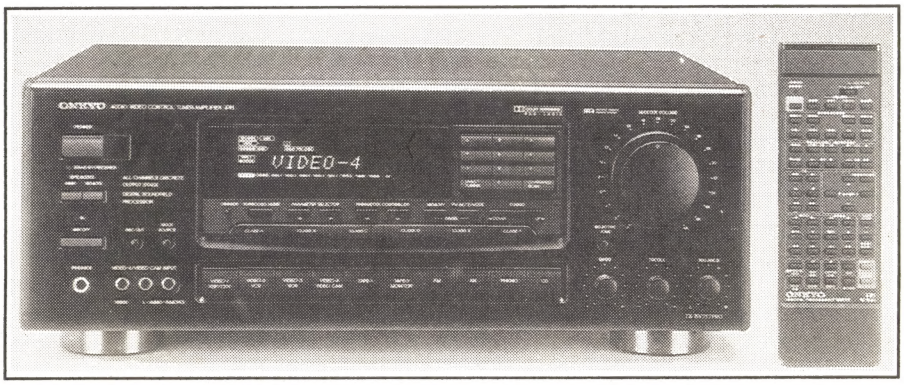
The amplifier is equipped with Dolby Pro Logic Surround Sound to faithfully recreate the dynamic realism of a movie theatre. The adaptive matrix circuitry steers the dominant sound to its proper channel while damping the other channels, resulting in channel separation up to 25dB greater than ordinary systems.

Onkyo's TX-SV717PRO is simple to operate, thanks to the integrated on-screen display capability built in. Comprehensive, easy to understand menus pop up on a connected television or video monitor and provide an immediate visual display of all system parameters.

The entire system can be programmed and operated by remote control from the comfort of an armchair, even in a completely darkened room.

Features of the TX-SV717PRO include: four video and six audio sources to handle all present and future home theatre requirements; comprehensive audio and video dubbing capabilities; a recording selector to listen to an alternative source while recording; 40 station random preset FM and AM tuning; automatic scan tuning; built-in AM loop antenna; audio muting and sleep timer functions on remote control; a motor drive four gang master volume control; auto input balance for Dolby Pro Logic signals; a big, bright and easy to see fluorescent dot matrix display; battery free backup of parameters when powered down; and an RI compatible remote control which will also control other RI equipped Onkyo components.

The Onkyo TX-SV717PRO measures 455 x 190 x 425mm, weighs 22kg, and is finished in black brushed aluminium. The recommended retail price is $2299.



Portable system has CD changer

Sanyo's new MCH-900F stereo radio/cassette recorder features a front loading six disc CD changer, allowing random or sequenced playback of your favourite CD music without interruption. The disc scan function and forward and backward skip and search buttons allow easy selection of songs. Pre-programmed playback of up to 32 selections from all of the six discs in any desired order is possible with the CD music memory programme function. The compact size of the MCH-900F makes it handy for carrying around and storing neatly, without compromising on sound quality. With the BassXpander sound system, low frequencies are enhanced for a rich extended bass sound which adds depth and presence to the music.

Also featuring an FM stereo/AM radio, synchronised CD to cassette dubbing system, 60W (PMPO) output power and optional headphones, the MCH-900F retails for $449.00

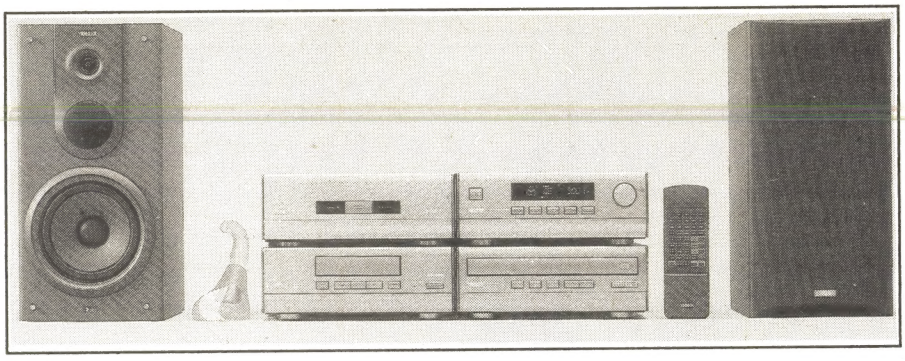


Mightier mini system

Yamaha's new CC-90 mini system is a step-up from the popular CC-70W, introduced last year. The new model adds power, features, and improved performance to the system.

Like CC-70W, the new model is an active servo technology four component plus speaker system. The individual CD changer, tuner, cassette deck, and amplifier components can be stacked vertically, spread out horizontally, or arrayed in a variety of different configurations.

A major upgrade incorporated in the CC-90 is the more powerful amplifier, which provides 70 watts per channel, a 40% increase over the amp in the CC-70W. The active Servo technology system used by both models is a complementary amp/speaker circuitry design which is able to deliver deep and accurate bass from small speakers.



Also unusual for a mini system today, the CC-90 has a phono input and preamp, so that a turntable can easily be connected to the system. The amp has four additional inputs for the system's tuner, tape, and CD components, plus an aux input for any other supplemental components the listener might want to use.

The CC-90's three disc carousel type CD changer features Yamaha's Play-Xchange, which isolates the disc being played from the two remaining in the tray. The isolation eliminates vibration and improves performance. Performance is also improved through the use of Yamaha's new designed S-Bit digital-to-analog converter LSI chip and eight times oversampling digital filters.

The CC-90 system comes with a pair of three way complementary active servo technology speakers. The amplifier provides one half of the sound equation and the speaker provides the other. The combination results in accurately delivered sound from 35 to 35,000Hz. It has a suggested retail price of $1999.

New stereo systems from Sony

Sony has released five new midi stereo systems with features and functions to satisfy the most critical of listeners. The models start from $999 and all feature an amplifier, tuner, CD player, tape deck and speakers. Optional turntables are also available.

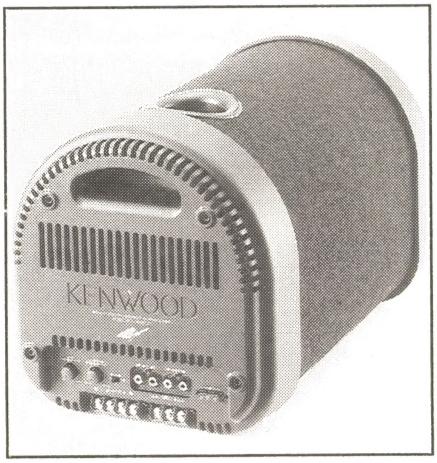
The new range includes the LBTA295, which delivers 35 watts per channel RMS, has video inputs, as well as surround speaker and headphone outputs for those who want to integrate audio and video for more realistic theatre viewing. It has a one-bit pulse D/A converter, five disc CD carousel changer with all features including shuffle, repeat and program play.

This model also features three way twin duct speakers with 160mm woofers to enhance the deep bass sounds. Sound adjustments include Dynamic Bass Feedback, which reinforces low frequencies, a preset equaliser allowing users to customise their favourite dance, pop, rock, classic or soft music songs by simply pressing a button; and a seven band spectrum analyser which gives a visual representation of the sound. Sony's RRP for the LBTA295 is $999.

At the top end of the range is the LBTA795, described as the most advanced midi system ever released by Sony. This model features a twin drive speaker system, as well as centre and rear speakers, which enhances the bass sound — eliminating the need to add extra channel speakers when you want to create a 'home theatre' environment.

Ideal for movie buffs, the LBTA795 features Digital Pro-Logic and a Digital Parametric Equaliser which can change the tone setting with real time accuracy. It features the Dynamic Bass System to reinforce the low frequencies and a DSP menu which lets the user simulate various listening environments.

This model has two x 125 watts per channel, as well as 25 watts per channel for the centre and rear speakers. Audio/video inputs and outputs including Video A/MC; Video 2/DAT; Video 3; centre out and optical out. There's also a digital FM/AM tuner with 30 presets. The five disc CD player uses a one-bit D/A converter. The tape deck features a twin auto reverse mechanism, Dolby B/C/HX Pro noise reduction and MS. Sony's RRP is $3799.



Active 'letterbox' 100W subwoofer

As a follow-on to their successful 'Letterbox' KSC-W800 subwoofer system, Kenwood Electronics has announced a 100 watt version. The KSC-WA801 measures only 25cm wide, 26cm high and 40cm deep, and is designed to be mounted behind the seat, on the floor, or in the boot.

The KSC-WA801 comprises a 100W RMS amplifier that drives a dual voice coil 200mm (8") driver, capable of reproducing bass down to 20Hz. RCA gold plated input/output jacks take the signal directly from any compatible graphic equaliser output, receiver or CD player output. The active in-built amplifier can be bypassed, so direct connection to the output of a car receiver/amplifier is also possible. When using the in-built subwoofer amplifier the input sensitivity is adjustable to match the out- put level of the car receiver or graphic equaliser. The cutoff frequency is adjustable from 60Hz to 300Hz and a phase control permits correct phase matching to other speakers in the system. The KSC-WA801 is a bass reflex system, employing a specially designed spherical flow duct that produces 'breathtaking' low frequency extension.

It has an RRP of $649 and is covered by a 12 month parts and labour warranty. For further information on Kenwood's car audio products, call your nearest Kenwood car audio dealer or ring 008 066 190. ❖

CD-ROM Encyclopedia of Science & Technology

McGraw-Hill has just released a multimedia version of its highly regarded Encyclopedia of Science and Technology (seventh edition), on a single *Windows* compatible CD-ROM. As well as providing a great deal of the Encyclopedia's resources in a convenient computer-accessible form, the disc also provides the terms and definitions from the fifth edition of McGraw-Hill's Dictionary of Scientific and Technical Terms, plus 250 biographies and 39 audio-visual annimations.

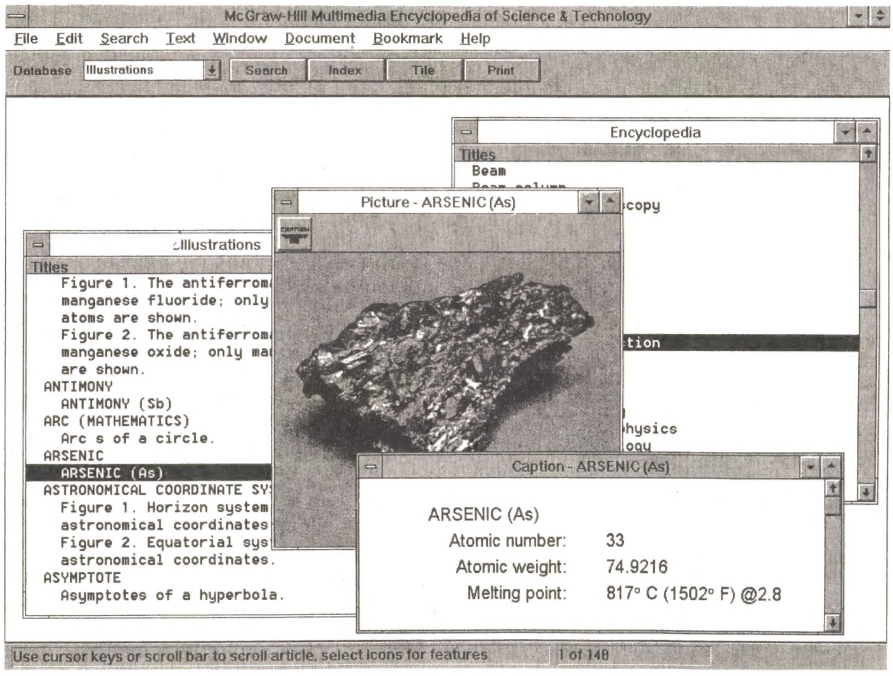
by JIM ROWE

When personal computers first started to appear on our desks, there were firm predictions from the experts that we had entered the era of the 'paperless office'. Thirteen years on, we still seem to be quite a way from seeing this prediction come true, and I suspect the claims of multimedia enthusiasts that paper-based books and magazines are about to disappear may be in the same category.

Of course there are *some* kinds of book which are very suitable for conversion into the multimedia equivalent, and reference books like encyclopedias, dictionaries, atlases and directories are excellent examples. Here a CD-ROM multimedia version can have a number of clear advantages over its equivalent printed on paper: faster and more convenient access to the wanted information, the added dimensions of sound and moving images to clarify concepts and expand the information available, and the ability to update the full resource at significantly lower cost.

No doubt it's these advantages that have prompted so many publishers of traditional encyclopedias, dictionaries and directories to produce CD-ROM versions of these works. From recent news reports, I gather some of these have been so successful that their publishers are now starting to wonder how much longer they'll bother producing the printed versions...

As you'd expect from McGraw-Hill's background in science and technology publishing as well as information technology, *it* hasn't been backward in this area either. The CD-ROM version of its *McGraw-Hill Science and Technical Reference Set* has been out for a while, and is in its second release, I gather; now they've produced a disc version of the highly regarded seventh edition of the *McGraw-Hill Encyclopedia of Science and Technology*, which came out in 1992.



A total of eight separate data bases are available on the disc, and each of these can be called up separately if desired — although there are extensive cross reference links. Shown here are a typical illustration and caption combination.

Originally published back in 1960, the printed version of the *Encyclopedia* has become an established international reference on science and technology. The seventh edition runs to 20 thick quarto-sized hardbound volumes, with 13,450 pages presenting some 7500 different entries and 13,000 illustrations. The articles are written by 3000 expert contributors from around the world, 21 of them Nobel laureates.

The new CD-ROM version offers an updated version of the text for 7300 of the *Encyclopedia*'s articles, plus some 550 high-resolution colour photos, drawings, maps and charts. In addition, it provides 39 different animated visual sequences, illustrating various natural and physical science concepts, and also nearly 39 minutes of audio — including animation voice-overs and demonstrations of acoustic topics, etc.

Apparently it also includes the full 105,100 terms and 122,600 definitions from the fifth edition of the latest *McGraw-Hill Dictionary of Scientific and Technical Terms*, plus a set of 250 biographies for 'historically important scientists'.

There's also a study guide with standard curriculum outlines for physics, chemistry, biology, geoscience, health and engineering; a phonetic chart with audible pronunciations; and an interactive periodic chart and geographic maps, with data about each element and country.

All of these resources are provided with multiple search facilities, a standard *Windows* on-line help system and extensive cross-reference linking — the latter using the 'hypertext' system, where you

simply click on a highlighted word or phrase in the text, to open another window and get further information on that topic.

Needless to say McGraw-Hill plans to take advantage of the relatively low production costs associated with the CD-ROM version, by issuing annual updates. These should keep it much more up to date than was feasible with the printed version — a major advantage in a reference for fields as rapidly changing as science and technology.

In short, like the equivalent printed resources, the new CD-ROM has all the qualifications to make it an excellent reference for science students at high school, college and university, as well as technical professionals (like 'GP' electronics magazine editors, for example).

The only sobering aspect is that the cost of this resource is still rather too high for purchase by many private individuals. The single-user version has an RRP of $2500, plus $595 for each annual update. However network versions are available for libraries and other organisations, with the 2-8 workstation version priced at $3200 and the 9-20 workstation version $3600; in these cases the annual network update cost is $795.

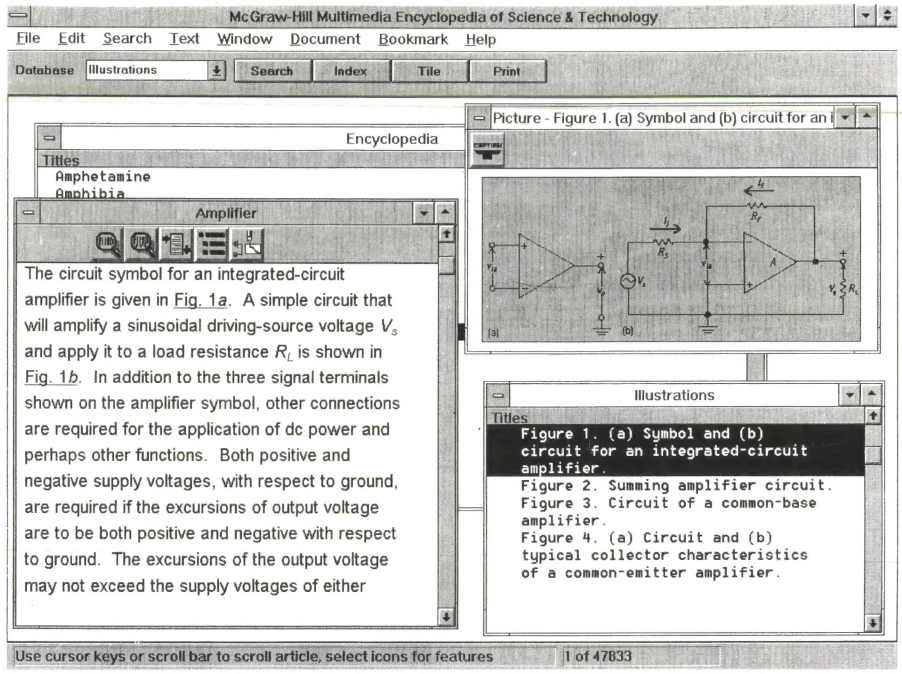
Trying it out

To allow us to evaluate the new multimedia version of the *Encyclopedia*, McGraw-Hill Australia sent us a 'demo' version of the CD-ROM disc, containing the topic articles from 'A' to 'C' plus a reasonable sampling of the dictionary, biography listings, illustrations and animations (15).

So that we could compare it with the printed version, they also very kindly sent samples of the first couple of volumes of the seventh edition.

It was very easy to install the demo multimedia package; it's simply a matter of calling a SETUP utility on the disc itself, using the 'Run...' option in *Windows*' Program Manager. Installation is then virtually automatic, and when it's finished you have a new program group and icon. You can then start up the *Encyclopedia* at any time by double clicking on the icon — providing the disc is currently in your CD-ROM drive, of course.

Although initially I had to refer to the on-line help facility a couple of times to get the hang of the multiple searching options, and also to decipher the meanings of some of the tool-bar buttons, after this navigating around the various parts of the package was quite easy. You initially open one of the databases using a pull-down menu, and after that you can either open others in the same way, or jump to them as needed using the hypertext linking.



Although some of the Encyclopedia's articles have embedded illustrations, with others the illustrations are separate and must be called up by the user when needed. With multiple windows open, less text can be seen on the screen.

Even from the limited scope covered by the demo disc, it's clear that like the printed version of the *Encyclopedia*, the multimedia version contains a huge body of information on science and technology. And the new searching and cross-linking facilities of this version certainly seems to make the information faster and more convenient to access, on the whole.

I do have a few criticisms, though. Probably the most serious is that compared with the printed version, the CD-ROM contains far fewer illustrations; according to McGraw-Hill itself, a total of only 550 compared with 13,000. I found myself noticing the scarcity of illustrations quite often with the demo version, and frustrated as a result.

Comparing the multimedia and printed versions of a sampling of articles confirmed that many either lack their original illustrations altogether, or have had them significantly reduced. For example the 'Accelerator Mass Spectrometry' article has lost its original excellent diagram showing the construction of an AMS; the 'Acoustic Microscope' article has lost all nine of its original illustrations, and the text referring to them; and there are now only eight diagrams for the very thorough 'Amplifier' article, instead of the original 21.

Although I can understand *why* this pruning of illustrations has been performed (they take up a great deal of disc space, of course — far more than text), I still find it quite disappointing. The old adage of 'one picture replacing a thousand words' is surely more true now than ever before — especially when it comes to explaining scientific and technical concepts.

Frankly, I think it would have been better to retain all of the illustrations — even expanding on them, if possible — and make the multimedia *Encyclopedia* run to multiple CD-ROMs rather than squeeze it onto a single disc.

Another criticism is that there's a confusing inconsistency when it comes to the illustrations that *are* still present. In some articles the illustrations are effectively 'embedded' in the text file, and seem to automatically appear with it in the viewing window, while with others you seem to have to call up the 'Illustrations' database and fetch them for yourself...

Even with the articles that have the embedded illustrations, these seem to shrink down to sub-postage stamp size when you print the article out — unless you do call them up and print them out separately, one by one. The printing function also seems to get into trouble when equations fall on page breaks, too — when this occurs the page number can be overprinted.

Some of the other little things I noted may only be due to the 'nobbled' nature of the demo version — like the Biography database missing out quite a few noteworthy names, including even Marconi!

Continued on page 17

The Challis Report:

ACTIVE ATTENUATION: A UNIVERSAL PANACEA?

This month, instead of reviewing a specific product, Louis Challis has written us a report on the current state of play in the high-tech area of active attenuation — as applied to noise, vibration and earthquake-proofing of buildings. He was prompted to write it after visiting Japan recently, and seeing at first hand some of the research being done there.

At the end of August, I attended the prestigious 'Inter-Noise 94' conference which was held in Yokohama, Japan. The conference was well attended, with more than 1000 people coming from 37 countries to hear papers on a wide range of noise and vibration related subjects.

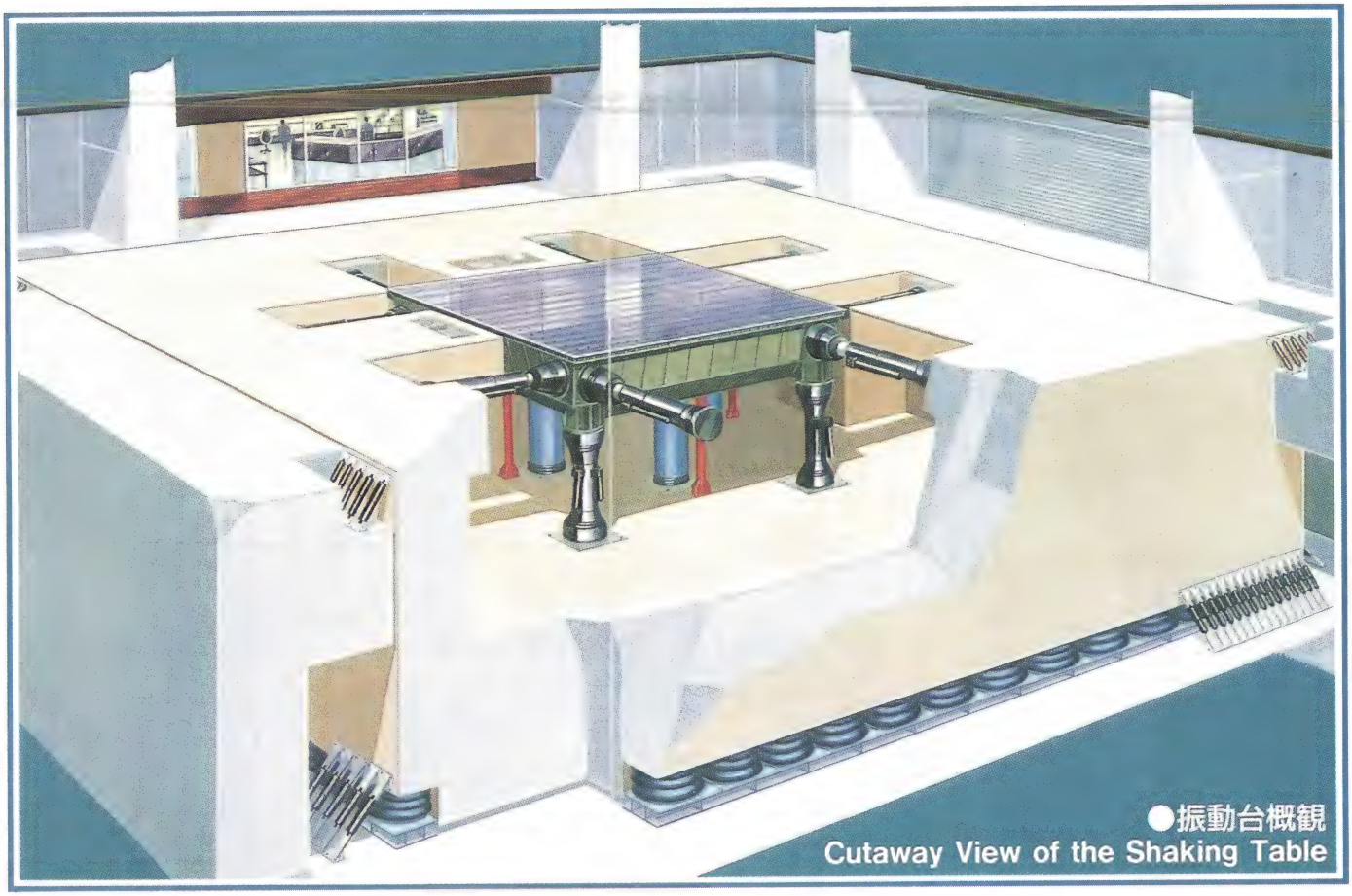
What made this conference a little different to its predecessors was that more than 10% of the papers presented were devoted to the subject of *active* noise and vibration control — using electronically processed signals derived from the noise or vibration to cancel out or otherwise control them. This is a clear sign of how important this subject has become, and how much time and resources are now being devoted to it by universities, manufacturers and some government and defence agencies.

Whilst many of the papers examined the theoretical and mathematical aspects of the algorithms associated with the digital sound processing (DSP) of acoustical and vibration signals, others reviewed the practicality and experimental advantages and/or deficiencies of 'real-world' sound and vibration control systems.

As I sat through some of the lectures, I had the feeling that the presenters were censoring the information that they had collected. I perceived that what they were illustrating was a very narrow perspective of what has actually been achieved. I also felt



The monster 'shaker table' at Kajima Corporation's Technical Research Institute in Tokyo. It can test model buildings of up to 30 tons, exerting up to 2G.



A diagram showing the construction of Kajima's shaking table. The isolated concrete supporting plinth itself, weighs 4600 tons, and is supported by 110 massive air springs supplemented by 256 oil dampers — very large shock absorbers.

that they were frequently skirting around the real issues involved, as well as many of the more practical implementations of this exciting new technique.

Manufacturers shy

I soon discovered that there are many examples of practical active attenuation already being sold across the counter in 'white goods' shops in America and Europe. The problem is that the manufacturers who are successfully making use of the new technology are frequently loathe to tell the purchasers that they have adopted this approach. One reason for not telling the purchasers is that they don't want to alert their competitors to what they have achieved, as the industry is plagued by a fear of industrial espionage and 'me too' look-alike copies.

The most prominent industry which has taken the active attenuation concept to its heart is the heating, ventilating and air conditioning industry. The reasons for this, as you will soon see, is that active attenuation can cost-effectively solve a wide range of otherwise intractible problems — particularly in new buildings where space is at a premium. Those problems are further exacerbated by on-site problems which frequently occur after the building has been designed and constructed, and the critical space is about to be occupied by an equally critical tenant.

The automotive industry has also now accepted that active attenuation has much to offer, particularly with the more expensive cars, as well as with large and/or expensive trucks. In this regard the Japanese are clearly leading the Americans, and the Nissan Corporation clearly leads the rest of the field. Although I did not see it, I understand that Nissan has already released a new vehicle in Japan in which incorporates active attenuation for the passengers sitting in the rear seats.

This system makes use of technology comparable to that which I discussed in my review of the ANVT Noise Quietening Headphones (see *EA* June 1994). As you may well appreciate, the size of the vehicular active noise control markets is significantly larger than that of any other market at present. More significantly, that market is plagued by many seemingly intractable problems, which disturb both the manufacturers as well as prospective purchasers.

The automotive market offers incentives which have convinced the manufacturers that the risk involved in undertaking the research and development work is well worth the trouble. With a US market of 10 million cars and trucks, and another 20 million being manufactured elsewhere in the world, it is not surprising that this market is so attractive.

There are a range of different products required to achieve quieter and more vibration-free cars and trucks. You may be aware of the electronic muffler, but there are other related products under development which are equally significant.

The Americans and the Japanese are currently working on electronic engine induction systems (quieter air intakes). They are also working on vibration-free engine mountings, adaptive ride control systems, and also interior sound control systems to attenuate those nasty low frequency resonances. These are often most disturbing when a vehicle's windows are open, but are frequently still problematical even when the windows are closed.

Integrated system

Considerable research is now being devoted to integrating each of the separate systems described above into a single system which accommodates both road and engine vibration — which are coupled into the vehicle's interior to manifest themselves as unwanted and disturbing noise. The vibration is frequently felt as stressful components in your hands, feet and seat, and equally disturbing sensations at the drivers and passenger's ears. No single system can resolve those problems, but currently at least three major Japanese vehicle makers are experimenting with multi- element systems to address the problem.

The time frame for the development of a successful integrated system is typically three to five years, and the Japanese manufacturers have been working on some of their systems for at least three years. It would

thus appear that we can expect to see the first examples of practical automotive noise control systems being released in Australia and New Zealand within the next two years, but no sooner.

The first of the systems that we are likely to see will most probably be internal cabin sound conditioning systems, which offer a limited zone of attenuation and over a limited range of frequencies. Those systems will be site specific, and will be directed at passenger's heads adjacent to a headrest, in which the noise detecting microphone and loudspeaker drivers will have been integrated.

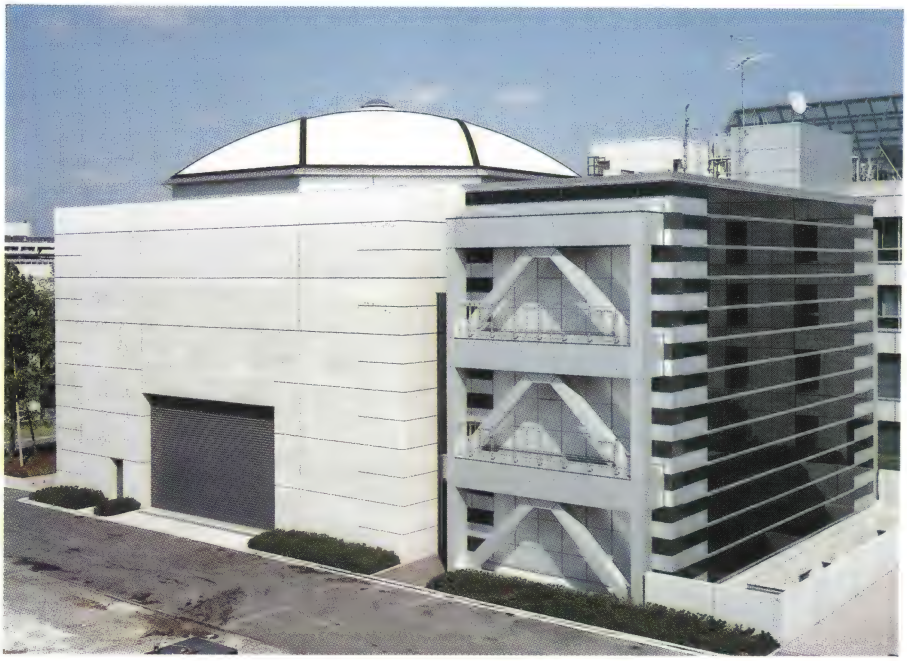
A more practical and potentially universal application of active noise control systems will be the electronic muffler, which is available now, and which will prospectively be available on at least one Japanese car. Developmental work on electronic mufflers has been taking place all over the world, and even the Australian CSIRO and University of Adelaide have developed successful electronic muffler systems.

The advantage of the electronic muffler is that it requires considerably less space than the conventional passive muffler system. In theory it should be quieter than its passive counterpart, but more significantly, it offers the scope for increased engine efficiency and output, as a result of reduced back pressure. The order of achievable power improvement is typically 3-5%.

Although that figure may be equated to reduced operating costs, the improvement will not necessarily equate to the additional costs of an electronic muffler system assessed over the life of the vehicle.

How reliable?

A significant problem which has yet to be resolved is the *reliability* of electronic mufflers, and whether they will conform to the warranty period of the vehicle. With premium cars now having a warranty period of two to three years in Australia, and as long as six years for the premium vehicles in America, this is a very significant factor which is attracting considerable attention from the vehicle manufacturers.



The Kajima Technical Research Institute's shaker table laboratory building. The open steel framework on the right incorporates active 'sway brace' elements, developed to achieve a controlled building stiffness and hence modify the building's response to earthquakes and vibration.

The typical electronic muffler, of the type used in vehicles or in air conditioning systems, has a schematic design similar to that shown in Fig.1. It incorporates the following components:

1. An input sensor system that measures the acoustical signature of the pressure wave in the exhaust pipe, and generates the electronic inputs which are fed to the control circuitry.
2. A digital signal processor (DSP) unit, which uses the electrical signal provided by the input sensor, and an internally programmed real-time adaptive algorithm which then generates a set of filter coefficients (which are frequently based on 'least square error' solutions), so as to minimise the residual (error) sensor signal.
3. A residual sensor that measures the residual acoustical pressure within the exhaust pipe and whose output is also fed into the DSP chip as part of the signal minimisation process.
4. A digital and programmable electronic filter which generates the signal fed to the power amplifier.
5. The power amplifier, which provides the electrical signal to the transducer whose output is coupled directly into the exhaust pipe.
6. The output transducer, which is a specially designed loudspeaker — and depending on the application, may incorporate special thermal rating.
7. Where the input and residual sensors are incorporated inside the exhaust pipe of the vehicle, then the transducer's cancelling signal will feed back into the exhaust signal sensor. Where this occurs, an adaptive filter has to be incorporated into the filter circuit to accommodate the additional pressure waves. One way of minimising this problem is to place the residual sensor outside the exhaust pipe, and that technique is now commonly adopted.



The young lady is posing with one of the large rubber isolators, of the type being used to protect buildings from earthquakes — and also provide isolation from vibration caused by passing rail and road traffic.

Available now

Active electronic noise cancelling systems of the type illustrated in Fig.1 can now be purchased from a number of American manufacturers. Foremost amongst these are Digisonics and Noise Cancellation Technologies Inc. Both of these firms market practical attenuation systems which achieve attenuations of up to 25dB at low frequencies (i.e., within the 50-500Hz range), with zero pressure drop.

Such systems are now being incorporated into the air conditioning ductwork in buildings in which problems are anticipated, or where space inhibits the use of more conventional systems. Whilst few building owners, architects or engineers willingly spend the money on such systems, what they offer by way of space savings are so

impressive that where space is at a premium, they offer unparalleled convenience in resolving problems. I am aware of at least half a dozen buildings in Sydney whose problems would have been solved by these systems, had they been available.

As I discovered at the 'Inter-Noise 94' conference, active noise attenuation systems are now being incorporated in a wide range of other products including washing machines, dishwashers, gas fired water heaters, and even large transformers, all of whose noise emission characteristics are amenable to such solutions.

The problem tends to be that the larger the item of equipment, the more complex the problem, and the greater number of transducers required to resolve that problem. Although conventional electro-dynamic transducers can resolve this problem, there are newer transducers being developed, which may provide the breakthrough that the industry is now seeking.

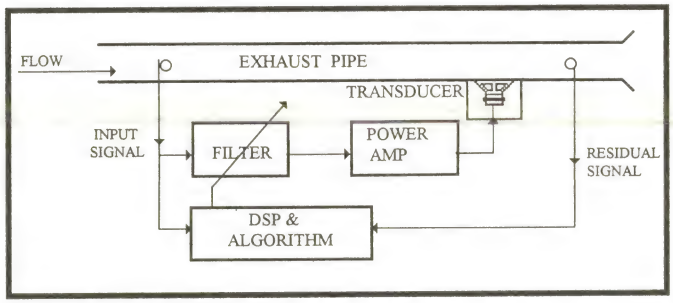


Fig.1: A block diagram showing the basic design of an electronic muffler.

Laboratory visit

Following 'Inter-Noise 94', I was invited to visit the laboratories of the Kajima Technical Research Institute in Tokyo. Whilst there, I met Mr Nojiri, the Director, and Mr T. Furasama the Assistant Director, as well as Dr K. Andow and T. Mamiya who then showed me some of the company's research facilities.

I accepted the invitation to visit the Kajima TRI because I had previously inspected one of their first 'intelligent' buildings in Osaka in 1986, after it was featured on the 'Towards 2000' program. My inspection of that building had convinced me that the Kajima's Corporation approach to building design was revolutionary and exceptionally well researched.

The Kajima Corporation's TRI is the result of 45 years of evolutionary development, in which the company have developed a philosophy which is peculiar to Japan. They were the first major construction company in Japan to set up a major research facility, with the goal of providing new technology which would in turn lead to competitive successes in the market place.

What particularly impressed me was the size and scale of the company's involvement in the research field. The technical research institute has 450 employees, of whom 320 are engineers. The company devotes an annual budget of 10 billion yen, which is approximately A$150 million.

Kajima itself has four primary divisions, which are respectively Construction, Architectural and Engineering Design, Developmental and New Business. The Research & Development division has two technical centres, one being the Nishichofu complex to which I was invited, and the other being the Tobitakyu complex, which is at another site.

Throughout its history, Japan has been plagued with earthquakes. As you may appreciate, the taller the building, the bigger the problem, and when a building has a glass facade, and typical long slender aspect ratio, the magnitude of the design problems to create an earthquake resistant building become quite daunting. But while other companies *were* daunted by the problem, Kajima Corporation took a more practical approach and decided they would seek ways of solving these seemingly insurmountable problems.

The first thing they decided to do was to accurately measure earthquakes, and they devised instrumentation which would enable them to define accurately the characteristics of an earthquake for future reference. As an aside, they also collected data from famous historical earthquakes, and converted that data into a matching parametric format so that they could assess future designs against the characteristics of those 'historical yardsticks'. Whilst this was progressing, they constructed a 'Shaking Table Laboratory', which is capable of simulating any type of movement with which a new building is likely to be faced in the future. Those problems include horizontal seismic movement, as typified by an earthquake, as well as vertical motion which is produced by passing trains, and to a limited degree by local earthquake activity.

Monster shaker

The size of this facility was extremely impressive. The main feature of the system is a five-metre square table, which has a rated load capacity of 30 tons and can produce 2G of acceleration in both the horizontal and vertical directions — while supporting a specimen weighing 30 tons!

The system has the potential to operate with six degrees of freedom, to reproduce any practical combination of ground motion within a DC to 60Hz frequency range.

The computer sensing and control system coupled to this gigantic shaker table can record 144 separate data channels for high speed precision data recording.

Even if this system were not impressive in its own right, the shaker table is itself installed on a gigantic isolated concrete supporting plinth which itself weighs 4600 tons. This gigantic plinth is separately vibration isolated from the primary building foundation below by means of 110 air springs, supplemented by 256 oil dampers (very large shock absorbers).

To dramatise the importance of this facility and its ultimate purpose, Dr Andow arranged for hand rails to be temporarily fixed to the top of the shaker table. I was then asked to stand on the shaker table so that I could experience artificial earthquake, which reproduced the ground motion of previously recorded earthquakes...

The first earthquake I experienced was the 1993 Hokaido earthquake, which was ap-

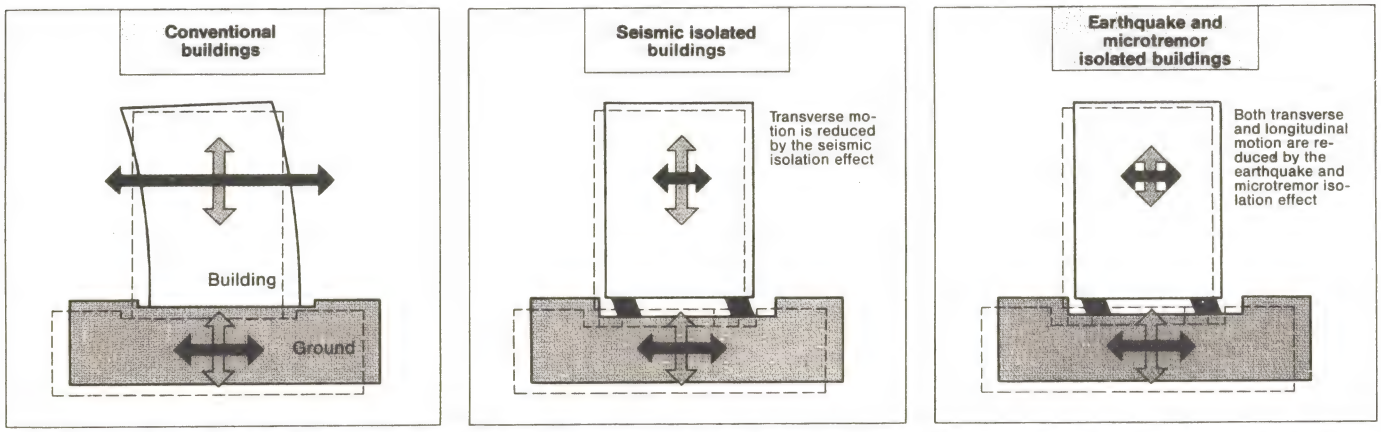


Fig.2: Taken from a Kajima brochure, these diagrams illustrate how a conventional building shakes during an earthquake (left), and how a seismically isolated building moves much less (centre). Kajima's earthquake and microtremor isolation system (right) has the added benefit of reducing longitudinal microtremors caused by traffic vibration.

proximately 6.4 on the Richter scale. Had I been exposed to that earthquake in a 'real-world' situation, I think I would have needed a change of clothes.

The second earthquake I experienced was reproduced from the California earthquake of 1940 — thoughtfully scaled down by 60%. The extent of ground motion of this one was far greater than the first, far longer and much more frightening. I was very glad that Dr Andow and his associates chose to scale the vibration limits down, as I doubt that I would have been able to stay on my feet had the full strength been applied!

With forces of that magnitude being applied to a conventional brick and mortar building (of the type with which we are all familiar), it is no wonder that so many buildings collapsed, and so many people are killed during earthquakes. The only limiting factor is the design integrity of the buildings, and the extent to which they are 'fit for purpose'.

Key concept

Now the concept of designing buildings which are 'fit for purpose' has motivated the Kajima Corporation since the early 1950's, and they have devoted a significant proportion of their resources — and most of their R&D effort — into developing solutions to both old and new problems.

Nowhere was this more evident than in the design of vibration (earthquake) resistant buildings. The solutions that they have developed are a combination of improvements in existing technology, coupled to the innovative use of new technology.

When the ground below a conventional building shakes horizontally, the building which sits on that ground shakes like a tree in the wind. The deformation (and movement) of the building is highest at the upper stories. This increasing movement with increasing height generates stresses and strains which most building materials have difficulty in resisting. Where the buildings are not designed to withstand the stresses, the results are frequently catastrophic.

If the building is mounted on large rubber isolators, of the type displayed by the young woman in the photo, the building can behave like a seismic isolator, and move transversely, with minimal rotational movement.

If the isolators are simultaneously designed to provide vertical isolation to conventional traffic and train vibration, then the isolation process achieves even higher levels of internal environmental amenity. Kajima's engineers realised that by combining both functions into the one isolation system, it would be possible to design a building next to a railway line or a tunnel, which would achieve optimum isolation efficiency, without prejudicing the cost or the ultimate 'fit for purpose' requirements of such a building (Fig.2).

Although Kajima Corporation has constructed a number of outstanding buildings which incorporated these design concepts, their model studies and their field investigations confirmed that even more potent solutions were required. At that stage their research engineers developed a new seismic response control mechanism which uses active control, applied at the intersection between 'sway brace' elements and the supporting beams to achieve a controlled stiffness — and thereby modify the building's vibration response characteristics.

Dr Andow pointed to the open steel frame at the two ends of the seven-storey building which is located on one side of the Shaker Table Laboratory, and proudly drew my attention to the unusual three sets of stiffening braces within each of those structural portals. The central termination points of each of those sway braces incorporates an active servo-controlled sway brace system, which changes the dynamic stiffening characteristics of the structure so as to minimise the building's motion under earthquake conditions (see photo).

The system obviously works, but will obviously require mains power to function correctly, in the presence of a real earthquake...

Other solutions

Dr Andow and his team of researchers have developed other exciting solutions for building vibration — including the AMD system, which uses a large horizontal sliding mass on the roof of the building to achieve comparable reductions in building motion. This system takes the form of a large computer controlled electro-dynamically activated mass.

The movement of the mass is controlled to counteract the movement of the building, and this was displayed by two models — one with the AMD control system on its roof, and one without.

Both buildings were mounted on a common base, which was shaken horizontally to simulate an earthquake. The model building without any treatment twisted wildly, whereas the model with the AMD system on its roof moved almost imperceptibly. The demonstration was impressive, and the model was obviously 'fit for purpose'.

Most impressive

I saw other exciting technological developments at the Kajima Corporation's Research centre, which demonstrated how close the Japanese are to the cutting edge of new technology. Even though each of those developments was worthy of an article in its own right, the use of active attenuation for seismic control most certainly eclipsed each of those developments.

Fortunately neither I, nor most of you have ever experienced a real earthquake. Notwithstanding, what I experienced on the Kajima TRI's shaker table convinced me that I have absolutely no desire to ever experience one. If however I had to work or live in Japan, or New Zealand, and I had to face such an ordeal, then I would pray that the building's owners had had the presence of mind to design the building appropriately.

Having seen what can be done, I am now convinced that active attenuation offers one practical and convenient means of minimising the problem, and that this particular 'holy grail' is almost within our grasp. ❖

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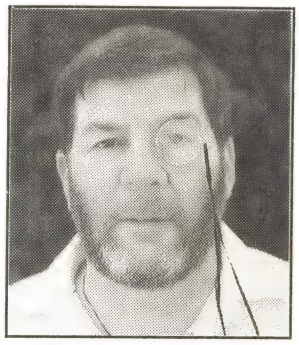
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L.L. BROWN ADVERTISING 4803

Moffat's Madhouse...

by TOM MOFFAT



Danger! There's a rocky road ahead...

Well, here we go again. Another perfectly good column idea gets put in the freezer for a while because it gets pre-empted by something else.

It all started when the mail came today. Nothing unusual; a few kit orders, more bills and two magazines: *Amateur Radio Action* and *Time*.

Interesting reading: Somebody's writing in *ARA*, anonymously, saying amateur radio will be finished by the year 2000. By then we'll all be connected to the Information Highway. *Time* magazine, in a major feature, wonders if it's worthwhile to be connected to the Information Highway. And by coincidence, the week before, Tom Moffat got connected to the Information Highway...

I guess I've got a bit of explaining to do. First, the *ARA* thing. This author suggests that amateur radio will be made redundant, forbidden in fact. The frequencies we now use, or reserve for our amateur radio use, will be flogged off to the highest bidder among the global communications companies. They will then issue us all with 'personal communicators' (presently known as mobile phones), from which we can talk or exchange data with anyone else in the world. For a price, of course.

No need for radio gear any more. All our 'hamming' can be done by simulation. For instance, to work a hundred countries for the DXCC award: 'You just dial up a 0055 number from a list of most wanted DX countries, then wait in a queue until acknowledged by a computer'. What the author failed to point out is that the situation nowadays isn't far off that. You just tune into a known 'net' frequency and then wait in a queue until acknowledged by the net controller.

Another item relates to that old ham activity of calling 'CQ', and then having a chat with whoever responds. Our author suggests you might instead dial a '0055-CQ' number to connect with new- found friends. Well, I'm pretty sure this already exists; I think I've seen it advertised in the newspaper. As I remember, it's called 'Party Line' and (for a hefty fee of course) you can connect into a simulated crossed-line on which everybody there can talk to everybody else.

Simulated this, simulated that. Another example from the *ARA* piece concerns the Post Office and first-day covers from Antarctica. Back in the good old days these were totally authentic, with the envelopes taken to Antarctica, physically stamped there, and then returned to Australia. The anonymous author even accuses intrepid explorer Tom Moffat of sitting in an igloo down there sticking all the stamps on the envelopes. Wrong: I only did that for my friends and relatives, but that involved quite a heap of them all the same.

Now, according to the article, 'the envelopes are stamped by a franking machine in Melbourne, with the postmarks of each of the Antarctic bases.' If this is so, it is a very sad state of affairs for collectors. But there may be no choice eventually. The *Time* magazine that arrived today has a story suggesting Australia's Antarctic bases may be abolished. I suppose future explorers can then visit the 'simulated Antarctic environment', in the Antarctic interpretation centre proposed for Hobart.

Money-guzzling modems

That article in *ARA*, although somewhat grim, is to be welcomed. Because between now and the year 2000 those pressures for the amateur frequencies, and the pressures to abolish amateur radio, will be building day by day. If the mega-giant-multi-national communications companies have their way, we'll all be cruising the Information Highway with our money-guzzling modems, with no turns allowed and no exit ramps. If hams at least are made aware of moves to abolish us, perhaps we can form some kind of resistance against it.

Information Highway, or Information HYPEway? Methinks its street lights are razzle-dazzle. Everywhere you look, everywhere you turn, the word is Information Highway.

ABC Television is running a gee-whizz technology series called 'The Big Byte'. And last night's subject? You guessed it — how we just won't be able to EXIST without the Information Highway.

This brings us to the *Time* feature, which asks 'is going on-line worth the money?'. Going on-line is the process of driving up the on-ramp to the Information Highway. The article is primarily American based, but the highway accesses in Australia are similar to there — names like Prodigy and CompuServe.

These are commercial dial-up services which are in reality elaborate computer bulletin boards. They've got file areas from where you can download stuff into your own computer, be it programs or text information.

They all seem to have some form of electronic mail, or 'e-mail', and they give you access to Newsgroups, which are open electronic forums about any subject under the sun. You can enter into a Newsgroup and then see what people all over the world are saying about, for instance 'feminism', and then add your two cents' worth.

The commercial on-line services also have research facilities. A student preparing a school report can tap into an on-line live version of Grolier's or Compton's Encyclopedia, presumably updated on a regular basis rather than once a year. Business entrepreneurs planning their next takeovers can dig out detailed financial reports on their target companies. The CompuServe system alone has nearly 2000 databases you can access.

But, as *Time* points out, these things don't come cheap. They gave as an example a call to CompuServe to find the phone numbers of two companies. This was successful, but at a cost to the user of $11.00, and that's in the USA. In Australia — ouch! I'm just wondering why the reporter didn't ring the telephone company's information service and ask them, for nothing...

When I was in the USA a couple of years ago I managed to wangle a one-month trial membership to CompuServe.

This was jolly good fun. Using my tiny Hewlett-Packard palmtop computer and a borrowed modem, I could make CompuServe send me a continuous feed of the up-to-the-minute news. Or I could look at world weather and find out the temperature in Sydney RIGHT NOW. Or I could scan a database of movie reviews to see if any of the rubbish on cable-TV that night was really worth watching. (It wasn't.)

When I signed on for this trial membership, I gave Compuserve USA my home address in Tasmania. So when the time was about to run out they asked if I would like to continue my membership on 'CompuServe Pacific'. This sounded like a fine idea — I'll admit they had me hooked by then — but then I found out what it cost.

In the USA there's a local phone number for CompuServe in just about every city. So the call is free, and all you have to pay for are some of the special services, which is how that guy blew $11 to find two phone numbers.

But to connect to CompuServe from Tasmania, there was no local number in Hobart — so I would have to ring the Mainland just to connect. Result: one trunk call to pay for, by the minute. Once into the Australian system it was then necessary to link across the Pacific to the USA, via a commercial communications company. Result: hefty per-minute line charges. One would then be into the regular USA system, subject to whatever charges are levied there.

I guess this is why some unkind people in Australia have referred to CompuServe as 'Compu$erve'. However the prices quoted to me were two years ago, and I'm sure they must come down, especially if there's competition from other services.

The real highway

These on-line services, advanced as they are, are still not the 'Information Highway'. They are only the truck stops along it, the road houses or motels. The real 'highway', at least in the current meaning, is the Internet. This is a vast web of communication links tying together, at last count, over 20 million computers throughout the world. This web, and the environment it lives in, has its own buzz-word: cyberspace.

I sometimes feel that all the world's knowledge exists somewhere in cyberspace. Whenever I am preparing an article nowadays, I always end up knocking on the door of cyberspace.

As this is being written, what concerns me is the comet that will soon impact into Jupiter. The latest time estimates, I am told, can be got from cyberspace via the Internet. We are going to attempt to observe any radio emissions from this event in the company of Grote Reber, on the site of his early radio telescope in central Tasmania. It would be a pity to get the wrong day.

Trouble is, up until now, access to the Internet in Australia has been in the grip of a stranglehold by the academic community via its own network 'AARNET'. But now AARNET is admitting some 'affiliate members' into the 'net, thus opening the doors for people like you and me. So, as of late last week, Tom Moffat is 'on line', a fledgling resident of cyberspace. I've even got the latest status symbol, my own e-mail address!

This all came about through the good offices of APANA, the Australian Public Access Network Association. Anyone can join APANA and thus have their computer become a 'site' on the Internet, joining the 20 million computers already there. This new computer can in turn open its doors to external users, as a 'bulletin board system' (BBS). Members of the BBS are then associate members of APANA.

The owner of a BBS here in Hobart has become a member of APANA, and his computer is now recognised as a 'site' throughout the Internet. And all the subscribers to his BBS are associate members. But the BBS isn't hooked full-time into the 'net, because the connection is in Melbourne and we are in Hobart. So once a day the local machine rings Melbourne and exchanges a heap of data with the machine there over the phone. This of course takes an STD call, for which someone has to pay. And that's one reason we pay user fees.

What we in Hobart have, then, is Internet e-mail access, as well as access to selected Newsgroups on the 'net. But we can't tap into every group just on a whim; you must decide which group is of particular interest and then ask the local operator to arrange for its transfer from Melbourne. You can read what's there and then add your own contribution to the discussion, for transmission back the next day.

E-mail works the same way, with one transfer a day, but it's still fantastic. And as I see it, e-mail will be a necessity of life before long, instead of a status symbol.

When I first signed up with the system, I decided to see if I could reach my daughter by e-mail, through her husband's computer. They live in Cupertino, California — right in the heart of Silicon Valley, and just down the road from the world headquarters of Apple Computer.

Normally a postal letter takes a couple of weeks to get from Cupertino to Hobart. This type of mail is now called 'snail-mail' by those who have become on-line. My test letter, via Internet e-mail, made it to Cupertino in one day and a reply arrived back the next day. With this link open we are now corresponding regularly, and things we talk about aren't two weeks out of date.

The APANA blurb says they are working toward full 'live' Internet access for anyone in Australia who wants it, at an affordable price. This will not happen overnight, and it will take a lot of dedication from the APANA people and support from those who lust after the Internet. Remember, APANA is totally non-profit. So I guess we'd better give them a little plug here — an address to write to if you'd like to help:

REPLY PAID 7
Propaganda Department (that's right!)
APANA Inc.
PO Box 145,
Keilor, Vic 3036

And if you already have e-mail access in some roundabout way, try this one:

propaganda@apana.org.au

See you on the Internet, sometime? ❖

Multimedia Encyclopedia

Continued from page 9

My only other complaint is a general one, which really applies to any *Windows*-based program where you need to access quite a deal of text. Even with a single window opened, there's still only a small amount of text visible at once; much less than you can see on the double spread of an opened quarto volume. And the only way to move forward and backward inside a particular article is by either using the vertical scroll bar buttons, or dragging the elevator button up and down. It can be rather frustrating — particularly when you have to limit the size of the text window, to see an illustration at the same time...

On the whole, though, and based on the demo version, I can report that the McGraw-Hill *Multimedia Encyclopedia of Science and Technology* looks to be a very impressive production, and an excellent information resource for anyone studying or working in this field. Hopefully as it is updated, the publisher will take the opportunity to make it even better — by providing more pictures, animations and sound to augment and enhance its value. ❖

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Electronics AUSTRALIA

ELT/MUL/000 10,11,12/94

New Australian-designed educational robots:



HERE COME THE FANDERS!

The educational robot scene may seem to have been dormant for the past few years, but it's certainly not dead. Development has been going on behind the scenes, and now the latest and most elaborate machine has hit the market. The Fander-1, from Branch and Associates in Hobart, is a top-shelf product aimed squarely at the university market — for training students who will eventually be designing robots themselves.

by TOM MOFFAT

First some history: Fander-1's designer Allan Branch was a medical student back in the late 1970's, when he realised the human body wasn't all that complicated, and he thought he could reproduce some of its functions mechanically — thus, robotics! An early experiment I saw was a reproduction of a human hand, made of jointed bits of wood with strings where the tendons should be.

At that stage, computers were just coming into schools and common wisdom was that all children should learn to program them. The LOGO language was developed for this purpose. The kids learned to move a little triangular 'turtle' around the screen, leaving a trail behind it to draw fancy designs. Then somebody got the idea that this would be more impressive if there was a physical 'turtle' that could be directed under computer control to move around the floor instead of the screen, drawing designs on a big piece of paper with a felt-tipped pen. And so the turtle robot was born.

Allan Branch saw there was money to be made here, and developed the Tasman Turtle — a circular platform with a clear plastic dome. It had a wheel at each side, and wooden skids front and rear. The turtle could move forward or backward by driving both wheels in one direction, or it could turn in its own length by driving one wheel forward and the other backward. Combinations of these movements, directed by a computer connected to the turtle by a cable, could make the turtle move in an infinite combination of patterns.

In the centre of the platform was a solenoid which could lower a pen to paper to make the turtle draw, or raise the pen while the turtle moved to a new location.

The Tasman Turtle also had a pair of 'eyes' which could be flashed on and off, a horn that could toot, and even a speech synthesiser to make it talk. These were simple gimmicks to make the robot more appealing to the kids.

But foremost was a bumper arrangement that sent information back to the computer when the turtle collided with something. This data allowed the computer to react to a stimulus and then make a decision based upon it. So, with some creative programming, the Tasman Turtle could become 'autonomous', learning to work its way out of a corner or through a maze.

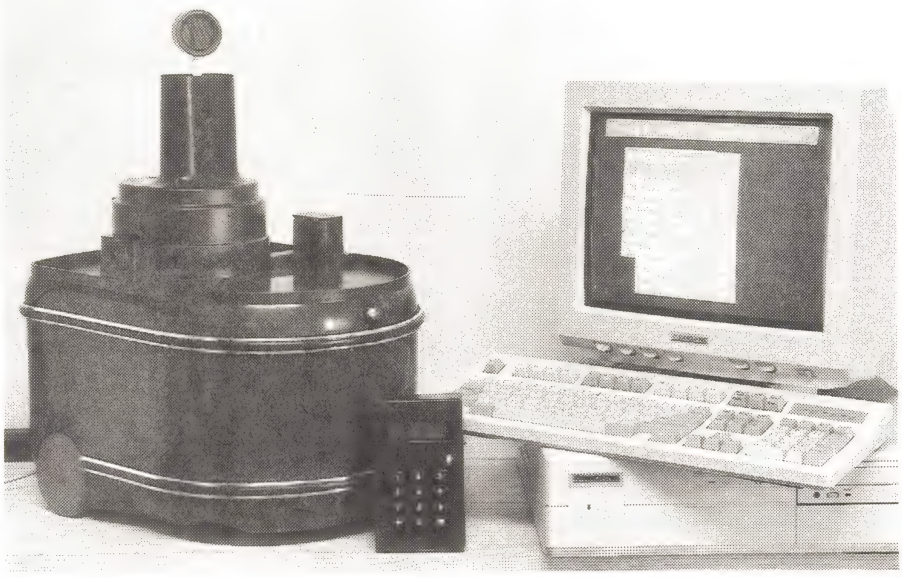
The whole works under the plastic dome came to be known as 'turtle guts', and was the basis for many big things to come. An early spinoff was the Elami robot, a metre-high machine with arms and a face and scaled-up turtle guts to make him move. The original Elami found a career hosting shopping centre promotions, and a quarter-sized version was manufactured as a toy.

At this stage Allan Branch was getting offers to hit the big-time in the USA, so I was hired by the robot company Flexible Systems to replace him. My main job was to produce a smaller, simpler, and cheaper turtle robot, which sold very successfully as the Turtle Tot. I also did further development on Elami, and also designed a rather snazzy infrared driven turtle — which unfortunately never made it to market for various commercial reasons. That was the last turtle; from then on we got into weather facsimile systems, which still occupy much of my time to this day.

As for Allan Branch and his USA career, I kept getting snippets of news about him via the barber shop which we both attended (who needs computer networks when you've got a good barber shop?). Allan was working for Commodore Computer, and there was a self-guiding vacuum cleaner project, and an office setup in Hobart to bring some of his designs into production.

What the Hobart office, Branch and Associates, was working on was Fander-1. The name Fander, I am told, is based on an acronym for 'find and deliver' (any relation to Ned Kelly?). The robot is built upon a platform, no longer circular, with wheels at each side and the rest filled with turtle guts. What is it now — 15 years? — and the turtle technology lives on. And why not; if it ain't broke, don't fix it.

But Fander-1 has some enhancements, lots of them. It now carries its own onboard computer, and not just a little micro-controller but a full-blown IBM-PC '386 model. Obviously there's no room for a proper keyboard and monitor, so they've been replaced by a controller that looks like a calculator; a keypad and LCD display, connected to Fander-1 by a cable. You can follow the



A Fander-1 robot with its hand controller (front centre) and a PC which can be used for more serious programming. Note the sonar 'scanner' on top of the robot.

Fander around as it moves, punching the keys to keep a firm rein on it, or you can set the robot running and then let the controller ride around on it as Fander-1 does its own thing.

For more elaborate tasks, an external IBM-PC can be connected to the Fander-1 by a standard serial cable. This gives you a full keyboard and a colour monitor, and Fander comes with some flashy demo software to make use of them. But more importantly, you can write your own software and try it out on Fander.

In operation

I saw Fander-1 operating in both its PC-controlled and stand-alone modes. I will state quite clearly that it wasn't perfect, but I don't think it is supposed to be. The demo software is just that — a basic demonstration of what Fander's hardware gadgets can do. You see it running and think "Hey, I can do better than that!", and off you go, writing your own control programs.

That's the whole thrust of the Fander-1 concept. If the supplied software WAS perfect, the robot would get boring pretty quickly.

It would be like going out and buying some gripping adventure game for your computer, only to find out the solution was included with it. You'd run it once, and marvel at the graphics, and then what? You'd feel cheated, most likely.

What you CAN get with Fander-1 is all the information you need to access the hardware features and use them for your own purposes. There are C language routines and headers, along with some machine code stuff. Most of

Here come the Fanders!

Fander's operations are interrupt driven, but it doesn't look difficult to come to grips with them if you have any reasonable proficiency in C. In fact you can rewrite the whole Fander operating system and produce a new EPROM for it, if you want to get that radical.

Upgraded hardware

Fander-1 sports some interesting enhancements on the hardware side. Here's a sampling:

Wheel drive motors: In the early turtles, the wheels were driven by stepper motors. You sent a pulse to the motor, it rotated a fixed number of degrees, and that side of the turtle moved a certain distance known as a 'step'. You had no way of knowing if the turtle had actually moved the desired amount. If the turtle was running on a carpet, movement was unpredictable.

With the first turtles we always thought how clever it would be to put shaft encoders on the wheels, so the computer could *know* how much they actually moved. Now, in Fander-1, it's finally been done. Each wheel has a notched disk fixed to its axle, so that the notches interrupt a light beam as the wheel turns. The result is a train of pulses sent back to the computer, a pulse for each 'step' the turtle actually moves on each wheel.

With this system it's no longer necessary to use expensive stepper motors and the special driver chips that go with them. (Stepper motors were messy to program anyway.) Fander uses simple DC motors. Apply voltage one way and the motor moves forward, reverse the voltage and the motor reverses.

The shaft encoders also provide a very direct method of collision detection. If you apply the juice to the motor but you don't get any shaft encoder pulses back, you can assume the robot is stuck. There is no more need for bumpers as such; the computer 'knows' when the motors stop unexpectedly.

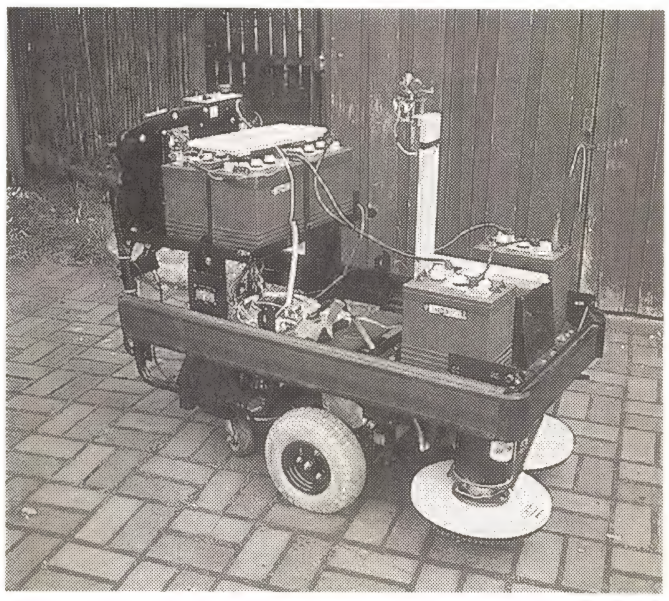
Proximity detectors: Three infrared LED's are located around the front of Fander-1; near each one is an IR phototransistor. They are arranged so that any IR light reflecting from a nearby surface is picked up by a phototransistor and signalled to the computer. The idea is that Fander-1 'sees' an obstacle before charging into it, allowing it to stop and back away without actually touching anything. This would make it a much more 'civilised' robot, in the presence of antique furniture or sleeping dogs.

Rotating sonar rangefinder: This one is a real goodie. Mounted atop Fander-1 is a pole topped by an ultrasonic transducer, of the type used on autofocus Polaroid cameras. The shaft attaches to an upward facing stepper motor such that the transducer can be rotated in 7.5° increments. It's much like the radar atop a ship.

This sonar gadget can be used exactly like a radar, sending out an ultrasonic pulse and them measuring how long it takes to come back. The transducer can then be rotated a few degrees by the stepper motor and the process repeated. The computer can be programmed to make this happen continuously and plot



A Fander-1 robot following a white line on the floor.



A commercial floor cleaning machine that is currently undergoing Fanderisation.

returned echoes on the screen, so the rangefinder works as a simple 'radar'.

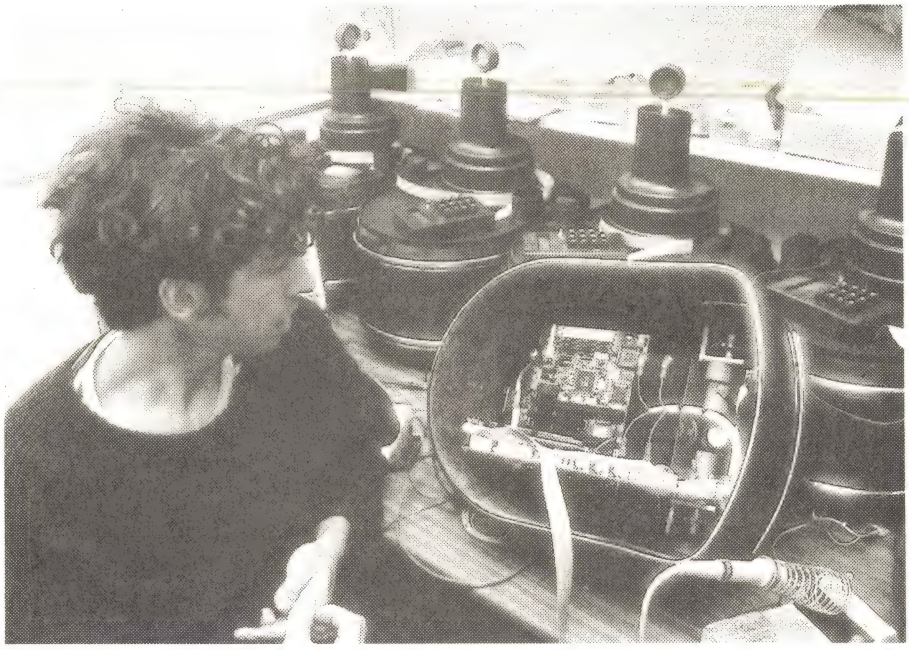
The resolution is a bit on the coarse side, with fairly large dots showing where the echoes come from. But it works very well for what it is — if people are standing around the robot, the sonar sees their legs and shows them as a line or three or four dots on the computer's screen. If a person moves, the line moves with him. And further away are lines of dots corresponding to the walls of the room.

It's obvious the sonar system has enormous potential if developed for a 'real-world' application. If a robot is programmed to move about while the sonar is scanning its environment, it should be possible for it to navigate just about anywhere. In fact one of the Fander-1 demo programs does just that; the robot moves along trying to stay a set distance from a wall. It's a little rough at the moment, but a clever student of robotics could smarten it up; the hardware needed is all there.

With all this moving about under control of computers, one would expect some embarrassment should the software go haywire or the serial cable fail. However Fander-1 is like the safety freak who wears both belt and braces. If all else fails, and both on-board and external computers crash, there is some hardware circuitry to shut down the motors if a bump is detected and the software doesn't respond to it.

Stereo ears: On each side of Fander-1's body is a microphone which will signal if a sharp sound such as a handclap occurs. If the source of the sound is off-centre it will arrive at one microphone before the other, so the computer can work out a direction. This of course could be 180° out, but if you made the robot turn slightly and then listen again the discrepancy should be resolved. One of the demo programs tries to make Fander-1 turn toward the source of hand clapping and then follow it.

Line sensor: Beneath the front of Fander-1 is a linear array of eight red LEDs, each matched to a light-dependent resistor (LDR). The LDRs pick up light reflected from the floor, and report not only its presence but its brightness in 256 levels. So the computer can be programmed to look at the output of each detector and steer the robot so that the lightest (or darkest) area is kept in the centre of the array. The robot thus follows a line painted on the floor. With present technology this is a very common method of guiding a robot; for example, an unmanned goods cart moving through a warehouse.



Assembling Fander robots in the Branch & Associates factory.

Possible improvements?

Having seen Fander-1 in action, I would like to suggest some further enhancements that would not be difficult to implement, but useful. For the sole purpose of impressing visitors (who might be holding the funding purse-strings), it would be nice to reintroduce the old turtle flashing eyes and tooting horn. These are totally useless in the science of robotics, but they can be used to give the machine a kind of 'personality'.

Especially nice would be a speech synthesiser. These are easy to implement nowadays, and fairly cheap. Fander's designers could assign the synthesiser to some 80386 port addresses, and programmers could either use it or ignore it. For the Turtle Tot we had an obstacle-avoider program that made the turtle yell "DANGER!" every time it ran into something. When you turned this thing loose bumbling around a room, it would bleat "DANGER! DANGER!" at every opportunity. Even staid old businessmen loved it.

Another enhancement, almost in the 'must-have' category, is the Forth programming language. This was developed many years ago primarily for machine control. Its first application was steering telescopes at the Kitt Peak observatory in Arizona. Nowadays Forth software is found in such things as controllers for washing machines and microwave ovens. It's an absolute natural for robotics, but not heavily promoted nowadays, probably because nobody has found a way to make money selling it. Forth is traditionally in the public domain, with complete language packages available on various computer bulletin boards and in an enormous area on the Internet.

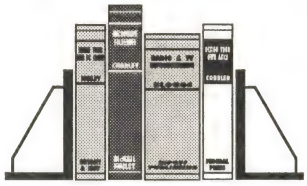
C programmers will know that programs are made up of procedures which can call other procedures, and there's most likely something called 'forward(steps)' in Fander's collection of procedures. You can write a program calling the routine with a number of steps — forward(30) for instance — and Fander should march along in a straight line for 30 steps and then stop. But to do this you must declare variables in a very special way, and then compile the program, and then hope for the best.

In Forth you get instant gratification. Sitting at the keyboard you can type '30 FORWARD' and the robot will move. No messing about with compilers or syntax. You can make the robot go out and then come back to where it started by typing '30 FORWARD 30 BACKWARD'.

If you find this routine useful, you can turn it into a procedure by typing ': OUT_AND_BACK 30 FORWARD 30 BACKWARD ;'. The robot won't move yet, but you have just made a *colon definition* called 'OUT_AND_BACK'. If you now type 'OUT_AND_BACK' and hit ENTER, the robot will do its movement. With that working you can then use OUT_AND_BACK as part of another, more elaborate colon defin-ition. This is how we programmed

Continued on page 30

NEW BOOKS



Switchmode supplies

HIGH-FREQUENCY SWITCHING POWER SUPPLIES, Theory and Design, by George C. Chryssis. Second (International) Edition, published by McGraw-Hill Book Co., 1989. Hard covers, 234 x 156mm, 288 pages. ISBN 0 07 100713 X. RRP $39.95.

The first edition of this book was very well received, and this updated and expanded version looks set to do even better. The author is a very experienced power supply designer, having been co-founder and VP responsible for all R&D at Power General Corporation.

As the second part of the title suggests, it takes you right the way through the theory and design of switchmode supplies, starting with the basics and covering all of the main topologies — plus the design and selection of key components like transformers, inductors etc. In this edition we also get coverage of things like new topologies for supplies operating above 100kHz, resonant converters, synchronous rectification, PWM control IC's, the use of power MOSFETs, feedback loop stability problems and EMI-RFI suppression.

The coverage throughout seems to be comprehensive, concise and yet highly readable and accessible. Even more than with the first edition, then, it's a book that's virtually a 'must' for anyone involved in SMPS design.

Since this edition has been printed in Singapore, the price is also very attractive for a book of this quality.

The review copy came from McGraw-Hill Australia, of 4 Barcoo Street (PO Box 239), Roseville 2069. But you should find copies in all major and technical bookstores. (J.R.)

Assembly standards

ELECTRONICS ASSEMBLY, by Keith Brindley. Published by Butterworth-Heinemann, 1990. Soft covers, 190 x 245mm, 345 pages. ISBN 0 7506 1630 X. RRP $45.95.

As technology advances, increasingly sophisticated techniques are being used to create the electronic assemblies that connect the complex components involved. To cope with the new developments, and the ever-increasing demand for high reliability, standards for the electronics assembly industry are constantly being developed and revised. The author, who claims considerable experience in the electronics industry, sets out to provide a basis for standard manufacturing procedures within an organisation.

This book covers the use of electronics assembly standards and includes a listing of worldwide standards and publications. The listing even includes those standards which only partly cover the subject in question. There's also a listing of standards and publications by reference number and title. These are in an 80-page appendix — so be warned!

Standards listed include BS, UK defence, IEC, ANSI, USA defence and DIN. Being a British publication, you won't find any AS (Australian Standard) listings, though.

As you'd expect, the book covers the role of the printed circuit board. Standards associated with PCB manufacture are given, as is a description of PCB design, both for through-hole and surface mount assembly. Quality and reliability testing are also described.

The book gives numerous practical hints and the writing style is friendly, yet appropriate to the subject matter. The review copy came from Butterworth-Heinemann, PO Box 345, North Ryde 2113. It should be available from technical and larger bookshops. (P.P.)

Spread spectrum

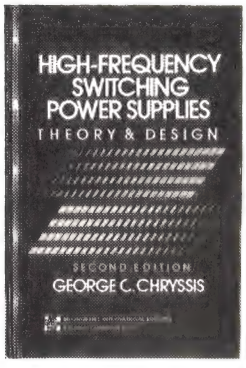
SPREAD SPECTRUM COMMUNICATIONS HANDBOOK, by Marvin Simon, Jim Omura, Robert Scholtz and Barry Levitt. Revised edition 1994, published by McGraw-Hill Inc. Hard covers, 235 x 157mm, 1228 pages. ISBN 0 07 057629 7. RRP $260.

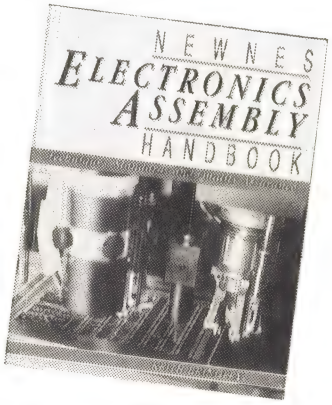
From their closeted beginnings a couple of decades ago in hush-hush military and security force communications, spread spectrum techniques have emerged into the wider sphere — where they look likely to play a major role in CDMA digital cellular networks and the coming 'personal communications' era.

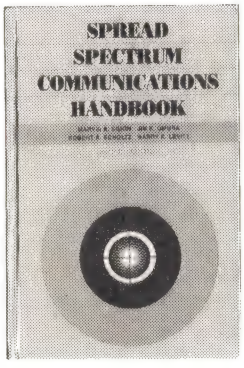
The authors of this weighty tome are all acknowledged experts on the subject, and their first three-volume edition *Spread Spectrum Communications* was published in 1985. This rapidly became established as the most complete reference on the subject, but of course this is very much a fast-moving target — with developments coming at such a rate that an update soon became essential. Hence this new and revised edition, in a single volume for greater convenience.

As with the first edition, it's not a book for the faint hearted. But if you want a really comprehensive, detailed engineering level reference book on the theory and applications of spread spectrum communications technology, there's no question that here it is. It takes you all the way from basic principles, right up to the nitty-gritty of current and near-future commercial applications, and with more than enough detail to satisfy all except the most fastidious of specialists.

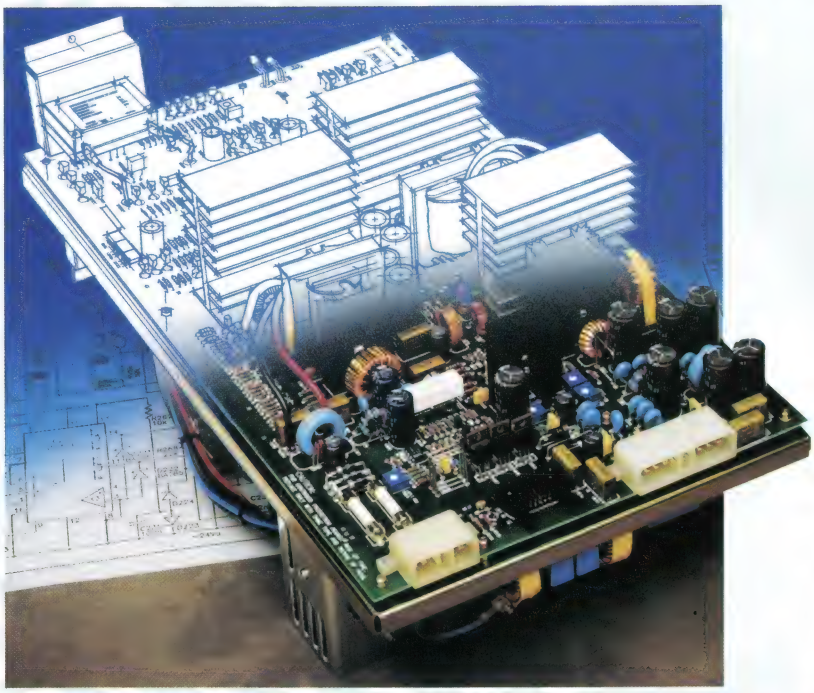
The review copy came from McGraw-Hill Australia, of 4 Barcoo Street (PO Box 239), Roseville 2069. Bearing in mind its specialised nature and price, you may need to order it direct; the phone number is (02) 4177003. (J.R) ❖







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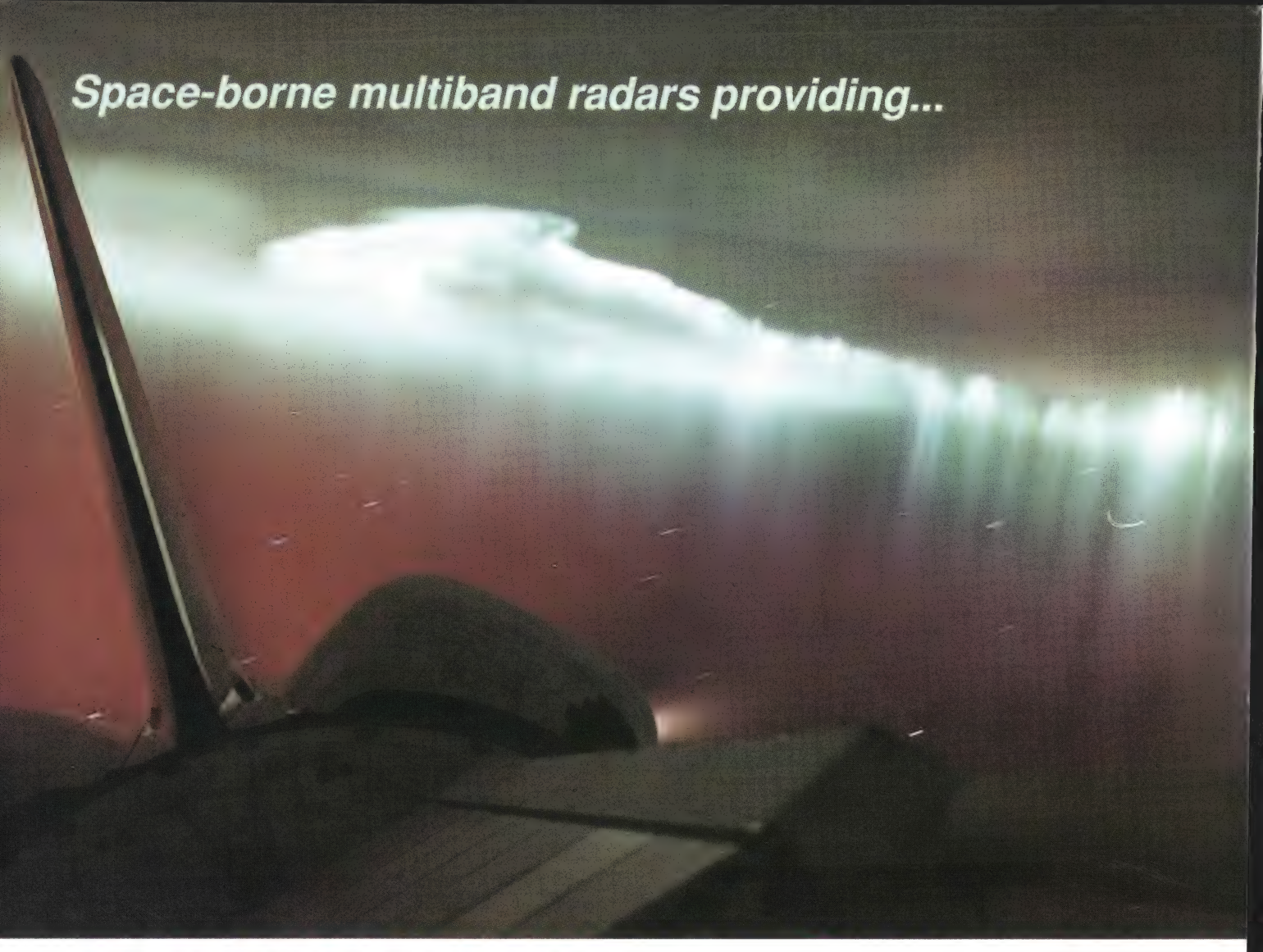
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A NEW VIEW OF PLANET EARTH

Earlier this year, a high-technology radar imaging system called the Spaceborne Radar Laboratory (SRL-1) was tested in orbit by NASA aboard the shuttle *Endeavour*, as part of flight STS 59. SRL-1 provided the first opportunity to observe the Earth simultaneously on different radar wavelengths and with dual polarisation, allowing high-resolution mapping in virtually all weather conditions.

When the Apollo astronauts visited the Moon during the late sixties and early seventies, they bought back some incredible photographs.

Most of these photographs were of the Moon but the images that caught the imagination of everyone were of the Earth from over a million kilometres away. We saw a fragile blue, white and brown globe surrounded by the black of space.

These images have been in constant use ever since the end of the Apollo program, and serve as a constant reminder of the fragility of our existence. They also remind us to preserve and protect what we already have.

As part of this effort, the US National Aeronautics and Space Administration (NASA) has begun a programme entitled 'Mission to Planet Earth' (MTPE).

by KATE DOOLAN

From the unique vantage point of Earth orbit, the MTPE will be observing, monitoring and assessing large scale environmental processes — which focuses on global change. The spacecraft data, complemented by aircraft and ground studies, will give scientists detailed data to help them identify human-induced environmental changes from natural forms of change.

NASA is distributing the Mission to Planet Earth data to the international scientific community, so it is available world wide to assist governments, organisations and individuals in making informed decisions about protecting our environment.

As part of the Mission to Planet Earth, the Spaceborne Radar Laboratory (SRL) made its debut on the space shuttle *Endeavour*, during flight STS 59 in April this year. The SRL was the first spaceborne radar system to simultaneously acquire data at multiple wave-



Above: The space borne imaging radar's antenna, with a mass of 10,500 kilograms, is being lowered into the cargo test equipment stand. The antenna has hundreds of small transmitters and receivers embedded in it and will almost fill the space shuttle's cargo bay. Left: Part of the Space Shuttle Endeavour against a colourful display of the Southern Lights.

lengths, and is a technological break through in the observation of Earth by radar.

Mapping by radar

Developed in 1951 during the midst of the Cold War, radar imaging was confined to military uses only and remained classified until 1964. The first use of radar mapping for civilian purposes took place in 1968, when a province in Central America was mapped. The province was constantly covered by cloud, and radar was the only way to do a thorough mapping of the area.

NASA has been using imaging radar to study the Earth and other planets since the late seventies, as it can collect data over any region — in particular, areas that are inaccessible due to remoteness, weather and/or light conditions. A spaceborne radar under certain conditions can penetrate vegetation, ice, snow and desert.

The first large scale radar observations from orbit took place when NASA launched the SEASAT satellite on 27 June 1978. For the next 105 days until an electrical short-circuit caused its demise, SEASAT operated pioneering spaceborne and other microwave equipment and gave scientists new views of the world's oceans.

In November 1981 during the second space shuttle flight STS 2, spare flight hardware from SEASAT was flown as the Spaceborne Imaging Radar A (SIR-A). Three years later on STS 41G in October 1984, equipment from SIR-A was rebuilt and reflown as Spaceborne Imaging Radar B (SIR-B).

One of the more amazing results from SIR-A was the discovery of ancient river beds and landscapes from under the sands of the Sahara Desert. This data has been used by archaeologists to assist in the search for evidence of prehistoric civilisations, as well as providing assistance in the search for oil and water. Another discovery was that of an ore-rich area in a remote Mexican desert.

The most public discovery from SIR-B was that of the Lost City of Ubar. Using data from the SIR-B, SPOT and LANDSAT spacecraft, famed explorer and adventurer Ranulph Fiennes led an expedition that located Ubar in the state of Oman in late 1991. According to mythology, the three wise men who visited the baby Jesus departed from Ubar, where they had picked up the spices and riches they needed for their journey.

Another successful space radar flight has been that of the Magellan spacecraft — which is still orbiting the planet Venus five years after launch, and returning excellent data.

Two instruments

The Spaceborne Radar Laboratory 1 (SRL-1) comprises two radar instruments, the Spaceborne Imaging Radar C (SIR-C) and the X-band Synthetic Aperture Radar (X-SAR), both developed by the Jet Propulsion Laboratory located in Pasadena, California in conjunction with the Deutsche Agentur Fuer Raumfahrtangelegenheiten (DARA, or the German Space Agency for short!) and the Agnezia Spaziale Italiana (ASI, or Italian Space Agency).

The Spaceborne Imaging Radar C was built by the Jet Propulsion Laboratory and the Ball Communications System Division. The SIR-C antenna weighs in at 10,500 kilograms — one of the heaviest payloads ever carried by the space shuttle. It measures 12 x 4 metres, and took up almost all the room in the space shuttle's payload bay.

Most of the SIR-C's surface is taken up by nine pairs of panels which make up the 12m

A New View of Planet Earth



A surprisingly clear photo of the San Francisco Bay area, taken by one of the STS-59 crew members from an altitude of less than 120 nautical miles. The city itself is in the very centre, with the Golden Gate Bridge to its left, and the Bay area on the right. Silicon Valley and San Jose are at lower right, with Sausalito and Muir Woods on the left.

x 3m L-band antenna. The 750mm wide C-band antenna is made up of 18 panels, running the full length of one side of the structure.

The images provided by SIR-C contain more information about the earth's surface than images collected by single frequency, single polarisation radars like SIR-A and SIR-B because SIR-C has been designed to transmit and receive both horizontally and vertically polarised radar waves in the 23cm (1300MHz) L-band and 6cm (5GHz) C-band simultaneously. SIR-C can transmit and receive waves in a horizontal plane (known as HH polarisation) or in the vertical plane (VV polarisation) or in combinations (HV and VH polarisation).

Multipolarisation data is useful to scientists studying vegetation, because the data allows them to see different types of crops and to estimate the number of trees contained under the canopy of a jungle, bush or forest.

SIR-C's radar beam is formed by hundreds of tiny transmitting antennas that are embedded in the surface of the antenna. The phasing of the energy that they emit is adjusted precisely to electronically 'steer' the radar beam, without moving the antenna itself. This electronic beam steering and the space shuttle's roll and yaw manoeuvring system allows the radar to acquire data at angles of incidence of 15° to 55°.

The X-Band Synthetic Aperture Radar (X-SAR) was constructed by the German aerospace company Dornier and the Italian aerospace company Alenio Spazio. The X-SAR is a single polarisation instrument that operates at a wavelength of 31mm (9.6GHz) in the X-band.

X-SAR uses a slotted-waveguide antenna, which is finely tuned to produce a narrow pencil-thin beam of energy. The X-SAR antenna is mounted onto a supporting structure that is tilted mechanically to align the X-band beam with the L- and C-band beams. X-SAR provides VV polarisation images. Like all microwave sensors, X- SAR can take measurements regardless of weather and lighting conditions.

The SIR-C and X-SAR instruments can be operated individually or simultaneously. The width of the ground swath varies from 15 to 90 kilometres, depending on the orientation of the antenna beams. The resolution of the radars can be varied from 10 to 200 kilometres.

During the space shuttle's flight, the radar antenna radiates towards a swath of the Earth and maps it continuously as the shuttle flies over its orbital path. Since the target stays in the radar beam for a while, the radar can observe it from many locations along the flight path; the collected echoes form a 'Doppler history', which is summarised for ground processing. A synthetic antenna is created, whose effective aperture length equals the distance the space shuttle travels during the summation period.

Four hundred sites

Over four hundred sites around the world were selected to take data from during the flight of STS 59. Nineteen of these sites were selected as 'supersites', making them the

highest priority targets and the focal point for many of the scientific investigators. The supersites and their backup sites were representative of environments that were the focus of the study by the scientific disciplines of hydrology, ecology, oceanography, geology and calibration. These activities complemented other national and international measurement programs like the European Resources Satellite 1, the Japanese Earth Resources Satellite 1, SPOT and LANDSAT.

Four of the supersites — Oberpfaffenhofen in Germany, Flevoland in the Netherlands, Death Valley in California and Kerang in Victoria — were equipped with instruments to measure the amount of SIR-C/X-SAR radar energy received on the ground during the flight. This information was used after the flight of STS 59 when the radar data was being processed, to help scientists calibrate the radar data.

During the flight, 'ground truth' teams at different sites made ground or sea-based measurements of vegetation, soil moisture, sea state, snow and weather conditions as the space shuttle passed over the sites. This data will be supplemented with information taken from aircraft and ships, to ensure the accurate interpretation of the data taken from orbit. In addition, the STS 59 crew recorded their personal observations of weather and environmental conditions, in coordination with SIR-C/X-SAR operations.

The science teams used the SRL-1 flight to perform ecological studies such as identifying the volume, extent and type of vegetation in various regions around the world; hydrological analysis of soil moisture and ocean waves; plus surveys of geological structures in the Sahara Desert, Andes Mountains and Galapagos Islands.



Astronaut Linda M. Godwin talks to students via the Shuttle Amateur Radio Experiment (SAREX), from the mid-deck of Shuttle Endeavour.

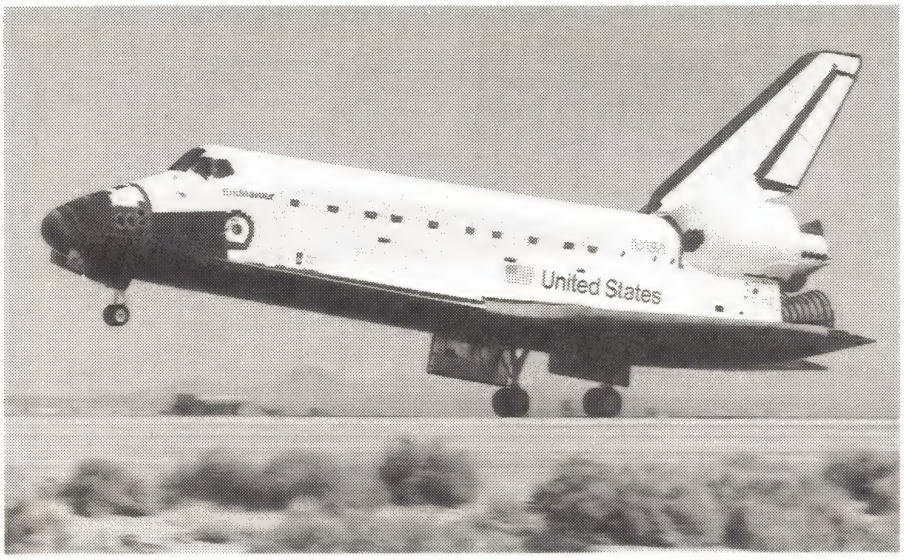
Digital recorders

SIR-C/X-SAR was designed to collect 50 hours of data, covering approximately 50 million square kilometres. All data was stored onboard the space shuttle using a new generation of high-density, rotary head digital tape recorders. There were 180 digital tape cartridges carried onboard *Endeavour*, to record all of this data. The tape cartridges are similar in size and appearance to VHS videotapes. Portions of the data collected was down linked to the ground by the Tracking and Data Relay Satellite System (see *EA*, June 1993).

Ultimately, the mission returned 32 terabits (32 million million bits) of information, which is equivalent to 20,000 encyclopedia volumes. To put it another way, the two radars together can produce 285 megabits of data per second — which is about the same as the output produced by 45 simultaneously operating television stations.

The raw data was processed into images using digital SAR (synthetic aperture radar) processing at the Jet Propulsion Laboratory, DARA headquarters in Oberpfaffenhofen and at the ASI in Matera, Italy. Historically, processing SAR data has taken a massive amount of computer time on special-purpose computer systems. However SIR-C and X-SAR scientists have benefited from rapid advances in computer technology, which have made it possible to process the images with a standard 'super mini' class computer. Even with those advances however, it will still take five months to produce a complete set of survey images from the large volume of data that was acquired. Detailed processing will take another nine months to complete.

One of the areas that SIR-C and X-SAR are exploring is the Arabian Desert, in an attempt to locate the hypothetical canal that may have been a barrier for the Israelites fleeing Egypt, in the Old Testament story of Exodus. Traces of such a canal were discovered in a series of aerial photographs taken by the Israeli air force during the seventies, but radar images from space could uncover the more definite evidence required.



The main landing gear of the Space Shuttle Endeavour touches down at Edwards Air Force Base to complete the 11 day STS-59/SRL-1 mission, at 9.54am on April 20th 1994.

Delayed launch

The launch of STS 59 was originally scheduled for April 7, but this was pushed back two days when NASA managers ordered checks on *Endeavour*'s three main engines for flawed pumps.

On April 1 an engineer at Rocketdyne, the engine's manufacturer had found that the vanes in the engines were cast below the standard specifications. This meant that if the vanes cracked in flight, it could cause a shutdown or explosion of the engine.

The vanes in *Endeavour*'s engines were found to be satisfactory and at 7:05am (local time) on April 9, *Endeavour* was launched from Pad 39A at the Kennedy Space Centre in Florida with a crew of six astronauts.

Commanding STS 59 was Sid Guttierez and pilot Kevin ('Chilli') Chilton. The Payload Commander was Linda Godwin, with Mission Specialists Jay Apt, Rich Clifford and Tom Jones — an astronaut, not the singer! All except Jones had flown in space previously. To

A New View of Planet Earth

enable the crew to work in continuous 24-hour shifts, they were divided into two teams — the 'blue shift' which included Guttierez, Chilton and Godwin, and the 'red shift' which included Apt, Clifford and Jones.

In a press conference before the flight, Jay Apt stated that the crew had trained for the Earth observation flights with the same intensity that some crews train for rendezvous flights — which are normally considered to be the most difficult task of space flights.

After the short eight and a half minute trip into orbit, the crew made preparations to activate the SIR-C and X-SAR equipment. However problems cropped up during the activation of the X-SAR, when the high power amplifier failed to provide power to the systems antennas. Ground controllers decided to turn the X-SAR off, to consider options for further activation attempts. After three hours of testing on the ground, it was decided to restore power to the amplifier and a good response was received. The controllers decided to continue a deliberate step-by-step check of the instrument and eventually they were able to bounce X-band radar pulses of the Earth's surface and successfully obtain data.

Over the duration of the flight, *Endeavour*'s crew was kept busy by executing 412 planned manoeuvres of the shuttle and continuously updating the digital autopilot to maintain the optimal viewing position for the SIR-C and X-SAR. The crew used zero Doppler steering of *Endeavour*, to remove any blurs that were created in SRL-1's radar images by the Earth's rotation. To avoid this, the crew had to feed in autopilot changes every 60 seconds, to maintain a yaw rate of 0.003° per second for the orbiter.

The crew also yawed *Endeavour* 180° forty times during the mission, to point its nose and tail in the direction of flight to image specific targets. SRL-1's radar were canted 14° to the right in the payload bay of *Endeavour* which generally orbited in a roll attitude of 26° to maintain a viewing angle to the Earth of 40° for the radars. *Endeavour* was flown nose forward to view targets north of its orbital track, and tail forward to view targets to the south.

The performance of *Endeavour* during the flight was excellent, which allowed the crew to spend all of their time on scientific work.

The crew did however report finding air bubbles in their water supply (which can often cause stomach upsets or flatulence), so it was decided to connect a water dispensing hose directly to the main supply tank — bypassing the normal water supply.

Amateur radio link

All through the flight, astronauts Linda Godwin and Jay Apt used the Shuttle Amateur Radio Experiment (SAREX).

This was developed by NASA, the American Radio Relay League and the Amateur Radio Satellite Corporation to encourage public participation in the space program, through the use of shortwave radio transmission between the space shuttle and ground-based radio operators. Through this very successful program, hundreds of thousands of people have been able to talk to and eavesdrop on the astronauts.

During the STS 59 flight, the astronauts successfully contacted cosmonauts on the Mir space station, which was monitored in real time by many amateur radio stations via telebridge and rebroadcasts. Later in the flight, Jay Apt used SAREX to contact his colleagues Bonnie Dunbar and Norm Thagard, who are currently training in Russia for a joint flight to Mir early next year. Nine schools from the United States, Finland and Western Australia also had the opportunity to speak to the astronauts for short periods of time.

The STS 59 flight was extended for one day after the weather at the Kennedy Space Centre was not suitable for landing. The crew had already deactivated the SIR-C and X-SAR, but they were able to re-activate SIR-C to make additional observations.

They also used their time to take more photographs of the Earth. *Endeavour* carried some 14,000 frames of film, for four Hasselblad cameras and two Linhof cameras. By the end of the flight, most of the film had been used and the Earth photographs taken on that flight were among the best ever brought back from space.

Back to earth

After a flight of 11 days and 188 orbits of the Earth, *Endeavour* landed at the Edwards Air Force base in California at 11:54am (local time) on 20 April. During the flight, *Endeavour* had mapped more than 70 million square kilometres of the Earth, which represented some 12% of the Earth's total surface and 25% of the planet's land surface.

The SIR-C and X-SAR payload was due to fly again on STS 68 in late August to provide radar, ground and optical observations during a different season on Earth. To provide continuity between the two missions, astronaut Tom Jones who flew on STS 59 was to fly again as the Payload Commander.

The success of STS 59 has had some scientists calling for a permanent radar mapping satellite in orbit, but this has not been acted on yet. The scientists state that a limited-duration space shuttle flight limits the amount of data that can be collected. It would cost $150 million dollars to build a free flying satellite, which is half the cost of the SRL-1 flight. So for the present, we have turned away from exploring space and have begun to focus on exploring the most important planet of all for humans: Earth.

In closing, the author wishes to thank Debbie Dodds of the Johnson Space Centre, Jim Elliott of the Goddard Space Flight Centre, Kay Grinter of the Kennedy Space Centre and Mary Hardin of the Jet Propulsion Laboratory for their assistance in the completion of this article. All photographs shown are by courtesy of NASA.

Finally, for readers who would like more information on the discovery of the lost city of Ubar, I can recommend the book *Atlantis of the Sands*, by Ranulph Fiennes (Penguin Books). ❖

Here come the Fanders!

Continued from page 23

two turtles to do a square dance. Such is the beauty of Forth...

In the real world

So what's all this really good for? Well, pictured herein is a commercial floor-cleaning machine which is receiving a transplant of turtle guts by Branch and Associates. It's going to be one enormous Fander robot when it's finished, enhanced with some spinning brushes and squirting water.

The stock-standard machine needs an operator to walk along behind it, steering it to systematically cover the whole floor. Once it's Fanderised, the machine will move about on its own, possibly following lines painted on the floor, or using its sonar to follow the walls.

The machine seems to weigh a ton, as we discovered when trying to get it out of the shed to photograph it. It's filled with heaps of lead-acid batteries and a big tank of water. So its motors have a heavy load to move around. It was necessary to modify the drive system so the two wheels can be controlled independently, but now with shaft encoders attached to the left and right axles it should move and steer just like the traditional turtle.

Of course the question now arises, what happens to the machine's former operator? Another 'redundancy'? I'll bet he's hoping the thing runs over a hospital patient or something. It's up to Branch and Associates designers to ensure this is impossible.

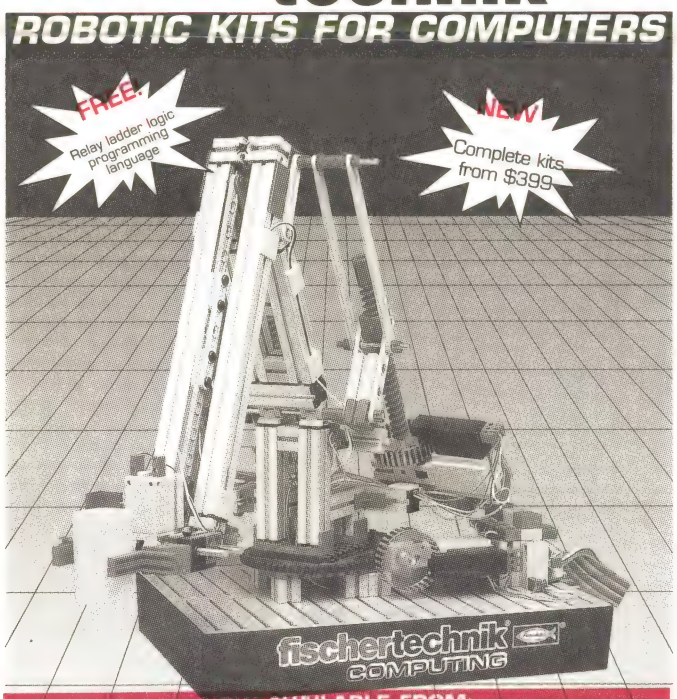
The bottom line

If all this makes you want to run right out and buy a Fander-1 robot, it won't come cheap. The unit is priced at $US5500. That won't fit on too many Bankcards, but institutions such as universities seem quite happy to cough up for such a useful educational device. The price is probably justified when you realise that every Fander-1 is hand made, and a production run is measured in tens instead of thousands.

What surprises me a bit is that Branch and Associates are prepared to offer their technology to users who will learn about it and then go into competition with them. Because that's certainly what's going to happen when university graduates trained on Fander-1's get out into the workforce. That floor-cleaning machine is only the beginning... ❖

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Mini 'Construction Project':

LOW TECH ACOUSTIC AMPS

The other day, in his kitchen of all places, Tom Moffat rediscovered an old but still quite practical technology for acoustic amplification. Luckily for us, he couldn't resist the temptation to pass on the details of his discovery to *EA*'s readers — in his usual entertaining fashion...

by TOM MOFFAT

We have all heard the term 'political correctness'. But have you heard of 'technical correctness'? Technical correctness stipulates that if a particular technology exists, we must use it. To avoid the latest whizz-bang gimmicks, to revert to the old ways, is to be living in the past. And this is Not Correct.

Technical correctness is using a computer to store your recipes. Technical incorrectness is to do what I do — recipes for such delicacies as 'Moffat's Murderous Chile-Pepper Beef Jerky And Instant Laxative' live in a notebook made of paper, instead of a notebook computer. My address book is not the personal organiser in my palmtop computer; instead it is on many scraps of paper that circulate around in my top desk drawer. Who shall I ring today? Give them a stir and phone the slip of paper that comes out on top!

Now as for electronics, one would think that if there is an electronic way to do something, we, especially as aficionados of this electronics magazine, would use electronics. Well, today we are going to commit the ultimate sacrilege: we will look at some useful amplification and communication techniques without once mentioning a wire, or a transistor, or even a valve...

This whole idea came about by accident. I have a small amateur-band VHF walkie-talkie which, with its general coverage receiver, makes a very nice scanner. Trouble is, with its tiny speaker it's not very loud, and I had been thinking about adding an external speaker and amplifier to give it a bit more oomph.

One day this radio was sitting on the kitchen counter in its usual spot, scanning away, when I spilled a cup of coffee. As a brown flood gushed toward the radio, I grabbed it and popped it into a large pottery bowl that was sitting nearby. This kept the radio high and dry as I cleaned up the mess; but then a call came through: "VKT TO ALL UNITS!"

The mild-mannered copper, sitting at his dispatch console, ROARED out of



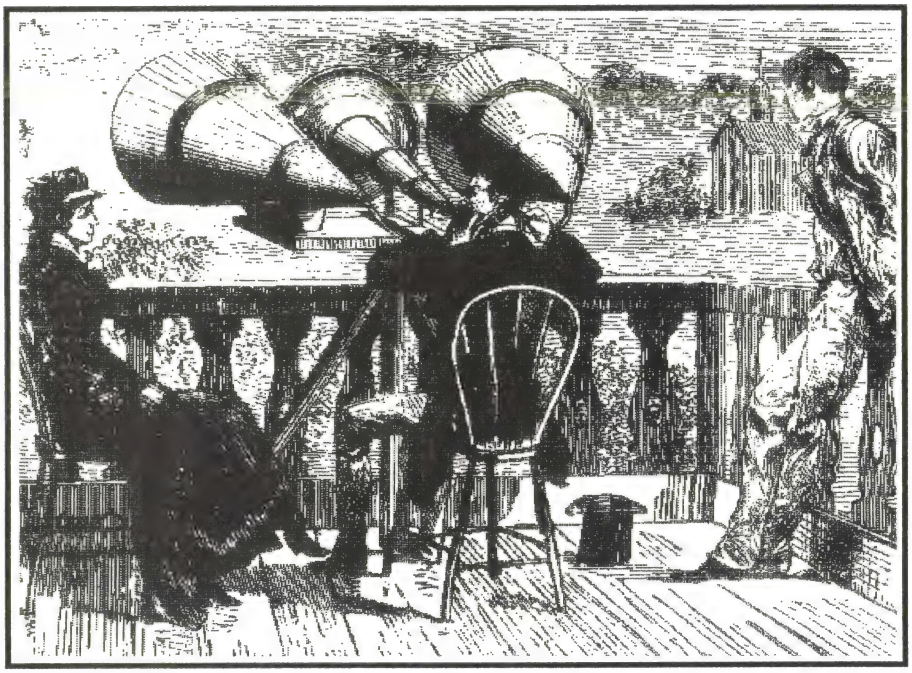
my scanner. How come? Acoustic amplification, that's how come. The bowl was most likely acting as a transformer, matching the strange acoustic impedance of the radio's tiny speaker to the acoustic impedance of the surrounding air. Nothing was made more powerful, just more efficient. So, scanner owners, you can consider this a project for this month. Construction details of the scanner amplifier should be clear from the accompanying photo. I notice that the offending coffee mug, my favorite with the picture of Mister Ducky on it, is still in view.

Selection of materials is important. The bowl in the photo is of handmade ceramic with a very hard and reflective glaze, especially for sound waves. So it is comforting to know that this scanner amplifier will withstand temperatures up to 900°C if required. However I have not tested the radio at this temperature.

I tried the scheme with similar sized bowls made of other materials. A wooden bowl did not have near the amplification (damped resonances?). A plastic Tupperware bowl was even worse — totally useless. I tried a round metal biscuit tin of the same size and it sounded, well, tinny. So it's best to stick with ceramic pottery.

Acoustic amplification, and communication, is not such a rare thing. It's just that the interesting technology behind it is seldom recognised for what it is. Take the Sidney Myer Music Bowl in Melbourne — it's just another bowl after all, although a bit bigger than table-top size.

Sometimes these things occur naturally. I remember as a kid living in the USA, there was a rest stop along the highway between Albuquerque and Santa Fe, in New Mexico. A track led from this parking area to a cliff about 10 minutes walk away. The cliff was carved by wind and rain so that it was shaped like a parabolic reflector, facing back out toward the road. You could stand in the 'focus' of this reflector and speak in a normal voice, and



the cliff would project your words back so they could be heard clearly in the car park — which must have been a good kilometre away.

This cliff, of course, worked in both directions, so you could hear as well as talk. I remember during one memorable trip to 'Echo Rock', we were having a picnic right at the focus point. Back at the road, a car pulled up, containing an amorous young couple who just couldn't wait to get back to town. Nobody was about, so they proceeded to do what comes naturally.

The sould effects of this activity were clearly audible back at the cliff. And when the deed was done, the participants were rewarded by a mighty cheer coming from — who knows? They didn't stay around to investigate.

Parabolic reflectors, of a much smaller size, are now used to record sounds from shorter distances, but they are still very effective. They are a favourite with ornithologists, who want to record bird songs, and they are also used by private eyes intent on capturing the kinds of sounds referred to in the paragraph above. This is sometimes referred to as 'evidence'.

I once took part in an interesting test of long distance acoustic communication during a bushwalking trip. We used Boy Scout whistles, over a distance of a kilometre or so.

We transmitted Morse Code, keyed by quick flicks of the tongue at about 15 words a minute.

And it worked great! Only trouble is, experienced Morse operators are needed at each end of the path, and you don't find too many of those in the bush nowadays.

So voice is the only way to go; just ask that wily old inventor Thomas Edison. Pictured herein is an engraving of Edison's 'Megaphone'. This illustration appeared in the book Popular Scientific Recreations, published over 100 years ago.

The instrument was made from three cones of cardboard. There was one cone for each ear, connected thereto by tubes of 'india-rubber', with the central cone equipped with a mouthpiece for speaking. According to the book it was 'fixed upon the balcony of Mr Edison's house. At a mile and a half distant from the house another instrument was fixed, and conversation was carried on easily'.

Within this quaint tranquil scene, Edison's lady friend looks on with admiration while the great scientist determinedly transmits a message about his assistant standing to his right: "Will somebody get this guy outta here? He keeps using my hat for a spittoon!" (Only joking, I think.)

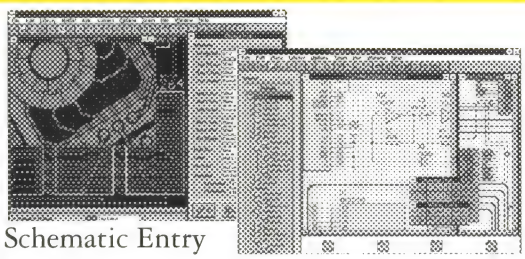
So what of the futre of acoustic communication? Well, it is still as practical as it was a century ago. You may remember the old dance bands of the 1930's, in which the singer bellowed sweet words of love into a megaphone.

The band I play with, Burglar's Dog, still uses a megaphone. At Hobart's Salamanca Market where we play from time to time, electric amplifiers are totally verboten.

So the lead singer belts out the lyrics into a big round hole in the end of a fibre cone. Trouble is, the megaphone achieves its gain by virtue of a narrow radiation pattern. So the singer must bob and weave from side to side if the entire audience is to hear.

Of course, this action also enables him to dodge the rotten tomatoes... ❖

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When I Think Back...

by Neville Williams

Harry Mauger - 1: Photographer, radio technician, amateur, soldier and recording engineer

Born in 1921 in the rural fringe of Melbourne, Harry Mauger's boyhood interests were bushwalking and things mechanical and electrical — including hobby 'wireless'. Turning down an art scholarship, he took an electrical course at Swinburn College and a radio course at RMIT, gaining initial work experience at Eclipse Radio. This led in a roundabout way to a rewarding career, in the recording and production of analog discs and tapes at all three of the Astor/Mercury/Philips Melbourne facilities.

How this story came to be written is a somewhat odd tale. Having compiled stories on Sydney's Thom & Smith and Stromberg-Carlson, my thoughts strayed to pioneering factories in other centres — such as Eclipse and Astor in Melbourne. There my ideas faltered, because I could not recall any personal contacts from Eclipse and only one from Astor — a disc recording engineer whom I used to consult on occasions when preparing the record review columns for this magazine.

His name, I recalled, was Harry Major, pronounced and presumably spelt that way. He was a few years my junior but would, by now, have been well and truly retired. Where he might be living and in what state of health, I thought might be difficult to establish.

Then, out of the blue, I received a letter from a Melbourne reader describing an historic multi-channel microwave link between Melbourne and Sydney, set up by the Armed Forces in September 1945. He hoped that I might remember him, having once shared the platform with him at a hifi presentation to the IREE.

He signed his name 'Harry Mauger', which I pronounced — mentally — as 'Morger'.

I hesitated to reply in the negative but, try as I might, I could not recall ever having met a Harry 'Morger'. So I put the letter aside, hoping for possible inspiration.

It had apparently been prompted by a mention in the January 1994 issue of carrier telephone systems. Correspondent 'Harry M' said that some people seemed to believe that, using a UHF radio link, the Channel 9 organisation had set up the first ever carrier telephone circuit between Sydney and Melbourne in 1956, to support their coverage of the Melbourne Olympics.

In fact, he said, the two cities had been directly linked by an eight (voice) channel, pulse modulated 10cm (4500MHz) UHF system in 1945, just before the end of the war. It had been set up by the 1st Multichannel Wireless Section of the Australian Army Signals, using then-new equipment known as the '10 Set'.

Very advanced for its time, technical details of the equipment were initially shrouded in tight secrecy, although subsequently publicised in *Wireless World* for June and September 1946. The '10-Set' had reportedly carried crucial cross-Channel communications for D-day, offering much greater security than other radio links (a) because of the narrow transmission beam and (b) because there would be little risk of the enemy being able to decode the very complex modulation at short notice.

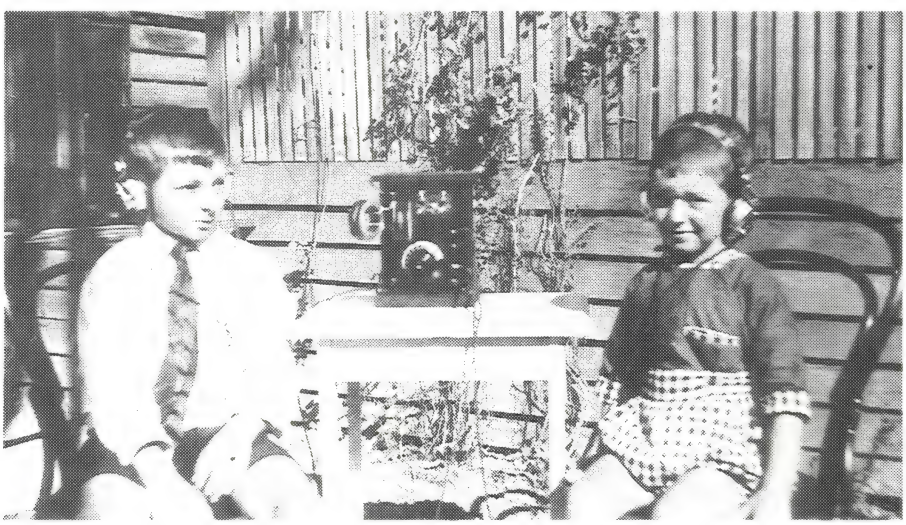


Fig.1: Harry Mauger in 'rompers' and his older brother (left) pose with headphones and a crystal wireless set constructed by their father. Both boys subsequently pursued a career in radio.

A different 'Major'?

Interesting as it might have been, the letter offered no other clue to the iden-

tity of the writer, and it remained in the 'too hard' basket until April when, for some reason, Astor again came to mind. Then suddenly something clicked and I recalled — vaguely — that Harry 'Major' had spelt his name in an odd way... Harry Mauger, of course!

When I duly rang and apologised for my memory lapse, it was to uncover a bonus: not only had Harry been a prominent and very helpful recording engineer for Astor — that would be a story in itself. He had also 'learned the ropes' pre-war at the Eclipse factory, which had susequently been taken over by Astor. (So *that's* what happened to them!)

While an article on Eclipse remains at best 'a possibility', I now have two contacts, the other being Graeme Mackenzie of Brighton, Vic. However, I would certainly like to hear from other old-timers who worked at Eclipse, especially if they could help with photos, magazine clippings, advertisements or brochures that could serve to illustrate a future article. The information can be posted to me via the Editor at the *EA* office. In the meantime, let's hear from Harry Mauger — pronounced 'Major':

Harry says he was born in Box Hill, an eastern suburb of Melbourne, in May 1921. His boyhood was spent mostly at nearby Blackburn, 'when it was mainly bush and orchards'. Sometimes with his father, but often alone, he would spend endless hours wandering through the bush, looking at the flora and fauna and setting the scene for a lifelong hobby of wildflower photography — which he has since pursued 'all over Australia'.

At the same time, he was picking up an interest in popular science from a father and grandfather who dabbled in things mechanical and electrical. This was in a 'country' style family home, mechanised by a one-cylinder kerosene engine to pump water and maintain a 12-volt electricity supply based on 'big, glass accumulators'.

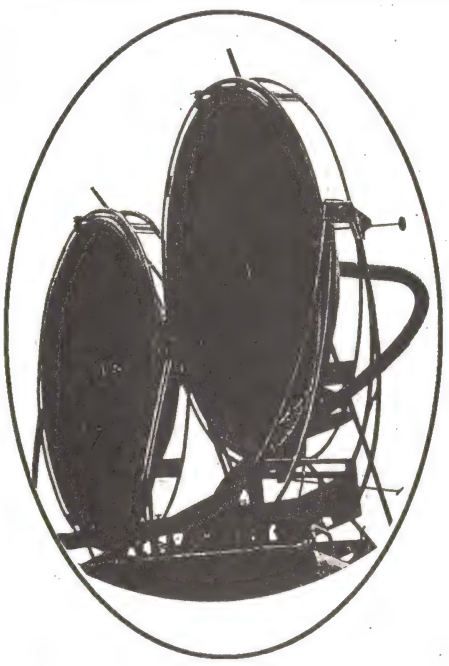


Fig.2: From the cover of 'Wireless World', September 1946, this photo shows the twin parabolas atop the military trailer carrying a complete '10-set' and power supply. Two such units cabled back-to-back could function as a repeater.

Hobby became career

In the early 1920's the Mauger household was also involved in crystal and small regenerative radio sets, which ultimately enticed both Harry and his brother into radio careers (Fig.1). His brother started out with Howard Radio, became Service Manager for Vealls, joined the RAAF and finished up in the Measurements Lab of DCA (Dept. of Civil Aviation).

Harry himself was educated at Blackburn State School and Swinburn College, gaining excellent credits. With jobs in radio rather few and far between, his father managed to get him a position as a junior wirer at Eclipse Radio in Melbourne, for the princely sum of thirteen shillings ($1.30) per week. Fortunately, those were the days when a trainee could buy a hot meat pie for threepence (3c) and an economy three-course meal for ninepence (10c). I know, because I often did!

Harry's job involved being issued with parts for a radio — most commonly a five-valve mains powered superhet — which had to be assembled, wired and got to 'the plug-in and get a signal stage', in an elapsed time of one hour and 45 minutes.

In the process, Harry became familiar with complex circuits, learned to recognise components, and developed skills at assembly and wiring. At night, at RMIT (thanks to a scholarship from Swinburn) he studied radio technology under Dr McKay.

Once again, Harry performed better than average and was adept enough to accumulate 'spare time' from assembly duties, enabling him to watch receivers being serviced and/or aligned by senior trainees. In due course he, himself, became a tester and a 'final OK' man earning £2.10.0 ($5.00) per week.

According to *Mingay's 1939 Radio Trade Annual*, Eclipse was an active and enterprising firm in the 1930's, with its factory at City Road, South Melbourne and branches at Sydney, Brisbane, Adelaide and Perth. Eclipse produced a wide range of house brand components, plus complete mains and battery powered receivers and were also a wholesale supplier of components, local and imported — including Empire phono pickups and motors, Tungsol valves and Plessey capacitors.

They also supplied unbranded receivers for sale under other distributors' logos, such that in Sydney, the first receivers sold by Reliance Radio came from the Eclipse factory, loudspeakers and all!



Fig.3: The Harry Mauger that I remember from the 1970's — not always with shirt and tie! He was singularly well informed about what was going on in the sound recording industry.

Interlude in Sydney

In 1939, Eclipse's Sydney Branch was beset by more then its fair share of technical problems, and Harry Mauger was despatched to sort them out as the Company's factory-trained trouble-shooter. Harry still has painful memories of arriving at Sydney's Central rail station, 'suitcase in hand and mouth open', wondering where all the people were coming from and hurrying to!

Fortunately, the Branch Manager, Mr Salmon was there to meet him and saw him settled in a comfortable boarding house at Bondi.

At home, Harry had been accustomed to plenty of music. His father was an accomplished pianist, who earned extra

money by providing musical accompaniment for silent movies. For good measure, the Maugers also had a three-manual Bell organ in the living room — no mean instrument in those days.

Perhaps it was the comparative quiet of the boarding house that induced him one day to walk into the Harmony House Recording Studios in York Street, Sydney. There he met and made friends with the Proprietor's son and an ex-BBC recording engineer they had on staff. During the next few months, hours of discussion followed on recording, amplifiers and sound, from which they all probably profited.

In 1940, Harry returned home and to a job in the Eclipse Research Lab — and for good measure, joined the Army Reserve in Infantry Signals. Called up soon after, he promptly applied for a transfer from Infantry to Divisional Signals, with the idea of exchanging switchboards and (''would you believe?'') flags and Lucas lamps for (then) modern military radio transmitters and receivers!

Divisional Sigs sent him back to RMIT, where he was re-taught much of what he had already learned — plus the theory and practice of PMG-style carrier telephony systems.

A different world

Harry's first assignment after training was to be one of team of five, charged with the responsibility of maintaining all Army Signals equipment between Albany and Geraldton in Western Australia.

From there he had to make a memorable trip by train across the Nullarbor, then by sea to Townsville in Qld, and overland by truck to Cape York. He spent two years there and in the Torres Strait Islands as a staff-sergeant, servicing Army Signals equipment, including field transmitters up to a half-kilowatt — not always an easy job in such circumstances!

In 1944, Harry was sent back to Melbourne to work on a 'hush-hush' project. Having been duly sworn to secrecy, he became one of a group to be sent to the Radiophysics Lab at Sydney University to learn the wonders of magnetrons and klystrons, and how radio signals could be sent along pipes called 'waveguides', to be focused and radiated by parabolic dishes. Says Harry:

"We were taught how to plan signal paths at UHF using contour maps. We were then sent back to Melbourne, where we were introduced by two English sergeants and a captain to the '10 Set'. The very latest in Army Radio, it could simultaneously handle eight audio channels, pulse-width modulated and transmitted at 10cm."

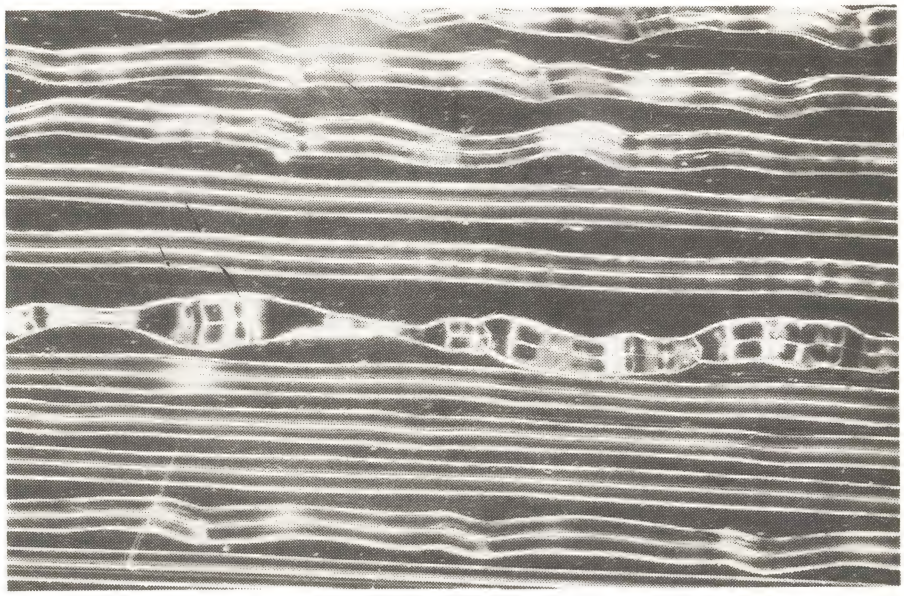


Fig.4: 'Oops!' One of Harry Mauger's own photos showing a sudden transient breaking through into the adjacent groove. To minimise the risk of such an eventuality, some recording lathes had provision for manual or automatic variation in the pitch of the groove spiral while a recording was in progress.

"Nothing like this had ever been heard of at the time by non-specialists, and our job was to train selected groups in the mysteries of this equipment and turn them into field operators."

"Our first tryout and probably the first use of 10cm pulse modulated communication in Australia was from Balcombe Military Camp across the Bay to Flinders Park near Geelong — about 70 miles. We learned two things from that experience:

(1) Rain could affect 10cm signals at that distance and

(2) As our line of sight was grazing the water, the rising tide could also result in loss of signals, obliging us to relocate the equipment further up the mountain."

Intercity phone link

The next exercise was to establish a telephone link via a chain of bases between Sydney and Melbourne, to demonstrate the systems's utility and reliability. Two units could be cabled together to form a repeater, each unit being mounted in its own trailer with dish aerials, dipoles, etc. folded on top for travel — and a 230V petrol driven generator in a compartment at the rear (Fig.2).

Valves used included a magnetron, with EF50's in all other stages, thereby greatly simplifying the situation with regard to spares.

Each audio channel could be split into three teleprinter channels, each capable of 66 words per minute, putting the traffic handling capacity of the equipment ahead of anything else available up to that time. Says Harry:

"The exercise was headed up by Captain (later Lieut. Colonel) Jacoby, whose headquarters were at a relay site on Mount St Leonard, about 80km out of Melbourne."

"Once established, the respective ends of the link were connected into the PMG system in each city. You may recall that, at this time, to place a call from city to city, it was necessary to go through a manual switchboard and wait your turn to be connected."

"Imagine the novelty of being able to dial a number directly from one city to the other; the Top Brass were suitably impressed!"

"As it happened, a day or so after the system was in place, the war ended and, as I had a job to go back to, I was demobilised promptly. As a result, I went back to Eclipse — by now taken over by Astor — as a project engineer."

Wide-ranging experience

Harry's first post-war assignment for Astor/Eclipse was to complete and have approved a large PMG contract for ABC Program Termination Equipment, Type EY-1. It consisted of multiple Program amps (amplifiers) bridging amps and attenuators, in eight-foot (2.5m) racks. It provided invaluable audio experience.

20,000 MASTERS: PORTRAIT OF A DISC RECORDING ENGINEER

In *Electronics Australia* for January 1979, an article by Bill Hawtin, President of the Audio Engineering Society (Melbourne) commended the productivity of the Astor/Mercury disc record enterprise. During the previous year (1978) the Company's Chief Recording Engineer had cut his 20,000th master disc!

Like many other technician/engineers of the era, Frank Hulbert had come up the hard way. Born in London, he had been obliged to leave school at 14 and help support the family.

Starting as a 'tea boy' at an electrical company, he showed sufficient interest and aptitude to begin training as a lathe operator, which later stood him in good stead. However, an asthmatic condition was aggravated by factory conditions and, at age 15, he obtained a job as a stage hand at the London Coliseum Theatre, which introduced him to the world of showbiz.

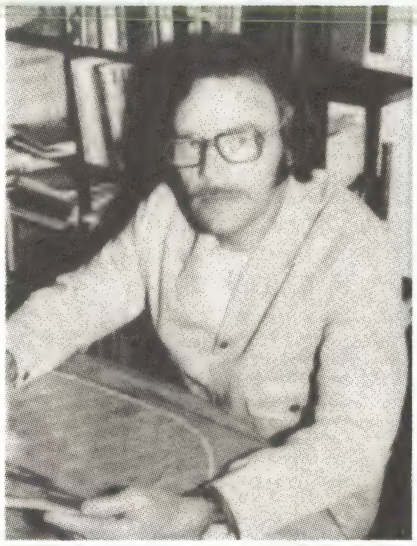
Frank joined the Army in 1943 and became a Bofors gunner in the Thames Estuary. There he was exposed to radar equipment and gained an interest in things electronic.

Back in civvies, he took a job as a comptometer operator and hated it. He turned instead to importing jazz records in small numbers from the USA and selling them in the UK by mail order.

From there, he combined his earlier interests and, in 1948, purchased a small disc recorder which he used to cut acetate discs for sale back to the musos in jazz clubs for fifteen shillings each. With the help of a photographer friend, his discs were later embellished with a suitable label and packaged with a picture of the artist. Frank had created his own 'Discophoto' label. In this environment, he developed musical skills of his own and ended up as percussionist in the Burne Regal Quartet, as well as playing as a professional around the London Club circuit.

About this same time, tape appeared on the scene and Frank invested in an early model Ferrograph. He made recordings, had them cut as LP's and advertised them through *Melody Maker* magazine. For good measure, he was also a foundation member of the Glen Miller Society.

Still troubled by London's fog laden atmosphere, however, he headed for Australia in 1955 and joined Astor/Mercury in their 'Tin Shed' factory in Richmond in 1956. To his extreme delight, they paid him to audition jazz records — this at a time when they were often obliged to use their Connoisseur lathe to dub masters from imported pressings of sometimes dubious merit.



But better things lay ahead, and when Astor Records moved to Huntingdale with its sharply upgraded equipment and conditions, the self-taught boy from London was given his big chance as Recording Engineer.

Twelve years later (1978) and still operating the faithful Neumann equipment, his personal log showed that he had cut his 20,000th master — a staggering figure when one considers the implications of making any one recording. Thinking back in 1979, he volunteered these memories:

MY SILLIEST BOO-BOO: Recording a Tom Paxton single and inscribing the matrix number over the run-out groove!

MOST CURIOUS LP: 'Sounds of Silence', with normal looking but unmodulated tracks — presumably for checking acoustic feedback.

SHORTEST LP: A Trini Lopez album at 9-1/2 minutes per side!

LONGEST LP: A Caruso re-issue with one side lasting 37-1/2 minutes!

MOST EXCITING LP: Australia's first direct-cut LP.

MOST HAIRY MOMENT: A swarf problem which nearly wrote off the above!

TIME TO RETIRE: When he found himself keeping time by tapping his feet to tempo, when mastering from a steam train tape!

Next, he spent months getting Astor Radiosonde production under way.

He was then transferred to the Astor Research Lab, to work on audio gear and radiograms. At this stage, Astor was producing a high quality radiogram with a wideband tuner, separate bass and treble controls, a proper preamp for the pickup, a push-pull Williamson type amplifier and multiple loudspeakers in an elaborate cabinet.

About this same time, an Astor executive, a Mr McGregor, had visited America on a business trip and had met the people at Mercury Records. They had convinced him that, as Astor was producing consumer hifi equipment, they should also consider marketing hifi records to go with it. All fired up, he approached Harry Mauger and the Company's electroplating specialist, Colin Swan, and requested them to investigate 'mother' and 'stamper' production, along with master recording equipment for record production. Harry said that he headed for the Public Library to find out all he could about the subject (Fig.3).

McGregor himself contacted Johns, who made moulding machines, with a view to adapting one of their designs to moulding records. Dies were imported from the USA and Harry Mauger and Colin Swan directed their joint efforts towards setting up a Master Cutting and Plating Centre. At this juncture, a specialist by the name of Charlie Gendle, who had been a Technical Manager to ARC (Australian Record Company), was persuaded to join the Astor Group to help set up Mercury (Australia) in a factory at Richmond, Melbourne. This was in the early 1950's.

The word 'factory' comes from Harry's own notes, on which I am basing this article. In terms of producing even 78rpm discs, it would appear to have fallen somewhat short of the ideal environment.

Writing in January 1979 issue of this magazine, Bill Hawtin, President of the Audio Engineering Society (Melbourne) recounted the setting up of Mercury Records in Australia in less expansive terms. I quote: "The Record Company was housed in a tin shed in the suburb of Richmond."

When I brought this to Harry's notice, he conceded that as factories go "it was a pretty terrible place" with a leaky roof, no internal partitions and few amenities. Nor was it improved when they started milling operations, which further blanketed eveything with a thin layer of black dust. However, they were apparently so preoccupied with learning the fundamentals of record production that they were prepared to put up with the accommodation.

All-Australian enterprise

'Tin shed' or not, Richmond was envisaged as a completely self-contained operation, including the above mentioned milling equipment and the production of 'shellac' biscuits, which were the basis for 78rpm consumer discs of the day.

There were presses for both 10" and 12" discs (25 and 30cm), electroplating facilities to process 'mothers' and 'stampers', and a master cutting room to produce the acetate masters from both imported and local master tapes — a task which fell to Harry Mauger himself, in the early days.

Start-up equipment included a Mag-

record tape deck with outriggers to accommodate 10" (25cm) spools and a 'Connoisseur' cutting lathe, made by Sugden in England — the machine made famous by Briggs of Wharfedale, with his 'Breaking Glass' demonstration disc. It was fitted with a moving-coil cutting head, with a huge magnet and driven by a Leak amplifier.

The Connoisseur lathe had the facility — notable for those days — to vary the groove pitch while cutting (Fig.4). The first disc produced from tape to pressing, entirely in the Richmond factory, was a 78rpm childrens' record titled 'Journey to the Moon' (around 1953).

However, despite the reputation of the equipment, the team at Richmond soon realised that they could not match the peak levels impressed on the American Mercury discs.

But, equally, they could not base the Australian enterprise on imported mother discs. Some seemed to take forever to arrive, thereby missing the market peak. Some also had original imperfections, or suffered damage here during the plating process, thereby doubling up on the waiting time.

It turned out that Mercury in America were using a special cutter developed in Britain by the BBC. It incorporated a feedback winding which, when used in conjunction with a 100-watt Grampian amplifier, reduced distortion and resonance effects and increased the available groove amplitude. Mercury Australia decided to follow suit.

The microgroove era

Another important change came as a result of a high level of breakages, which resulted when normal discs were despatched interstate by old-fashioned freight trains or along unsealed roads.

Their attention was drawn to a British company which had produced a plastic that could be compression moulded in existing presses. Astor imported a ton of the material, and succeeded in producing what became the first 'unbreakable' 78's in Australia. Charlie Gendle was soon producing the material in his own mill, and the extra know-how stood them in good stead when the time came to move to 45rpm and 33rpm microgroove technology.

Before that happened, Harry Mauger says that he was appointed as Production Foreman for the whole factory. Bob Morrison took over the cutting room and Frank Hulbert assumed responsibility for the mastering. (An article in this magazine for January 1979 featured Frank Hulbert, who had just celebrated his 20,000th master cut for Mercury Australia. See panel).

New Huntingdale plant

Harry Mauger says that they were never short of technical problems, but they were handled successfully by the local team: Charlie Gendle with his wealth of knowledge, Colin Swan in the plating area, Frank Hulbert, Bob Morrison and himself in the mastering section, and a staff who were genuinely interested in making a top quality product. Rarely, if ever, did they need to seek assistance from their overseas affiliate.

The team had demonstrated their ability to make records — and money — but, as the focus shifted from 78rpm discs to microgroove, the need became evident for improved facilities and conditions. In 1956, management agreed to establish a new plant, especially designed for record production, at Huntingdale, across the road from the Anodeon valve factory. By then, Charles Gendle had retired and Harry Mauger became Technical Manager.

(To be continued) ❖

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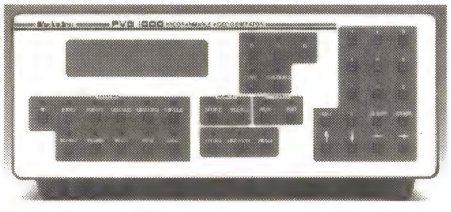
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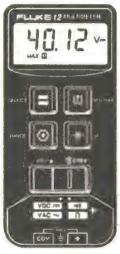
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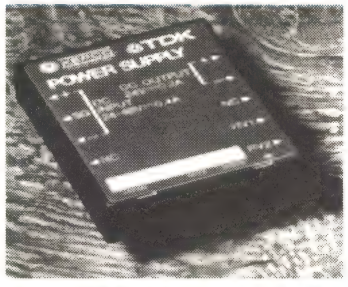
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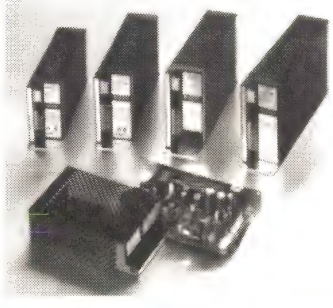
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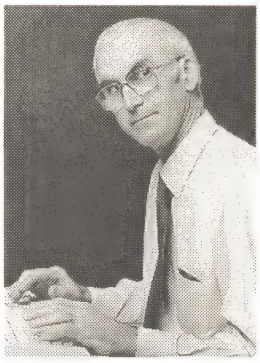
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READER INFO NO. 10

FORUM

Conducted by Jim Rowe



It's easy to jump to the wrong conclusions, isn't it?

I have a few 'loose ends' letters for you this month, dealing with topics we've discussed recently. There are a couple more about that report of some amateurs being heard 'out of band' (including one from the original writer), and another couple on the subject of service technicians and their qualifications. One of these also makes some very interesting suggestions about the thorny subject of technician licensing...

You may recall that in the May column, I published a letter from reader John Smith of Middleton in South Australia, with some comments relating to our discussion of unsavoury behaviour on the amateur bands. Among other things, Mr Smith reported that he and a colleague had clearly heard signals from people who gave amateur call signs but were operating around 13.112MHz, about 1MHz *outside* the 14MHz amateur band.

Since then, we've received quite a few letters and faxes following up on this point. Most have been from other amateurs, who not surprisingly have been keen to suggest that either the people concerned were not really operating outside the amateur band at all, and only appeared to be, or that they weren't amateurs anyway — but 'pirates' pretending to be...

One suggestion, made by our regular contributor Tom Moffat VK7TM and published in the May column, was that Mr Smith and his colleague may have been using relatively simple single-conversion superhet receivers with 455kHz or thereabouts IF's, and as a result relatively poor image rejection. This would have allowed them to hear the signals 910kHz or so below their actual frequency, hence making it seem as if they were operating out of band. This certainly sounded as if it might have been a possible explanation, at least.

We'll find out shortly whether or not it does fully explain things, because Mr Smith himself has written with further information on the receivers that he and his colleague were using. But before we do, I'd like to present another letter on the same topic which arrived just before it. This letter came from New Zealand amateur Fred Johnston ZL2AMJ, and I'm presenting it because it illustrates the attitude some amateurs take with regard to ANY criticism, real or implied, to their hobby, their colleagues and their activities:

Greetings! It is with complete amazement that I read the comment in your 'Forum' column in the May 1994 issue. I refer to the bottom of the second column and the top of the third column.

The amateur stations in question that were being received, would be operating quite legally on the frequency 14,042kHz — in the CW part of the amateur 20 metre band. Simple arithmetic shows that the listener in question was listening to amateur stations operating on the 'image frequency' of that particular receiver. The receiver would be using an intermediate frequency (IF) of (say) 465kHz. If the receiver IF was at some other value — say 455kHz — the image frequency would still be in the 20 metre band (at 14,022kHz).

The receiver in question shows a lack of 'front-end selectivity', with poor image-frequency rejection. This type of receiver is typical of many models used by listeners — even as in the case quoted — in the 1980's. It is usual in many receivers for the local oscillator to run higher in frequency than the required signal (in this case for a signal at 13,112kHz the local oscillator will be at 13,577kHz — for a 465kHz IF).

So, the reason that your listener heard amateur signals '1MHz out of band' is not due to any bad operating features by the amateurs concerned, but is entirely due to the deficient receiver in use by your listener. (The '1MHz' should be 930kHz for a 465kHz IF.)

That disparaging remarks are made of this incident in your column is all the more disappointing.

I think some sort of apology is called for. This is especially so considering that the purpose of the article was to continue in some 'anti-amateur' or similar tone with this (erroneous) incident as one of the examples.

Well, there you are. Mr Johnston has no doubts whatever; the amateurs concerned WERE operating inside the band, and John Smith and his colleague WERE misled by the poor image response of their receivers. No if's or buts, they were mistaken. The amateurs concerned, whoever they were, were without fault — and I was stupid to publish the letter. Damn cheek, daring to criticise any of Mr Johnston's fellow hams; this kind of 'anti-amateur' activity is inexcusable, and he demands an apology!

Even *knows* their IF!

As you can see, Mr Johnston is not only *certain* that the apparent out-of-band operation was 'entirely due' to the 'deficient receivers' being used by Mr Smith and his colleague, but he also *knows* their IF. He even corrects the figure given by Mr Smith for the distance the amateurs seemed to be operating out of band: it should have been quoted as 930kHz, not 1MHz. So there!

Now before we try to decide who, if anyone, should be providing any apologies, let's have a look at the follow-up letter from Mr Smith himself. As well as commenting on Tom Moffat's rather more friendly and less dogmatic suggestion, in the August column, that poor image response could have been to blame, Mr Smith is also responding to the suggestion from WA amateur Bob Elms VK6BE, that the operators heard were unlikely to be licensed amateurs because they would have been crazy to give their call signs:



Just a reply to the comments made by a couple of respondants in the August 'Forum', to clarify the IF systems of the two receivers used by my colleague and I.

My receiver at that time was an Icom IC-R70 and the other was a Kenwood R-5000. Since both of us have sold the receivers and upgraded in the meantime, I can't recall the exact 'specs; but both would have been at least double conversion with a first IF of around 70.5MHz and a second of around 9MHz. Sorry Bob and Tom, but do you REALLY think that we would have good decoding equipment with silly 'El cheapo' 455kHz IF's in our receivers? (By the way Tom, I love eggs of all types — bantam to emu, and scrambled to poached.)

As for the 'hated CB'ers', I was taking a quote from a previous correspondant to 'Forum'! I was once a CB'er, call sign WAA-641. The Karri log has now become Balsa I think.

Real world? I did state that my listening IS broad band; you know the style, DC to daylight. And it is not only Aussies dragging down the amateur status, but I think it is a world wide problem. I did mention a US station, along with a G, OK and DJ that were in that net.

I too had the inkling of doubt about the Full Calls using their correct call signs. It was one of the reasons that I called for a second opinion. Maybe I should have put that in my original letter.

Anyway as the old saying goes — 'It takes all types...' and it's good to see that the topic has got the readers stirred up.

Thanks for the right of reply, Jim.

Well, thank *you* for supplying that additional information, John. It certainly seems to change the situation a little, wouldn't you say?

It sounds like the people who assumed that John Smith and his friend were misled by the poor image response of 'el cheapo' receiver may have jumped to the wrong conclusions, doesn't it?

At least Tom Moffat and the other earlier correspondents only offered this as a *possible* explanation, in the hope that the signals heard may still have been within the amateur band, if they were in fact originating from amateurs. It was only Fred Johnston who was prepared to categorically state that it was the ONLY explanation...

Since John Smith and his colleague turn out to have been using receivers of the calibre concerned, though, with double-conversion front ends and a first IF of 70MHz or so, this makes it very unlikely indeed that they were being misled by image response problems.

So perhaps if *anyone* needs to offer an apology regarding this unfortunate matter, Mr Johnston himself looks the most likely candidate at this stage, wouldn't you say?

Hopefully in future he'll be a little more temperate, in his haste to jump on anyone who suggests that *not all* radio amateurs may be as blameless as Mr Johnston seems to believe...

Supplied callsigns

By the way, in a footnote to his second letter, John Smith quotes the actual call signs given by the operators who were heard working on 13.112MHz, taken from his log. He's asked me not to publish them, to avoid embarrassment of possible innocent parties, and I'm happy to go along with this. However they *do* look like valid amateur call signs, I have to agree. There's an Australian 'VK' call, a couple of British 'G' calls, a US 'W' call and calls with 'OK' and 'DJ' prefixes.

I have two final thoughts on this topic. One is that there is, of course, no way to prove one way or the other whether the operators concerned were radio amateurs at all. They may well have been 'pirates' of some kind, as various people have pointed out. Presumably if this is the ex-

planation, they would have been pirates with some sort of axe to grind, in getting legitimate hams into trouble.

The other thought is this. If *you* were a somewhat rebellious and antisocial ham, who wanted to try a bit of 'forbidden' out-of-band operation, what frequencies would you choose to operate on? Perhaps you would choose a frequency which just happens to correspond to where an image *would* appear on an 'el cheapo' receiver, if you *had* been operating inside the band. That way, you could always claim that anyone who happened to hear you was mistaken by the image response of their receiver, couldn't you?

Service tech responds

Now let's change the subject, back to that thorny question of service technicians and their qualifications.

You'll no doubt recall that in the July column, I published a letter from reader Robert Heywood of Canterbury in Victoria, commenting on the announcement in the April Serviceman column by Jim Lawler of TETIA, to the effect that they would no longer be supplying 'Fault of the Month' items. Mr Heywood raised the issue of what TETIA regarded a 'qualified technician', and his comments and my own immediately upset both Jim Lawler and his TETIA colleagues. Within days Mr Lawler wrote me a very angry letter, which I published in the September column (along with an explanation and qualified apology). He also ran a piece in the Tasmanian TETIA publication *Tastronix*, asking members to write to me and 'give me a serve'.

I don't know if the next letter was written in response to this request, although it seems possible. The author is Mr A.F. Ransley, who runs a radio, TV and electrical sales/service company in Wynyard, Tasmania and is also a TETIA member. I'm publishing his letter not because it was intended to give me a 'serve', but because it gives an idea of the reasons why some TETIA members are opposed to helping non-members with servicing information. Perhaps it also shows that radio amateurs are not alone in their tendency to over-react to any perceived criticism...

I was staggered at the letter published in July Electronics Forum section, and your vindication of comments in that letter.

I have been in the Electronics service industry for 28 years, having got my 'piece of paper' at a leading Victorian Institute of Technology and doing it the hard way in a retailers workshop.

Of course over the years I have attended most of the Manufacturers Training Courses on products and learnt the correct way to service sensitive circuits such as SMPS and chroma. But of course this was totally unnecessary as like Mr Heyward, I could have learnt by my mistakes, costing the poor old customer copious lots of dollars in the process.

Let's be sensible, if a manufacturer will let me service his products under Warranty at his cost, does HE rate me qualified? Should a Technician get his training by trial and error, or should there be a minimum of College Training before he is let loose on someone else's property?

I am a member of TETIA and proud of it. I had to submit to a rigorous examination of my abilities before being admitted.

I suppose I should not complain, it is people like Mr Heyward who make work for me, usually making a $30 job into a $100 job. 'Qualified' hobbyists should stick to their own gear and not try and service customers products with just a soldering iron and a circuit.

I tend to use a multimeter and a CRO and other test equipment, as well as the soldering iron and circuit while servicing, but then I am 'Qualified'.

Anyway, why should I spend hours tracing and repairing an elusive fault and then tell my customer how for free, himself. I have a living to earn.

Well, Mr Ransley, thanks for those insights. Your final paragraph certainly helps us understand the thinking behind TETIA's decision to discontinue 'Fault of the Month'. You seem to have jumped on poor old Mr Heywood rather mercilously, though.

It seems rather unwise, for example, to assume that people like Mr Heywood, who have learned electronics and servicing by reading and practical experience, are the only ones 'making the customers pay for their mistakes'.

It also seems inappropriate to imply that only those with the kind of formal qualifications accepted by TETIA know how to use test instruments. Why, your colleague Jim Lawler took some pains to emphasise in his letter that my own qualifications would *not* be acceptable to TETIA, even though I regularly use a somewhat larger number of test instruments than most service technicians, and have in fact designed and built quite a few!

More on qualifications

Moving along, but still on the subject of servicing qualifications and the closing of 'Fault of the Month', this month's second letter on the topic gives a rather more considered response to both. It comes from Mr Ray Banks, who has a video servicing business in Wagga Wagga, NSW:

You have opened a 'can of worms' larger than that @#$%~! speaker cable one, but it has been needed for quite a while and it will probably bring forth a large number of valid arguments on qualifications and licensing.

As a country member of TETIA, I agree with the withdrawal of the 'Fault of the Month', but for different reasons.

1. They encourage inexperienced people to 'have a go' and cause greater damage to their equipment. For example, I have had video's brought in with capacitors replaced by a customer using a plumber's soldering iron, when the original fault was that it needed belts.

2. Lazy 'technicians' tend to use these, and other fault lists (there are at least five on the market) to cure a fault without 'putting their brain into gear' first. A fault list can be useful, but they should all say 'IF YOU DO NOT HAVE THIS FAULT, DO NOT REPLACE THESE PARTS', as they are a list of possible faults and parts to CHECK only.

3. These 'Fault of the Month' items could be expanded into a training or teaching aid, explaining diagnostic methods and techniques, similar to 'The Serviceman' but with emphasis on technique.

In regard to the question of licensing, I believe that it is an absolute MUST as the public have a very low opinion of technicians, as is illustrated by their unwillingness to pay a fair price for work done.

Any person who charges for repairing consumer electronic equipment should be licensed to do so. In the motor trade, a person may repair their own vehicle, but they are not allowed to repair and charge unless licensed.

The question of who would qualify for a licence is a 'hairy' one, and requires much discussion as there are good technicians with no formal qualifications and useless technicians with a 'piece of paper'. I would like to suggest a number of questions:

Should audio technicians be licensed to repair TV's?

Should TV technicians be licensed to repair VCR's?

Should VCR technicians be licensed to repair camcorders?

Who would be licensed to repair videodisc players?

And what about computers, fax machines and other 'brown goods'?

As an explanation of my reason for posing these questions, which to the non-technical are 'pretty much the same', they are not. An audio amplifier circuit diagram can be printed on an A4 sheet of paper. A TV diagram can be

printed on an A3 (both sides, if it has Teletext). A CD player's circuit runs from two to five A3's, a VCR five to 10 A3's — while a camcorder may need anywhere from 15 to 25 A3's for their diagrams, in a unit which would fit inside a football.

In my opinion, when licensing comes, it will need to be ONE licence, graded or endorsed to indicate training and experience, and should be an Australia-wide licence.

Licence qualifications

We (the technicians of Australia) need to set up a Qualifications Board that is not tied to any association, manufacturer or government. The QB should consist of working technicians who are up to date in their fields, drawn from all states (number/population) with wide representation of the electronics trade.

The chairperson could be one who is neutral, such as Tom Moffat, Rob Humphris (RMIT teacher) or yourself (Jim Rowe). The technicians should be five representing manufacturers and six representing large and small service companies, city and country.

The QB could devise written examinations to test an applicant's knowledge in each field (and/or collate or modify suggested questions sent in by readers). The questions could be 'what waveform would you expect at point X', with a marked circuit diagram, or 'how do you adjust ... on a VCR' type of questions.

The examinations could be held at any High School in Australia, under the supervision of their Science Department; schools always want to be involved with industry.

Any technician not having Trade qualifications less than five years old should be tested for a licence, endorsed to their level of training and experience, with those under five years being endorsed for the subjects covered in their course ONLY and tested for additional subjects.

Due to advancing technology, licences should be issued for ONLY five years. This would force technicians to 'keep up or get out'.

The cost of the QB could be kept to a minimum by mailing copies of all material to all members for comment and return, with only a few actual meetings (which could be sponsored by parts suppliers).

When the initial work of the QB is completed and has general approval of technicians, it should be sent to the 'Consumer Affairs' ministers in all states, with the comment 'This is what we want — make it LAW'. It should be done soon (within 12 months) or we could be 'lumbered' with some unworkable system by bureaucrats.

Keep up the good work. I have been an EA/ETI reader for nearly 40 years.

Thanks you for those comments, Mr Banks. It's obvious you've not only given the matter considerable thought yourself, but have also provided quite a lot for the rest of us to think about as well.

Your reasons for not being in favour of the continuation of the 'Fault of the Month' item are carefully explained, and as a result seem to present the 'NO' case rather well. I only wish that some of the previous and more 'official' explanations had been as calm and considered...

Your point about the complexity and variety of modern consumer electronics gear is also an important one, and would indeed complicate any scheme of licensing — just as it already makes life very difficult for any technical person trying to 'keep up'. As you say, someone qualified by training and experience to repair TV receivers may well not be equally qualified to repair VCRs, CD players, camcorders, videodisc players, computers, DAT players, MD recorders or the host of other new devices coming into our homes and offices in a never-ending stream. Your idea of a basic licence with endorsements may well be the only way to cope sensibly with this problem.

Qualifications board?

Your suggestion of a 'qualifications board' is also very interesting food for thought, although I suspect that at least two of your suggested people for chairperson would not be universally acceptable! Without seeking to denigrate Tom Moffat's many skills and rich experience, I imagine that someone like Mr Humphris of RMIT would be a much more appropriate choice than either Tom or myself.

To be honest, I'm not sure how advisable it would be to try to set up a whole new qualifications approval organisation, separate from existing TAFE and other educational bodies — as well as from industry associations. However I'm sure others will want to comment on this aspect, now that you've raised it for discussion.

Thanks for the time and trouble you've taken to prepare your letter, though, and I feel confident that many of our readers will find it as interesting to read as I did.

And that's all for this month, folks. I hope you'll join us here at the Forum next time. Just don't bring any baseball bats, bricks or rotten apples, please — we'd like to keep it fairly calm and friendly, if you don't mind. ❖

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READER INFO NO. 13

THE SERVICEMAN

A VCR with weird symptoms, and other strange stories

I have an interesting set of stories for you this month, with most of them falling into the 'strange but true' category. One is about an old Kreisler colour TV set that kept on bouncing back with different faults; another is about an old VW 'Beetle' that insisted on blowing up its cassette player, every time it was repaired! There's also a somewhat embarrassing explanation for a Sanyo CTV fault I presented a few months ago...

This month I'm happy to start off by presenting another story from A.K., of Blackmans Bay in Tasmania. If you remember, I introduced A.K. a few months back as an enthusiastic reader who was struggling to convert his mother tongue from Polish to English. His latest story is once more about a VCR, but this time with an electronic fault — one of the more obscure types. See if you can predict the outcome, as he tells of the 'Hum Bars and Ghostly Lights':

The customer brought in a Philips VCR (model VR674) with the complaint that there was a cassette stuck in it, and the machine wasn't operating.

I was able to manually unload the cassette, after which I cleaned the mode switch and retimed the mechanism. This brought all the mechanical functions back to normal, including playback — which gave a perfect picture.

However, there was still one strange problem with the machine. When I selected channel 6, the picture on screen showed a sort of hum bar, like 50Hz but much faster. Oddly enough, channel 2 was fine — no sign of the bars.

Then there was another thing — when the VCR was turned off with the standby switch on the front panel, some of the symbols on the right hand corner of the display remained half lit. Normally, only the clock digits should be alight, and so they were; but in this case they were accompanied by the dim outline of the Play, FF and Rew symbols as well.

At first I didn't link these two symptoms (hum bars and lighted symbols), and concentrated on curing the hum bars. For some reason I had got the impression that the bars resulted from a problem in the tuner or IF strip, so I began by replacing the tuner — not a very difficult job in this model.

However, it produced no beneficial result, so I replaced the original tuner and tried warming the assembly with a hair dryer. This produced a small improvement, so I decided to follow up this lead, after I'd had my morning cuppa. Before leaving the workshop, I turned the VCR off at the stand-by switch.

When I returned to the job, some 15 or 20 minutes later, I noticed that the hum bars were a bit less noticeable, and the unwanted display symbols had become somewhat dimmer. At this point I realised that the two symptoms were part of the same trouble, and that it was probably something to do with the DC-DC converter.

This is contained in a small aluminium box on the tuner/IF board and as luck would have it, I had no circuit diagram for this Philips model. However, it is very similar to the Sharp VC-486X and I did have a manual for this one.

The device takes in 12 volts on pin 2 and outputs a variety of rails — minus 28V on pin 3, 3.4V AC on pins 5 and 6, and plus 50V on pin 7.

I measured the -28V rail and found only -20V. I hit the converter with a freezer spray and the -20V became -19V. This was hardly a significant change, considering the error already noted. So I turned to the 32V tuning supply, on the emitter of Q1403, and here I found just 31V, again hardly a significant difference.

At this point I decided to look at waveforms with the CRO, and it's as well that I did. Instead of a steady DC voltage, I found 26V of AC with a weird half-sine waveform. This obviously pointed to a fault in the converter, so, with nothing to lose, I removed the converter and tried to dismantle it.

It looked like a sealed unit, but with care I was able to prise the bottom part open and gain access to the small PCB inside. The first thing I noticed were four small electrolytic capacitors, and we all know what that means.

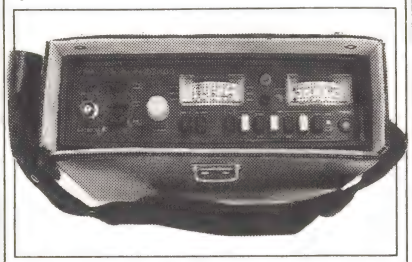
I removed them one by one and the first, a 1uF/50V unit, tested open circuit on my capacitance meter. So did the second one, marked 47uF/50V. The third capacitor was marked 47uF/63V, but measured only 20uF. Finally, the last capacitor was supposed to be 47uF/25V but was another open circuit. No wonder the converter was playing up. It was amazing that it worked at all!

The original capacitors were supposedly high temperature (85°C) types, but when I replaced them, I used samples from a new range of 105°C types. I hope that they will last forever!

After replacing the caps and resealing

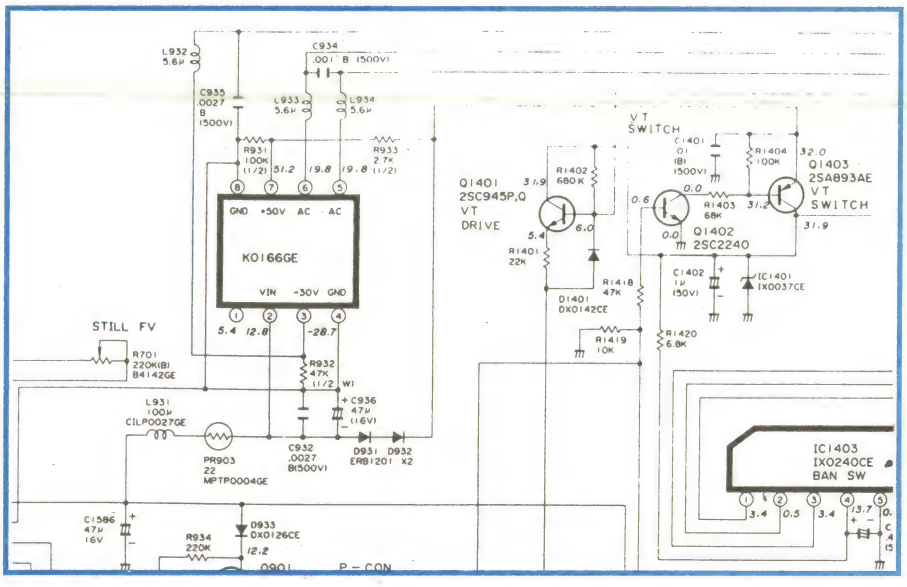
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READER INFO NO. 14



This section of the schematic of a Sharp VC-486X video recorder is almost identical to that for the Philips VR674 discussed in A.K., story. It shows the circuitry around the DC-DC converter module.

the enclosure, I resoldered the converter back onto the IF board and crossed my fingers. At power-up I had only the clock figures on display and at switch-on, channel 6 appeared without any sign of the hum bars. I used the CRO again to look at the tuning voltage at the emitter of Q1403 and found pure, clean DC, without any trace of the AC that had been present previously.

So that was obviously the problem. Out of a total of 142 microfarads, between them the four capacitors could only muster a meagre 20uF. It probably had something to do with being shut up in the sealed enclosure. No ventilation and all that. So the higher temp rated replacements might be an advantage...

Well, now! How would *you* have gone sorting that one out? I must admit, my first thoughts were a long way from the DC-DC converter. I was thinking about microprocessors and just about everything else.

Once again A.K., with his relatively limited English, has managed to convey a complex and very technical story for your edufication*. I hope he can keep them coming. Thanks, A.K.

Red face time

Now we come my bench, and to one of my less creditable exercises.

I'm glad this page doesn't carry a photo of The Serviceman, like 'Madhouse' or 'Forum'. If it did, the red glow of embarrassment would shine through even the black and white reproduction!

In these pages a few months ago, (April '94 to be exact), I told the story of a Sanyo CTP3001 in which the line output transistor suffered an obscure failure that caused it to appear to draw excessive current, without showing any other signs of damage. If you remember, the HT rail dropped from 130V to 70V with the transistor in circuit, and recovered when it was removed. A new transistor 'cured' the problem and the set went home to a happy customer.

Well, less than a month later the set was back again — with exactly the same problem. It didn't take long to confirm that the new transistor had failed in the same way, but the circumstances left an enormous question mark over the whole affair. Once again, a new transistor got the set up and running, even though the old device showed no sign of damage. To all intents and purposes, it was in exactly the same condition as the previous 'faulty' device.

It seemed pretty obvious that the breakdown occurred only under load, and setting up a suitable test rig was hardly a realistic proposition. For a time it looked as though replacing the transistor and trusting to luck was about the only outlet available to me.

While the set was still on the bench and awaiting some definitive action, I had reason to call on the colleague who had supplied the multiple circuit diagrams mentioned in the previous story. He is an accredited Sanyo service agent and probably knows as much about the brand as anyone in my city.

I outlined the problem to him and asked him to apply his usual tests to the questionable transistor, then give me his opinion of its quality. He did just as I had done, and gave the transistor a clean bill of health. Yet we both knew that it wouldn't work in the set on my bench!

We batted the breeze for quite some time, trying to devise a scenario that could account for the symptoms. But nothing fitted. None of us has ever come across a line output transistor that is only 'half bad'. Ninety-nine percent of dud transistors go short circuit. The other one percent goes open. That leaves no percent at all to go half and half!

Eventually, we came to the conclusion that this was an entirely new phenomenon, possibly one that would prove to be characteristic of 2SD1649 transistors. It was one that we would have to remember for future occasions. In the meantime, my colleague suggested that I ring a Sanyo expert in Melbourne. He gave me the name of a senior man in the Sanyo service division, and advised me to discuss the matter with him.

It was a week or so before I was able to make contact, but it's just as well that I did. It seems that this fault is known, if not *well* known! As I outlined my problem, the voice at the other end of the line kept saying "mmm!", "uh-uh!" and "yeah!"

I got the distinct impression that I was relating a story that had been told many times before. Finally, my contact simply said "Change C315 from 0.012uF to 0.015uF!"

"Is that all?", I challenged. Indeed it was!

This capacitor is across the base-emitter junction of the chopper power supply driver transistor, Q312. It's hard to see quite how this capacitor has such a dramatic effect on the power supply output, but it seems that a small change in the cap's value is enough to upset the supply regulation.

Even so, the set will still operate while ever the line output transistor draws current on the lower side of normal. As the transistor ages, its current demand rises and the supply can no longer regulate. Fitting a new line output transistor reduces the current demand and the set resumes normal service — until the new transistor ages.

In this case I proved the point, by replacing the old transistor; the set would not work. Then I fitted a new capacitor of slightly higher value and away it went, as good as ever it had been — even with the old transistor in place.

All of which goes to show why I expressed embarrassment at the head of this story. I had presented the April report honestly, believing that I had solved the problem. But time has proved me wrong, and it took the superior

knowledge and experience of the man from Sanyo to put me right.

Oh, well! I win more than I lose, so I guess I can't complain too much...

Incidentally, I learned something more about this Sanyo power supply while talking to my Melbourne contact. It seems that the supply will run quite safely with the line output transistor disconnected. If everything is in order, the 130V rail will rise to 140V when unloaded.

When I first ran the faulty supply unloaded, the output rose from around 70V to 131 or 132 volts. This is indicative of a supply that is not regulating properly and one that needs the capacitor change mentioned earlier.

It seems that all of the later models using the similar supply configuration have had this modification done in the factory. That's something to note in your faults list.

Box of trouble

Now we go back to another contributor, one G.W. from Gawler in South Australia. G.W. opens his story with a question, one that I'm sure we have all asked ourselves at one time or another...

Do you ever have the feeling that a particular TV set will never stay fixed?

This story begins with a request from a customer to attend to an elderly Kriesler CTV, a model 59-02. The complaint was, sound but no picture. "An easy one!" I thought, imagining a quick replacement of an open circuit 8.2-megohm focus resistor. This would deprive the tube of focus voltage, thus producing a blank screen.

However, it was not to be so easy. When I arrived I realised that the 'no picture' report was more accurately a 'blank raster' symptom — the CRT was functioning, but was being deprived of video drive. This suggested a dead tuner/IF strip, and injection of signals into the strip pointed to a dead TCA540 synchronous demodulator IC. Unfortunately, this necessitated a trip to the workshop for a replacement chip.

Shortly after, I returned. Not with a new IC, but with one salvaged from a surplus panel from a wrecked set. This brought the present set back into action. "Well!", I thought. "A bit more hassle than I originally suspected, but at least the set is fixed!" But was it?

Two days later a call from the customer reported "...smoke and a banging noise..." With a sinking feeling and no great enthusiasm, I again called at the address and found that the EHT tripler, the beam current sensing resistor, and the .047uF 1kV capacitor in the earth return of the tripler were all faulty. In fact the tripler had bulged out to twice its normal size!

After a deal of time and trouble, the offending components were replaced and the set was producing a good picture once again. But what are the chances of two quite independent faults within two days of each other?

However, the story doesn't even end there. Two days later, the customer was on the phone again to say the picture was faulty in a way that I couldn't quite identify. So I made my third trip to that address, to find a silvery picture, with highlights smearing and intermittent loss of sync and picture.

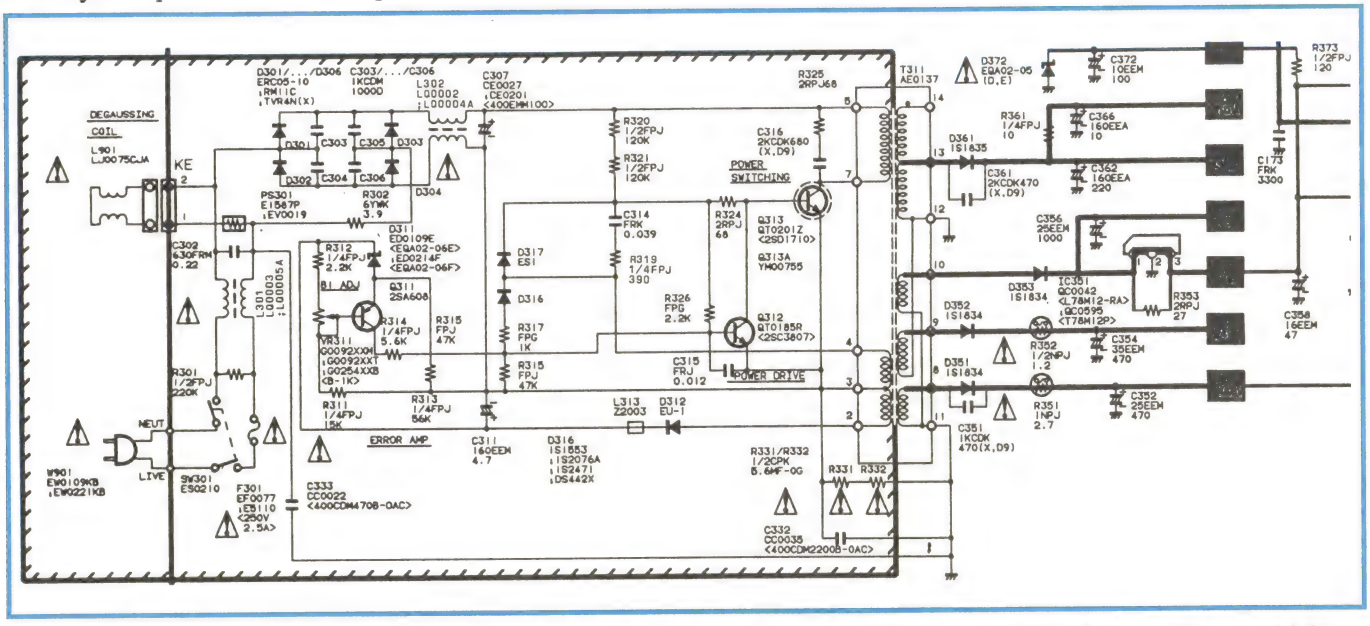
"What is it THIS time?" I wondered, as I decided to replace the whole small signal panel with a known good one from a scrapped set. This produced good, stable pictures, but it frustrated me not to know why the fault occurred.

Later, with time for a little clearer thinking, I remembered where the replacement TCA540 had come from. About a year before I had done a similar panel exchange, to an old Kriesler that had suffered from a smeary, silvery, tearing picture.

By now you are probably ahead of me — the original fault in the first repair had obviously been the TCA540, and I had unwittingly transferred the fault to the present customer's TV. But why, when the first set had permanent picture disturbance, did second set behave perfectly for four days and even survive the tripler catastrophe before playing up!

So all told, the job produced two major faults, plus one that I introduced myself! I really do hope that I've seen that set for the last time.

Well, G.W., for your sake I hope you are right. Unfortunately, being an expert in the laws of Murphy, I can state unequivocably that like General MacArthur, '...the set will return!'



Here's the schematic for the switchmode power supply section of a Sanyo CTP3001 colour TV. This was the set which our Serviceman thought he'd fixed some months ago — and it came back again, because it kept on 'blowing' switching transistors. The funny thing is they still tested alright. The cure turned out to be rather surprising...

I've known a customer to sell off a troublesome set like yours, only to have the XYZ thing come back to me from its new owner, from right over the other side of town! It seems that fate decrees that once you become involved with something like this then it is your problem for ever more. Or at least until it finishes on the tip...

Thanks for the warning, G.W. We'll watch out for that one!

Incredible story!

To finish up this time, I've got a contributor's story for you that almost defies belief. As I read it through the first time, I felt that he was pulling my leg — there are people who would try to trick me into believing a fairy story.

Then I began to wonder if perhaps it might be true, so I consulted a couple of friends who are more knowledgeable about the subject than I am. Both assured me that the story is possible, although very unlikely. So I'll pass it on, for your amazement and entertainment. But remember, since it's out of my sphere, I can take no responsibility etc..

The story comes from P.G., of Nymboida in N.S.W. It's only a short item, although the explanation at the end might make it as long as any other recent story in these pages. Here's what P.G. has to say...

Last year, I was working for a company in Grafton NSW, and a customer brought me a car cassette player with the complaint that it just wouldn't go. No other explanation was forthcoming.

On pulling the player apart, the fault was seen to be that the polarity had been reversed on the supply. Fortunately, this player had a reverse biased diode, to protect against just such a mishap.

After much dismantling, the diode was replaced and the player reassembled. It tested fine so was returned to the customer. I should point out that we have lots of people in this area using alternative power supplies for their houses, and reverse polarity is a very common problem for us to deal with. But this was not the end of the story.

About a week later, the customer returned to tell me that I hadn't fixed the player at all and it was just the same as before. I dismantled it again and found the same fault. I duly repaired it and rang the owner for more details.

After explaining to him that the player had once again been connected with reversed polarity, he was very confused. Although it was his son's car, there were very few wires to be connected and he couldn't imagine how it could be done wrongly.

I asked him to bring the car in for an examination and when he arrived I checked the wiring myself. All seemed to be in order, at least to a visual inspection. I checked the battery connections and they seemed OK — positive to positive and neg to neg. It wasn't until I checked the voltage at the player's connection that I realised that there really WAS a problem.

The power at the player was indeed reversed. I couldn't figure this out at all, so I made a more careful check at the battery terminals. And would you believe, the battery polarity was reversed — the '+' terminal was negative and the '-' was positive!

Quizzing the owner revealed the history of the problem, but not the technical details.

The car, an old VW, had a flat battery and his son had given it a jump start from a mate's car. It seems he must have swapped the jumper leads and had flashed the generator up in reverse. The generator continued to function quite happily and proceeded to charge the battery back to front! I was surprised that this was possible, but it seems that it is!

The car functioned perfectly, since the starter is a series wound unit and always rotates in the same direction. All other functions in the car work normally; the only polarity conscious item was the cassette player!

The customer was sent off to an auto electrician to have a new battery fitted, so all ended well.

How about that? First time you read it, P.G's story sounds ridiculous. But then you begin to wonder if perhaps it might be true, and finally you realise that it is distinctly possible, though highly unlikely.

It appears that the secret lies in the fact that the old Veedub used a generator rather than a more modern alternator. A generator relies on residual magnetism in the field pole pieces to induce current at startup. Once current starts to flow, the field magnetism builds rapidly and the machine begins to charge the battery.

In this case, accidentally swapping the supply polarity forced a reverse current through the generator field coils, which changed the direction of the remanent magnetism in the field poles and eventually reversed the output of the machine. (At least, I'm told that is what happened!)

It seems that it's true that the starter motor runs in the same direction, irrespective of the polarity of the supply. And none of the lights or instruments are polarity concious, so there is really no reason why the vehicle should not perform quite normally, with positive swapped for negative.

Except for the battery. For openers, the VW's battery must have been dead flat, otherwise there would have been a mighty 'SPLAT' as soon as the jumper leads completed the circuit. Then consider how the battery functions and what must have occurred in this case.

A fully charged lead-acid battery has for its negative plate, a solid lead grid filled with spongy metallic lead. The positive plate is a similar lead grid, but filled with lead sulphate. As the battery discharges, the sulphate migrates across to the negative plate, more or less reversing the plate's composition.

A flat battery has a positive plate that comprises lead sulphate with most of the sulphate driven out of it — in other words, it's mostly metallic lead. And similarly, the spongy lead in the negative plate has become loaded with sulphate, in the process becoming more or less lead sulphate!

Recharging a battery requires that the sulphate be forced back to where it belongs — on the positive plate. Except that in the story told above, the process worked the wrong way. The reversed charging current forced the remnants of sulphate out of the positive plate, onto the negative one, effectively repolarising the battery. Apparently, this can and does happen, although the result is a damaged battery with much lower capacity than it should have.

If this Veedub had lived in a colder part of the country, the first early morning start would have revealed a battery problem. As it was, the warmer climate made starting easier, so the lower battery capacity wasn't noticed. Only the cassette player suffered...

As I said at the beginning, this story looked at first like a put-on; but after thinking it through, it's turned out to be the likely result of a very unusual set of circumstances. P.G. deserves a vote of thanks for passing it on.

Stories needed

Well, that's it for this month — except for an announcement:

At present, the contributor's file is empty, so I look forward to more interesting servicing stories from YOUR bench. I'm specially interested in stories from E2L (English as a second language) readers, so get them in write away! (Sorry about that pun).

* Finally, 'edufication' is my attempt to devise a word that means 'educational and entertaining' — without sounding quite so painful as the commonly used 'infotainment'. ❖

Experimenting with Electronics

by PETER PHILLIPS

Stepper Motors — 2

Having presented the background on stepper motors last month, it's time now to look at some practical stepper motor driver circuits, and how they work. We describe two circuits, one that uses a dedicated IC, the other a transistor interface to a computer.

Before getting into actual circuits, first a look at a 'trick' you should know about stepper motors. We looked at how to make a stepper motor actually rotate last month, but we now need to address the issue of speed.

As you know, a stepper is moved by applying pulses in a certain sequence to its windings. However, when a voltage pulse is applied to an inductor, the inductor current obeys Lenz's law. This means it takes time to rise to its maximum, and then, when the pulse is removed, time to drop back to zero.

This delay is determined by the time constant of the circuit, which can be found by the equation L/R, where L is the inductance of the winding, and R its resistance. The larger the resistive component, the smaller the time constant, although Ohm's law now gets in the way, as increasing the resistance also reduces the current in the winding. So the trick is to first increase the resistance by adding a resistor in series with the winding. Then, increase the supply voltage to get the same value of current as that in the winding without the series resistor.

The effect is shown by the curves in Fig.1. A typical resistor value is around 20 to 60 ohms. The value is found by dividing the current taken by the motor at its rated voltage into the voltage drop across the resistor. For example, let's say a 12V motor takes 300mA (0.3A) and you intend powering the motor from a 25V DC source.

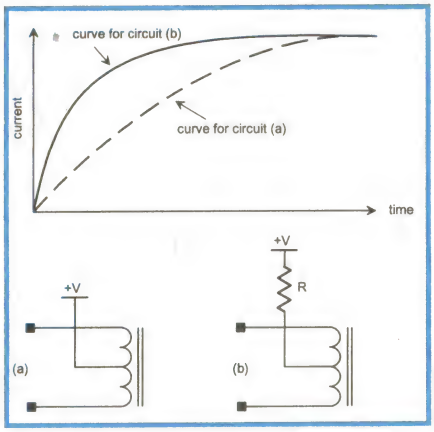


Fig.1: Adding a series resistor and increasing the supply voltage gives a substantial increase in maximum stepper motor speed.

The voltage drop across the resistor is 25-12 = 13V. The series resistance is therefore 13/0.3, which equals 43.3 ohms. Its power rating has to be calculated as well; in this case using the equation P=VI, which gives 13 x 0.3 = 3.9W. A 47 ohm, 5W wirewound resistor would be suitable, although the motor current will be slightly less than its rated value, as we've erred on the high side for the resistor.

Another trick is to also use two voltages to power the motor — a high value while the motor is turning and a lower one while it's stationary. This allows the motor (with its series resistor) to be operated at a current higher than its normal rating, on the assumption that the motor spends at least half its time stationary.

The difficulty is that the motor voltage has to be switched together with the signals to the motor. For critical applications, it's usually necessary to switch the high voltage first before pulsing the motor. Otherwise, the first few pulses might be lost.

Now to our first circuit, which needs a computer program to drive it. The circuit is a full bridge driver for a four-wire motor.

Full bridge driver

The circuit is shown in Fig.2, although two of these are required — one each per motor winding. It works like this...

If the signal input to the circuit is a high, Q1 is biased on and its collector voltage is about 0.5V. Transistor Q2 is held off by the voltage drop across D4, and Q3 is also switched off as R3 and R5 keep its base voltage at less than 0.6V. Transistor Q4 will be biased on by R4 and motor current flows from the supply, through Q4, the motor winding, D4 and to ground via Q1.

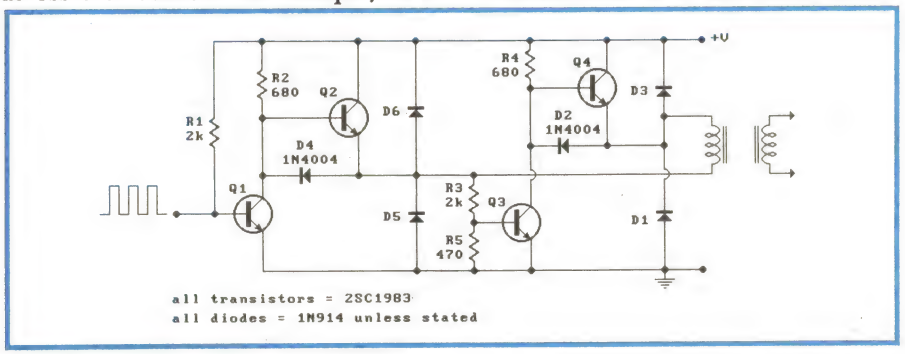


Fig.2: When the input signal is high, motor current flows via Q4, the motor winding, D4 and Q1. When the signal is low, current is in the opposite direction, flowing via Q2, motor winding, D2 and Q3.

On the other hand when the input pulse is low, Q1 is off, so Q2 can now turn on. This increases the bias voltage to Q3 and it also turns on, turning off Q4. Motor current is now from the supply, via Q2, the motor winding (in the reverse direction), D2 and to ground via Q3.

So when the input signal is high, current in the winding is in one direction, and when the signal is low, the direction of this current reverses. The driver circuit for the other winding is identical, and the pulses received by both circuits determine the direction and speed of rotation.

The pulses to drive both circuits are externally derived, in this case from a computer program. So by now you're probably wondering how you can possibly get all this together.

The easiest way is to buy a ready-to-go kit, instead of designing your own PCB, building the circuit then writing a computer program to drive it. A kit including the PCB, all components, a stepper motor, a very detailed manual, suitable software and program listings is available from Oatley Electronics. See the end of this article for details. A photo of a fully constructed driver board is shown in Fig.3.

The 5804 stepper IC

The 5804 stepper motor driver IC was released in 1989 and has many improvements over the once-popular SAA1027. It can pass a load current of 1.5A, although its usual rating is

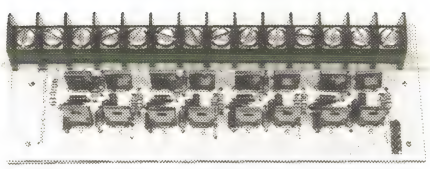


Fig.3: This shot shows an assembled version of the driver circuit of Fig.2. There are two complete full bridge drivers on the PCB, so two stepper motors can be driven by the board.

1.25A at a maximum motor supply voltage of 35V.

A simplified block diagram of the IC is shown in Fig.4. The output stage is actually more complex than shown, where each transistor comprises a Darlington pair with additional protection diodes. Those shown in the diagram protect the output stage from the back EMF of the motor. The IC also has internal thermal protection circuitry, which disables all outputs when the chip temperature exceeds 165°C. Operation is restored at 145°C.

Table 1

drive mode	pin 9	pin 10
two-phase	0	0
one-phase	1	0
half-step	0	1
step inhibit	1	1

The inputs to the IC are CMOS, and therefore directly compatible with standard CMOS logic. The logic circuitry is supplied separately from the motor supply, with a maximum voltage of 7V. The current consumption of the logic circuit is about 30mA. Typically the IC is supplied with 5V, derived via a voltage regulator from the supply to the motor.

Motor connections

The IC is designed for 6-wire motors, as shown in Fig.4. As already explained, the resistors are only necessary to get an increased speed and in many applications they are not needed.

One motor winding connects to pins 1, 2 and 3, and the other connects to 6, 7 and 8. It doesn't matter which winding connects to which three pins. The centre tap of each winding must be correctly identified, but the outside wires of each coil can be connected either way round.

It's easy enough to identify the motor leads using an ohmmeter. The centre tap is that wire where the resistance between it and the outer leads is the same. This wire must go to either pin 2 or 7. The outer leads go to pins 1 and 3 (or 6 and 8 if centre tap to pin 7).

Inputs

The stepper motor drive format options supported by the IC are wave-drive (one-phase), two-phase and half-step. These are externally selected with logic levels to pins 9 and 10

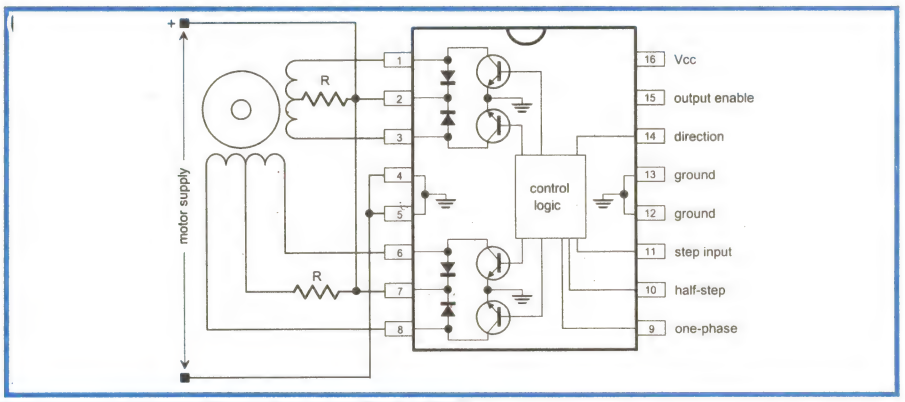


Fig.4: The simplified block diagram of the 5804 stepper motor driver IC. It has CMOS inputs, and is designed for six wire stepper motors up to a maximum of 35V at 1.25A.

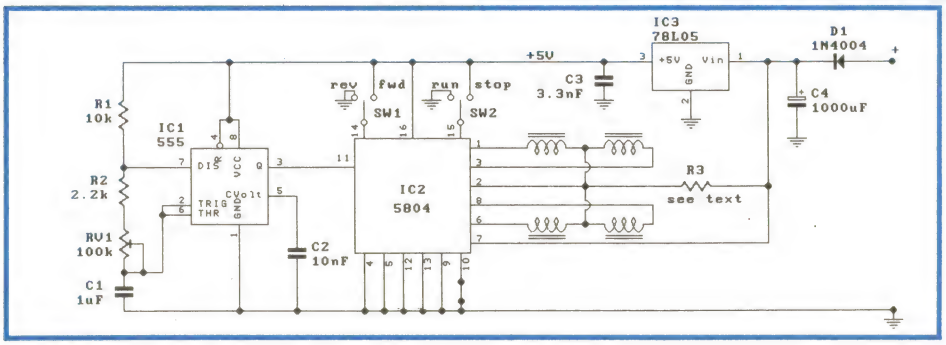


Fig.5: The speed of rotation of the stepper motor is determined by the frequency of IC1, adjustable with RV1. The motor direction is selected with SW1 and the 5804 outputs are enabled with SW2. Hal step mode is selected by connecting pin 10 to the +5V rail.

as shown in Table 1. The step-inhibit function means the input pulses to the IC are ignored, and the motor is held stationary.

This is useful if several motors are being driven from different ICs but by the same signal, and an individual motor has to be stopped or started independently of the others.

Input pulses are fed to pin 11. The outputs advance one sequence position on the high-to-low transition of the input pulse. The minimum pulse width is 500ns (half a microsecond), and while there's no maximum limit, the rise and fall times should be reasonably fast to prevent noise affecting the circuit.

The logic levels to pins 9, 10 and direction control pin 14 must change state only when the step input (pin 11) is low. This prevents disruption to the step sequence, which could lead to lost, or even extra steps.

This is particularly important if you are controlling the motor from a computer program by counting pulses. Over a period of time, lost or extra pulses can really throw out the position of the motor, and things get totally lost. I speak from bitter experience!

The direction of rotation is determined by the logic level at pin 14. Pin 15 is the output enable pin, and all outputs are off when this pin is connected to a logic 1.

Normally this pin is connected to ground, as its main function is to allow the IC to be used with chopper current control circuits. However it can also be used to switch off power to the motor when it's stationary.

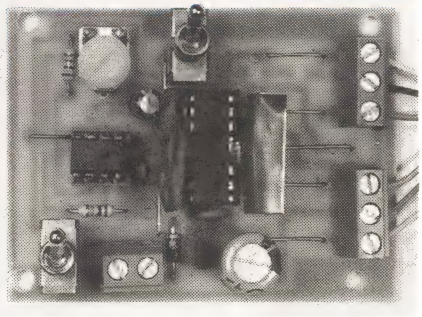


Fig.6: This is the prototype experimenter's 5804 stepper motor controller board. Copper shim heatsinks should be soldered to pins 4 and 5 and pins 12 and 13 of the 5804. Make sure the heatsink doesn't touch other IC pins though.

5804 application

The circuit in Fig.5 shows a simple way to use the 5804. A 555 timer (IC1) supplies pulses to the 5804, SW1 selects the direction of rotation and SW2 turns the motor current on and off by disabling the 5804 outputs.

Another way of stopping the motor is to disable the 555 by connecting its reset terminal (pin 4) to ground. However this will leave the outputs of IC2 enabled, with current flowing in the motor windings. Use this method if you want the motor locked in position when it's stationary, but be aware of the extra heat being dissipated.

The speed the stepper runs at is determined by the operating frequency of IC1, which is adjustable with RV1. Unless you are trying for a high motor speed, use a wire link for R3. Select half-step mode by connecting pin 10 to the +5V rail instead of ground.

Voltage regulator IC3 is not needed if the supply voltage to the circuit is around 5V. Remember that the maximum supply voltage to IC2 (at pin 16) is 7V. The motor supply is from the unregulated input voltage and depends on the stepper motor. Diode D4 protects the circuit from accidental supply polarity reversal.

PCB design

A PCB design for this circuit, developed by Oatley Electronics, is included here. A photo of the prototype is in Fig.6. Notice the copper shim heatsinks, which are soldered on one side to pins 4 and 5, and on the other to pins 12 and 13 of the IC.

The heatsinks are about the width and length of the IC, cut with a tab to solder to the IC pins. These pins are connected to ground, so make sure the copper shim doesn't contact the remaining pins.

The PCB component layout for the circuit is in Fig.7. There are quite a few links on the board, as it was designed so other components could be added if needed. The artwork for the PCB itself is in Fig.8, so you can make your own.

Adding remote control

A remote controlled stepper motor has uses limited only by your imagination. For instance, it could be a way of adding a remote volume control function to an amplifier. The photo in Fig.9 shows how I coupled a stepper motor to a potentiometer. This arrangement is somewhat bulky, but it shows the idea.

The gear on the shaft of the pot is

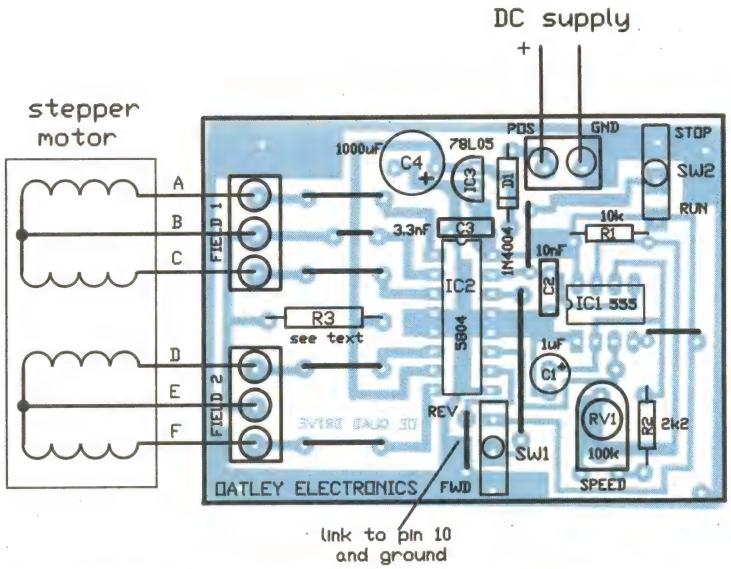


Fig.7: Here's the layout for the experimenter's 5804 stepper motor controller PCB.

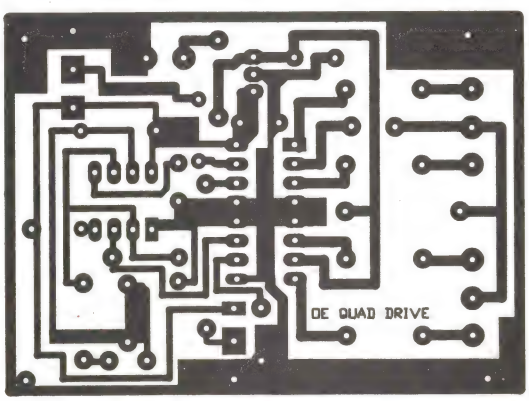


Fig.8: This is the artwork for the 5804 stepper motor controller PCB, reproduced full size. The artwork is copyright to Oatley Electronics but can be used by individual constructors.

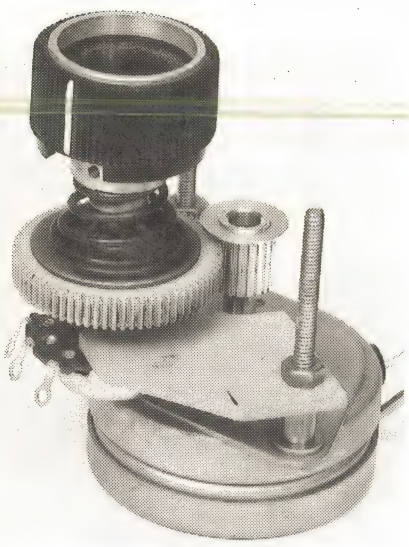


Fig.9: This photo shows a stepper motor driving a potentiometer. The simple spring clutch allows the pot to be turned by hand, and stops the motor trying to turn the pot past its limits.

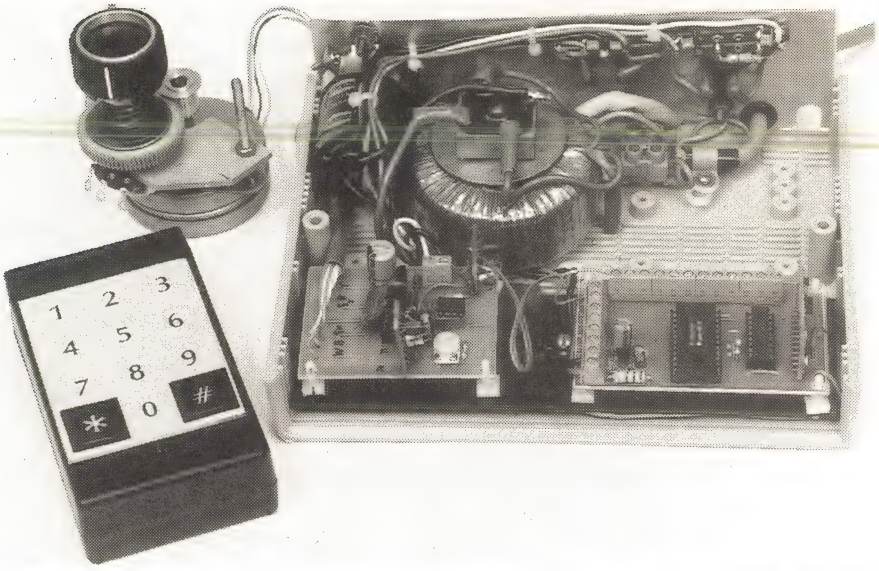


Fig.11: This photo shows all the parts needed for a remote controlled stepper motor. The 5804 experimenter's PCB is on the left, inside the box. The UHF remote receiver decoder is on the right. The rest of the circuit is the power supply.

from an old electric typewriter. The stepper motor came from Oatley Electronics and the gear on its shaft meshed perfectly with that from the typewriter. Luck perhaps, but it suggests a certain degree of uniformity in gears associated with stepper motors. I fitted a clutch to the assembly so the pot shaft could be turned manually, and also to prevent the stepper motor trying to turn the shaft of the pot past its limits.

The clutch is simply a spring pushing against the gear. The spring is attached to a boss fitted to the shaft, just under the knob on the shaft. The position of the boss determines the spring tension. The gear is a neat but free fit over the shaft of the pot.

Circuit details

The circuit I used is shown in Fig.10, based on the experimenter's circuit just described. The main change is that the switches have been replaced by transistors that are switched by the remote control system. The transistors provide interfacing between the CMOS inputs of the 5804 and the outputs of the remote control system.

The remote control system can be either infra-red or UHF. Two outputs from the system are needed, one that goes high if clockwise rotation of the motor is selected, the other for anticlockwise. So the remote control system must have a minimum of two channels.

The operation is quite straightforward. When a high is received at the fwd/rev output of the remote system, both Q1 and Q2 are biased on, and pins 14 and 15 of IC2 are therefore pulled low. When pin 15 is low, the outputs of IC2 are enabled and the stepper motor runs at a speed determined by the pulse rate at pin 11. Because pin 14 is also held low, the motor will rotate in a given direction.

If a high is developed at the stop/run output of the remote system, Q2 is switched on, but Q1 is not. Therefore pin 15 is pulled low, but pin 14 is held high by R6. The motor then runs, but in the opposite direction to before.

The stepper motor I used worked best at a voltage of around 6.5V, so I included a voltage regulator in the circuit. The value of this voltage is important, as if it's too high, the stepper motor is noisy. Too low, and the motor won't turn reliably.

The regulator is based around a 5V, TO3 regulator type 309K, with R8-10 adjusting the output to about 6.5V. Capacitors C5 - 7 help the regulator handle transients.

Notice the connection for pin 10 of the 5804. This is the half- step pin, and connecting it to the 5V supply gives the half-step mode. I used this mode as the motor resolution was 7.5°, which was a bit low for the purpose. Using half-step

Continued on page 61

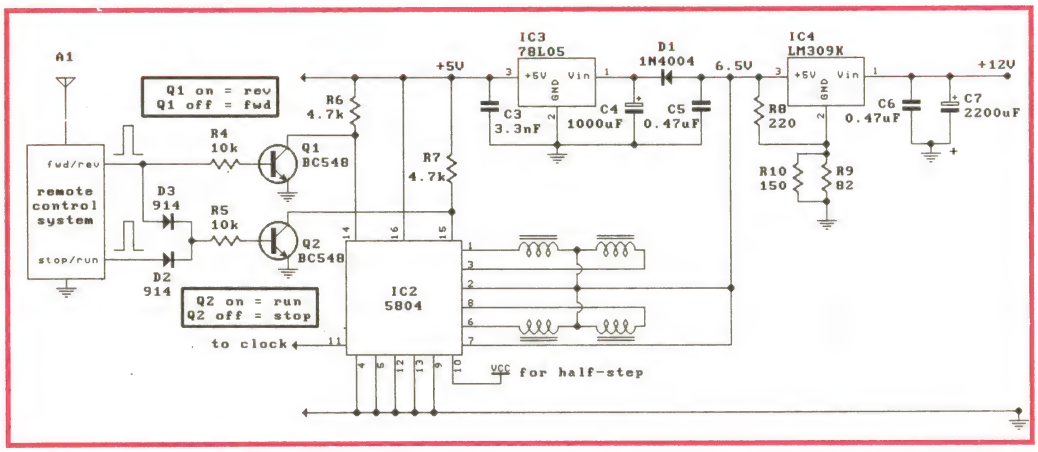


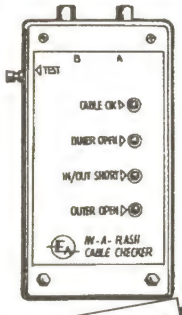
Fig.10: Transistors Q1 and Q2 interface the remote control system to IC2. The 555 timer in Fig.5 is not shown here, but should be included in the circuit.

DICK SMITH ELECTRONICS

Please contact your nearest store for availability as some kits may still be in production.

YOU CAN BUILD THESE WITH EASE!

In-A-Flash Cable Checker



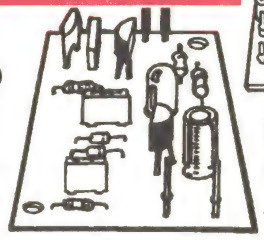
If you work with a lot of coaxial and shielded cables, you'll find this checking device extremely useful. It does the job quickly and easily - you simply connect the cable you're testing between two of the checker's sockets, press the TEST button and checker LEDs immediately indicate the condition of the cable. Similarly, you'll find it easy to build, requiring just a single LM324 quad co-amp IC. Supplied with all components, hardware, front panel label and case.

Cat K-7230

$18.95

EA Nov '94

Crystal Tester



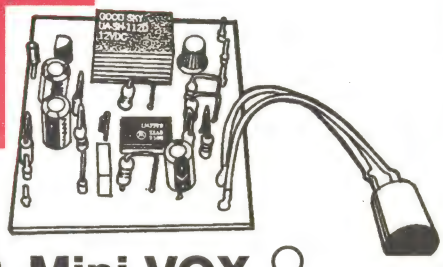
We all need an easy, quick way to check whether those fragile (yet essential) crystals are working before we install them in projects. Well, this easy-to-build circuit is the answer - it gives you a simple "good" or "bad" indication via an LED. The kit comes complete with PCB, all components and battery snap to suit 9V battery (not supplied).

Cat K-7228

$5.95

SILICON CHIP Aug '94

Mini VOX



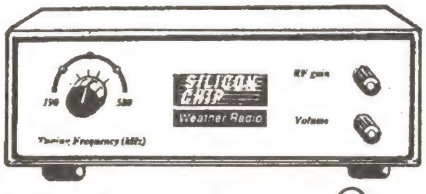
Build your own tiny voice-activated relay! Great for amateur radio or where hands-free operation is required, it has a very short turn-on delay and will save you the hassle of pushing buttons every time you want to talk. Using just a single IC and an SPDT 12VDC relay, it's designed to fit in the tightest space and runs off just about any 12V DC supply. Supplied in short form with PCB and components only.

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SILICON CHIP Sept '94

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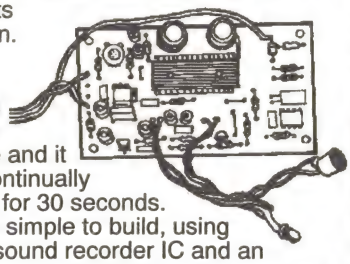
Cat K-5022

$24.95

SILICON CHIP Sept '94

Sick Of Getting A Flat Battery?

Talking Headlight Reminder

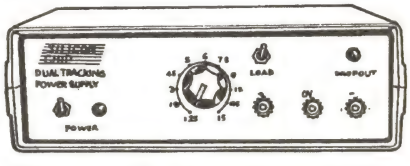


This ingenious kit can be used as a reminder alarm to alert you when your headlights are left on. Simply record your own reminder message and it will be continually replayed for 30 seconds. The kit is simple to build, using a single sound recorder IC and an external speaker which can be mounted under the dashboard or under a seat. It can be used for a number of other applications - anywhere you need a solid-state message recorder that repeats a recorded message for 30 seconds. Comes in short form with components, PCB, and hardware items such as switches, mic. insert, speaker and record LED.

Cat K-5024

$49.95

SILICON CHIP OCT '94



Great For Beginners!

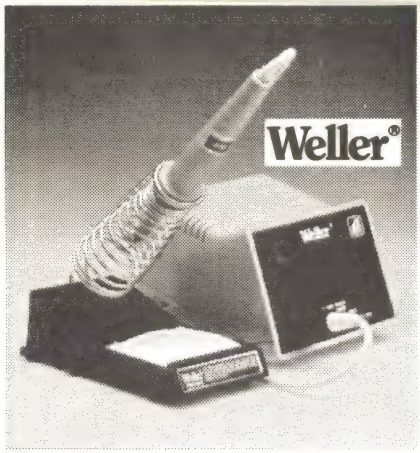
Dual-Rail Power Supply

As this kit requires no mains wiring, it's the perfect starting kit for beginners. You can build your very own dual-rail power supply using an AC plug pack which already contains all the mains wiring. It provides 11 separate voltages from 1.25V to 15V and has a load switch and drop out LED. Comes complete with all components, PCB, hardware, case, front panel (punched & screened) and AC plug pack.

Cat K-3201

$59.95

SILICON CHIP Oct '94



Bonus Side Cutters!

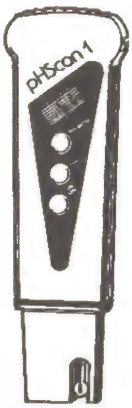
WTCPS Quality Solder Station

Its non-burning silicon rubber power cable and long-life, iron-plated tip make this soldering station very reliable. With 48 watts capacity, low voltage internal transfomer, lightweight soldering pencil and special "closed-loop" temperature control.

Cat T-3000 **$179**

Bonus Side Cutters (T-2999) valued at $30

Digital pH Meter (pH-Scan 1)



A top-quality, highly accurate meter designed for testing the pH level of water systems such as pools, aquariums, rivers and streams. It indicates whether the solution has a safe pH level or it's acidic or alkaline. Offers push-button calibration for accuracy, hold function, auto-off to conserve your batteries and a large LCD that allows for easy reading.

Cat Q-1404 **$149.95**

Also Available:

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Packet of 5 pH-7 Buffer Tablets Cat Q-1408 **$6.95**

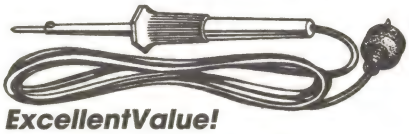


Pro's Kit Soldering System

The Soldering Kit You Can Afford!

Includes quality butane iron, non-slip stand, solder, side cutters and pliers. With torch tip, 2.4mm soldering tip, hot knife tip and handy carry case. *(Gas not included).*

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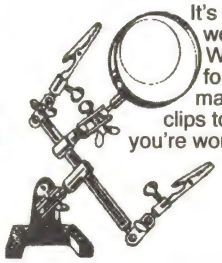
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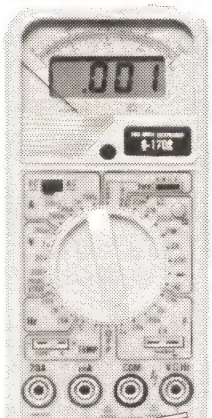
PCB Workstation



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AC/DC Current: 200uA, 2mA, 20mA, 200mA, 20A
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Capacitance: 2nf, 20nf, 200nf, 2uf, 20uf
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26-Way Rainbow Cable

Includes 26 strands of 10 x 0.12mm conductors with a conductor area of 0.11mm²
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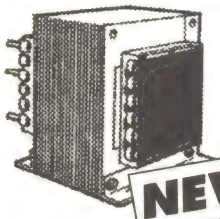


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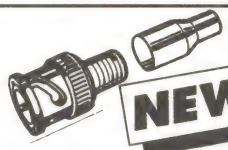
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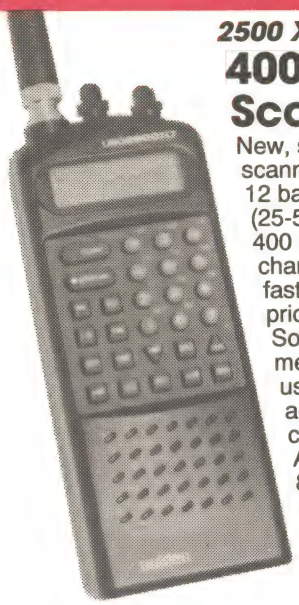
One of the 'Do-It-Yourself' Dick Smith Electronics publications, it includes clear diagrams and instructions to make securing your house a breeze. Plus, it provides helpful advice on the kind of security you need, where to place alarms and buying the right equipment.
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Cat D-2725

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Uniden 220XLT Scanner

Super Fast Scanning!

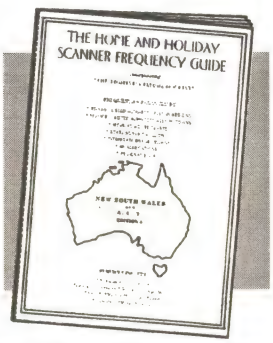
The Twin Turbo 220XLT hand-held scanning receiver provides ten-band VHF/UHF coverage including air band, 200 memories and improved super fast scan and search features (scan up to 100 channels/sec, search at 100 or 300 steps/sec). Also features pre-programmed channel steps to suit Australian conditions, including 800MHz. Complete with NiCad batteries, AC charger and detailed instructions. 2-year warranty.
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Home & Holiday Scanner Frequency Guide

Listings include ambulance, fire, police, Emergency Services, Government Departments, Aircraft, Marine, Railways, Taxis, Recreation and media.

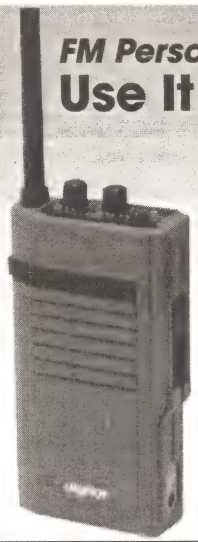


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*** STORES IN RED ARE OPEN SUNDAYS..STORES ACROSS AUSTRALIA AND NEW ZEALAND**

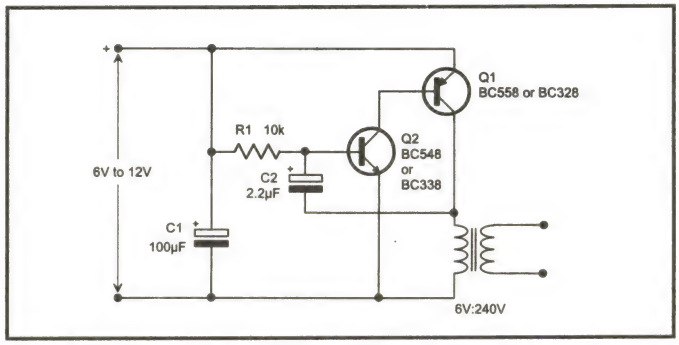
Circuit & Design Ideas

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.

High voltage generator

This circuit produces high voltage pulses from a DC supply of between 6V and 12V. The circuit is a two-transistor oscillator that generates a pulsing DC voltage source at about 3Hz, which is fed to a 6V:240V transformer. Every time the pulse ends, a high voltage is generated in the secondary windings of the transformer. The repetition rate of the pulses can be changed by altering the value of C2 or R1.

The circuit can be powered from various DC voltages sources ranging in voltage from 6V to 12V. For an electric fence, use a lead-acid battery, or similar. In this application, make Q1 a BC328 and Q2 a BC338. It's also a good idea to fit clip-on heatsinks. For lower power applications, power the circuit from six AA size batteries, and use a BC558 for Q1 and a BC548 for Q2.



Sammy Isreb,
Traralgon, Vic. **$35**

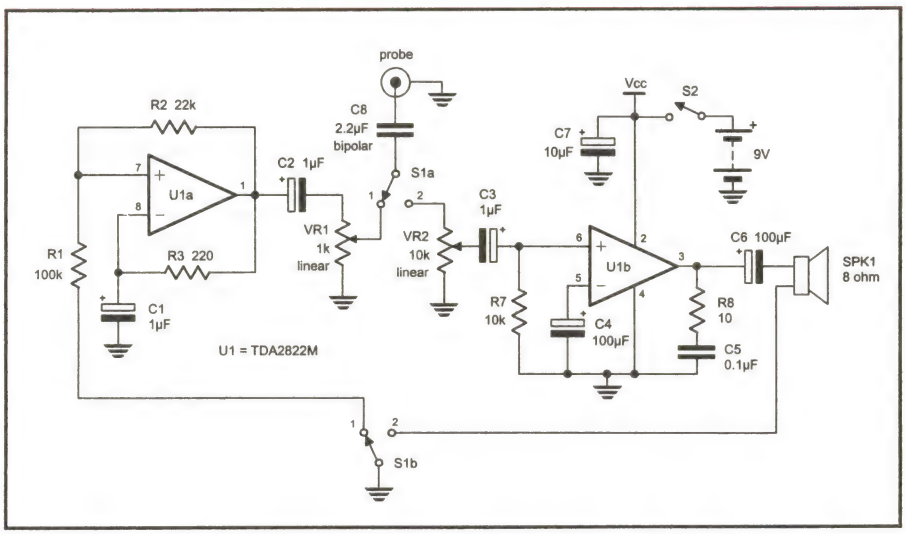
Signal injector/tracer

This is one of the handiest devices I ever threw in my tool box. It is a basic signal injector/tracer, based around a single IC, the TDA2822M, a dual low-voltage power amplifier. I got mine from Farnell Electronic Components.

A single probe is used, and the unit can be made quite small if laid out well on a board. I built the prototype on Veroboard, and by using a sub-miniature speaker and compact potentiometers, it all fitted in a small plastic box with a moulded battery compartment. Op amp U1a is configured as a pulse oscillator with a frequency of around 800 - 1200Hz. The frequency can be varied with the value of R3 or C1. The duty cycle of the pulse can be varied by the ratio of R1 to R2, which also varies the frequency.

Resistor R1 is disconnected from ground by SW1b, which stops the oscillator. This is necessary when the signal tracer is used, as the injector signal will 'bleed' through the power supply to the tracer if the oscillator is left running.

The output level of the injector is set with VR1, and then switched to the probe via SW1a. Electrolytic capacitor C8 should be a bipolar type, as the DC component of the circuit under test is unknown.



Op amp U1b is wired as a power amplifier with an output of about 500mW. The sensitivity is set with VR2. The speaker is disconnected by SW1b when the injector circuit is being used, to avoid the annoying 'bleed' mentioned before. The circuit has a voltage gain of around 40dB. When SW1 is moved to position 1, the oscillator starts and its output is fed to the probe. At this point the output of the tracer circuit is silent as the speaker is disconnected from ground. When SW1 is moved to position 2, the probe is connected to the tracer input and the injector circuit is disabled.

Bruce Colledge,
Keperra, Qld. **$45**

Variable-temp soldering iron

Here is what must be the simplest way possible to get a variable temperature soldering iron.

Buy a Dick Smith 12V 30W soldering iron (cat no T-1913) and use it with a 2.5A variable power supply. The table shows the current and therefore power taken by the soldering iron for a range of voltages. These are approximate.

Other benefits are the supply to the iron is DC and floating above earth, making it ideal for working with CMOS devices. The bit is a standard 2.5mm (1/8") and is interchangeable. The cost of the iron is a low $9.95.

Bruce Porter,
Port Macquarie, NSW. **$25**

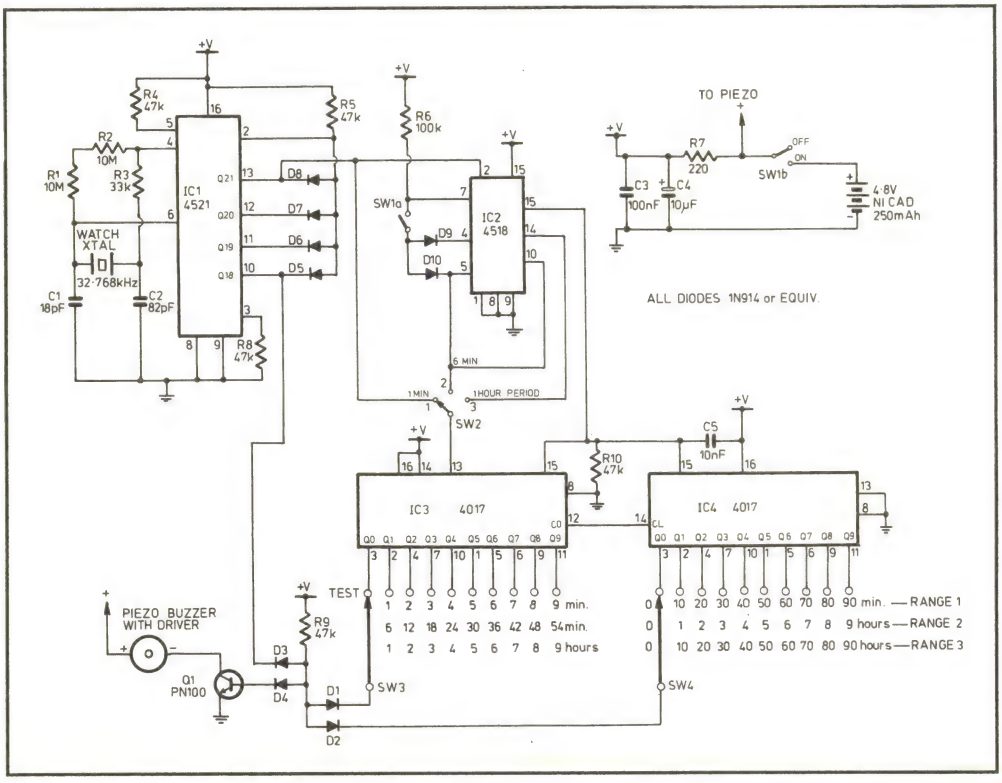
Voltage (volts)	Current (amps)	Power (watts)
9	1.3	12
10	1.5	15
12	1.75	20
14	2	28

Crystal controlled timer

This timer circuit is very versatile, accurate and easy to build. It has four ICs, where IC1 is a crystal oscillator/frequency divider, IC2 a dual binary counter and IC3 and 4 are decade counters. The minimum time delay is one minute and its maximum is 99 hours. The circuit sounds a buzzer for a preset time after the time delay.

The internal inverter of IC1 is wired as a 32.768kHz, crystal controlled clock. The crystal is from a watch and its frequency is divided by an internal 24-stage divider chain in IC1. Outputs Q18 to Q21 are ANDed for a division of 1.966,080, resulting in a period of exactly one minute at Q21 (32 seconds low, 28 seconds high). The falling edge of each one minute pulse advances counter A in IC2 giving a division by six at pin 5 (IC2). This signal clocks the other counter in the IC, giving a further division by 10. There are thus three signals from IC2: a pulse every minute, a pulse every six minutes and a pulse every hour. One of these outputs is selected by SW2 and fed to the clock input of IC3.

Counter IC3 has its 10 outputs connected to a 10-pole wafer switch SW3, and its carry-out terminal connected to the clock input of IC4. Thus IC4 advances after every 10 pulses fed to IC3. Again the outputs of IC4 are selected by a 10-pole wafer switch, SW4. For example, for a delay of 24 hours, set SW2 to position 3, which will cause IC3 to advance by one every hour. Then set SW3 to the four hour position (selects Q4 of IC3), and SW4 to the 20 hour position (selects Q2 of IC4).



When both these outputs are high, the AND gate formed by D1, D2 and R9 will allow Q1 to turn on, as both D1 and D2 are reverse biased. Output Q18 of IC1 is also connected to the base of Q1 via D3. This output pulses every four seconds, turning Q1 on and off, as long as both selected outputs remain high, in this case for one hour. On the lowest range, the buzzer will sound for one minute, and for six minutes on the next.

The circuit is started and reset by SW1, which also switches power to the circuit. Current consumption is about 0.5mA at a supply voltage of 5V, which gives around 21 days continuous operation from a 0.25Ah NiCad battery. Everything including the switches and battery fits in a 90 x 75 x 35mm box, and the prototype has been working reliably for nearly two years.

Manfred Schmidt,
Edgewater, WA. **$50**

EVER THOUGHT OF CONTRIBUTING TO *EA*?

If you've developed a great new circuit or design, and can't wait to tell others about it, or if you've written the best article ever on electronics theory or practice, why not see your work published as widely as possible. ***Electronics Australia*** has by far the country's largest circulation, with more readers than our nearest competitors. This makes us the best possible way to bring your achievements and knowledge to the largest number of your colleagues and fellow enthusiasts.

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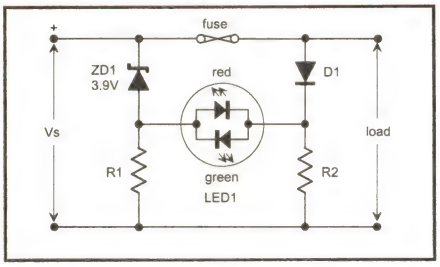
Electronics Australia,
PO Box 199, Alexandria 2015,
or fax on (02) 353 0613.

DC voltage status indicator

This circuit was designed for a 12/24V volt power distribution system. It shows the fuse and power status, using only one bi-colour LED. With power on and the fuse intact, the current path is through D1, the green LED and R1. The voltage drop across D1 and the green LED is less than 3.9V, so the zener diode ZD1 doesn't conduct and the green LED lights. When the fuse blows the current path is ZD1, the red LED and R2, giving a red light. Diode D1 prevents current bypassing the blown fuse and flowing through the LED into the load.

The zener diode is a 3.9V 400mW zener, LED1 a bi-colour LED and D1 is any diode with a current rating greater than 50mA and a PIV rating greater than the supply. For example, a 1N914, 1N4148 or any of the 1N4000 series.

The value of R1 is found by the equation = (Vs-2.7)/green LED current (assuming a 2V drop across the green LED and O.7V across D1). Resistor R2 is found by (Vs-5.6)/red LED current, which assumes a 1.7V drop across the red LED. This means the circuit is not suitable for supplies below about 8V.



For a 12V DC supply, and assuming a LED current of 10mA, R1 is around 1k and R2 is about 680 ohms. Both resistors can be 1/4W rated, although a 1/2W rating gives a wider margin.

Rodger Bean,
Watson, ACT. **$40**

Construction Project:

IN-A-FLASH CABLE CHECKER

Here's a really handy little device for anyone working with a lot of co-axial and shielded cables used to carry video, audio or data. To check a cable, all you need do is connect both ends to the checker and press the button. Instantly one of four LEDs will glow, to show its condition — much faster than doing the job with a multimeter. It uses only a handful of low cost parts, and can be assembled in a couple of hours...

by JIM ROWE

Why would you want a unit dedicated purely for checking video, audio or data co-axial cables? Because it makes the job so much easier and faster, that's why. If you've ever had to check a few cables in the traditional way, with a multimeter or a continuity/insulation checker, you'll know it's both fiddly and tedious.

Apart from anything else, you often seem to need at least three hands!

I got the basic idea for this project one lunchtime, when I was casually reading through an overseas electronics magazine. In the 'New Products' section I saw a small item on a cable checker, with a tiny picture. Apart from the price, the only real information given was that the checker ran from a 9V battery, and gave an instant indication of the cable's condition via a set of LEDs...



What an *interesting* idea, I thought. I wonder how they were able to make it do all that, and for the fairly low price quoted? It became a challenge, to see if I could come up with a circuit that would do the same. And that's how this little project came about.

I have no way of knowing whether the commercial unit concerned works in the same way, but of course it doesn't matter. My design seems to work very nicely, and it uses only a handful of parts; I estimate that all up, they should only cost you around $25.It's designed basically for testing cables fitted with BNC or RCA connectors, as the majority of commonly-used co-ax and shielded cables used for audio, video and data use these connectors. (You can also check cables with a BNC at one end and an RCA at the other, as used for video with some VCRs, etc.)

For checking cables with other types of connector you can either use adaptors, or simply build the checker in a larger box and fit it with some additional sockets.

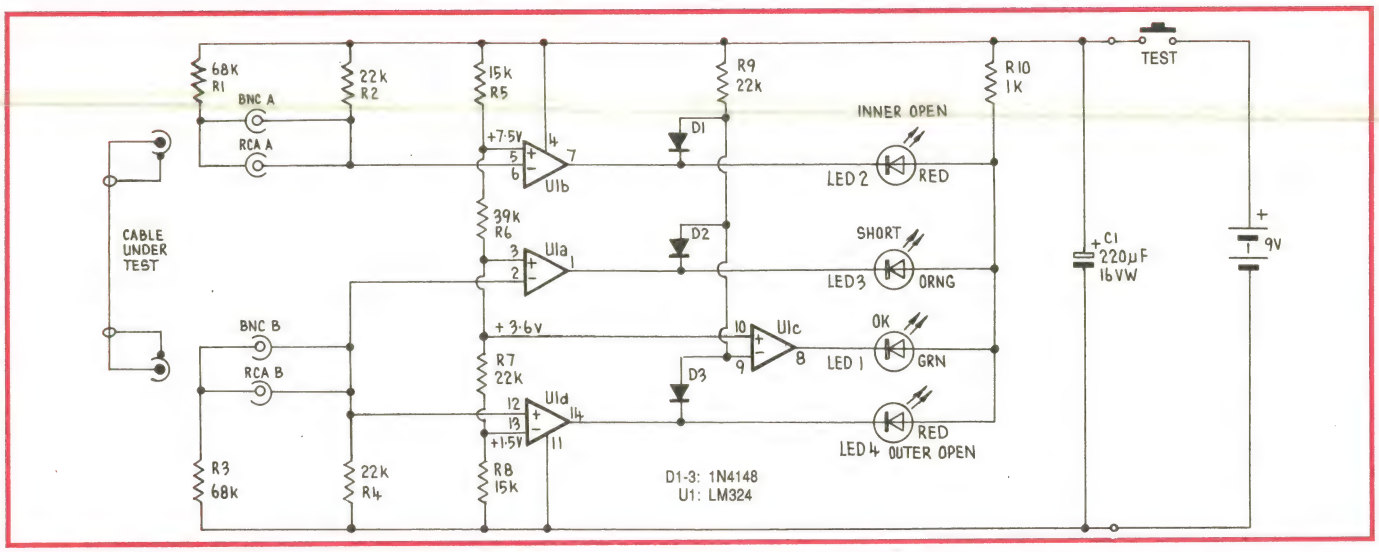
It's particularly easy to use. You simply connect the cable concerned between two of the checker's sockets (one from each of the two pairs, 'A' and 'B'), and press the TEST button. The condition of the cable is then indicated immediately (in a flash!) by the checker's LEDs. If both the inner conductor and outer shield braids have continuity, and there's no short between the two, the green 'OK' LED will light; otherwise one or more of the other LEDs with light instead, to indicate the type of fault detected. What could be simpler?

How it works

All of the checker's tests are performed by a set of four voltage comparators, using a single low cost LM324 quad op-amp IC. To see how it all works, let's look at the schematic.

As you can see, the cable to be checked is connected between one of the sockets at upper left marked 'A', and one of those at lower left marked 'B'. (The sockets in each group are simply connected in parallel.)

This connects the inner and outer conductors of the cable into two separate voltage divider circuits, each connected across the 9V supply from the battery. The voltages present on the cable conductors are then compared with the voltages on a reference divider, formed by resistors R5 - R8,



As you can see from the schematic, only a handful of components are used in the checker. It works by connecting the cable under test into a pair of voltage dividers, and then comparing the voltages on the conductors against those in the reference divider formed by resistors R5 - R8. A single quad op-amp chip and three diodes do all the work...

to determine whether the cable is OK or not.

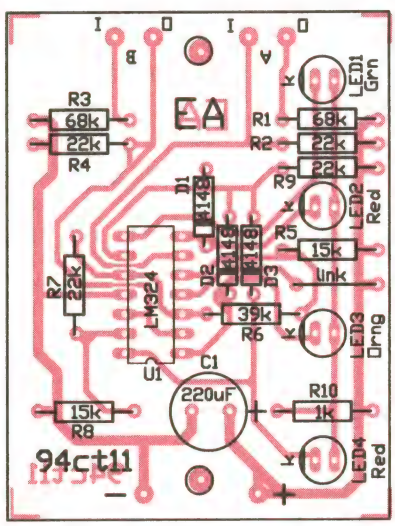
Comparator U1b is used to check the continuity of the *inner* conductor of the cable. Its positive input is held at +7.5V by the reference divider, while its negative input is connected to the cable's inner conductor via the 'A' socket.

If the cable's inner conductor is continuous, the voltage level at U1b's negative input will be +6.8V, because of the voltage divider formed by R2 at the top end and R3 at the bottom end. As the positive input of the comparator will be more positive than the negative input, the output of U1b will therefore go high, and no current will flow through LED2.

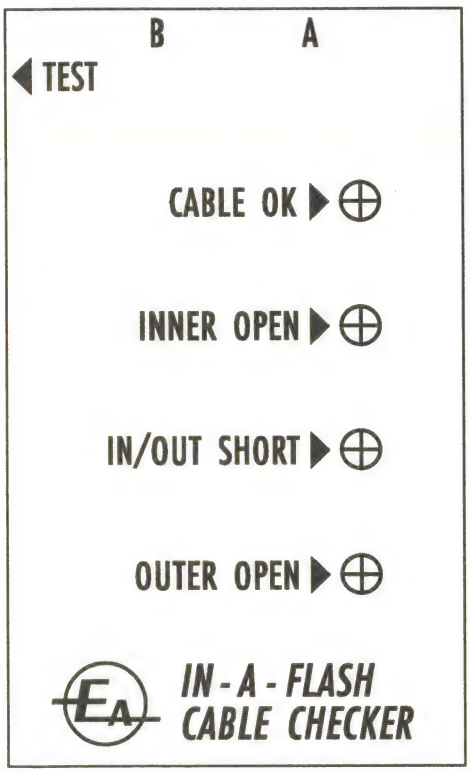
On the other hand, if the inner conductor of the cable is open circuit, the negative input of U1b will be simply pulled up to +9V by resistor R2. As a result, the relative polarities of the comparator's inputs will be reversed, and its output will swing down to nearly 0V. This will cause current to flow through LED1 via limiting resistor R10, and it will glow to indicate the fault: 'INNER OPEN'.

In a very similar way, comparator U1d is used to check the continuity of the cable's *outer* conductor. Here the negative comparator input is held at +1.5V by the reference divider, while resistors R4 at the bottom and R1 at the top are used to determine the voltage at the positive input. If the outer conductor is continuous the voltage at this input will be +2.2V, while it will fall to zero if it's open circuited — causing the comparator's input polarities to reverse, and current to flow through LED4, indicating 'OUTER OPEN'.

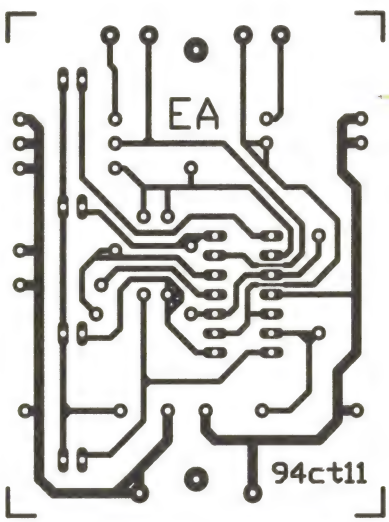
Note that if *both* of the cable's inner and outer conductors are open circuit (or no cable is connected at all), both of these LEDs will glow...



Use this overlay diagram as a guide to fitting all of the minor components to the PC board.



Here is the front panel artwork for the checker, reproduced actual size for those who wish to make their own.



And we probably don't need to tell you that this is the PCB artwork, again shown actual size.

Cable Checker

Now consider the operation of comparator U1a, which is used to check for shorts between the inner and outer conductors.

The positive input of this comparator is held at +3.6V by the reference divider, and as you can see its negative input is taken to the 'outer' side of the 'B' sockets — the same point as the positive input of U1d.

What this means is that if the cable has no short between its inner and outer conductors, the negative input of U1a will be held at either +2.2V (if the outer conductor is continuous) or at 0V (if the outer is open). In either case, the relative polarities of the inputs will be correct (i.e., '+' more positive than '-'), and its output will be high — drawing no current via LED3.

But if the cable has a short between its inner and outer conductors, and both conductors are continuous, the voltage level at the negative input of U1a will rise to +4.5V, because of the action of both the R1/R4 and R2/R3 dividers in parallel.

This will cause the relative polarities of the U1a input voltages to be reversed, and as a result its output will drop to nearly 0V, and current will flow through LED3 — indicating 'INNER/OUTER SHORT'.

(What if the inner and outer are shorted, but one or the other is *also* open circuited? Depending on the relative positions of the open circuit and short, the voltage at the negative input of U1a will vary between about +1.8V and +7.2V — so LED3 may or may not glow. But in this case either LED2 or LED4 will glow anyway, due to the open circuit, so that a fault will still be indicated — even if it isn't the *only* fault present...)

The fourth op-amp comparator U1c is used to drive LED1, for the 'CABLE OK' indication when none of the above fault situations is present. This is done by connecting the positive input of U1c to the +3.6V point on the reference divider, and feeding its negative input from a simple three-input AND gate, formed from diodes D1-D3 and resistor R9.

As you can see, resistor R9 is connected between the negative input and the +9V rail, and tries to pull it high. On the other hand the diodes are each connected between the input and one of the other comparator inputs, so the input will only be able to *go* high when the outputs of U1b, U1a and U1d are ALL high at the same time — in other words, when both cable conductors are continuous, and there's no short between the two.

Only when this occurs will the relative polarities of the inputs of U1c be reversed, causing its output to go low and draw current through LED1, indicating 'CABLE OK'.

So that's how the checker works. Everything is powered from a standard 213-type 9V battery, and the 'TEST' button is simple a momentary-contact power switch. Power is only drawn from the battery during the test, and is only about 8 - 10mA — so the battery will last a long time.



This photo of the top of the tester shows the two pairs of connectors.

Construction

For compactness and convenience the checker is housed in one of the small 'UB3' plastic jiffy boxes, measuring 130 x 68 x 41mm. All of the components apart from the cable connectors, test pushbutton and battery are mounted on a small PC board, measuring 65 x 50mm and coded 94ct11.

The board is mounted centrally and horizontally inside the case, using two countersunk 3mm x 25mm long machine screws mounted in the rear, and using nuts for spacing.

The battery fits below the PCB in the bottom of the case, while the test button mounts in a hole drilled in the left-hand side, up near the 'top end' where the connectors are fitted.

The LEDs mount directly on the PCB, with their leads left long so that their bodies protrude through corresponding holes in the front panel. This construction and layout makes the checker not only easy to use, but also quite easy to assemble.

PARTS LIST

Resistors

All 1/4W 1% metal film:

R1,3	68k
R2,4,7,9	22k
R5,8	15k
R6	39k
R10	1k

Capacitors

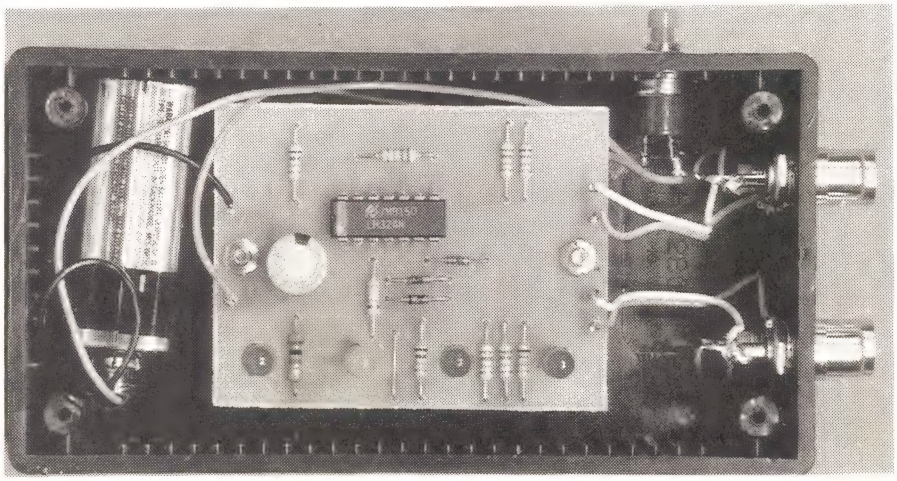
C1	220uF 16VW electrolytic (RB)

Semiconductors

U1	LM324 quad op-amp
D1-3	1N4148 or 1N914 diode
LED1	5mm green LED
LED2,4	5mm red LED
LED3	5mm orange LED

Miscellaneous

Plastic utility box (UB3), 130 x 68 x 41mm; PC board, 66 x 50mm, coded 94ct11; two BNC sockets, single hole panel mount; two RCA sockets, single hole panel mount; one small pushbutton switch, N/O momentary action; 213-type 9V battery with 'snap' connector lead; two 25mm x 3mm countersink-head machine screws, with six 3mm nuts and four star lockwashers; insulated hookup wire, solder etc.



This view inside the checker case shows how the PC board mounts on a pair of 25mm long machine screws attached to the base. The cable connectors, test push button and battery connect to six matrix pins on the board.

Cable Checker

Fitting the smaller components to the PCB should be quite straightforward if you use the overlay diagram and photos as a guide. The main things to watch are the polarity of the IC, diodes, 220uF electrolytic cap and of course the LEDs.

The latter all mount with their anode leads (usually the longer lead) towards the adjacent edge of the PCB — i.e., away from the IC.

The LEDs should be mounted so that they are as vertical as possible, relative to the PCB, and so that when the PCB is mounted in the case, the rounded ends of the LEDs protrude about 1.5mm from the front panel. If you are supplied LEDs with leads that are too short to allow this, you'll need to 'extend' them using short lengths of tinned copper wire (such as trimmed-off resistor leads).

Note that only one short wire link needs to be fitted to the PC board. It is located alongside R5, between LED2 and LED3.

As you can see, there are only six connections between the PCB and the rest of the circuit — the 'inner' and 'outer' connections to the A and B pairs of cable connectors, and the positive and negative supply connections. The latter connect to the battery, via the test pushbutton.

I fitted all six of these off-board connections with PCB pins, so that they could easily be made after the PCB was mounted inside the box.

The main thing to watch when you're making these off-board connections is to wire the leads to the cable connectors correctly, with those marked 'inner' (I) and 'outer' (O) going to the correct sides of the respective A and B connectors.

If you make a mistake here, the checker may give some incorrect — and rather misleading — indications...

That's about it, though. There are no setting-up adjustments, so if you wire up the checker as shown, it should work as soon as you've finished and fitted a battery. The only other thing you might want to do is wrap the battery in a small piece of plastic foam, to prevent it from moving around inside the box.

Once you've built it and tried it out, I feel sure you'll find this little checker as handy as I've found the prototype. It sure beats fiddling around trying to check suspect cables with a multimeter! ❖

EXPERIMENTING WITH ELECTRONICS

Continued from page 51

doubled the resolution and also made the motor run more smoothly.

The complete system is shown in Fig.11. I used a 12-channel UHF remote control system from Oatley Electronics, as apart from the stepper motor, I wanted to control a number of lights. In fact, this system is for remote controlled lighting, and the stepper motor operates the potentiometer in a specially designed light dimmer. The toroidal transformer supplies power to quite a few things, including a number of relays, the stepper motor and all the electronics. As you can see, it takes up most of the room.

The 6.5V regulator and another 12V regulator are mounted on a piece of aluminium cut as the back panel of the plastic case. To attach the transistor interface circuitry I constructed each interface on stripboard, then connected this assembly to the PCB using the holes previously occupied by the switches.

In conclusion

There's much more that could be said about stepper motors, but using the circuits described here, you should be able to at least get a stepper motor going, either from a computer or simply using a 555 timer.

Computer programming to drive these circuits is really only a matter of writing numbers to the computer output port. The program can be written in BASIC; all it needs is a timing loop, and instructions to write values to the output port. The time delay should be long enough to allow the motor to follow the pulses.

Incidentally, there's a stepping rate, called the pull-in rate, where the stepper motor won't start from standstill. However, if the motor is gradually accelerated, it will eventually be able to run at this rate. The same applies to slowing it down again. Complex programming, but interesting. ❖

PARTS LIST (5804 PCB)

Resistors

All 1/4W, 5% unless otherwise stated:

R1	10k
R2	2.2k
R3	see text
RV1	100k trimpot

Capacitors

C1	1uF 25V RBLL electrolytic
C2	10nF polyester
C3	3.3nF ceramic
C4	1000uF 25V electrolytic

Semiconductors

D1	1N4004 1A diode
IC1	555 timer
IC2	5804 stepper motor driver IC
IC3	78L05 +5V regulator TO92

Miscellaneous

PCB 70mm x 50mm; two x SPDT PCB mount toggle switches; one each 8-pin and 16-pin IC sockets; copper shim for heatsink, 30 x 30mm; 6-wire stepper motor; hookup wire.

Kits of parts for these projects are available from:
Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Fax (02) 579 3955
Postal address (mail orders):
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PCB and all on-board components for full bridge stepper controller, a 6-wire stepper motor, suitable software on disk, manual that includes the program listings $35
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Screen printed PCB for UCL5804 stepper motor driver IC $7
6-wire 5V 7.5° stepper motor $14
4-wire 7.2V 1.8° stepper motor $20
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ELECTRONIC TEST GEAR TO BUILD

Volume 2

Test instruments are important tools for anyone who needs to work with electronic circuits — whether you're a designer, a service technician or a hobbyist experimenter. With the right test instruments, you can tell quite accurately what is going on in a circuit, but without them, you're often forced to rely on luck or blind intuition.

This book is a collection of some of the most popular designs that we've produced in the last few years, brought together and re-presented by popular demand. In each case, you'll find that as well as the original articles, we've also included any subsequent ntoes and errata on the projects concerned, to make sure you have all the information needed to make each project a success.

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- Polarity reversible plugs and sockets.
- Switch selectable output voltage
- 1.0, 1.3, 2.1 & 2.5mm DC plugs supplied



M19006
$39.95

Variable Temperature Soldering Iron

T12478
$59.95



Professional quality iron with variable 250 to 450 degrees Celsius phase controlled element.

- Fully variable between 16 to 25 watt.
- Iron clad chrome plated long life tips.
- Replacement tips: RT1, RT1.5 & RT3
- Weight: 180 grams

16 PIECE SCREWDRIVER SET



Complete set of flat/Philips jewellers screwdrivers plus nut and hex keys. Comes in hard plastic storage case.

- 3 x Hex Keys: 1.5/2 & 2.5mm
- 3 x Nut Drives: 3/4 & 5mm
- 4 x Philips: 0/0.2/1.1 & 1.2
- 6 x Flat Drivers: 1/1.4/2/2.4/3 3.8mm

T12203
$20.95

REPLACEMENT CD CASE

Each case holds one compacts disc.

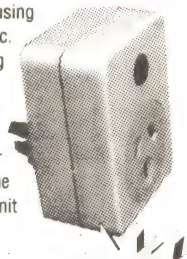
- Ideal as replacements for broken or damaged cases.
- Standard size case has flip open transparent cover & clips for displaying original dust jacket and label.



A10030
$6.95

240VAC MAINS SURGE PROTECTOR

Atmospheric discharges that cause power spikes and surges often occur in the AC mains reticulation system sometimes causing severe damage to appliances, computers, Hi Fi systems etc. Protection of any device can be achieved by simply inserting the PAC 15 into the power point and plugging the appliance into the front of the PAC 15. Built in M.O.V. circuitry absorbs most spikes and surges that enter the PAC 15 through the AC power system before they reach the appliance. An amber indicator shows when the unit is working properly. If a large spike or surge occurs and the M.O.V.s are used to their limit they will break the circuit preventing the surge striking the appliance and this will be indicated by the LED. As a result the PAC 15 has done its job and will need to be replaced.



- *Approved by the Australian Dept of Minerals and Energy.*
- *Approval #:N11361*

M10091
$26.95



T1220A
$22.95

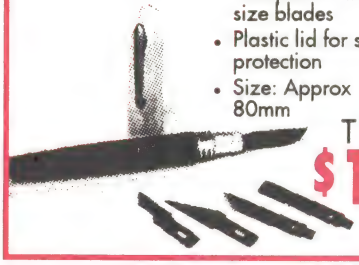
Precision 6 Piece Screwdriver Set

Set of high quality Nickel Chrome Molydenum Steel screwdrivers. Contains three flat and three Philips head drivers. Extra long shafts and handles.

HOBBY KNIFE WITH SPARE BLADES

Hobby knife with interchangeable blades.

- Handy pen type body & pocket clip
- Complete with 5 different size blades
- Plastic lid for safety & blade protection
- Size: Approx 110 x 90 x 80mm



T10038
$10.95

X15693
$10.95



KEYBOARD ADAPTOR

6 pin mini DIN female to 5 pin DIN male

- Allows keyboards with a 6 pin mini DIN plug to be used with computers that have a 5 pin DIN socket keyboard input.

NEW VIDEO TAPES...

E-180 A11465.....$19.95 pack of 6
E-180 A17030.....$3.95 each

KEYBOARD CABLE

Modular plug to modular plug replacement cable for keyboards and handsets.

- 4 way/4 wire connectors/cable
- Length: Curly cord 4.5 metres extended.
- Available in bulk quantities without display packaging

Y16023 **$9.95**



COMPONENT RETRIEVAL KIT

Supplied with two fully insulated tweezers and a long flexible finger with a magnet on the end. Allows small components and objects to be picked up or manipulated in small, narrow hard-to-get-at places.

T12084
$10.95



240VAC MAINS SURGE PROTECTION and FILTER

This unit is similar to the PAC 15 in that inbuilt M.O.V. circuitry prevents most AC power spikes or surges entering the appliance that it is protecting. An additional feature has been added to this unit. Line filtering and conditioning circuits have been included with the use of a torroid coil which suppresses electro magnetic interference (EMI) caused by other appliances operating in the AC system IE: computers, neon starters, refrigerators etc. The PAC 18 is rated at 10 amps and is sufficient for most domestic and many commercial applications. It is further enhanced by using low resistance circuitry which allows normal operation on earth leakage devices which are being used in all new building installations.



X10092
$62.95

- *Approved by the Australian Dept of Minerals & Energy.*
- *Approval # N11361*

DUAL TELEPHONE ADAPTOR

Y16035
$5.95



6 way/4wire modular plug to two modular sockets

- Colour: Cream
- Available in bulk

ERRORS & OMISSIONS EXCEPTED. PRICES CHANGE WITHOUT NOTICE

COMPONENTS SPECIAL!! FOR ELECTRONIC KIT ENTHUSIASTS.



GREY FLAT RIBBON CABLE

Cat no.		$/Mtr
W12614	14way	$1.90
W12616	16way	$2.20
W12620	20way	$2.50
W12624	24way	$2.90
W12625	25way	$3.20
W12626	26way	$3.60
W12634	34way	$3.90
W12636	36way	$3.90
W12640	40way	$4.90
W12650	50way	$5.90
W12660	60way	$6.90

ON SUPA SPECIAL



GENERAL PURPOSE TRANSISTORS

PN100: a NPN general purpose medium power amp and switch with continuous collector current up to 500mA. PN200: a PNP general purpose amp at collector currents to 1 AMP. Both are TO-82 plastic package.

PN100 REPLACES:
PN2221, PN2222, PN2222A, PN3585, PN3568, PN3569, PN3643, PN5133, 2N2219A, 2N2222A, 2N3414, 2N3415, 2N3416, 2N3417, 2N3700, 2N3704, 2N3904, 2N4123, 2N4124, 2N4401, 2N5088, 2N5210.

PN200 REPLACES:
PN2907, PN2907A, PN3638, PN3638A, PN3640, PN3644, PN4121, PN4143, PN4248, PN4249, PN4250, PN4355, PN4916, PN4917, PN5910, 2N205A, 2N3467, 2N3702, 2N3906, 2N4125, 2N4126, 2N4291, 2N4402, 2N4403, 2N5086, 2N5087, 2N5447.

PN100.....T90001
PN200.....T90002

1-9	10+	100+
$0.20	**$0.18**	**$0.15**



ALL PLASTIC UTILITY BOXES

Comes with 4 Screws
Black in colour.

	1-9	10+
H10128 83 x 54 x 28mm	$1.95	$1.70
H10126 130 x 68 x 41mm	$2.50	$1.95
H10122 150 x 90 x 50mm	$3.95	$3.50
H10124 195 x 113 x 60mm	$4.95	$ 4.25

FERRIC CHLORIDE



25% more from RIE at the same prices as our opposition

H10810	250gm	$4.95
H10812	500gm	$7.95
H10814	1Kg	$11.95

Discount



DIODES BUY IN BULK & SAVE!

Cat No.	10+	100+	1000+	10K
Z10135 IN4148	$0.05	$0.04	$0.03	$0.02
Z10105 IN4002	$0.06	$0.05	$0.04	$0.03
Z10107 IN4004	$0.08	$0.06	$0.05	$0.04
Z10110 IN4007	$0.10	$0.07	$0.06	$0.05
Z10115 IN5404	$0.18	$0.14	$0.13	$0.11
Z10119 IN5408	$0.20	$0.16	$0.15	$0.14



NICADS

Save a fortune on expensive throw away batteries with these quality Nicads and Rechargers!

Size AA 450mmAH

1-9	10+	100+
$2.95	$2.75	$2.50

Size C 12 A H

$9.95	$9.50	$8.95

Size D 12 A H

$6.95	$5.95	$4.50



LOW PROFILE IC SOCKETS

Save a small fortune on these "Direct import" low profile IC sockets! PCB mounting solder tall. All tin plated phosphor bronze or berryllium and dual wipe for reliability.

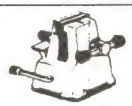
	1-9	10+	100+
P10550 8pin	15¢	12¢	10¢
P10560 14pin	20¢	18¢	15¢
P10565 16pin	20¢	18¢	16¢
P10567 18pin	30¢	25¢	22¢
P10568 20pin	35¢	30¢	25¢
P10569 22pin	35¢	30¢	26¢
P10570 24pin	35¢	30¢	26¢
P10572 28pin	45¢	35¢	30¢



WIRE WRAP IC SOCKETS

These quality 3 level wire wrap sockets are tin plated phosphor bronze.

P10579	8pin	$1.50	$1.40
P10580	14pin	$1.85	$1.70
P10585	16pin	$1.95	$1.80
P10587	18pin	$1.95	$1.80
P10590	20pin	$2.95	$2.75
P10592	22pin	$2.95	$2.70
P10594	24pin	$3.95	$3.50
P10596	28pin	$3.95	$3.50
P10598	40pin	$4.95	$4.50



MINIATURE HOBBY VICE

- Lever operated suction base grip for instant mounting & portability.
- Mounts on smooth non-porous surfaces
- Ideal for holding & other small objects.

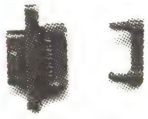
T12458 ..... $6.95

IDC PLUGS AND SOCKETS FROM ONLY $2.20



D TYPE IDC PLUGS

	1-9	10+	100+
DE9P 9pin plug			
P12166	$2.95	$2.50	$2.20
DA15P 15pin plug			
P12168	$2.95	$2.50	$2.20
DB25P 25pin plug			
P12170	$4.50	$3.95	$3.50



D TYPE IDC SOCKETS

	1-9	10+	100+
DE9P 9pin socket			
P12167	$2.95	$2.50	$2.20
DA15P 15pin socket			
P12169	$2.95	$2.50	$2.20
DB25P 25pin socket			
P12171	$4.50	$3.95	$3.50



ECONOMY TRANSFORMERS

Description	*1-9*	*10+*
2155 240V 6-15V 1A		
M12155	$9.95	$8.95
2156 240V 6-15V A2		
M12156	$13.95	$12.95
2851 240V 12-6V CT 250mA		
M12851	$7.95	$6.95
6672 240V 15 30vc 1A tapped		
M16672	$14.95	$12.95



TOGGLE SWITCHES

	1-9	10+
S11010 *S.P.D.T*	$1.20	$1.10
S11020 *D.P.D.T*	$1.30	$1.20



ICB VOLTAGE REGULATORS

Description	*1-9*	*10+*	*100+*
7805UC	$1.00	$0.90	$0.75
7812UC	$1.00	$0.90	$0.75
7815UC	$1.00	$0.90	$0.75
7905UC	$1.00	$0.90	$0.75
7912UC	$1.00	$0.90	$0.75
7915UC	$1.00	$0.90	$0.75
78L05	$0.40	$0.30	$0.28
78L12	$0.40	$0.30	$0.28
LM324	$1.00	$0.90	$0.80
555	$0.75	$0.65	$0.60
741	$0.75	$0.65	$0.60



PC BOARD HOLDER

A must for all PCB work.

T12444 $9.95

- ERRORS & OMISSIONS EXCEPTED, PRICES CHARGE WITHOUT NOTICE. -



QUALITY 3mm LEDS

	1-9	10-99	100+	1K 1000+
Z10140(R)	*$0.15*	$0.12	*$0.10*	$0.08
Z10141(G)	*$0.20*	$0.18	*$0.15*	$0.12
Z10143(Y)	*$0.20*	$0.18	*$0.15*	$0.12
Z10145(O)	*$0.20*	$0.18	*$0.15*	$0.12

QUALITY 5mm LEDS

Z10150(R)	*$0.15*	$0.12	*$0.10*	$0.08
Z10151(G)	*$0.25*	$0.20	*$0.18*	$0.12
Z10152(Y)	*$0.25*	$0.20	*$0.18*	$0.12



DB25 CONNECTOR SPECIALS

	1-9	10+	100+
P10880 DE9P	$1.00	$0.80	$0.60
P10885 DE9S	$1.00	$0.70	$0.60
P10891 DA15S	$1.00	$0.70	$0.60
P18092 DA15C	$1.00	$0.90	$0.60
P10895 DA15S	$1.00	$0.80	$0.60
P10902 DB25C	$1.00	$0.80	$0.60
P10904 DB25P	$1.00	$0.80	$0.60
P10905 DB25S	$1.00	$0.80	$0.60



DO YOU NEED A UART? "SCOOP PURCHASE' 16C450 (82450)

Features of the UART include programmable data, format parity, framing and overrun error detection etc.

	1-9	10+
U22185	*$7.95*	*$6.95*



TRANSISTORS BUY IN BULK & SAVE!

	1-9	10+	100+
BC 547	$0.15	$0.10	$0.07
BC 548	$0.15	$0.10	$0.07
BC 549	$0.15	$0.10	$0.07
BC 557	$0.15	$0.10	$0.07
BC 558	$0.15	$0.10	$0.07
BC 559	$0.15	$0.10	$0.07
BC 327	$0.20	$0.15	$0.12
BC 337	$0.20	$0.15	$0.12
BD 139	$0.70	$0.60	$0.50
BD 140	$0.70	$0.60	$0.50

ELECTRET MIC INSERTS



With Pins for easy board insertion. 10mm diameter, 10mm high.

C10170

1-9	10+	100+	1000+
$1.70	**$1.50**	**$1.20**	**$0.80**



MINI MIC INSERT

Omnidirctional mini mic insert, 6mm diameter. 7mm high.

C10650

1-9	10+	100+	1000+
$2.00	**$1.80**	**$1.30**	**$1.00**



K10470
$9.95

THE CHAMP: A HANDY AUDIO AMPLIFIER ON A SINGLE IC

What's the same size as a 9V battery, more useful than a deck of cards and uses only a half a dozen components? The CHAMP - a Cheap & Handy AMPlifier that will deliver 0.5W into eight ohms from a 9V supply for those little audio projects. *Silicon Chip Feb'94*

An electronic ballast for fluorescent lamps



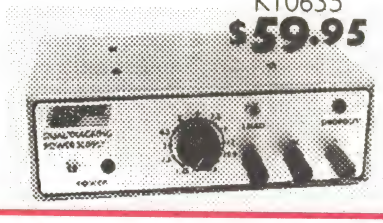
K10625 **$49.95**

Do you hate fluorescent lights with their inevitable flick, flic, flicker at switch-on, the flicker while they are running & the buzz or hum of the ballast? Now you can replace the internals of your fluorescent light fittings with this electronic ballast. It is highly efficient, gives instant starting & has no flicker, buzz or hum. *Silicon Chip Oct '94*

A BEGINNER'S VARIABLE DUAL-RAIL POWER SUPPLY

If you're just beginning in electronics, then you'll probably baulk at building a mains-operated power supply. This project uses a plugpack which means that you can make your own variable dual-rail power supply without worrying about mains wiring. *Silicon Chip Oct '94*

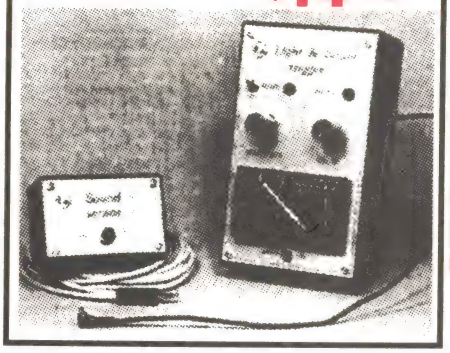
K10635
$59.95



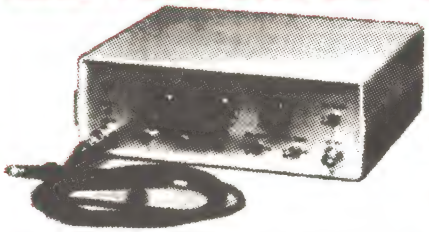
LIGHT AND SOUND TRIGGER

Photographers chasing those special effects often want to activate their camera flash from a sound source, or trigger a second flash from the main one, or even delay the flash by a controlled amount. Here's a simple circuit that will let you implement any of these techniques. ***Silicon Chip Sept '94***

K10535
$14.95



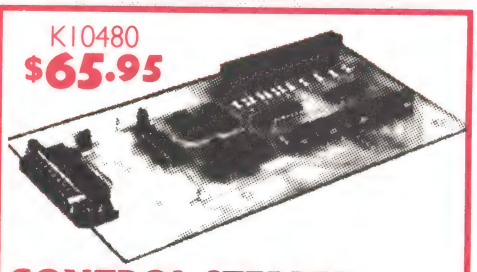
AN IMPROVED DSO ADAPTOR FOR PC'S - 1



Use this audio DSO to display, store and output samples waveform from your PC. It uses only a small number of low-cost ICs. Features a calibrated vertical amplifier, with a maximum input sensivity of 1V full scale, a calibrated sampling timebase, circuitry which allows direct control from PC software. *Silicon Chip Feb '94*

K10520
$229.95

K10480
$65.95



CONTROL STEPPER MOTORS WITH YOUR PC

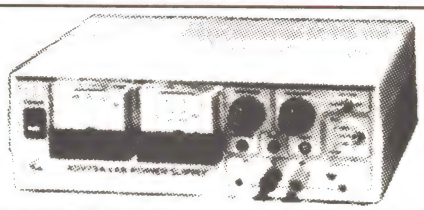
Discover how stepper motor works and how you may control them using your PC with this kit. A ready source of stepper motors can be found in "dead" hard discs or floppies drives. *EA Feb'94*

90 SECOND MESSAGE RECORDER



K10475
$98.00

This 90-second message recorder runs from a 6V battery and features more power output, a pause button, 90 seconds of continuous recording time and zero-power memory storage. ***Silicon Chip Feb'94***



VERSATILE 40V/3A LAB POWER SUPPLY

K10460
$165.95

This new supply is designed to handle most specialized tasks on a home or professional workbench. Based on readily available components, it has full electrical and thermal overload protection, adjustable current timing, dual meters, and can be used as either as a single or dual-tracking-supply. *EA Dec'93*

LOW COST MIDI "BREAKOUT BOX"



Most sound cards in the market do not have a MIDI port to communicate with external music keyboards and synthesisers. You would need a special MIDI adaptor cable or "breakout box", which are hard to find. Build one yourself with this kit. ***EA Feb'94***

K10490
$32.95

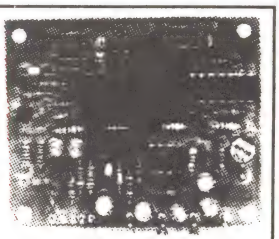


VOICE ACTIVATED AUDIO SWITCH FOR FM WIRELESS MICROPHONES

This VOX circuit is intended for use with FM wireless microphone circuits and will provide audio muting of the transmitter section. It uses just one CMOS IC and a handful of transistors. *Silicon Chip March'94*

K10500
$12.95

IMPROVED DECODER FOR ACS SIGNALS



K10445
$19.95

Many Australian FM broadcasters are now radiating either one or two "piggyback" ACS subcarrier signals. This new low cost decoder when added to a FM receiver, will pick up those hidden signals at the flick of a switch. This new design overcome some of the shortcomings of earlier designs. *EA Oct'93*

ERRORS & OMISSION EXCEPTED. PRICES CHANGE WITHOUT NOTICE

WE NOW OFFER 2 TOP-OF-LINE 486DX2-66 MULTIMEDIA SYSTEMS

WARNING: DON'T BUY OUT-DATED TECHNOLOGY. COME TO RIE FOR THE LATEST DX2-66 SYSTEM. WE ALWAYS HAVE THE LATEST PRODUCTS

AT A PREHISTORIC PRICE!

WOW!! ALL THIS AT A BUDGET PRICE!

IDEAL FOR THAT XMAS GIFT OR LAYBY!

$1895 EX. TAX

$2199 INC. TAX

CPU OPTIONS	TAX INC	TAX EX
486DX2-50.	$2139	$1845
486DX-40...	$1999	$1699

SOUND BLASTER MULTIMEDIA

486DX2-66 /420 HDD VESA LOCAL BUS 3 SLOT MOTHERBOARD FITTED

Here's another Value-Packed Budget-Priced MultiMedia 486DX2-66 System that will suit those who just want to enjoy the world of Music, Sound & Computer Games and yet is sufficiently powerful for that system intensive software! Place your order now!

INCLUDES: ●VESA 3 Slot Motherboard ●VESA 1 MEG SVGA Card ●Ritron Mouse Pad ●101 High quality keyboard ●Sound Blaster 16 Sound Card ●Creative CD-200 2x Speed MultiSession CD ROM Drive (feature front panel play, pause & eject buttons. Listen to your favourite music CD at the touch of a button in true stereo)

MULTIMEDIA ENTERTAINMENT:
● SPEED Interactive Movie ● 3D Dinosaurs Adventure ● Groliers Encylopedia ● Text to Speech ●Wave Studio ●Ensemble Remote Control ● Sound O'Le WAV Recorder ●Creative & Channel Mixer ● Mosaic Board Game ●CD Play Utility ●FM Intelligent Organ

HARDWARE/SOFTWARE CONFIGURATION FOR BOTH SYSTEM:
- ☐ 420MB Hard Disk Drive
- ☐ 1.44 Floppy Disk Drive
- ☐ 2 high speed serial ports fitted on VESA I/O card
- ☐ 14" Supa VGA Monitor-1024 x 768
- ☐ Microsoft Ergonomic Mouse
- ☐ Mini Tower Case and 200W P.S.
- ☐ Magnetically shielded Speakers
- ☐ MS DOS 6.2
- ☐ Windows 3.11

4 YEARS PARTS & LABOUR WARRANTY

$2399 EX. TAX

$2795 INC. TAX

SOFTWARE BONUS EXTRAS!!
MS 1994 ENCARTA
MS MONEY
PHONEDISC

$3 VESA VEGA GRAPHIC CARD

CPU OPTIONS	TAX INC	TAX EX
486DX2-50.	$2699	$2250
486DX-40...	$2599	$2150

486DX2-66 MULTIMEDIA SYSTEM PRO

LATEST TECHNOLOGY - PENTIUM 60/66 UPGRADABLE MOTHERBOARD

This is an enhanced version of our basic 486DX2-66 MultiMedia System. It offers faster graphics, expansion flexibility in a midi tower case and upgradability to the Pentium CPUs & Pentium OverDrive chips. Don't settle for anything less!

INCLUDES: ◆VESA LB components, including: I/O Card, Video Card & Motherboard. ◆4MB of SIMM RAM exp to 128MB ◆Chicony high quality keyboard ◆Internal Photo CD, CD ROM drive which plays the latest video software. ◆16 Bit Sound Card (SBlaster compatible)◆Joystick ◆MS Works for Windows* ***PREINSTALLED.*** $1,000 of value compared to what you used to pay for individual programs! Spreadsheets, Database, Word Processing and Mailing Lists all intergrated in one program. Learn these useful programs at your own pace, with the in-built help text and illustrated tutorial!

Microsoft 1994 Encarta- Saves hours in the library. Easy to find information. Funk and Wagnalls 29-volume encylopedia with more than 1,000 additional articles, eight hours of sound, 60 languages samples, 7,800 photos & illustrations, 100 animations & video clips, 800 maps, 100 interactive charts and an atlas all on a CD-ROM.

Microsoft Money- Personal financial organisation made easy. Has a calculator, currency conversion module. Easy spreadsheet and on-line bank payment or transfer capability.

Phonedisc - The latest in Australian Directory Assistance. Allow you to find virtually any business numbers in Australia, including Fax Numbers.

FREE 3 HOUR COMPUTER TRAINING COURSE- MELBOURNE ONLY

USE YOUR DINERS CLUB/AMEX CARDS TO GAIN FLYER POINTS! APPLYS TO THIS MULTIMEDIA SYSTEM PRODUCT OFFER ONLY.

COMPUTER SYSTEMS

386SX 40 **$1030** Tax Inc $1245	386DX 40 **$1090** Tax Inc $1319	With upgradable motherboard 486SX 25 **$1239** Tax Inc $1499
CYRIX CPU 486DX 40 **$1350** Tax Inc $1629	CYRIX CPU 486DX2 50 **$1350** Tax Inc $1629	486DX2 66 **$1399** Tax Inc $1699
486DX 100 **$2150** Tax Inc $2599	PENTIUM 60 External 256K Cache **$1999** Tax Inc $2418	PENTIUM 90 External 256K Cache **$2550** Tax Inc $3085

DOS 6.2 SETUP* WAS $22 NOW $15

DISCOUNTED SOFTWARE

DOS 6.22	$89
M.S. WORKS	$99
DOS 6.22 & Windows 3.11	$149
DOS 6.22 & Windows for Workgroups	$179
MS MONEY	$44
MS BOOKSHELF	$99
MS Encarta	$129

* When purchased with system only.

4 YEAR PARTS & LABOUR WARRANTY

All systems include 212 MEG Hard Disk • 1 MEG RAM • 101 Keyboard • 14" SUPER VGA (1024 X 768) (0.28 DOT PITCH) Colour Monitor • 2 SPG Ports • 1.44 MEG 3½" FDD • Mini or Baby AT casing • 3 Slots VESA Local Bus Motherboard & VESA Local Bus 1MB VGA Card, as supplied • Also options AT NOT EXACTLY as listed in 230 x 16.94 Resolution

CASH SPECIALS

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420M	12ms	$399	$329
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SHORTWAVE LISTENING

with Arthur Cushen,



Preserving SW Radio History

As the years move on, there is an increasing interest in radio history in the field of broadcasting, and the preservation of verifications and other memorabilia from radio stations past and present.

In New Zealand, the New Zealand Radio DX League at Oamaru has an Archives section where verification letters, cards and other information is stored as well as a selection of vintage radio receivers. It is in the United States however that the greatest accumulation of this material has been undertaken, by a group known as the Committee to Preserve Radio Verifications (CPRV) under the direction of Jerry Berg, with the material being stored in Boston. There are at least 25,000 verifications in store and these cover medium and shortwave broadcasting stations. It is the most complete and historically interesting collection in the world, and the material has been added to on a regular basis. As listeners give up their hobby or pass on, it is becoming widely known not to destroy this material from the past, but send it to a place where it can be kept.

Broadcasting verifications provide historical records for those who wish to research broadcasting in the past. Listeners should be aware of this, and also that their verifications should be located in a dry place.

Many of the earlier verifications are most attractive as radio stations were seeking reception reports and put a lot of effort into replying with an attractive card or letter.

Listeners throughout the world are able to enjoy the pleasure of looking at some of these verifications because they are reprinted in many DX magazines.

The CPRV distributes a Page to shortwave clubs for reproduction in their bulletin each month. In each monthly page up to four verifications are displayed, which could come from a particular country or period. There are captions under each card indicating some background about the station which is being reproduced in the publication.

In the South Pacific some of the DX magazines from time to time carry this special page, which promotes the saving of historic material.

For Archive material in NZ, the verifications and letters should be sent to Mr Peter Grenfell, Archives Section, NZ Radio DX League, 11 Sussex Street, Weston Oamaru, NZ.

55 years of KGEI

In 1939, the General Electric Company decided to promote the Golden Gate Exposition on Treasure Island in San Francisco Bay by installing a 50kW shortwave transmitter to promote the event worldwide. I first heard the broadcast in May 1939, when the station used the call W6XBE and was on 9530kHz.

The transmitter was seen by thousands of visitors to Treasure Island and they became aware of the role of international broadcasting. After the Exposition the transmitter was moved up to the mainland at Belmont and the aerials built along San Francisco Bay. Broadcasts were then heard with the call sign KGEI, standing for General Electric International.

At the outcome of World War II, the transmitter was taken over by the Office of War Information (which later became the Voice of America) and a second transmitter with the call KGEX was added. After the War transmissions were again operated by the General Electric Company as KGEI and in cooperation with some universities in California, it broadcast a series of programmes of an educational nature.

In 1960 the Far East Broadcasting Company purchased KGEI, for operation into Latin America in Spanish, and in 1974 they added a 250kW transmitter to the original 50kW unit which had been operating since 1939. Due to the high cost of operating in the San Francisco area, the station was closed down recently and it is expected that the old transmitter will be dismantled and sent to Liberia as part of ELWA, while the more recent 250kW transmitter would go to the headquarters of the FEBC in Manila, Philippines.

During World War II the transmitter was used to broadcast to the Philippines and carried the memorable worlds of General Douglas McArthur with the famous speech, "I shall return."

The station assumed the name of the Voice of Freedom in its earlier days of broadcast, until it became part of the Voice of America. In the meantime, the Voice of America were building transmitters at Delano and Dixon and CBS stations such as KCBR and others with a similar call were taken over by the VOA — as were NBC outlets and an independent station KWID, which all became part of the wartime broadcasts from the Californian area. ❖

AROUND THE WORLD

COSTA RICA: AWR, Latin America advise that they will be introducing a new schedule and the plan is to use higher frequencies for the next broadcast period. The channels which have been assigned are 11,870, 13,750 and 15,460kHz. At present broadcasts in English have been heard on 5030 and 6150kHz around 0700UTC.

FRENCH GUIANA: Swiss Radio International has installed a 500kW transmitter at Montsinnery, the site also of the transmitter of Radio France International.

The new relay of Swiss Radio is broadcasting to Australia in English 0900 - 0930UTC on 11,640kHz and this is supplemented by the usual frequencies from the transmitters in Switzerland. A service to North America is also using the new facility with English 0400 - 0500 on 11,620kHz.

GUAM: KTWR is now using 11,840kHz in English 0900 - 1000 while KSDA has reduced its English broadcast and now operates 1500 - 1700 on 9370; 2300 - 2400 on 11,980kHz.

HUNGARY: Budapest is using the low frequency of 3955kHz and carries English on this channel from 1900 - 1930UTC. The broadcast actually opens at 1800 with a programme in Hungarian.

KAZAKHSTAN: Alma Ata is also using 3955kHz, with English news at 1730 and then generally follows a music programme until 1800. After that time they suffer interference from Budapest on the same channel.

NEW ZEALAND: Radio Reading Service, Levin with the call ZLXA has introduced a new frequency of 5960kHz on a regular basis. The broadcasts are all continuous spoken material for those with reading difficulties and the frequency of 7290 is used in parallel from Sunday to Friday, sign on at 2130 to sign off Monday to Saturday at 0600UTC. This is the schedule when New Zealand is on daylight time.

SINGAPORE: The BBC Far Eastern Relay station which carries the World Service to this area is using the frequency of 3915kHz. It has been received at good strength to closing at 1745UTC.

SOUTH AFRICA: The Voice of America is using the transmitters of the SABC, which carry the Home Service on shortwave and these are located at Meyerton. English is broadcast to Africa from this site 1600 - 1700 on 3970; 1800 - 1900 on 4985kHz. This is the first time Voice of America transmissions have been noted in the topical land.

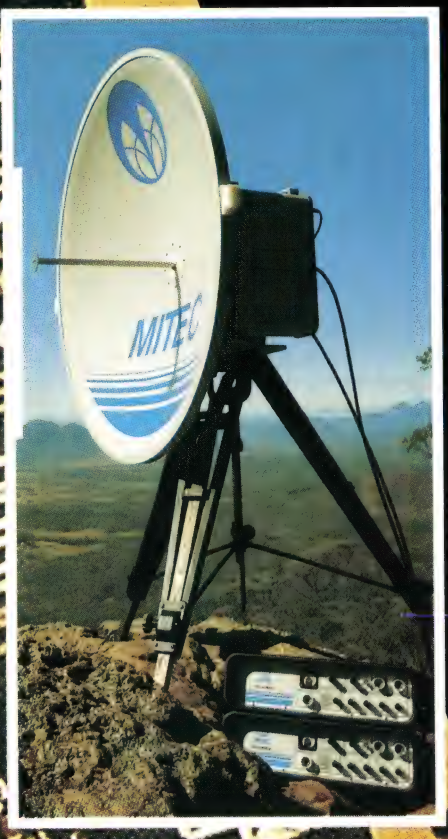
TAIWAN: The Voice of Free China has retimed its transmission to Australia and is now heard in English 1200 - 1300UTC. Two frequencies are used, 7135 and 9610kHz. The latter frequency gives the best reception.

THAILAND: The BBC is constructing a new shortwave relay station north of Bangkok. This will consist of four 250kW transmitters and the installation will cost £30M. The site is expected to be in operation in 1997 and is being built because of the uncertain future of the BBC relay base on Hong Kong as the British Colony is taken over by China in 1997.

This item is contributed by Arthur Cushen, 212 Earn Street, Invercargill New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Daylight Time and 13 hours behind NZ Daylight Time.

Electronics AUSTRALIA

SPECIAL FEATURE SUPPLEMENT:



QUEENSLAND'S ELECTRONICS INDUSTRY

ENTERPRISE IN THE SUN

The electronics industry in other Australian states may still seem to be struggling to pull out of the recession, but in Queensland there's a surprising amount of activity — not just in sales and distribution, but manufacturing as well. Educators are also taking important initiatives, to establish key links with industry. Here's a look at just some of the firms and organisations which reflect this enterprise and energy emanating from the 'sunshine state'.

To keep things simple and straightforward, we're going to take an alphabetic 'case by case' approach — with no attempt to make comparisons, because that wouldn't be either relevant or constructive. The link between all of these firms and organisations is basically that they're in Queensland, and they're displaying a degree of initiative that deserves more recognition than they've been granted to date.

You'll find full address and contact information on all of the firms discussed in the directory listing at the end of this feature, by the way.

Let's begin, then, with a look at:

Alcora

Based in Capalaba, Alcora is an importer and distributor of electronic components. When it was formed in 1987, the goal was to offer a faster and more dependable supply service for manufacturers, by adopting an alternative approach to that of the established distributors. Instead of simply accepting quoted lead times, Alcora's strategy has been to analyse trends, plan for the future and organise long-term ordering schedules.

Within 12 months, the company had set up a network of established suppliers in the USA and Asia, and was able to offer local high technology manufacturers a faster and more reliable source of components. In addition, it was able to offer the added feature of bill of materials kitting — supply of all components needed for the manufacture of a product, in kit form.

This enables simpler inventory control, accurate lead times, better planning and much greater control of the finished product.

Other services provided by Alcora included sourcing of components that were either 'difficult' or listed as factory obsolete, and a personal-liaison production support service.

Needless to say, manufacturers both in Queensland and other states have not been slow in appreciating the benefits of this approach. This has allowed the company to expand, and as part of this it has now established offices in both NSW and Victoria — with plans to open a fourth office shortly in New Zealand. Systems are also being implemented to enable accreditation to the ISO 9002 standard.

Overseas principals represented by Alcora include reed switch, relay and magnetic sensor specialist Hamlin Inc, semiconductor maker American Microsystems Inc (AMI) and Xecom Inc, which specialises in functional modules for modems, fax machines and telephone interfaces.



Bainbridge Marine

Cleveland-based Bainbridge Marine is the Australian distributor for Canadian power conversion specialist Statpower Technologies, and has recently released an impressive new range of Statpower AC inverters and TrueCharge battery chargers. Both ranges of products are based on the latest high efficiency, switchmode power conversion technology — which allows them to be smaller, lighter, cooler running and more reliable than previous products.

The Statpower range of AC inverters are designed for both recreational and industrial applications, and are rated at 90% efficiency which ensures that almost all of the battery energy is converted into useable AC



power. There are four models in the range, with continuous power capabilities ranging from 125W to 1500W and in each case with the ability to provide significantly higher power for short periods in order to cope with switch-on and motor starting surges. The smaller units are suitable for home and small office appliances, while the larger units can power machinery. The largest PW1500 can handle a 3/4 horsepower motor, for example.

Statpower inverters are designed for years of totally silent, maintenance-free operation, and internal circuitry protects load equipment from damaging spikes of other transients.

Built using the same technology, Statpower's TrueCharge range of deep cycle battery chargers provide a fast and accurate charge for any marine, industrial or RV deep-cycle battery. These batteries need the correct type of charging to deliver their rated performance and life, and the TrueCharge range is claimed to achieve this better than any competing products.

Advanced microcomputer control is used to improve the performance of these chargers, while also making them easier to use. This technology also ensures the fastest possible charge without risk of damage; Statpower claims they can charge batteries faster than many older technology 'taper chargers' with twice the rated output. The new chargers are also very quiet in operation, with none of the 'buzz' common with older technology.

There are three TrueCharge models available, with ratings of 10 20 and 30 amps.

Baltec Systems

Based in Paddington, Baltec Systems is an electronic engineering firm which grew from managing director Alistair Henderson's early work on microprocessor control systems. It has developed control systems for clients in the coal, power generation, mining, grain and petro-chemical industries, and is continuing research into advanced air pollution management techniques. With a recent Commonwealth GIRD scheme grant for this work, the



The left hand chimney is fitted with a Baltec precipitator controller.

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4N26		0.61
4N35		0.73
6N136		1.62
6N137		1.88
6N138		1.67
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AD	7528KN	8 BIT DAC	10.95
AD	7824KN	8 BIT ADC	16.60
AD	7828KN	ADC	17.60
ADC	0808CCN	8 BIT A/D CONV	6.30
ADC	0809CCN	8 BIT A/D CONV	4.96
ADC	1205CCJ-1	12 BIT CONV	28.50
TC	7106	CPL 3 1/2 DGT A/D	6.20
TC	7107	CPL 3 1/2 DGT A/D	6.20
ICL	7109	CPL 12 BIT A/D	31.40
ICL	7129	CPL 4 1/2 DGT A/D	28.95
ICL	7135	CPL 4 1/2 DGT A/D	24.60
ICL	7136	CPL 4 1/2 DGT A/D	26.78
ICM	7211	AIPI 4 DGT LED	12.48
ICM	7212	AMIPL 4 DGT LCD	9.47
ICM	7224	IPL 4 1/2 DGT	32.89
ICM	7226	AIJI 10 MHZ	98.47
ICM	7226	AIJL 10 MHZ	92.93

AMPLIFIERS

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AMP	01EX	INST AMP	30.25
LM	324	QUADAMP	0.46
LM	358 N	DUAL AMP	1.44
TLC	271 CP	CMOSAMP	1.28
TLC	272 CN	CMOS AMP	2.07
TLC	274 CN	QUAD JFET	3.43
TLO	84 CN	QUAD JFET	1.03

EPROMS

NMC	27C256Q150	EPROM 32K*8 CMOS	5.30
NMC	27C256Q200	EPROM 32K*8 CMOS	5.00
TMS	27C512-15JL	EPROM 64K*8 CMOS	6.05

REGULATORS

	7805CV	T0220	1.21
	7808CT	T0220	1.40
	7812CT	T0220	1.60
	7805CK	T03	2.60
	7812CK	T03	2.60
	7815CK	T03	2.60
	7905CK	T03	2.60
	7915CK	T03	2.60
	78L05	T092	0.39
	78L12	T092	0.39
	79L05	T092	0.39
	79L12	TO92	0.39
	79L15	T092	0.39
LM	294OCT-	5.0	1.19
LM	294OCT-	12.0	1.26
LM	317T		0.68

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P	80C31	8 BIT CMOS	5.00
MK	48Z08B25	ZERO POWER SRAM	16.75
MK	48T02B20	ZERO POWER SRAM	24.15
6264L-70		8K*8 SRAM	3.87
62256-70		32K*8 SRAM	6.21
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READER INFO NO. 15

company is aiming to maintain its reputation as Australia's leader in this field.

One of Baltec's most noteworthy achievements to date is the development and manufacture of the Optipower precipitator controller, which can be used to reduce energy costs and pollution in power stations and large industrial furnaces.

Electrostatic precipitators are used in large industrial plants to remove solid particles of fly ash from smoke stack emissions, to prevent them from polluting the atmosphere. The precipitators electrically charge the ash particles in the flue gas stream, and then collect them on a series of earthed plates. The efficiency of this process depends on a number of complex electro-physical effects, and has been the subject of world-wide study by research institutes, including the CSIRO in Sydney.

Using techniques patented throughout the world, the advanced microprocessor in Baltec's Optipower controller allows a user to reduce the amount of power needed by a precipitator, and to increase its performance in collecting the ash — particularly that from low-sulphur coal, which is normally hard to collect with a precipitator.

Emissions can be reduced by 60-70%, and power consumption by up to 95%, at the same time. This dramatic improvement is achieved by tight digital control of high-energy pulses in the precipitator.

As a typical electrostatic precipitator costs as much as $20 million and consumes up to 500kW continuously, the benefits of the Optipower controller are thus very significant indeed. It is now being exported to a number of countries, and Baltec sees a big potential market in developing countries.

Cliff Electronics

Based nowadays in Fortitude Valley, Australian owned Cliff Electronics actually began operation in Sydney 10 years ago, with the objective of importing and distributing the Cliff range of electronic hardware from the UK. The name is derived from the location of the manufacturing plant, which is situated right on the white cliffs of the English channel.

The Australian company moved to Brisbane in 1987, where the business has expanded to distribute a wide range of hardware and electronic test equipment. Products handled now include flight case hardware from Penn Fabrication, essential for protection of delicate electronic equipment during transport; and test instruments from manufacturers such as Fluke, Black Star, DeltaOhm, Pantec, AEMC and Kepco (all distributed as Queensland agent for Obiat Pty Ltd).

Currently the company is in the process of obtaining quality control accreditation to AS3902. This is a natural progression, since the Cliff factory in the UK was assessed in March 1993 and awarded the equivalent ISO 9002 accreditation.

The UK plant has also recently com-

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READER INFO NO. 17



missioned new hi-tech plastic moulding equipment, capable of moulding two colours on the same component in the same moulding cycle. The first hardware products to take advantage of this process are a new range of two-colour control knobs for audio mixers, etc.

Computer Hand Holding

Lutwyche based CHH is the Queensland distributor for Australian made Maestro modems and fax/modems. It also provides quality personal computer systems that are assembled, tested and warranted in house. Maestro modems are all Austel approved and come with a two-year hardware warranty and unlimited technical support, while CHH's own computer systems come with a two-year parts and three-year labour warranty, backed by extended factory warranties.

CHH spokesman Randy Jansen says that the most important distinguishing feature of his company is the 'customer comes first' approach followed by all staff, along with the 'hand holding' philosophy implied in the company name. This has been adopted in contrast with the approach often taken elsewhere in the computer industry, and CHH customers find it a refreshing change from what they've previously experienced.

Many PC buyers are relatively inexperienced, and frequently confused by the large amount of technical information available. CHH takes pride in helping customers understand what they are buying, believing this to be a necessary part of true customer service.

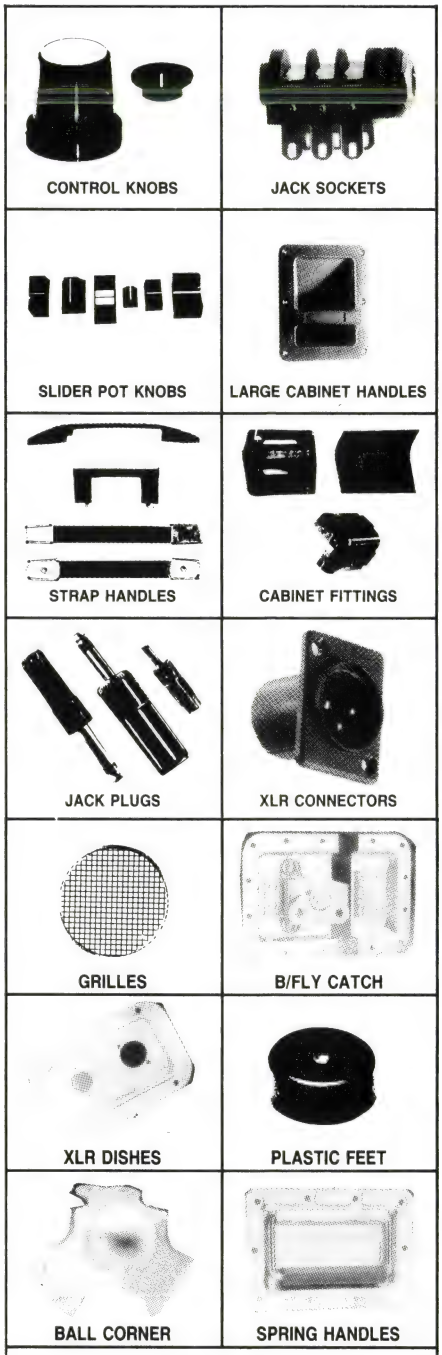
DNA Communications

Based in Broadway, radio communications and cellular telephone specialist DNA Communications designs and installs communications systems, trains staff and also supplies both equipment and technical books. Equipment supplied includes trunked radio, DTMF encoders and decoders for conventional mobile radio, while handbooks available cover subjects such as cellular radio and paging technology.

DNA's most recent development is a commercial billing system for trunked radio networks, which runs under DOS on an IBM-compatible PC and is capable of supporting between a few thousand and 100,000-plus subscribers. Unlike other billing systems developed for cellular applications, the DNA system was specifically designed for trunked radio and is priced realistically.

User friendly, the system is menu driven and available for either a stand-alone system or multi-user Novell network operation. It includes all of the high-level accounting capabilities required for a professional billing system, including a traffic engineering package offering much more than is available from trunk radio controller software.

The DNA system has been in use for



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READER INFO NO. 6

over a year on the nationwide Omninet MPT 1327 system in the Philippines — one of the largest wide-area trunk radio systems in the world. It has also been adapted for small cellular radio operations. Using the system operators can offer unlimited call times, long distance and even international telephone calls.

A demo disk and instruction manual are available.

Griffith University

In 1990, Griffith University became the first in Australia to offer an undergraduate course in microelectronic engineering. The University is now recognised as a leader in microelectronics research and teaching, and also highly regarded for its innovative approach to fostering university and industry partnerships in this specialised field.

The University's Industrial Affiliates Programme (IAP) provides the opportunity for all undergraduates in the Bachelor of Engineering in Microelectronics Engineering degree course to work with an industrial partner.

Students work on a range of projects which demand committment, innovation and engineering expertise. The partnership not only provides students with valuable practical experience, but also assists industry in the development of new or improved microelectronic products.



Mr. Steve O'Keefe, Assoc. Professor David Thiel and Dr Jun Lu of the School of Microelectronic Engineering Staff, who are working on the steerable antenna.

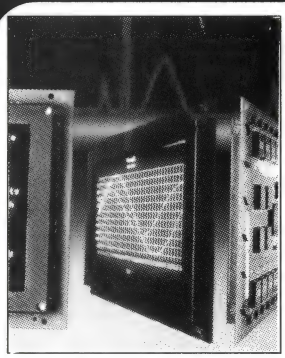
A team of Griffith Uni engineers, including a student participating in the IAP, has recently developed a small steerable antenna for handheld cellular phones — designed to minimise EM radiation exposure to the user's head. The antenna is believed to be the first of its type in the world, and was developed largely in response to reports that radiation exposure may cause brain tumours.

Microelectronics engineering student Po Lun Law worked with the team from Griffith Uni's Radio Science Laboratory, which invented and patented the new antenna. Laboratory spokesman Associate Professor David Thiel said Po Lun Law worked closely with the research team, and contributed to the project's success.

Associate Professor Thiel added that the antenna had major export potential, as it improves cellular phone performance and extends battery life as well as reducing radiation into the head by as much as 40%.

"While other steerable antennas are available, they tend to be large and to-

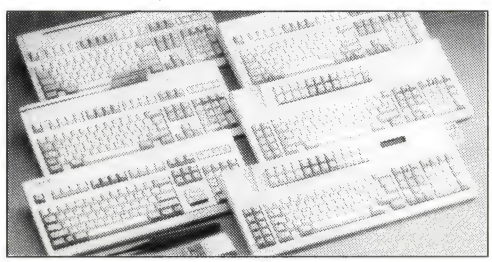
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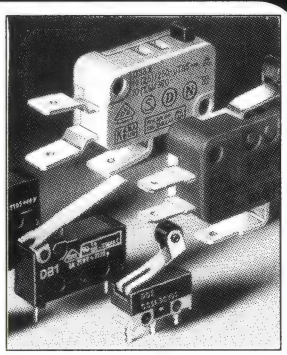
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Mr Peter Lambert of Nu-Lec with IAP students Paul Munday and Peter Bofinger.

tally unsuitable for mobile phones. This product can be easily fitted to hand-held transceivers as a drop-in replacement for existing antennas", he added.

Another product developed by students participating in the IAP is a high-tech monitor capable of locating faults in high voltage power cables. Developed by students Peter Bofinger and Paul Munday in conjunction with Nu-Lec Pty Ltd, the device will obviate the need for time-consuming physical location of cable faults. It incorporates an electronic monitoring circuit located inside a standard high voltage power line insulator, and constantly monitors the line voltage — transmitting the information via radio.

Griffith University graduate and former IAP participant Peter Lambert is now Manager of Electronic Products at Nu-Lec, a Queensland-based manufacturer and exporter of advanced microprocessor controlled high voltage switchgear.

Hi-Tech Software

Australian developer and supplier of C language cross compilers and embedded software development systems, Hi-Tech Software has specialised in this field for over 10 years and is a recognised leader.

They don't sell hardware or other software, or do consulting — devoting all of their resources to 'providing the best possible embedded software development tools'.

Processors and controllers supported include the 8051 family; the Z80, Z180, 64180 and derivatives; 68HC11, 6801 and 6301; 6805, 68HC05 and 6305; 8086, 80186, 80286 and 80188; 68000 family; H8/300; 8096 and 80C196; and the 6809 and 6309.

Hi-Tech's range of embedded software development tools are complete, including not just an ANSI/ISO standard C compiler but also a full-featured macro assembler for those occasions when assembly language is essential. They also include a linker and a remote debugger for running and debugging code in the user's hardware. These tools are all tied together with a fast, flexible and easy to use programming environment: the Hi-Tech Professional Development (HPD) Environment.

Hi-Tech boasts that its C compilers use advanced artificial intelligence techniques to produce the smallest and fastest code possible from a C source program. Apparently customers often report a code size reduction of up to 30% when moving from other compilers. Floating point and maths functions are included.

Metromatics

New Farm based Metromatics imports and distributes a range of test instruments, data acquisition products and microprocessor development systems.

Product brands supported include the Huntron range of signature analysers, the BoardWizard range of automated PCB testing systems, waveform analysis and data acquisition products from Bakker Electronics in Holland, and the Astro-Med range of chart recorders.

Recent additions to the Huntron Instruments range include a new Digital Storage Interface unit (DSI700) for the Huntron Tracker 2000 signature analyser, which allows PC control of

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READER INFO NO. 20

test routine generation and storage of signatures for comparison testing. Working with a PC, the Tracker 2000/DSI700 combination can instantly scan components with as many as 128 pins, learn and store signatures and create a permanent troubleshooting database.

The BoardWizard range, produced by Proteq Technologies in Singapore, now includes the model BW4080VX which is capable of PCB diagnostics and repair down to component level.

Intended for use by manufacturers, servicing organisations and for in-house PCB maintenance, the BW4080VX is a compact and advanced system which provides an easy to use test facility for automated diagnosis of board faults. Plug-in driver cards can be used to expand the number of channels to 80, without software changes.

The BW4080VX tests TTL, CMOS and ECL technologies, including LSI, VLSI, C-PAL, memory, microprocessor and analog devices. An extensive library of over 1500 ICs is supplied with the software, and is upgradeable to accommodate new devices.



Mitec

Microwave technology specialist Mitec Ltd was founded in 1987, originating from an R&D project at the University of Queensland that 'went commercial'.

Today it is a Queenland high-tech success story, having grown to a company with over 170 employees and annual sales of $16 million, of which approximately one third is exports. The company attributes its success to the dedication of its staff, around 44% of whom have equity in the company.

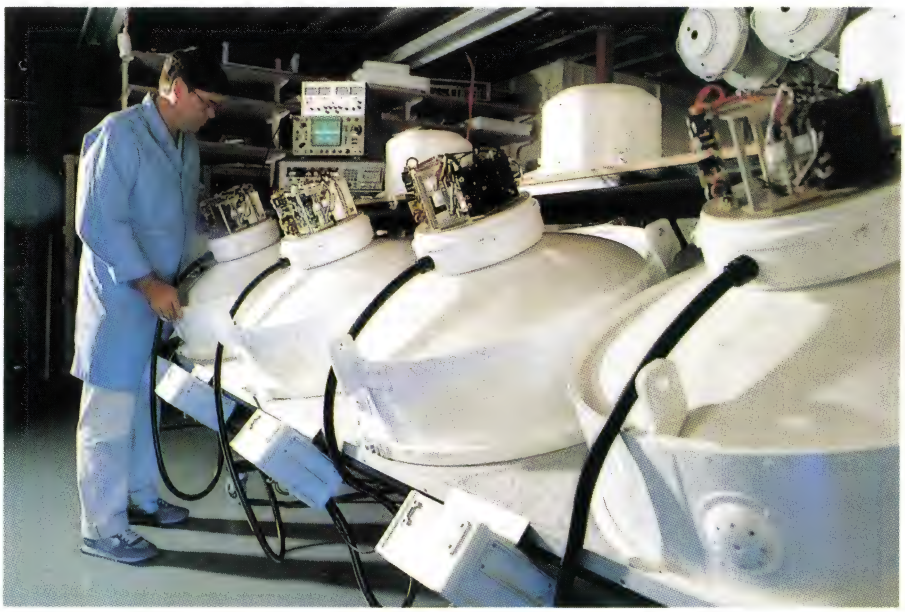
Products developed and manufactured by Mitec include video and digital microwave links, satellite ground station equipment, microwave modules and components.

The company also undertakes satellite system and microwave engineering projects. It has become a preferred supplier to some of the most highly regarded telecommunications carriers in the Asia-Pacific region, with its satellite ground station equipment and digital microwave links now in service in Antarctica, China, Cambodia, Indonesia, Malaysia, the Philippines, Thailand, Vietnam and New Zealand as well as throughout Australia.

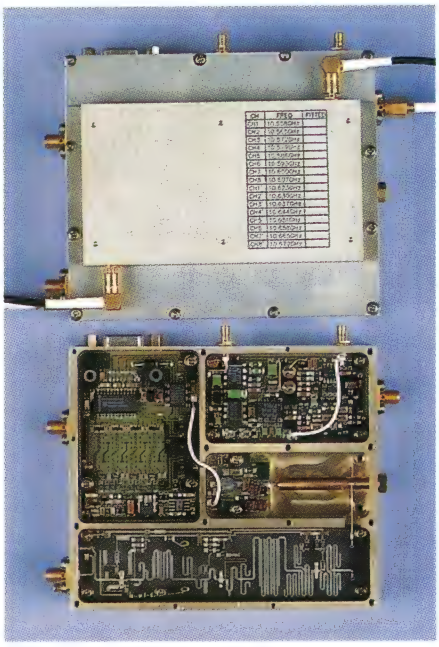
Recent additions to the Mitec product range include a microwave transmitter range for Pay-TV via MDS (Multipoint Distribution System).

The fully Australian designed and manufactured transmitters are available with 10W, 50W and 100W peak sync outputs in both Australian MDS bands (2076-2111MHz and 2300 - 2400MHz), and will allow transmission of MDS signals to receivers up to 50km away.

Each transmitter consists of rack mounted solid state modules, includ-



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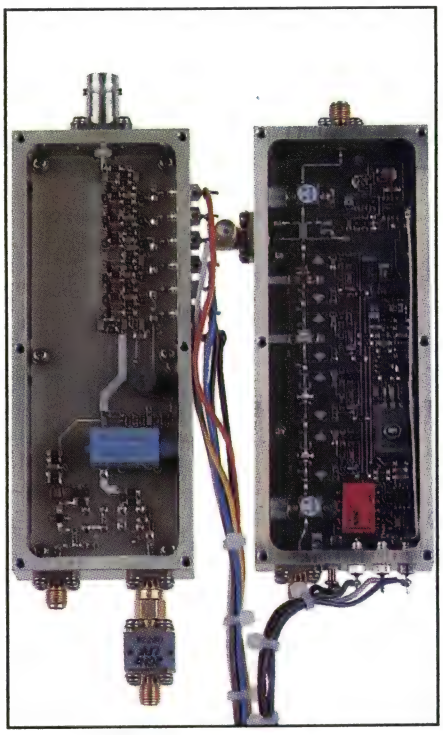


ing a broadcast-quality modulator, an upconverter and a solid state power amplifier. A digital AGC system maintains the output power for both the video and audio carriers to within +/- 0.5dB over the 0 - 50°C temperature range.

Mitec's impressive in-house manufacturing facilities include microwave PCB etching and assembly (25 micron resolution), precision machining with numerically controlled milling machines and automated surface-mount device assembly.

Clean working areas (qualified to space standards) are used for critical assembly operations and an environmental chamber allows design verification and production testing over a range of temperature and humidity conditions.

Mitec is qualified to Australian standard AS3901 and the international equivalent ISO 9001, receiving certification last year. The company is confident that its products and services will continue to improve, as a Total Quality Management programme has now been implemented.





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Objectives

Specialising in software, Everton Park based Objectives markets and supports the Layout range of object-oriented development tools. These are claimed to be revolutionising the way applications software is developed, by providing a programming system which is easy to learn, fast, productive and error free — yet also very powerful and flexible. It allows the production of fast and compact EXE files as well as fully commented C++, QuickBasic or Pascal source code.

Unlike 4GL systems, database generators and products like Visual Basic, Layout uses no pseudo code or scripting language. The user simply builds a flowchart of the program logic, and Layout creates the compiled program from this — normally generating assembler code for the highest speed and efficiency.

Powerful communications programming and drivers for external devices are easily achieved, and interrupts can easily be used for low-level hardware and system control. Created programs also feature a friendly GUI (graphical user interface), full multimedia support and context-sensitive online help.

A free information disk is available by calling Objectives at the number given in the listing.



An Oz Electronics coin unit.

Oz Electronics

Based in Sumner Park, Oz Electronics Manufacturing was established in 1989 and specialises in the assembly, testing, installation and maintenance of a wide range of electronic equipment. Currently it employs nine people, comprising engineering, technical and production staff, and provides a full range of contract electronic engineering support services. These include design for manufacturability and component sourcing, PCB assembly, cable looming, final assembly, installation and servicing.

OEM owns the intellectual property rights for the SCOUT (formerly Tracker and Traeger) high frequency SSB long range transceiver, and markets the SCOUT range of products throughout Australia and South-East Asia under the trading name Scout Communications.

An important area of OEM's manufacturing expertise is in the specialist field of electronic validation of coins and tokens. Its products are marketed under the StarMech name, and have been accepted to carry the 'Australia Made' logo.

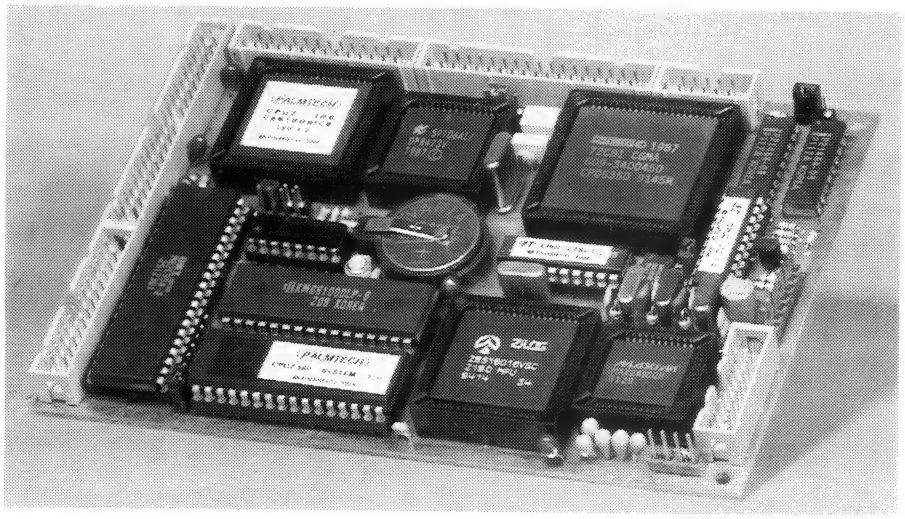
Oz Electronics Manufacturing works to the documented requirements of AS3902/ISO9002 and AS3563.

Palmtech

Based in Boulia, Palmtech has specialised in importing and distributing PCB prototyping products. Its product range includes the Toner Transfer System for producing prototype boards via a laser printer or photocopier, the Superfuser for automating the pattern transfer process, and precision eyelets which provide a reliable alternative to plated-through PCB holes.

Recently the company has also produced a stand-alone single board microcomputer, the CPUZ180. This is based on a high performance Zilog Z8S180 processor (Z80 compatible), running at 18.4MHz with zero wait states. The SBC measures only 150 x 100 x 17mm and draws only 400mA from a 5V DC supply.

On-board memory consists of 128KB or 448KB of non-volatile SRAM in ad-



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dition to 128KB or 512KB of writable Flash memory and 64KB of video DRAM.

The board also includes an industry standard IDE hard drive interface, a floppy drive controller, a real-time clock, a bi-directional Centronics port with nine I/O handshake lines, two serial ports operating up to 115kb/s, a speaker port and an 82C55A with 24 lines of parallel I/O.

The user interface consists of an IBM PC/XT compatible keyboard port and a colour/mono video controller with a selectable 14/16/24MHz dot clock. The video output supports a TTL level RGBI standard CGA or MDA monitor in addition to a mono composite video output with 16 levels of greyscale.

The SBC has been fully designed and manufactured by Palmtech, and it is expected to have significant export potential.

Precision Power

Norman Park based company Precision Power specialises in providing products for power line protection of computers and electronic business and factory equipment. The company was founded in 1975 by Jim Westwood, now its chief executive.

Today the company has its own R&D section, a local manufacturing facility and marketing operation, and exports its products into the major South-East Asian markets.

Products in the company's range include both power line filters and conditioners, to protect equipment against disruption or damage from line surges, and uninterruptible power supplies to maintain operation during power failures.

Precision Power is pround of its high standard of customer support, and provides a customer 'help line' in addition to advisory literature specially prepared for non-technical users.

Sonnall Electronics

Based in Morningside, Sonnall Electronics was founded by Gordon Bagnall, who began selling computers in 1975 but realised there was a need for mains filters to ensure reliable computer operation.

He designed and built his first UltraClean mains filter unit in 1987, and has since expanded the company's



activities in this area. Along with the manufacture and marketing of its own UltraClean filter, Sonnall is also Queensland distributor of filters and UPS systems manufactured by NSW manufacturer Total Power Systems, and a supplier of Statpower DC/AC inverters.

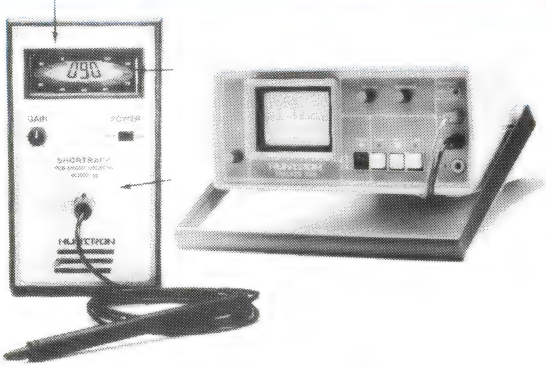
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KIT REPAIRS

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QUEENSLAND INDUSTRY FEATURE:

It is also the importer and sole Australian distributor of SafeWare, a range of intelligent UPS monitoring software specially designed for use with the AI-UPS range of uninterruptible power supplies.

Safeware V6.1 is available to suit a wide range of hardware platforms and operating systems, from single-user DOS PCs to professional graphics workstations, UNIX hosts and Novell NetWare file servers.

Sonnall has supplied approximately 300 of its mains filter units to SEQEB, and significant numbers to both metropolitan and regional abatoirs, and chemical manufacturer Incitec.

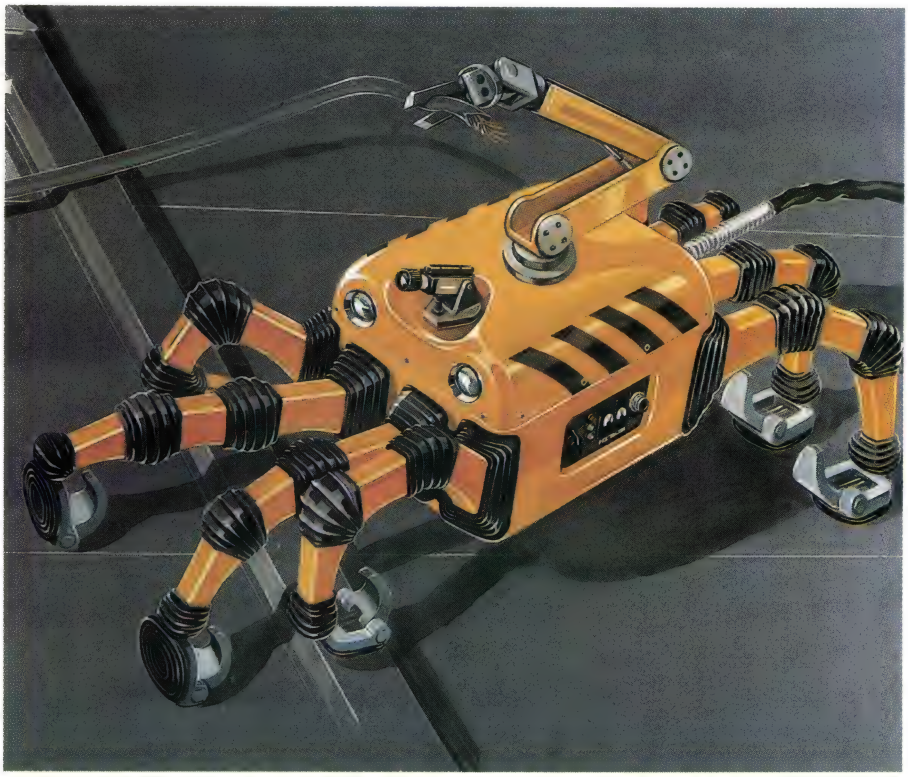
St Lucia Electronics

The St Lucia Electronics Group began operating in Southport in 1978, with the Southport Electronics Shop. A move to Brisbane followed soon after, and subsequent controlled growth has led to a distribution and sales group which now has a total of three outlets, managed from a head office in Bowen Hills.

The sales outlets are in Bowen Hills (Economic Electronics), Southport and Flemington, NSW (Prime Electronic Components). The entire group is committed to supplying a comprehensive range of quality electronic components, tools, testing and production equipment for the electronics manufacturing and servicing industries. It gives great emphasis to maintaining inventory levels of its 43,000 stock lines, in order to meet the needs of a rapidly expanding market place.

The St Lucia Electronics Group distributes spare parts for Panasonic, Akai, Sharp, Mitsubishi, Sanyo and Samsung, with a full range of proprietary spares being kept for each manufacturer. An ever-increasing range of semiconductors, passive components, connectors and cables enables convenient 'one stop' shopping at all trade outlets, while the company prides itself on competitive pricing.

All 58 employees of the Group are committed to the implementation of AS 3902, which is expected to be fully in place by the end of the year. The concept of Total Quality Management will also be an ongoing feature of the Group's operations in the future.



An artist's impression of Robug III which could soon have smooth and controlled leg motion thanks to a novel air valve being developed by researchers at the University of Southern Queensland in Toowoomba.

University of Southern Queensland

Researchers at the University of Southern Queensland (USQ) in Toowoomba have developed a pneumatic valve which provides smooth control of compressed air, to allow improved control of leg motion in an eight-legged robot which is capable of walking up walls and across ceilings.

The robot, Robug III, is being developed in the UK mainly as a rescue vehicle for the nuclear industry — it will have the strength to pull a human to safety, in a disorganised and cluttered environment.

Led by mechatronics whiz Professor John Billingsley, the USQ team are designing the software and strategies to coordinate the robot's legs with the motion of the vehicle.

Research has been focussed on developing a pneumatic valve for smooth control of airflow, to give the compressed-air powered robot a natural motion. Conventional valves made the robot's movements jerky as the air was delivered in sudden bursts.



Professor John Billingsley working on the wall-climbing toad built at the University of Southern Queensland.

Robug III's legs feature two 'knee' joints, to maximise movement over uneven terrain and allow it to 'walk tall' on level ground. It will be capable of carrying a load of 25kg vertically and exert a horizontal pull of 100kg, as well as performing a wide range of inspection and maintenance activities.

The project is led by Portsmouth Technology Consultants (Portec), a company which Professor Billingsley helped found in the UK before moving to Australia.

Professor Billingsley also worked with Portec to develop the concept for a much simpler wall-climbing robot called Toad, built by USQ's mechantronics team and features on BBC TV. Relatively cheap to manufacture, Toad is suitable for inspection work on motorway bridges or maintenance work such as painting ceilings or cleaning windows. Like Robug III, it is powered by compressed air. ❖

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Listing of Suppliers and Manufacturers

To assist our readers in identifying, locating and contacting suppliers and manufacturers based in Queensland, here is a listing showing each firm's address and contact details plus a summary of their main products and services:

Alcora

Unit 1, 31 Smith Street, Capalaba 4157. Phone (07) 245 2941; fax (07) 245 2943. Contact: Barry Miller

Supplies electronic components to a wide range of well-known customers throughout Australia, specialising in 'bill of materials kitting' for high-tech electronics manufacture. Provides a sourcing service for difficult and obsolete components.

Ausolar

PO Box 244, Deception Bay 4508. Phone/fax (07) 888 5051. Contact: Heinz Hempel.

Designs, manufactures, supplies and installs solar and renewable energy systems. Hybrid system specialists, solar water pumping, hot water, electric fencing, solar modules, inverters, batteries. Both domestic and industrial, 10 years experience.

Bainbridge Marine

2/77 Shore Street, Cleveland 4163. Phone (07) 821 3333, fax (07) 821 3977. Contact: Ron Heindorf.

Suppliers of the latest technology, highly efficient and lightweight Statpower range of 12/24V to 240V AC inverters and Truecharge range of battery chargers.

Baltec Systems

PO Box 107, Paddington 4064. Phone (07) 369 5900, fax (07) 369 5257. Contact: Stephen Gabb.

Distributors of data acquisition boards, industrial PCs, process control software and industrial measurement systems. Importers of embedded system software, in-circuit emulators and programmers for system development and manufacture. Design and manufacture of air pollution control systems.

BAS Audiotronics

398 Montague Road (PO Box 5201), West End 4101. Phone (07) 844 7566, fax (07) 846 1487. Contact: Dan Ryan.

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Brett Smith Technologies

Shop 4, 600 Sherwood Road, Sherwood 4075. Phone (07) 379 4840, fax (07) 379 2940. Contact: Brett Smith.

Design and manufacture of electronic equipment.

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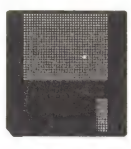
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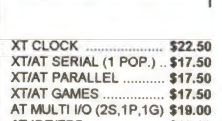
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READER INFO NO. 3

PROJECTS FOR RADIO CONTROL MODELLERS - 2

In this second article presenting some simple projects for use with modern digital proportional radio control systems, the author describes two further projects: a bidirectional variable speed controller for motors, and a handy 'Servo Signal Source' for testing servos and other modules designed to respond to a variable pulse width control signal.

by PETER STUART, B.E., VK2BEU

For those who wish to have bidirectional variable speed control of a large motor, the circuit shown in Fig.3 should be of interest. This circuit is the culmination of many hours of designing and testing. Its main features are that it will provide adjustable frequency, pulse width modulated (PWM) speed control of 6-12V motors drawing up to 10 amps, on a single sided board housed in a box measuring 130 x 68 x 41mm and weighing only 180 grams.

Adjustments are incorporated for full speed, low speed, gain and frequency. The circuit was designed to use readily available parts, and, for simplicity, a relay is used for reversing motor direction.

Another relay is used for full speed in the forward direction, to overcome the problem of voltage drop in semiconductors. This may seem a small point, but with a voltage drop of 0.6V across a typical power transistor, and a 12V supply, only 11.4 volts will reach the motor. Since power is proportional to voltage squared, only $(11.4^2/12.0^2) \times 100$, or 90% of the available power will reach the motor. With a load of 10 amps, six watts of valuable battery power will be dissipated as heat in the transistor(s).

At first glance the circuit looks quite complex, but it can be broken down into several stages for better understanding. The main function of the circuit is to produce a control voltage proportional to the length of the input pulse. The control voltage is then fed to two comparators which compare it with a triangular oscillator signal, to produce square waves of variable duty cycle. Other comparators enable the output, and activate the relays when required.

A sample-and-hold circuit is used to convert the incoming signal pulses to a control voltage. The operation is as follows: Incoming signal pulses are inverted by IC1a. The leading edge of each pulse triggers monostable IC2a, which puts a 1ms pulse onto pins 12 and 13 of IC3, closing two of its switches and rapidly charging C1 to 5V.

The monostable signal is also routed to a negative logic AND gate IC1b. This has the effect of preventing each input signal pulse from reaching pin 5 of IC3 until after the 1ms pulse has ended. The incoming pulse now takes over, closing the switch on pin 5 and discharging the capacitor through current source IC4 for a time determined by the length of the incoming pulse. At the end of the 1 - 2ms pulse, pin 6 is driven high, allowing the sampled voltage on the capacitor to be routed via pin 8 to high impedance inverting amplifier IC5a. R2 and C2 smooth the sampled voltage. The circuit remains at rest, holding the sampled voltage, for 20ms until the next control pulse arrives.

I used a current source instead of a simple resistor to improve linearity during the controlled discharge period. The 30-ohm resistor R3 determines the current.

We now have a control voltage proportional to incoming pulse length at the output of IC5a, suitable for use in the comparators — of which there are six. VR3 on IC5a allows the gain of the amplifier to be adjusted over the range 0.5 to 1.5, for setting-up purposes.

IC2b is an oscillator with a triangular waveform output at pin 8. This is applied to the inputs of IC6a and IC6b, which function as comparators to compare the control voltage with the oscillator signal, to produce variable width square waves.

However, the control voltage is not directly applied, but arrives as two offset voltages, after passing through IC5b and IC5c. The outputs of these amplifiers are two voltages, offset by equal amounts above and below half the supply voltage. The exact offset is determined by the setting of VR4. This allows us to have an adjustable low speed setting, which is equal in both forward and reverse directions.

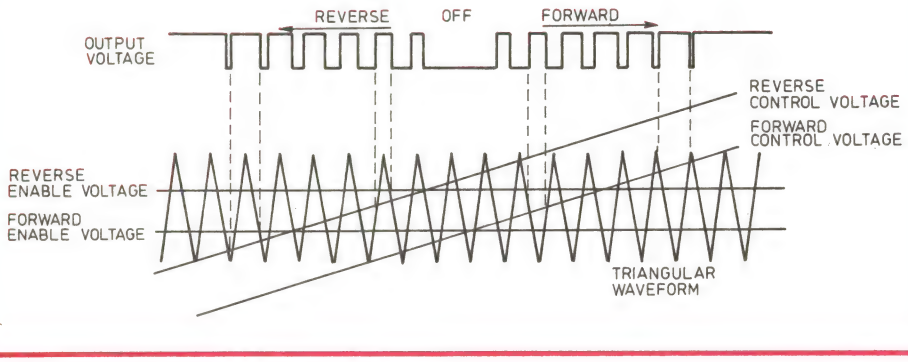


Fig.4: Relationships between the triangular waveform and the two offset control voltages of the motor speed control circuit, over the possible range. The combined effect of all the comparators can be seen in the PWM signal at top.

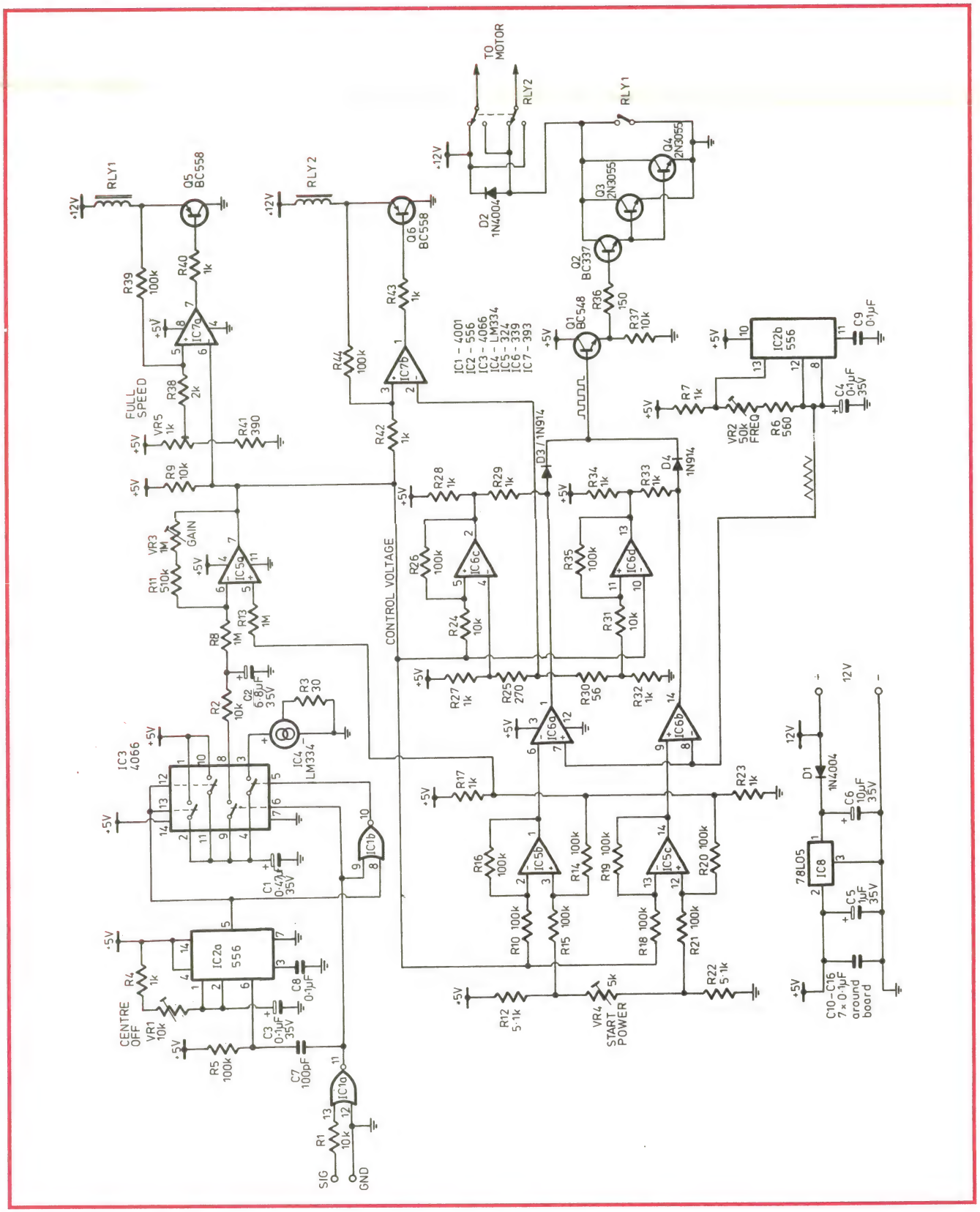
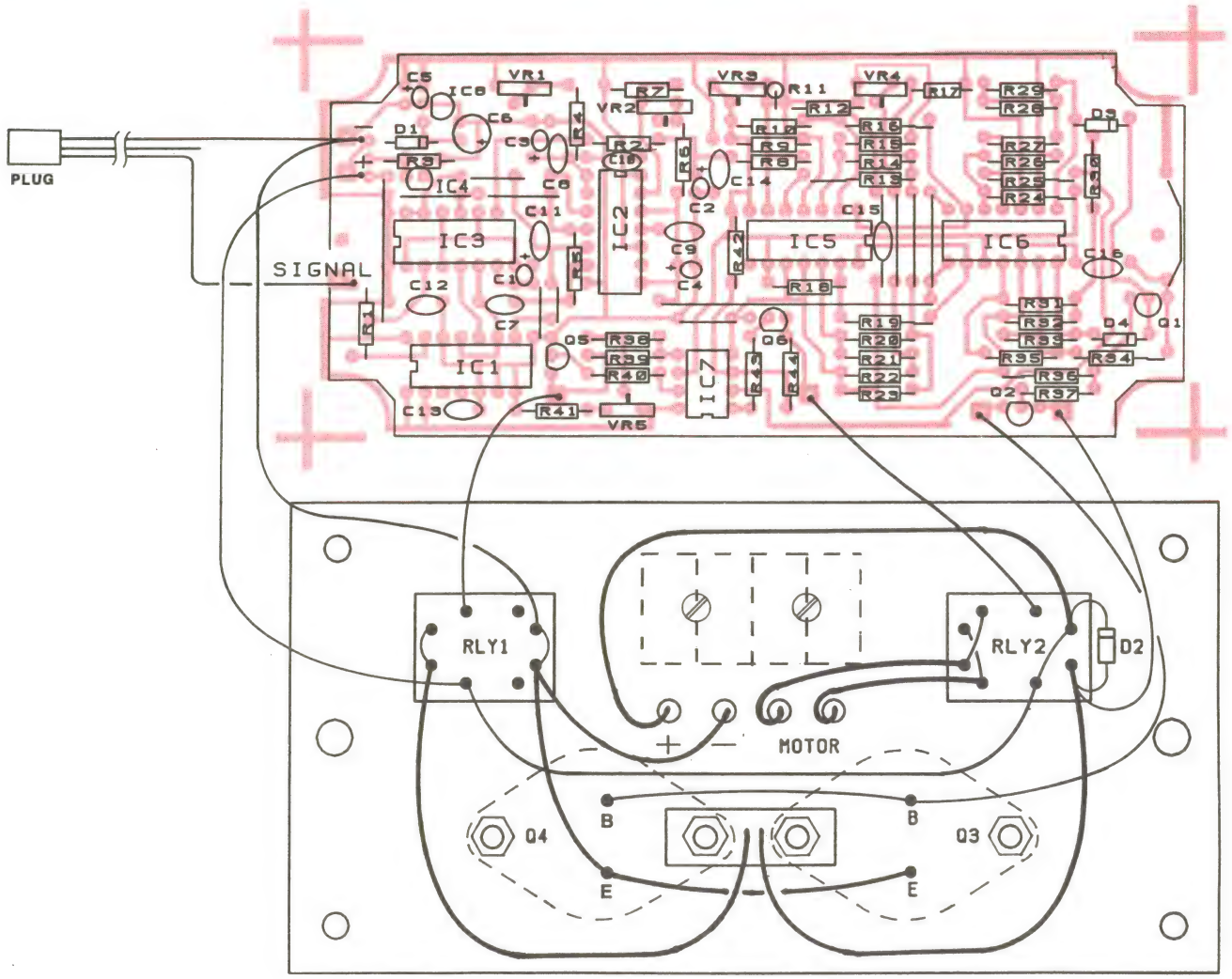


Fig.3: The schematic for the author's bidirectional variable speed control circuit.

Having now produced two PWM signals at the outputs of IC6a and IC6b, the circuit contains two more comparators IC6c and IC6d, to function as output enables — one for each direction. These comparators use the original control voltage, which is compared against two fixed voltages, symmetrical about the half supply voltage point, derived from resistor string R25, R27, R30 and R32. This gives us a centre-off position on the control stick, with a non-adjustable dead band.

Fig.4 shows the relationship between the triangular waveform and the two offset control voltages, over their possible range. The two enable voltages are also shown, and the combined effect of all the comparators can be seen at the top of the diagram as the PWM signal for forward and reverse directions.



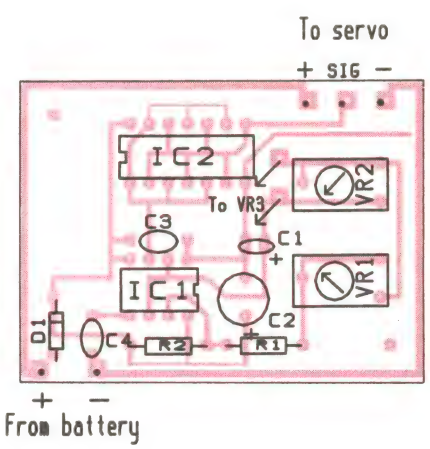
The author's overlay and wiring diagram for the motor speed control circuit. The servo control signals from the radio control receiver are fed in via the small 3-pin plug at upper left.

The comparators inside IC6 are of the open collector type, and require a pull-up resistor on the output. This requirement is used to advantage, with IC6c and IC6d pulling up IC6a and IC6b via 1k resistors when they are separately enabled, while also needing pull-up resistors themselves.

D3 and D4 pass either of the two PWM signals to a chain of transistors which control the output current. Two power transistors (Q3 and Q4) are shown, although for loads of less than 5A one is sufficient.

Where two are used, it is usually considered good practice to put low value resistors on the emitters of each transistor, to equalise the currents. However, I have not found this to be necessary, and I dislike the small loss of power which such resistors cause.

Two comparators remain unexplained; IC7a and IC7b. The former is used to activate the full speed relay in the forward direction, by comparing the control voltage with an adjustable voltage from VR5. I did not include a full speed relay for reverse direction, as this facility is seldom necessary in a model.

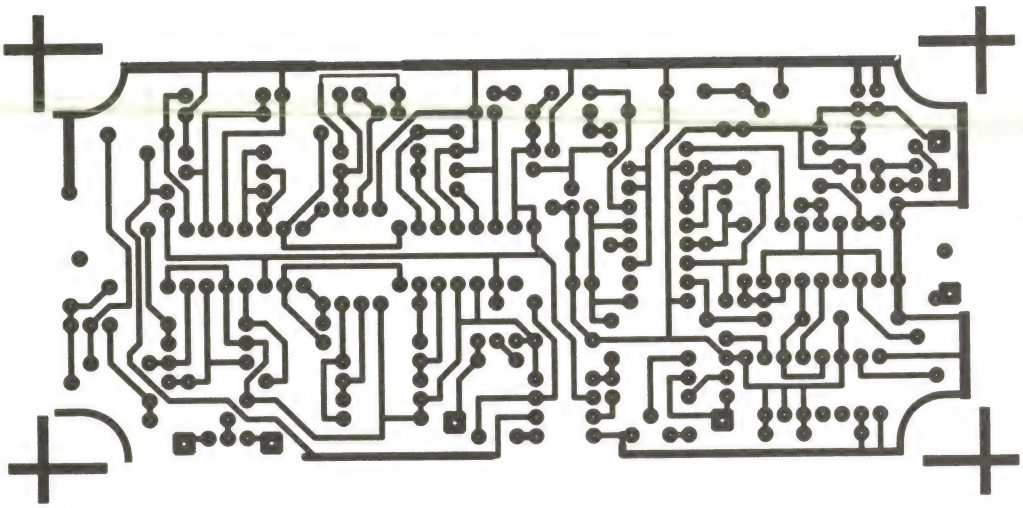


And here's the overlay diagram for the Servo Signal Source.

The other comparator IC7b switches the reversing relay, but its reference voltage is derived from the R25/R27/R30/R32 resistor string, so that the reference is a little under half the supply voltage. This is to ensure that the control stick must be moved away from the centre position before the relay closes. Both relay comparators are fitted with a small amount of hysteresis via 100k resistors, to prevent oscillation.

The reverse enable comparator IC6d is connected lower down the same resistor string, so that further stick movement is necessary before the motor starts rotating in reverse.

This arrangement is designed to en-



Here is the PCB pattern for the bidirectional motor control circuit, shown here actual size as usual, for those who wish to etch their own boards.

sure the relay is closed before the output is enabled, so that the relay contacts do not have to *switch* current, only carry it. A small relay with a modest current rating can then be used. Similar conditions apply for the full speed relay, which carries current in parallel with the transistors.

A 5V regulator, IC8, is mounted on the board to supply the circuit, which draws 30mA. The regulator takes its power from the 12V supply which powers the motor.

Construction notes

Constructors of this circuit should start by filing out the corners of the board with a round file, to clear the corner posts of the jiffy box. The curved copper tracks indicate the limit of filing. Be careful not to file into the tracks. Next insert the 12 wire links, noting that one link, at the end near IC5, loops around a support spacer, and insulated wire should be used here.

Now place the resistors and capacitors. When mounting the components take a great deal of care, especially with the placement of resistors, of which there are many with the same or similar value. Resistor R11 is standing upright next to VR3.

Next mount the PCB pins and trimpots.

Be careful with the orientation of the transistors and current source IC4 (which looks like a transistor). Leave the ICs until last and watch their orientation, taking the usual precautions with IC3 (a CMOS IC). Finally make a thorough inspection of the underside of the board to ensure there are no shorted tracks caused by excess solder. The board is very crowded and it is easy for solder to bridge tracks.

This board is designed to be mounted beneath the lid of a jiffy box with sufficient space in between for the relays and connecting wires. As a first step, mark out and drill the holes in the lid for the PCB spacer screws, the terminal block and the power transistors.

Mount the power transistors and terminal block, and glue the relays to the underside of the lid before commencing the connecting wiring, as shown in the wiring diagram. Note that there is a spike suppression diode (D2) wired between two contacts on the reversing relay. A small rectangle of shim brass is used as a strap to connect the collectors (cases) of the two power transistors together and as a soldering point for two heavy motor wires.

The PCB is held away from the lid by 32mm long spacers. I used 30mm cut lengths of 6mm aluminium tube, slipped over 3mm x 40mm long screws, with a nut to hold the spacer. I then slipped the board over the ends of the screws and put a second nut on the end of each screw.

Alternatively, it would be possible to use tapped spacers with a short screw entered from both ends. Spacers of 25mm and 6mm appear to be readily available, and could be screwed together with a short length of thread, to make up the required length.

Obtain a suitable plug with flying leads, and solder it to the two PCB pins at one end of the board. Note that because the circuit draws its power from the 12V supply, only two wires from the plug are connected; signal and ground.

Suggestions for identifying the flying leads on a purchased plug were given in the first of these articles. Make up a stick-on label to clearly identify the connections on the terminal strip.

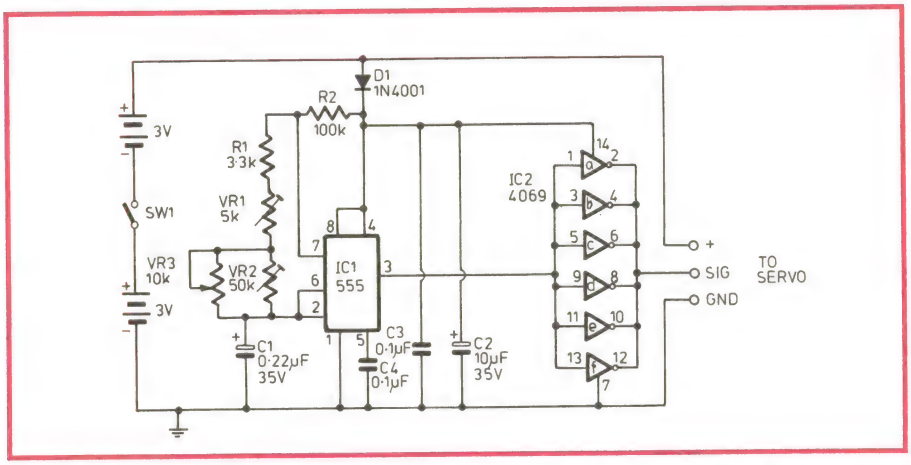


Fig.5: The schematic for the Servo Signal Source. As you can see, it is simply a 555 oscillator with adjustable mark/space ratio, driving a set of CMOS buffers.

Checkout time

Before switching on the power, make a final check of connections and set all trimpots to the centre position, with the exception of VR5, which is mounted on the lower edge of the board. It should be set fully clockwise. Connect a 12V supply and a small 12V globe to the output, for initial setting up. I recommend using the Servo Signal Source (described later in this article) to test the circuit.

Switch on the power, and with a multimeter check that you have 5V on the

supply tracks. Next, set your signal source to the mid or 1.5ms position, then monitor the voltage on C2. This is best done with a high impedance multimeter or DMM. Adjust VR1 until the voltage is 2.5 volts. This centres the control voltage in its range. Moving your signal source control towards the 1ms end should activate the reversing relay with an audible click.

If you have access to a CRO, you can connect it to the anode (marked stripe end) of either D3 or D4. You should see a square wave trace, and observe the width of the pulses increasing until they meet and join, as you move the signal source control to either of its extremities. In the centre position there should be no output.

If you don't have access to a CRO, don't despair. Simply observe the brilliance of the 12V globe you connected, as a good indication that all is well.

If all is well, you can now connect the circuit to your R/C receiver. Switch on the transmitter and receiver and repeat the adjustment you made earlier, using VR1 to centre the control voltage on 2.5V with the control stick in its centre position. This step is necessary in case there should be any difference in how your commercial gear is set up as regards the pulse duration at stick centre. Now you are ready to connect the model's motor to the circuit and make some further adjustments.

The motor adjustments are best made with the motor under load; for example with the prop under water in the case of a model boat. A second person is very handy to have around while you make the rest of the adjustments. Turn VR3 to give the desired range of stick movement, then adjust VR4 to give the desired slow speed.

Since these last two pots are interactive, several adjustments of each will be necessary. Leave a small amount of overtravel of the control stick in the forward direction for the full speed relay to be brought in.

When you are happy with the adjustments, move the full speed relay trimpot VR5 slowly anticlockwise until the relay pulls in near the full forward speed position of your control stick. This should increase the speed of the motor noticably in a single step, as full battery voltage is applied to the motor.

Astute constructors will have noticed we have not yet touched VR2, which adjusts the frequency of the PWM pulses. In reality it may have little affect on the performance of your motor at low speeds, but I included it for those who like to experiment.

The trimpot was deliberately set back from the edge of the circuit board because of its role as a secondary adjustment. For those who wish to try, the frequency can be varied over the range 200 - 8000Hz. I have found that a frequency around 400Hz usually gives the smoothest running. This adjustment will have no affect on any of the other adjustments.

Assuming the circuit has passed all its tests and is now set up for your model, a small notch can be filed in the top edge of the end of the box to enable the signal cable to pass out of the box when the lid is fitted. Tie a knot or fit a cable tie to anchor the cable. All that remains now is to permanently install the speed controller in your model.

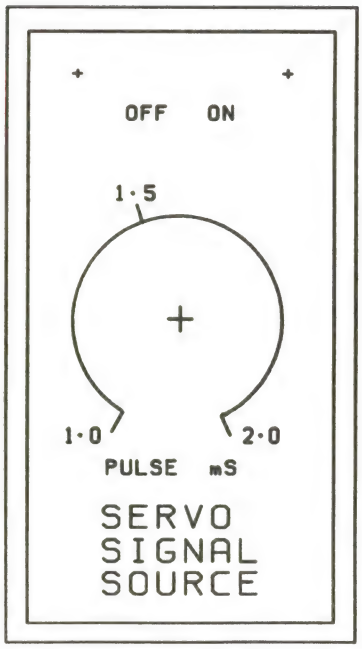
The Signal Source

The Servo Signal Source will now be described. Fig.5 shows the circuit, which is simply a 555 (IC1) timer connected as an astable oscillator to give a variable low period from 1 - 2ms and a high period of about 18ms.

Since this is the inverse of what we want, a CMOS 4069 hex inverter (IC2) is used, with all six inverters wired in parallel. A 10k pot (VR3) is used to vary the pulse duration, with parallel and series trimpots added to enable independent setting of the 1ms and 2ms durations at the extremities of the pot movement.

Construction of the Signal Source is quite straightforward, although care is needed handling the CMOS IC (IC2). Also watch the orientation of both ICs, as they are different.

The circuit board is mounted to the base of the box using 3mm screws and 6mm spacers. Since the screw heads



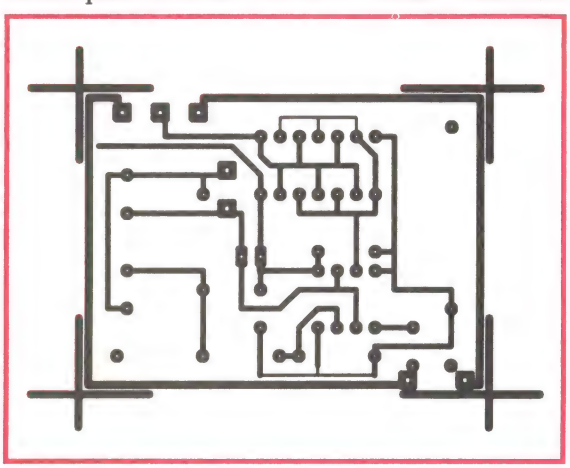
Suggested front panel artwork for the Servo Signal Source, when built into a small plastic jiffy box.

protrude out of the underside of the box, adhesive rubber feet can be positioned in four places to raise the box and prevent the screws from scratching your work surface.

Two battery holders containing four AA size batteries are mounted to the sides of the box. Since there is no room for nuts inside the battery holders, I used short 6BA screws which conveniently tapped themselves through existing holes in the polythene material from which the holders are made. Snap-on connectors are used to connect to the battery holders, and for convenience, the ON-OFF switch is wired between the two sets of batteries.

Testing & calibration

There are a number of ways to test and calibrate the signal source. If you have access to a CRO, simply connect



And finally, here's the PCB pattern for the Servo Signal Source, actual size as usual for those who wish to etch their own.

the probes to signal and ground, and monitor the waveform. Rotate the pot anticlockwise and adjust VR1 until a 1ms positive pulse is obtained. Then rotate the pot fully clockwise and adjust VR2 until a 2ms pulse is observed.

If you don't have a CRO, two possibilities are available to you.

Firstly you can use your multimeter and a calculator. To use this method you must accurately measure the battery voltage with the circuit switched on, preferably using a DMM. Next, calculate 1/18 of the battery voltage and 2/18 of the battery voltage.

Then follow the procedure described above, but with your multimeter connected between output and ground instead of a CRO. Adjust the trimpots to give the two calculated voltages at the extremes of rotation of the pot, and this should calibrate the unit close to the 1ms and 2ms periods required.

Finally, a servo can be used for calibration. Attach a piece of cardboard or other similar material to a fixed part of the servo, and attach a pointer to the rotating shaft. Plug the servo into your receiver and switch on both the transmitter and receiver.

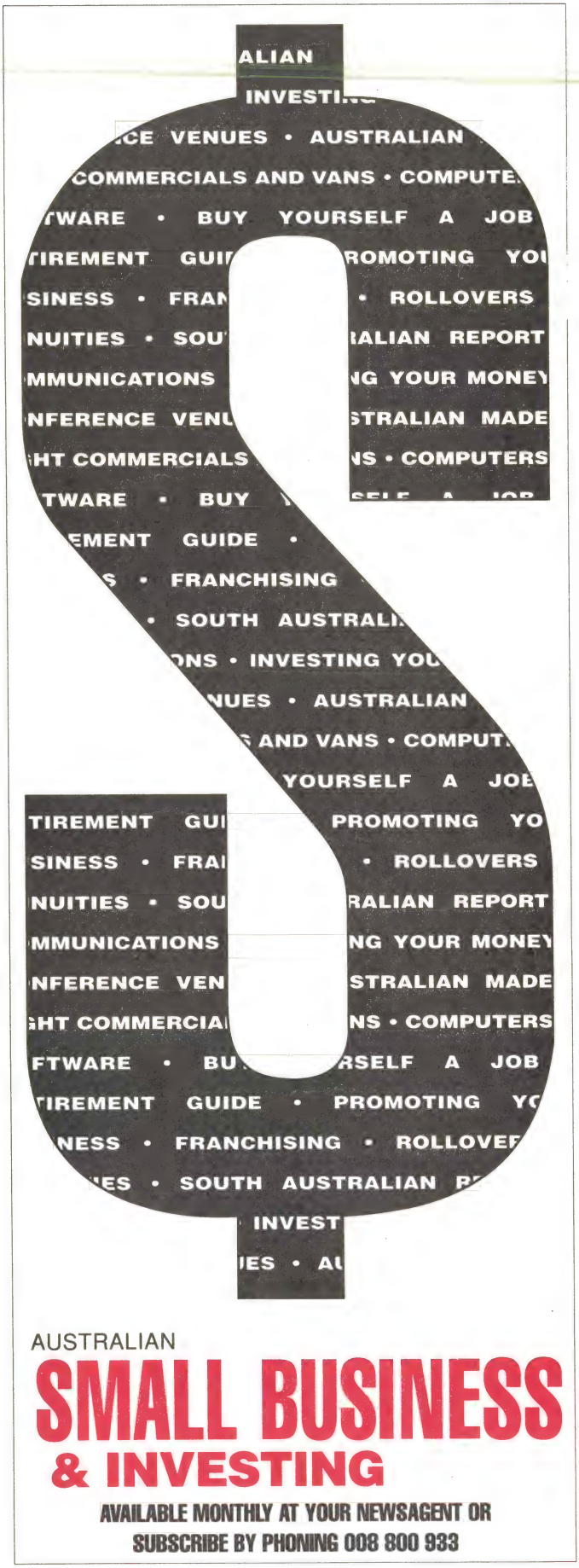
Move the control stick from one extreme to the other and mark the position of the pointer on the cardboard at each stopping position. Make sure the centre offset adjustment on your control stick is in the centre position. Now plug the servo into the Signal Source, move the pot, and adjust the trimpots as described above, to give the same stopping positions of the pointer.

That concludes these articles on radio control, and I trust they have been informative. The control of any type of model by radio is of interest to almost anyone with a technical mind, particularly those with an interest in electronics.

If you take the time to find out how your equipment works, and go on to build your own circuits, your interest and satisfaction levels will rise considerably. ❖

NOTES AND ERRATA

Guitar Tuner (Circuit & Design Ideas, August 1994): In the circuit diagram, U5 is shown incorrectly as a 4917 — it should be a 4017 (decade counter), as you would expect. Our thanks to those at Warwick Senior High School for drawing our attention to this error.



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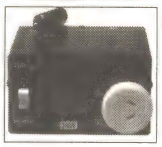
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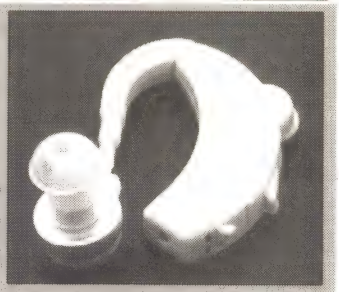
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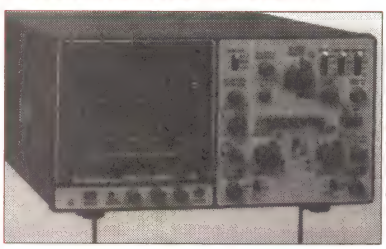
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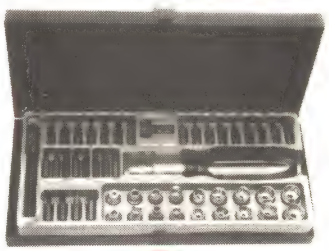
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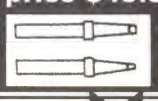


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DUKE SPEAKER KITS

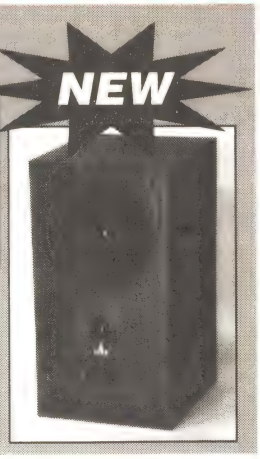
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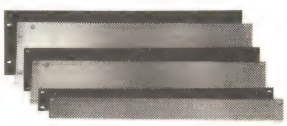


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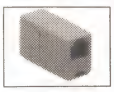
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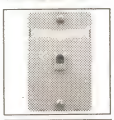
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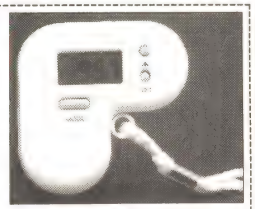
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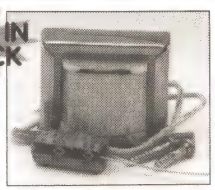
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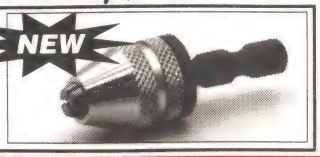
SAVE $$$

These are in our catalogue at $17.50. We have found that many of these have a problem with them where the LED won't light, or one of the charging bays doesn't work. So, we are offering these at below cost. You can now buy 2 for less than the price of one, & charge 6 batteries at a time! Note: As the price is so low, they are being sold as is - NO RETURN / NO WARRANTY.
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JAYCAR ELECTRONICS

IN-A-FLASH CABLE CHECKER KIT

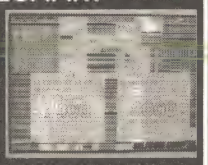
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If you work with coaxial or shielded cables, then this handy kit is a must. To check a cable, you connect both ends to the checker, and press a button. One of 4 LEDs will glow to show its condition - much faster than using a multimeter. Kit includes case, PCB, RCA and BNC sockets, label and all electronic components.

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See 94 cat P89 for full details.

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JAYCAR ELECTRONICS

Construction Project:

LOW COST PC-BASED PLC

Here's a very low cost approach to using an old XT or similar personal computer as a programmable logic controller. It's a minimum-hardware card which connects to the PC's printer and games ports, and provides seven relay outputs, nine digital inputs and four analog inputs. These are all easily controlled and sensed using simple BASIC routines, making the project ideal for both experimenters and as a teaching project in colleges.

by JOHN HOLLIDAY

Most people have now learned to live with and use computers in many facets of their work and leisure. Computers may have started as just number crunchers and huge machines which were appropriate for large businesses, but now, the personal computer revolution has made the computer available to the masses, and it is routinely used for word processing, spreadsheets, entertainment, etc.

One capability of the computer, however, has not enjoyed the same rapid acceptance as the other features mentioned earlier. That is the ability of the computer to control the real world environment. The ability of a computer to sense certain real world conditions and on the basis of these conditions then take appropriate action to control and affect the environment makes it a very powerful tool.

You can use computer control for a comprehensive lawn sprinkling system, to monitor your home's burglar alarm system, to turn on or off lights and appli- ances according to the state of the input conditions, to regulate the temperature in a room — the list is virtually endless.

In order for a computer to interact with its environment you need access to the computer's internal data lines to allow a two-way communication system to be set up between the computer and the environment. This usually means that some kind of add-on card is required to provide this access.

Most IBM-compatible computers have two ports already built in which will allow the sort of access we require: the printer port and the games port. In order to facilitate experimentation with computer control, I have developed an output circuit board which makes use of both these ports.

This board provides for nine digital inputs, four analog inputs and seven relay driven outputs. More outputs could be provided (up to five more), but I wanted the board to cost as little as possible and this over-riding criterion influenced many other decisions which had to be made in designing the board.

It should be possible to make the whole system for about $50.00. When you compare this to a PLC (program-

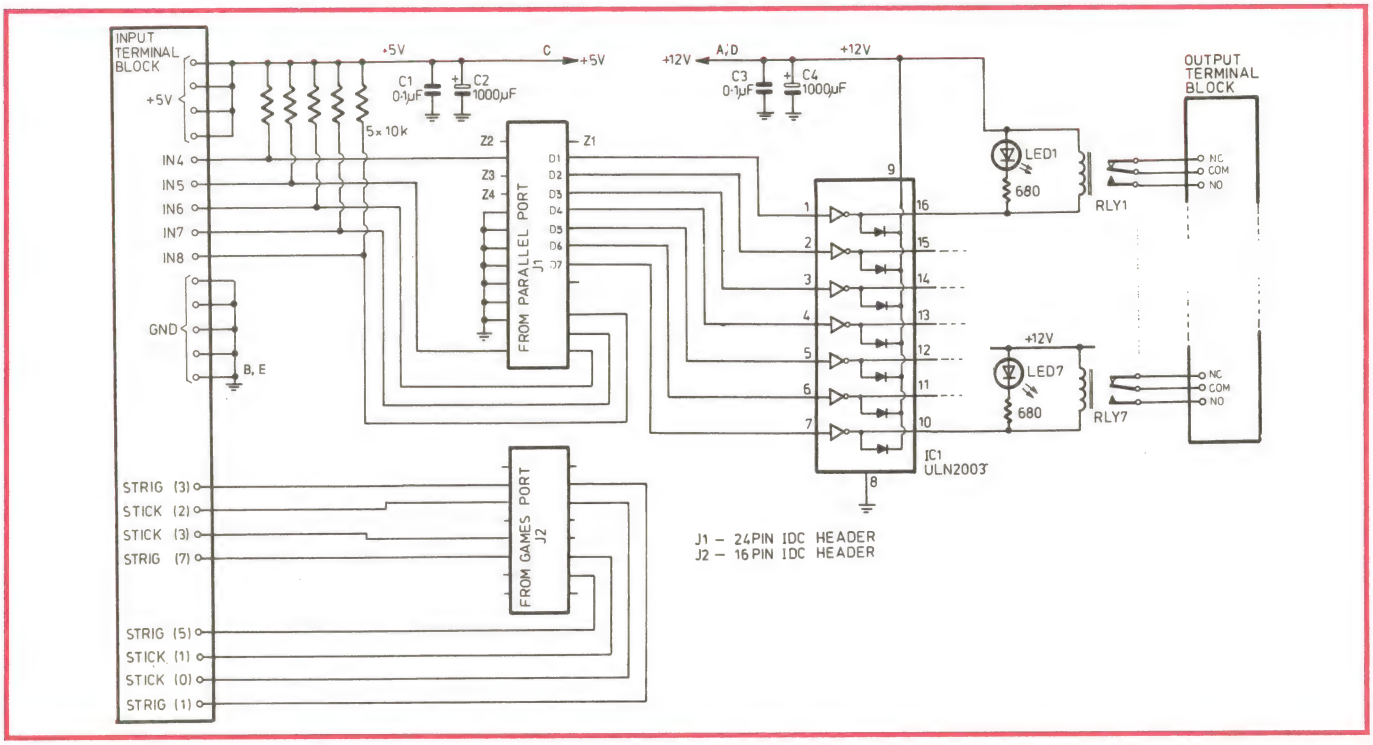
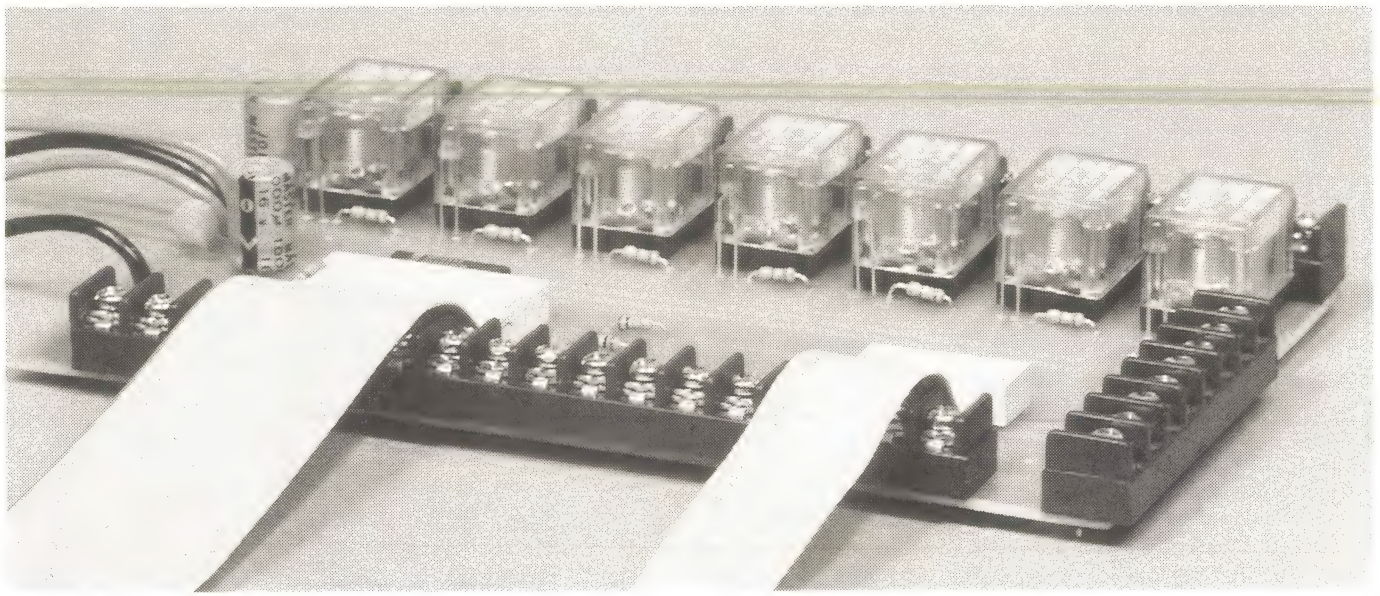


Fig.1: The schematic for the PLC interface, which provides seven relay controlled outputs, nine digital inputs and four analog inputs — all from a standard printer and games port.



mable logic controller) as used in industry, you would get a device with eight digital inputs and eight relay outputs, but it would probably cost well over $1000!

Simple circuit

Fig.1 shows the circuit diagram for the project. J1 is a 24- pin IDC header which handles input and output from the printer port, while J2 is a 16-pin IDC header which handles input to the games port.

There are five input lines available using the printer port. These are labelled IN4 to IN8, to remind us that during input these are connected to the computer's five higher data lines, D4 to D8. These five lines are held at +5 volts by five 10k ohm pull- up resistors.

The games port has four similar input lines available. These are labelled Strig(1) to Strig(7), since this is the way these inputs can be read using BASIC. These lines are normally pulled high by 1k resistors within the computer.

The nine input lines described so far are all digital in nature — that is, they will be read as being either high or low (within the TTL definition of these terms: high = 2 - 5V, low = 0 - 0.8V). Consequently, the nine digital inputs should be actuated by a simple switch to ground or perhaps by a switching transistor operating with non-reactive loads between 0 and 5 volts.

Fig.2 shows a simple water level detector using a transistor, suitable for this kind of digital input. The inputs should never be directly connected to a voltage source, particularly if that voltage is outside TTL limits, because such voltages will damage your printer card.

The games port also supplies four other input lines, of a different nature. These are labelled Stick(0) to Stick(3), again because this is the way these inputs are accessed using BASIC.

These inputs are analog in nature and in use each input would be connected to the +5 volt line by a variable resistor. This resistor (in series with an internal 2.2k resistor and a 0.01uF capacitor) forms the timing circuit in a quad 555 timer. The timing period for each timer is thus set by the external variable resistor, which is connected between the corresponding input and +5V supply. During the timing period an 8-bit counter is enabled so that the count value will depend on the value of the external variable resistor. It is the value of this counter which is returned by the Stick(n) function.

The maximum value which can be counted by an 8-bit counter is 255, and experimentally, I found that this count was reached when the external resistance was approximately 350k ohms. When the 350k value was exceeded the counter 'froze' on a small value such as '4', and would not resume normal counting until the resistance was lowered to a value less than 350k. The minimum count possible was '2'.

These four analog inputs are therefore suitable for monitoring such devices as light dependent resistors (e.g., ORP12 or DSCD01), or thermistors such as DSE's R-1797 which has a resistance of 100k ohms at 25°C, and a coefficient of resistance change of -5.2% per degree.

Since a transistor operating in its linear region also acts as a variable resistor, it should be possible to monitor analog voltages by arranging for that voltage to bias a PNP transistor in its linear region.

The eight data lines D1 to D8 in J1 are output lines, each of which is capable of driving a relay output via the darlington relay driver chip IC1. The use of this chip considerably simplifies the design of multiple relay outputs. The internal structure of this chip is indicated in Fig.1, and you can also see how easy it is to use it to drive a relay. Notice that the clamping diode is already designed into the chip, and also that the data lines can be connected directly to the chip's inputs. This is because each driver in the IC already has the correct series base resistor to allow direct operation from TTL voltage levels.

The only drawback is that the ULN2003 chip contains only seven drivers, so data line D8 remains unused.

Each relay has a normally open and a normally closed contact and is rated at 3A for 110V AC or 24V DC. Therefore this unit is not to be used to switch 240V AC mains operated appliances. The relays were chosen for their low cost — they're only $2.50 each from Jaycar.

Power supply

The PC board needs a 5V supply for the four analog inputs to the games port, and a 12 volt supply for the relays and the ULN 2003 driver chip.

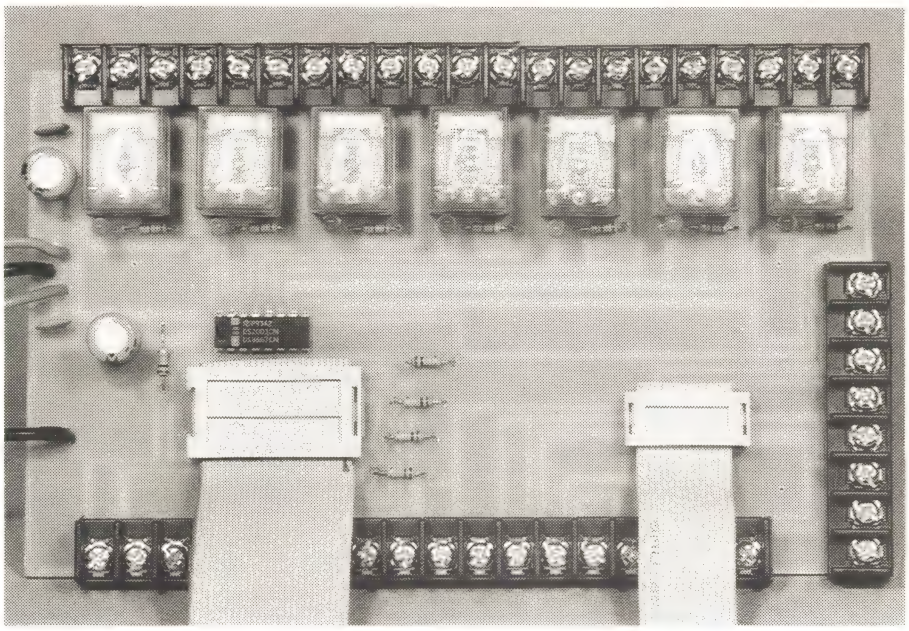
Both these voltages can be obtained most simply from a spare floppy disk drive connector within the computer itself. You will need a Utilux disc drive connector part number M8981-4M, and a packet of connector pins part number M8980-4L.

Fig.3 shows the pin connections needed for the connector. Note that it shows the view looking at the front of the connector, not the rear.

The 12 volt lines would be connected to points A and B on the PCB, whilst the 5 volt lines would be connected to points C and E. If you use this method you won't need the 7805 regulator device, which as you can see is allowed for on the board.

An in-line fuse holder with a 350mA fuse should be placed in the 5 and 12 volt supply lines.

If you don't want to use the computer's power supplies, an alternative is to use a 12V DC plugpack connected to points A and B and a 7805 voltage regulator connected to points C, D, and E in the orientation shown on the overlay (Fig.4) to provide the 5V supply. A plugpack rated at 500mA or greater should be fine.



A top view of the author's prototype of the PC-based PLC interface card. As you can see there are few components involved.

Construction

Constructing the board shouldn't present any difficulties; just follow Fig.4 and check for correct orientation of C2, C4, U1 and the seven LEDs. Solder in J1 and J2 after all other components have been installed, and after the cables have been made which terminate in J1 and J2.

One point to watch is the three terminal strips. These are obtainable from Jaycar and each strip has 20 connectors. The input terminal strip on the left of the board requires 18 connectors, so this can comfortably be cut from a single length. The analog input strip along the bottom requires eight connectors which can be cut from a second strip, leaving a strip of 12 connectors spare. The output terminal strip on the right requires 21 connectors and should be made up from the third terminal strip together with the spare strip of 12 connectors.

It is not a good idea to use the full strip of 20 plus one 'strip' of just one connector, as this latter strip would be only weakly held with one solder joint and would tend to tear away when you attempt to tighten the terminal screw. It makes a much stronger connection if the 21 connectors are made up from the spare set of 12 together with nine more cut from the third strip.

The wiring of the connections from the printer port and games port will require a little care to get the connections right.

Fig.5 shows how a 25-pin male IDC plug is connected to 25-way IDC cable. The view for both connectors looks on the back of the pins. The cable has to be connected to J1, a 24-pin IDC header plug, so one wire is not going to be connected. The wire sacrificed is the 24th wire (connected to pin 25 of the D plug), which is a spare ground connection.

One way of achieving the connections is to peel back the last two wires for about 50mm and connect the remaining 23 in the usual way for an IDC header connection.

Then separate the 25th wire (connected to pin 13 on the D plug) from the 24th wire and connect the 25th wire to the remaining unused connector on J1. The 24th wire remains disconnected and can be trimmed off neatly.

When soldering the 24-pin IDC header into the circuit, orientate the corner marked '1' in Fig.5 in the same way as it is shown on the overlay diagram.

The games port cable is wired in a similar way, except that now we have a 15-pin male IDC plug connected to J2, a 16-pin IDC header plug. So there will now be one unused pin on J2. Fig.6 shows the connections. As before, when soldering J2 to the board orientate the corner marked '1' to match the position shown on the overlay diagram.

TABLE ONE

INSTRUCTION	EFFECT
out 888,1	Relay 1 and associated LED activated
out 888,2	Relay 2 and associated LED activated
out 888,4	Relay 3 and associated LED activated
out 888,8	Relay 4 and associated LED activated
out 888,16	Relay 5 and associated LED activated
out 888,32	Relay 6 and associated LED activated
out 888,64	Relay 7 and associated LED activated
out 888,0	All relays and LEDs off

TABLE TWO

INSTRUCTION	EFFECT
out 888, 7	Relays 1, 2 & 3 activated
out 888, 80	relays 5 & 7 activated
out 888, 127	All relays activated

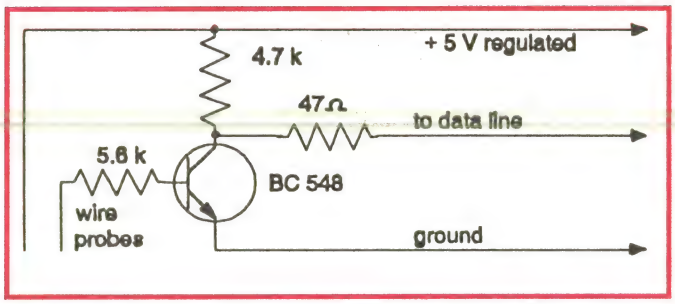


Fig.2: A simple water level switch circuit suitable for connection to one of the interface card digital inputs.

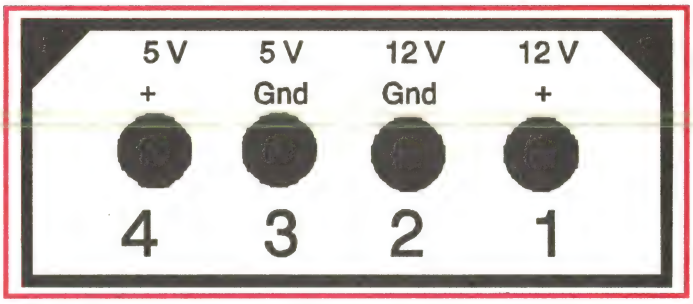


Fig.3: The connections used for disk drive power sockets. The interface card can be powered from one of these.

Testing the board

When all the wiring is done and a check for errors has been made, it's time to connect the unit to your computer. Turn the computer off and plug into the appropriate printer and games port sockets. Then make the power connections to a spare disk drive power outlet, or alternatively the 12 volt plugpack, and turn on your computer. As it goes through its boot-up procedure you will see some of the output LEDs light up. Next run a BASIC interpreter such as GW-BASIC. The address of the printer output port is 378H (888 decimal) if you are using the LPT1 printer port or 278H (632 Decimal) if you are connected to LPT2.

You can check the operation of each output port by typing the instructions in Table 1, in turn. Of course, any desired combinations of outputs can be activated by adding together the bit values for the data lines driving those outputs, and outputting that number. Examples of this are shown in Table 2.

The address of the printer *input* port is 889 decimal (or 633 if you are using LPT2 printer port). Only the five highest data lines are externally accessible in this operation and of these the highest is inverted by the printer card in the computer.

The instruction PRINT INP(889) will display a number which reflects the state of all eight data lines, but as we can control only the five highest lines, we clearly need some decoding of this number to tell us the state (high or low) of the five data lines which are of interest. Such decoding needs to take into account the inversion of data line 8 as previously mentioned.

The following BASIC program will display the status of the five data lines when run:

```
10 CLS:REM Decoding the input
conditions. @FLUSHPAR=100 X =
INP(889)
110 X4 = ((X AND 8) = 8)
120 X5 = ((X AND 16) = 16)
130 X6 = ((X AND 32) = 32)
140 X7 = ((X AND 64) = 64)
150 X8 = ((X AND 128) = 0)
200 LOCATE 1,1
210 PRINT "X4" = X4
```

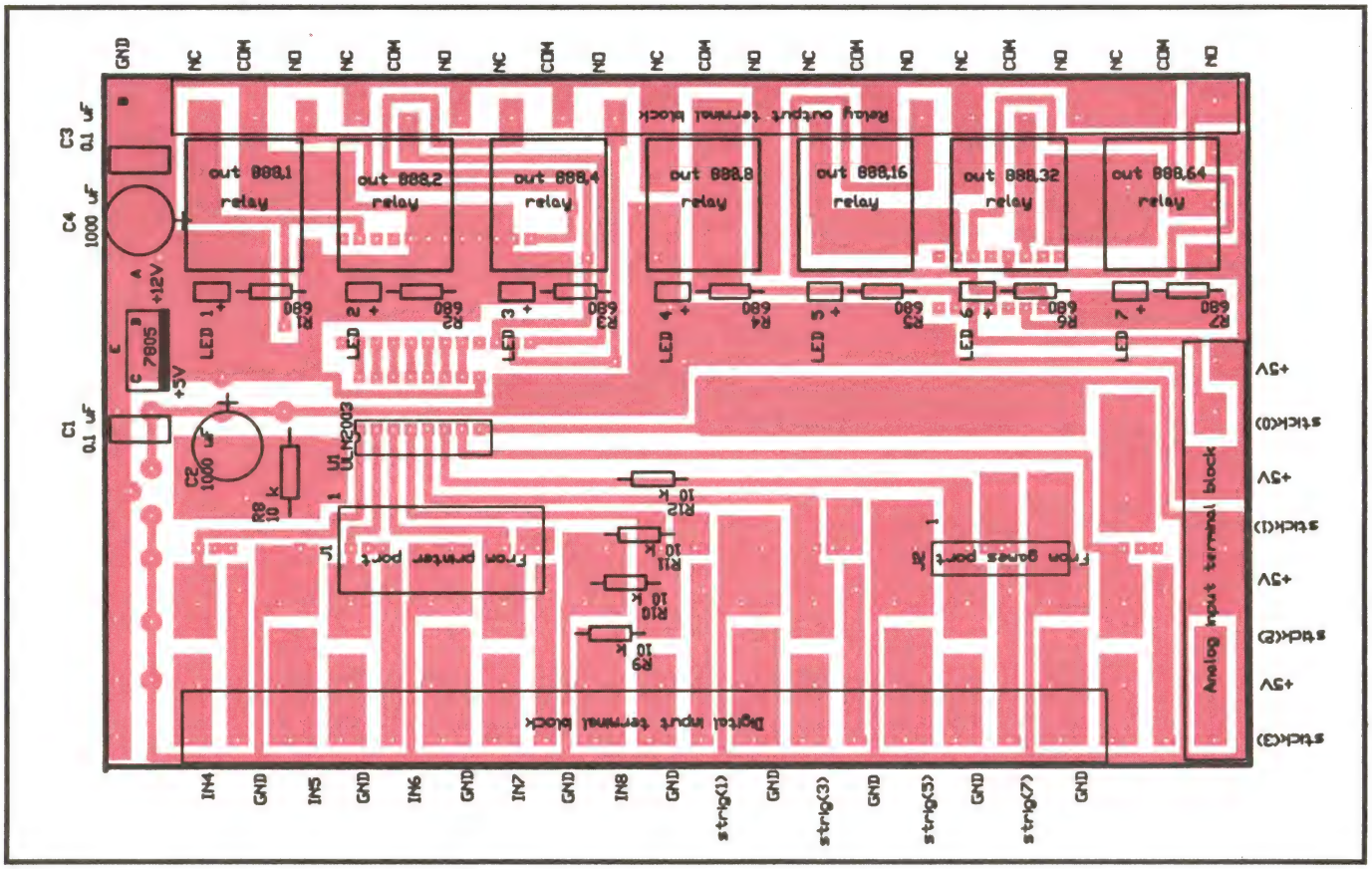


Fig.4: Use this overlay diagram as a guide when fitting the various components to the PLC interface card. Note that it shows the optional 7805 voltage regulator device, which is not needed if you power the card from a disk drive power socket.

```
220 PRINT "X5" = X5
230 PRINT "X6" = X6
240 PRINT "X7" = X7
250 PRINT "X8" = X8
1000 GOTO 100
```

The number stored in X at line 100 was the result of the eight data lines being individually high or low. Line 110 tests whether the fourth data line (representing 8 on the binary scale) is high or low and stores the result of this test in X4. If the result of the test is TRUE, that is, data line 4 was high, then X4 will store the number -1. Otherwise, if the result of the test was false, data line X4 was low, and X4 will be 0.

Line 150 tests data line 8 a little differently, to accommodate the inversion which takes place on this line.

When this program is run it continuously loops back to recheck the status of the input lines. At this stage, since all the input lines are pulled high by the five 10k resistors, the values printed for all five inputs should be -1.

You can now check the operation of each input by grounding it with a jumper wire. The overlay diagram shows the location of each input (labelled IN4 to IN8) at the top left of the board. Each input has a neighbouring ground terminal which can be used for this purpose. As each input is grounded, the corresponding value for that input should change from -1 to 0 and revert back to -1 when the ground is removed.

Save this program for future use.

The four digital inputs available through the games port can now be checked using the following program. These inputs are located at the left edge of the board and are labelled 'strig(1)', 'strig(3)', 'strig(5)', and 'strig(7)'.

```
10 CLS
300 LOCATE 1,1
310 FOR N = 1 TO 7 STEP 2
320 PRINT STRIG(N)
330 NEXT N
340 GOTO 300
```

Here, the four inputs will be continuously monitored and should change from -1 to 0 as each input is grounded as before.

The four analog inputs located along the bottom edge of the board and labelled 'stick(0)', 'stick(1)', 'stick(2)' and 'stick(3)' can be checked by the following program.

```
10 CLS
300 LOCATE 1,1
310 FOR N = 0 TO 3
320 PRINT STICK(N)
330 NEXT N
340 GOTO 300
```

Before running this program, connect a suitable variable resistance between the +5 volt terminal and one of the stick(n) terminals. The LDR or thermistor mentioned earlier in the article are ideal and can be directly connected, otherwise a 250k potentiometer would be OK. In the case of the LDR you should see the value of the number displayed change with changing light values. As you shield the LDR from the light, the value should increase and vice-versa. A similar effect would be observed with a thermistor, for temperature changes — the higher the temperature, the lower the number. With the potentiometer, the higher the resistance the higher the reading.

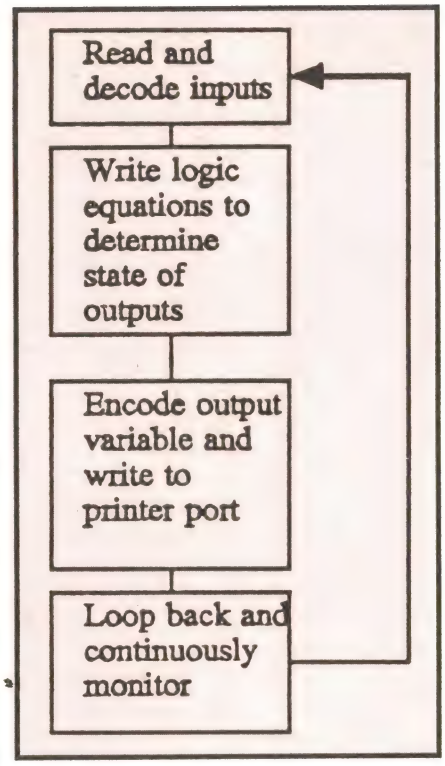


Fig.7: The flow chart for a typical PLC program, as explained in the text.

Using it

Now that your board checks out, you are ready to put it to use. Fig.7 illustrates a typical PLC program. We have already seen an example of reading and decoding the input conditions. It was that program that you used and saved (hopefully) earlier.

To see how the rest of the program might look, let us take as a practical example the use of the board to run a garden sprinkler system.

Suppose you have three outside taps and each is controlled by a separate solenoid which is operated by relays 1, 2, and 3 respectively. Suppose further that you are only allowed to water on three days a week (Monday, Wednesday and Friday say), between the hours of 7am to 10am, and that each tap will be turned on for one hour to water its section of the garden.

You also have a moisture detector to tell when it's raining and so turn off the sprinkling system during rain to conserve water. (The moisture detector in Fig.2 would be suitable). Let the moisture detector be connected to IN4. The moisture detector produces a high when it's OK to water and a low when it's wet.

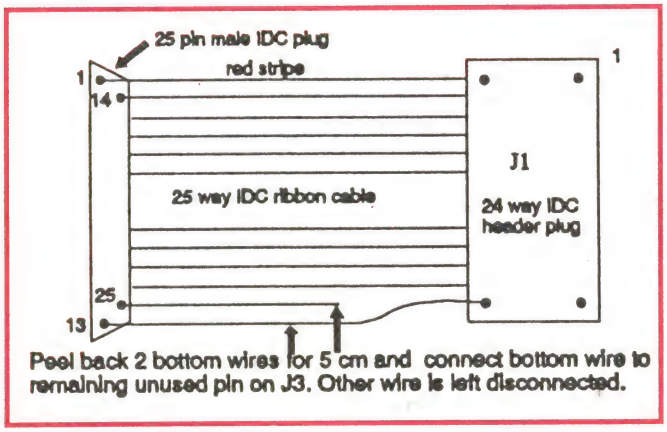


Fig.5: How to wire the 24 way printer port ribbon cable.

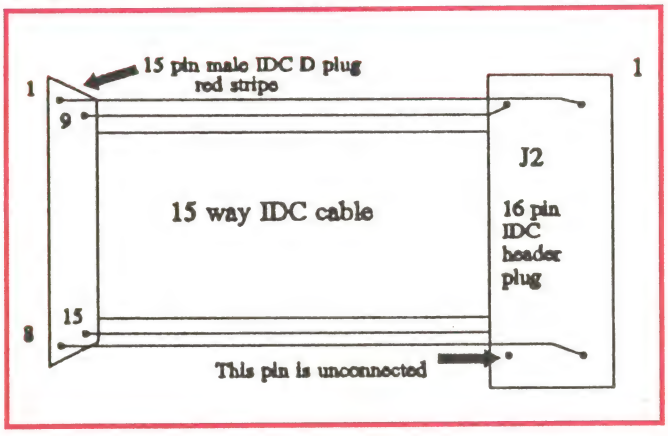


Fig.6: And how to wire the 15 way games port cable.

The input decoding routine would return -1 or TRUE for X4 when sprinkling should proceed, and this is the only external input condition of interest to us.

We also need to have a variable VALID.DAY which is TRUE (-1) when the day is a Monday, Wednesday or Friday, and FALSE (0) otherwise.

HOUR is a variable which gives the hour value of the current time. Both HOUR and VALID.DAY can be obtained using the TIME$ and DATE$ functions in BASIC. Let Y1, Y2 and Y3 be the BASIC variables which control relays 1 to 3 respectively. Relay 1 will be ON when Y1 is TRUE and OFF when Y1 is FALSE. Similarly Y2 controls relay 2 and Y3 controls relay 3.

The logic equations we would write would be:

300 Y1 = ((HOUR = 7) AND VALID.DAY AND X4)

310 Y2 = ((HOUR = 8) AND VALID.DAY AND X4)

320 Y3 = ((HOUR = 9) AND VALID.DAY AND X4)

Thus Y1 is only TRUE when the hour is 7 on a Monday, Wednesday or Friday, and it is not raining; the statements for Y2 and Y3 have the same effect. We must now encode the output variable (Y) to turn on the appropriate relays.

In the following two lines, line 400 encodes the output variable and line 410 outputs its value to the printer port:

400 Y = (Y1 AND 1) + (Y2 AND 2) + (Y3 AND 4)

410 OUT 888,Y

When Y1 is TRUE we need data line 1 to be high in order to operate relay 1, so we need to output a '1'. When Y2 is TRUE we need data line 2 to be high to operate relay 2, so we need to output a '2'; and when Y3 is TRUE we need data line 3 to be high to operate relay 3, so we need to output a '4'.

PARTS LIST

1	male 25-pin IDC D plug
1	male 15-pin IDC D plug
1	24-pin IDC header plug
1	16-pin IDC header plug
1	1m length 25-way IDC cable
1	1m length 15-way IDC cable
4	1m lengths (different colours) light duty hookup wire
3	terminal strips (Jaycar HM-3204)
7	relays (Jaycar SY-4066)
1	Printed circuit board, 170 x 102mm
7	3mm red LEDs
2	0.1uF ceramic capacitors
2	1000uF 25V electrolytic capacitors
7	680 ohm 0.5W metal film resistors
5	10k 0.25W resistors
1	IC, ULN2003 (DSE Z-5830)
1	Utilux disc drive connector M8981-4M
4	Utilux connector pins M8980-4L

As an alternative to the last two items:

1	12V 500mA DC plugpack supply
1	7805 regulator IC

In line 400, the first bracket returns a '1' when Y1 is TRUE, the second bracket returns a '2' when Y2 is TRUE and the third bracket returns a '4' when Y3 is TRUE, which correctly encodes the output. The whole process must now be repeated so that the inputs are continuously monitored and the output updated.

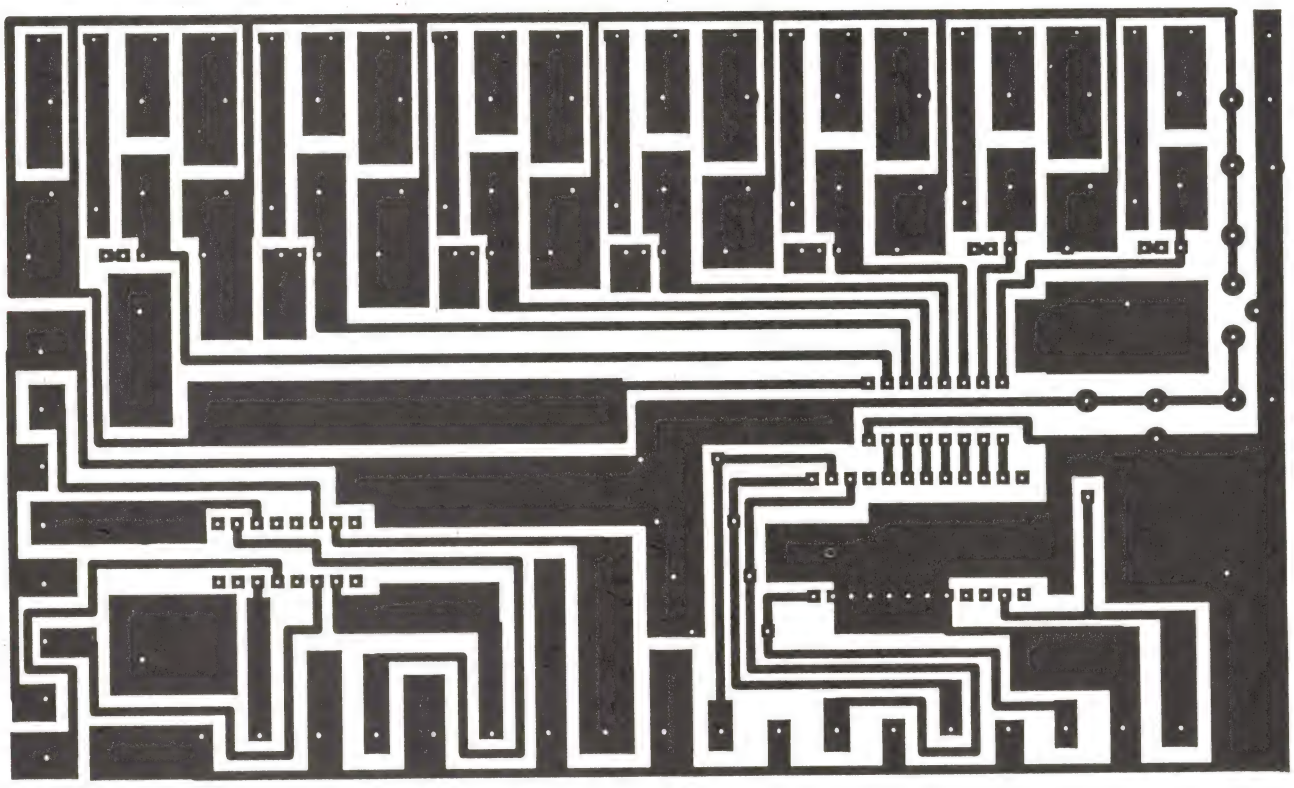
Clearly, the program can be added to, so that the computer could also be monitoring your home security devices (IR movement detectors, etc). If more outputs (Y4 to Y7) were to be used, then line 400 would be similarly expanded to encode these additional outputs.

I run my card using an old XT computer which is practically worthless on the open market, but which is ideal for this continuing monitoring task. The XT is stripped down to just a single 360K drive, printer port and monochrome CGA monitor. When the program is running the monitor is turned off.

Many people must be in a similar situation, with an old XT which won't die and which technology has passed by. If not, one of the above stripped-down XT systems can usually be bought very cheaply on the second hand market.

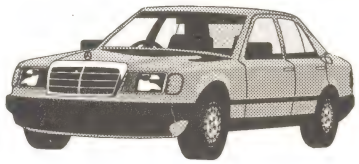
Whilst provision has been made to operate this card from the computer's

Continued on page 103



Here is the PCB pattern for the PC-based PLC interface card, shown here actual size for those who wish to etch their own PCB. Note however, that the author is retaining commercial copyright for this design.

AUTOMOTIVE ELECTRONICS



with NICK DE VRIES MIAME, AMSAE

Inside the exhaust gas analyser

This month we will delve into the nitty gritty of the automotive exhaust gas analyser. In particular, we'll look into the bowels of the Andros Spectrophotometric Non Dispersive Infra-Red model 256B, as a typical example. In principle, all modern gas analysers as used in the world of automotive repair shops are the same, even though in practice they can be like chalk and cheese. Like most things, the more you pay the better it gets.

The Andros 256B is one of the most widely used 'optical benches' in the world, since gas analysis became popular in the seventies. Andros Incorporated, of Berkeley, California has produced a series of optical benches for automotive gas analysers, and these are widely used in government run vehicle inspection stations for roadworthy checks. The robust 'Infra Red' design withstands the rigours of use and abuse that day to day life in a garage frequently brings.

A more precise method of analysis would be the 'Flame Ionisation' type, although this kind of equipment is best kept in a controlled laboratory environment. The calibration gas used by instrument technicians is also traceable to this exacting standard, and helps to keep garage equipment in an 'as delivered' state of accuracy.

To begin then, Fig.1 shows an exploded view of the Andros 256B optical bench with the important components labelled from A to G. Let's look at them in turn...

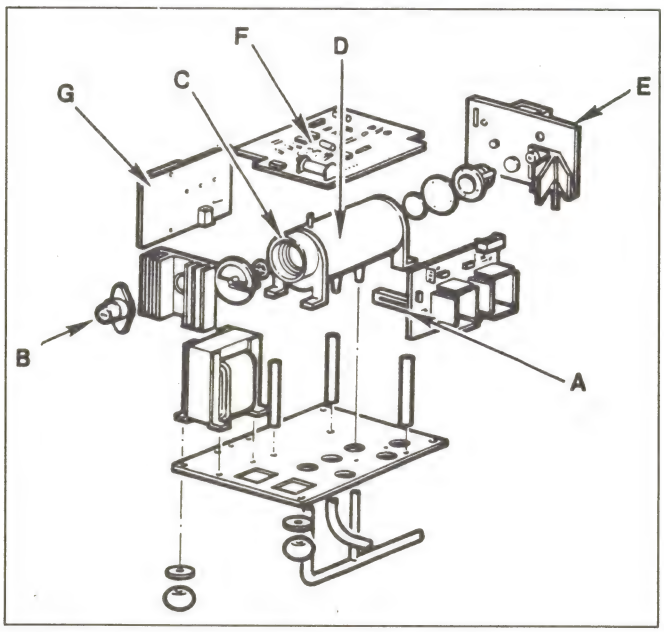
A. INFRA RED SOURCE: This is mounted on the source PCB, which provides it with a controlled power supply. The source tip is heated to the range 700 - 800°C, with the heat dissipated by the large finned heatsink. The infra-red (IR) light produced by the tip passes through a sapphire lens to the filter wheel assembly and on into the sample cell.

B. FILTER WHEEL/MOTOR ASSEMBLY: This consists of a set of coloured filter lenses mounted in a wheel, which is driven by the Faulhaber skew-wound micromotor. Each lens passes in front of the IR source and allows through only the appropriate wavelength for analysing each gas. The source PCB also maintains a precise motor speed of 5700rpm (95Hz).

C. FILTER HOUSING: This surrounds the filter wheel to provide a temperature-stable environment of 65°C. This is achieved by a resistance strip heater fixed to the inside of the housing and controlled by a thermistor. This arrangement helps to eliminate any unwanted transmission changes arising from fluctuations in ambient temperature.

D. SAMPLE CELL: Contains the conditioned exhaust gasses to be analysed, and is constructed from a special plastic with a negligible hydrocarbon release rate. Baffles inside the housing prevent reflections from condensation on the walls of the chamber affecting the readings, and three ports at the base facilitate gas flow through the cell. Rubber O-rings seal a small sapphire lens at the IR source end and a large mica lens at the detector end of the sample cell.

E. DETECTOR ASSEMBLY: This is a lead selenide (PbSe) hermetically sealed photoresistor, with its peak response and spectral range covering the absorption



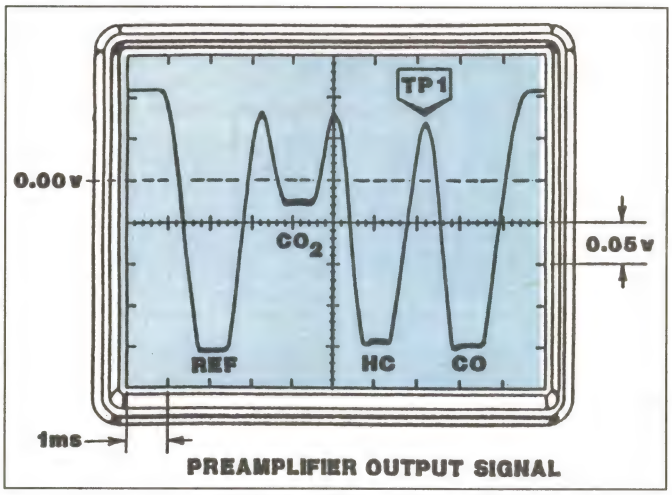


Fig.2 (above): The output signal from the detector preamp, showing the voltage levels corresponding to each gas.

Fig.1 (left): An exploded view of the Andros optical bench, with the important parts labelled A to G.

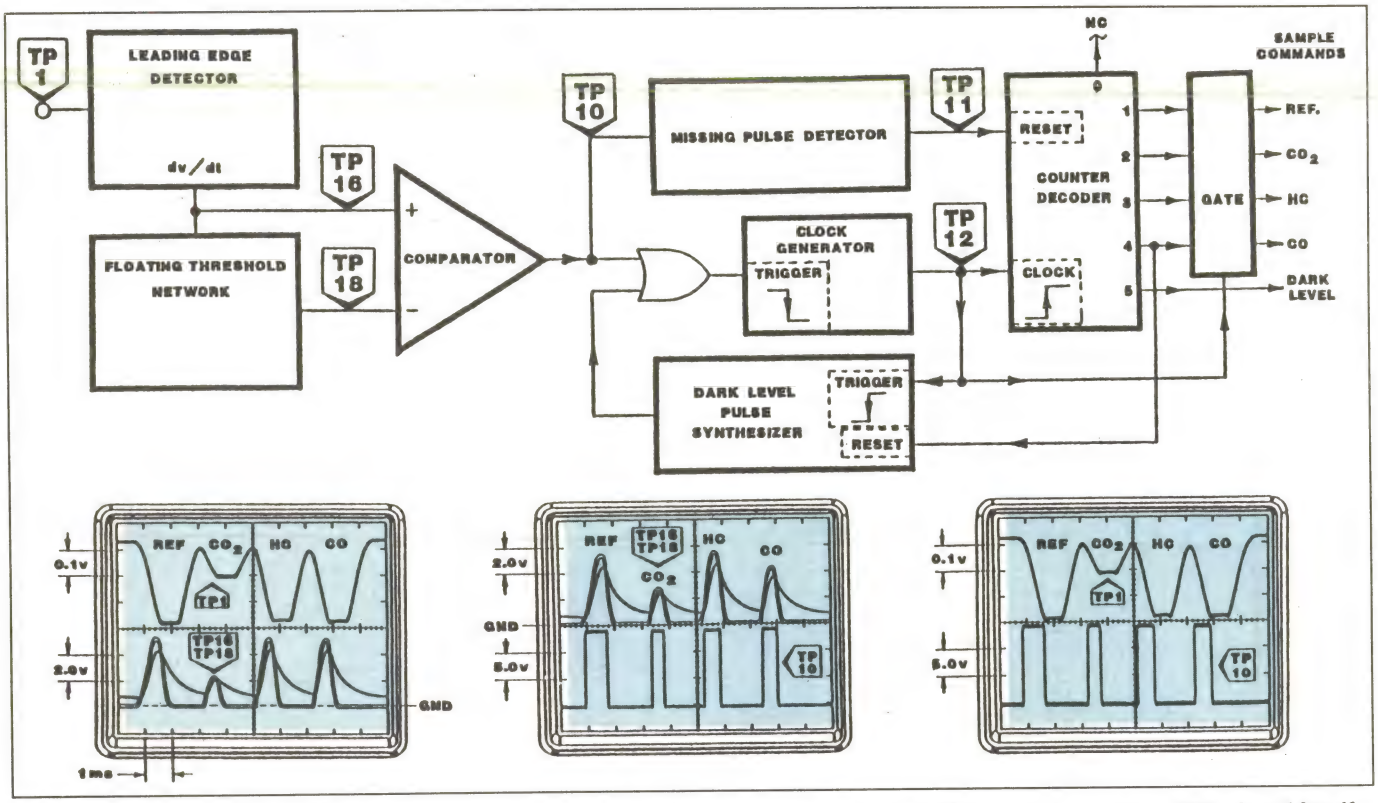


Fig.3: The operation of the Auto Synchroniser section, which generates sample gating pulses from the TP1 signal itself.

wavelengths of CO (4.7um), HC (Hexane, 3.43um), CO_2(4.25um). Its purpose is to convert the transmitted infra-red light into a train of electrical pulses, and pass them on to the processor PCB. A thermoelectric heater/cooler mounted directly beneath the detector chip maintains an operating temperature of 0°C. The Peltier effect cooling is controlled by a thermistor and a temperature-control servo loop, with both heating and cooling circuitry providing faster warmup of the instrument in cold climates as well as stability.

F. PROCESSOR PRINTED CIRCUIT BOARD: The function of this PCB is to link the power supply, detector, and source PCBs and control all the functions of the optical bench. Some further signal conditioning of the detector output is done here, and the interface for connection to a calibration board and host system is provided.

G. POWER SUPPLY: Powered by either 115V or 240V AC, this PCB supplies a high current +/-6.5V DC as well as low current +/-15V DC to each of the boards, via the processor.

Overview

Now that the main components have been identified, let us move on to the underlying principles of 'infra-red' analysis.

As you know, carbon monoxide is invisible to the naked eye, as well as having some other nasty attributes we discussed last month. In order therefore to observe the changes in concentration of this and the other two invisible gasses of interest, the infra-red area of the spectrum can be used — providing that appropriate filters are used to keep out unwanted interference from other light sources. It follows then that the greater the concentrations of gasses present in the sample cell, the greater the change in output of the detector.

The problem for the processor is to resolve the train of electrical pulses from the detector into three distinct analog voltages. The filter wheel begins the process, by introducing a 'blank lens' into the IR light path. This provides a reset function and enables the processor to keep track of which lens is 'in the frame' at any one moment.

Another requirement is to make certain that the output of the processor is referenced to a known standard to maintain drift to acceptable levels. Once again the filter wheel comes to the rescue, with a lens that is unaffected by any gasses found in automotive exhausts.

The train of electrical pulses from the IR detector, then, is as follows: Dark Level (from the blank lens); Reference; CO_2; HC; and CO. This sequence repeats over and over at 95 times per second, as the filter wheel rotates. Fig.2 shows an oscilloscope display of the output signal from the detector preamp, which can be measured at Test Point 1 on the processor. For convenience we will call this the TP1 signal.

From TP1 the signal splits into two paths. On one side is the Automatic Synchroniser circuit and on the other is the Signal Demodulator, which takes the AC coupled TP1 signal and resolves the pulses into three 0 - 10V DC outputs representing CO_2, HC and CO.

Auto synchroniser

Firstly let us deal with the Auto Synchroniser (Fig.3). Here the TP1 signal firstly goes into a Leading Edge Detector that produces a positive pulse with each dip in the TP1 signal; this can be viewed at TP16. Another signal is generated from this TP16 signal, called the Floating Threshold Network, and this can be measured at TP18.

The timing and decay of these two signals are arranged to correspond with the flat portion of each TP1 pulse. From there the two signals are fed into a comparator to generate a timing pulse (TP10), which enables the subsequent logic and timing controls to sample the correct parts of the TP1 signal (Fig.3).

A Missing Pulse Detector is employed to reset the Counter Decoder to '0' (TP11). The Clock Generator (TP12) increments the Counter Decoder for each low to high transition of its output. TP12

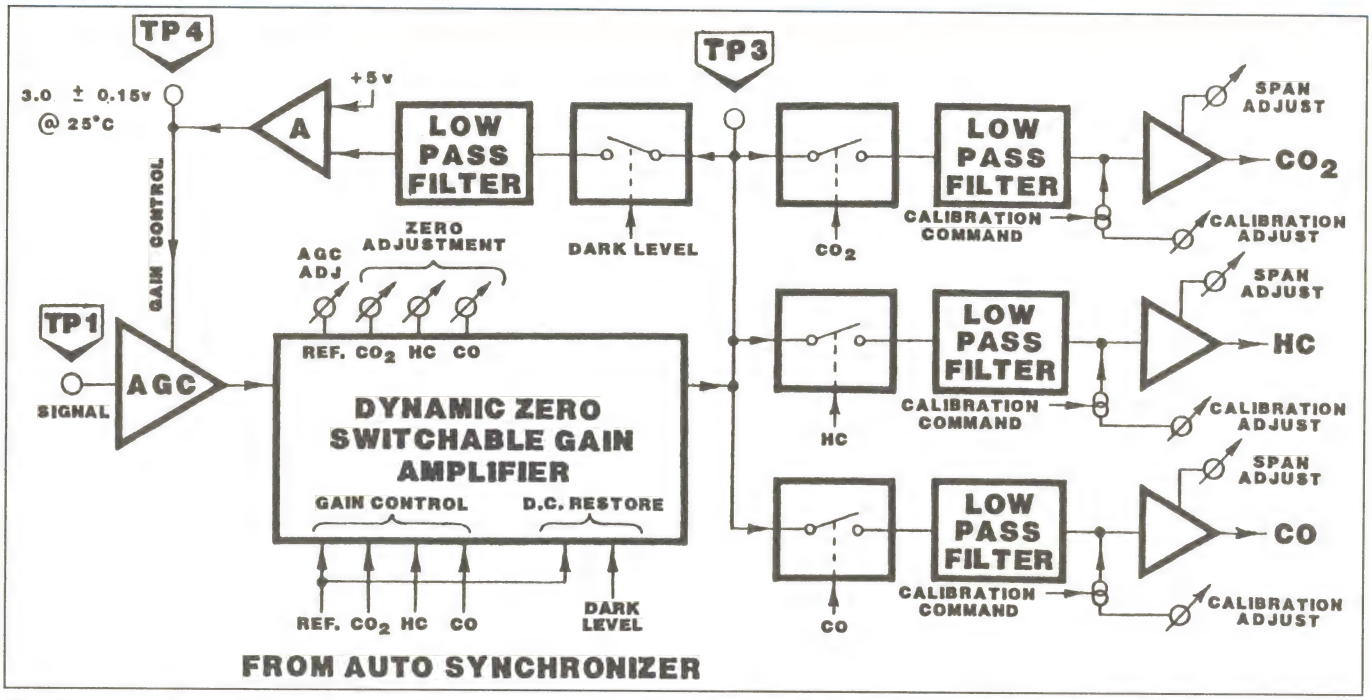


Fig.4 (above): A block diagram of the signal demodulator, where the TP1 signal is gated to separate the various gas signals.

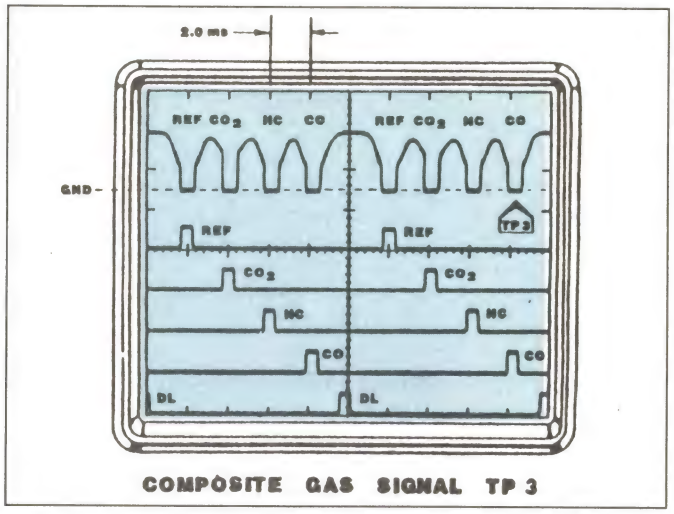


Fig.5: The output of the dynamic gain switchable amplifier, without an exhaust gas sample in the bench.

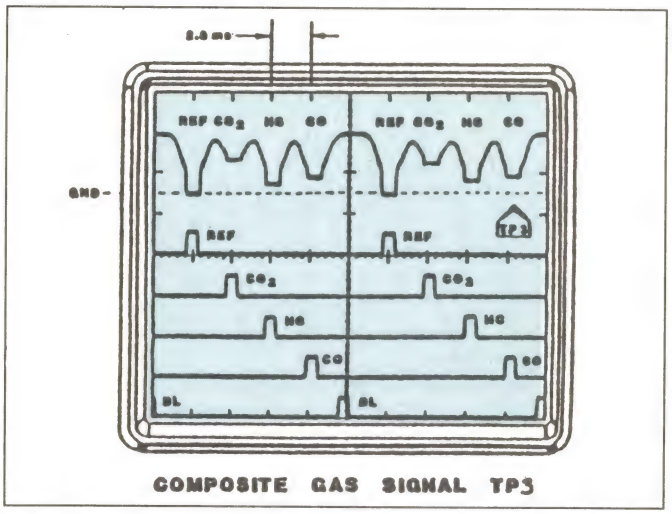


Fig.6: When an exhaust sample is present, the gas pulses deviate upwards from the reference pulse zero level.

also determines the sampling length of the TP1 pulses, because of its AND logic function with the Counter Decoder in the Gate block.

Finally the Clock Generator triggers the Dark Level Pulse Synthesiser, which is held in 'reset' mode until the CO portion of the Counter Decoder goes high. Then follows the output of the Clock Generator switching from high to low, firing off the Dark Level Pulse Synthesiser which in turn retriggers the Clock Generator high to low.

This sequence then increments the Counter Decoder into the Dark Level state. 500us later the Missing Pulse Detector resets the Counter Decoder to '0' and the whole process repeats itself at a rate of 95Hz.

Signal demodulator

The second path the TP1 signal follows is that of the Demodulator circuit, which must resolve the amplitude of the three gas concentrations. Fig.4 shows a block diagram of the Signal Demodulator, comprising three main signal paths: the Automatic Gain Control (AGC) stage, synchronised to the Dark Level pulse; a Dynamic Zero Switchable Gain Amplifier, that is switched by the signals from the Auto Synchroniser; and a Demodulator circuit to provide our three analog outputs.

Let's assume for the moment that the AGC stage is a linear amplifier with a fixed gain.

The Dynamic Zero Switchable Gain Amplifier has five different gains, controlled by the Auto Synchroniser (Fig.4). The Dark Level is the lowest and is a fundamental circuit parameter. The Reference gain (AGC) is factory set to (+3.0 +/-0.15)V at 25°C and sealed.

There are three other gain adjustment

pots on the processor, for coarse 'zero' adjustments; these are not usually changed in service but remain at their factory setting. The exhaust analyser has its own set of remote calibration pots to align the zero gas and span gas settings as well as electronic compensation; these can be adjusted by the operator.

The output of the Dynamic Zero Switchable Gain Amplifier is the TP3 signal (Fig.5). Without any exhaust sample in the bench, each of the 'dips' in the TP3 signal is equal to the Reference signal — remember that this lens is not affected by exhaust gas. However when exhaust gas enters the bench, each TP1 gas pulse responds proportionally to the presence of the various gas concentrations. At the TP3 test point we observe the Reference pulse remaining fixed and the gas pulses deviating upwards away from zero (Fig.6).

Getting back to the AGC amplifier, the amplification factor is in fact inversely proportional to the gain control voltage at TP4, so the feedback circuit between TP3 and TP4 compensates for variations within the instrument. With further conditioning by a low-pass filter to smooth the pulses, the DC output is ready for the final linear amplification and conversion to whatever style of display the individual manufacturers desire.

Conclusion

The superiority of the Andros design is in its simplicity. Because it uses only one IR source, sample cell and detector, major processing and cost problems are eliminated. Some competing designs have separate cell assemblies for each gas, with multiple light paths and detectors.

The Andros 256B optical bench has evolved through various revisions and is still available as the 257E, although newer models have taken over pride of place as the 'flagships' of the range. There must be hundreds of these analysers in Australia alone, but the instrument techs who service them are a somewhat exclusive group, having to possess a working knowledge of things automotive as well as a fairly comprehensive understanding of electronics.

In future articles we will look at one of the newer engine analysers, and how the PC-based oscilloscope is changing the face of diagnostic troubleshooting. ❖

HI-FI: AN INTRODUCTION

We've just produced an updated version of Neville Williams' very popular book, in response to many requests. You should find it now at your nearest newsagent, priced at only $4.95.

PC-based PLC

Continued from page 99

own power supply, it would not be wise to use the same source of power to operate devices via the relay contacts. You should use a separate external source for this purpose. The unused parallel port connections marked Z1 to Z4 in Fig.1 are four additional outputs which can be accessed via LPT1 port address 37AH (890 decimal). Additionally, D8 is an unused output available via LPT1 port address 378H (888 decimal).

A copy of the printed circuit board is provided for individual constructors to make their own personal boards. I am retaining commercial copyright on the board design and it must not be reproduced for any other purposes other than outlined above. As mentioned in the beginning, the uses of such a card are virtually endless. Perhaps we can start a data file of ideas from other readers on the imaginative uses they have found for such a device. ❖

NEW KITS FOR EA PROJECTS

We have received the following information from Jaycar Electronics regarding their release of kits for recently published *Electronics Australia* construction projects:

Active Crossover for Subwoofers (September 1994): Jaycar is providing two different kits for this project, a full kit (KA-1764) and a short-form version (KA-1765). The full kit includes all parts including MKT capacitors and 1% metal film resistors; case with pre-punched and silk-screened front panel; and mains transformer. The kit includes a modified front panel, with the RCA connectors now mounted on the rear panel. This kit is priced at $69.95. The short-form kit includes the PCB plus all minor electronic parts, but no case, panels or transformer; it is priced at $29.95.

In-A-Flash Cable Checker (November 1994): The Jaycar kit is complete, as described in our article, and includes 1% metal film resistors and a front-panel label. Designated KA-1766, it is priced at $22.95.

Dick Smith Electronics has also advised us of its release of the following kits for recent *Electronics Australia* construction projects:

Wideband Noise Source (August 1994): The DSE kit is complete, with all parts as described plus additional material to provide PCB shielding for improved stability and reduced pickup of external signals. Full details of the recommended shielding are supplied with the kit. Designated K-7622, the kit is priced at $34.95.

Active Crossover for Subwoofers (September 1994): The DSE kit is of the short-form type, and includes the PCB and all electronic parts but no case or transformer. Designated K-5404, it is priced at $29.95.

In-A-Flash Cable Checker (November 1994): The DSE kit is complete and includes all parts as described, including box, cable connectors and front panel label. Designated K-7230, it is priced at $18.95.

NOTE: This information is published in good faith, from information supplied by the firm or firms concerned and as a service to readers. Electronics Australia cannot accept responsibility for errors or omissions.

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World Vision of Australia, ACN 004 778 081. Australia's largest overseas aid agency, is a Christian humanitarian organisation reaching out to a hurting world. P22A

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All Altronics products are subject to our in house Quality Assurance (QA) program.

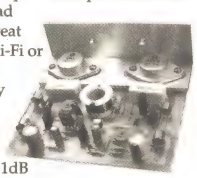
This is especially important for you our valued customer when buying from us via phone or mail order. We guarantee you will be pleased with the goods we ship you or we'll refund your money in full*; or if a fault or problem ever develops you can be assured of our prompt attention.

Regards Jack O'Donnell

* Less transportation costs. Returns must include all packaging.

50W Mosfet Amp Module Kit

This great module features moderate power output at low harmonic distortion. Simple to build and compact in size this unit makes a great replacement module for your old Hi-Fi or buy two and make your own stereo amplifier. Requires ±50V DC supply



Specifications:
Power Output: .....50W into 8Ω
64W into 4Ω
Freq. Response:.....25Hz-20kHz,±1dB
Input Sensitivity: .....1V RMS
Input Impedance:.....47kΩ
T.H.D.:.....0.05%

Ultra Compact Design!

K 5115 **$54.95**

Auto Power Switch Master/Slave Kit

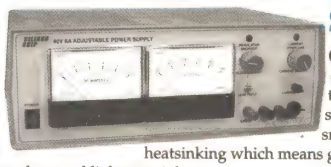
(See EA Jan '92) This unit has a 240V AC mains input and 2 240V AC outputs. The second output is automatically switched on when the first output draws current. For example, plug in your amplifier to the first output and your CD player, tuner and tape deck etc into the second output and each time you turn on the amp all the others automatically power up. Also great for computers and printers etc. etc.



K 6070 Normally $59.95

This Month Only **$49.95**

Adjustable 0-45V, 8 Amp Bench Power Supply Kit



(See SC Jan/Feb '92) Using state of the art circuitry this supply will be a great asset to the enthusiast and professional alike. It uses switch mode principles which allows for smaller transformers, and heatsinking which means greater efficiency, less heat and lighter weight.

Features: •Variable output •Variable current limit •Separate Earth Terminal •Individual Volt and Amp Meters •Constant 13.8V setting •Short circuit proof

Massive 8 Amp Capability!

K 3360 **$399.00**

Noise & Distortion Meter Kit

(EA May/June '93)
A commercial noise and distortion meter would probably cost three to five times our kit price. It delivers performance at a budget price. Measures distortion levels down to less than 0.01 % at spot frequencies of 100Hz, 1kHz and 10kHz as well as providing a built-in low distortion oscillator and AC milli-voltmeter.



Why Pay $$$$ for a Commercial Unit??

K 2542 Normally $129.00, **This Month Only $99**

Digital High Performance Signal Generator Kit



(SC July '90) This Digital Sine-Square Wave Generator uses high speed CMOS ICs and a digital filter IC to produce sine and square waves over the frequency range from 0.1Hz to 500kHz. It also features a 4-digit frequency readout and an output level control.

Ideal for Audio Experimenting and Servicing!

K 2547 **$155.00**

4-Digit Capacitance Meter Kit

(See SC May '90) This attractive 4-digit capacitance meter is designed for the workshop or laboratory. It can measure capacitance from 1pF up to 9999µF in seven ranges with an accuracy of better than ±1%. An over-range LED flashes whenever the capacitance value is too large for the range selected.



K 2524 **$119.95**

DiscoLite Chaser & Colour Organ Kit



(See SC July/Aug '88) The Discolite flashes party lights on and off in beat with music from your amplifier.

Features: • 4 light channels controlled by 4 separate audio channels • Forward reverse and auto-reversing chaser patterns • Simultaneous strobe on all four channels • Alternating light patterns • Music modulation available on chaser strobe and alternate patterns • Inbuilt microphone or direct inputs for beat triggering or audio modulation of lights • Sensitivity control • Individually pre-settable sensitivity levels for each channel • Front panel LEDs mimic light display • Altronics Kit pre-punched and silk screened

K 5805 **$159.50**

Gell Cell Charger

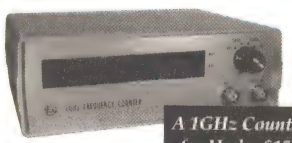


(See SC July '89) Charging current 300mA. Includes red and black colour coded spade terminals for easy connection to most gel cell batteries. A dedicated IC monitors the charge and intelligently varies the rate accordingly. Available for 6 and 12 volt gell cell batteries.

K 1685 12 Volt Version **$26.50**

K 1686 6 Volt Version **$26.50**

1 Ghz Frequency Counter Kit



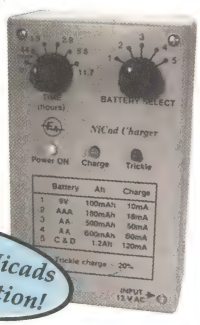
A 1GHz Counter for Under $150

(See EA April '93) This amazing high performance 1GHz frequency meter features an incredibly accurate 7 digit LED display, 2 BNC inputs 0-50MHz and 50MHz-1GHz) and 4input ranges (2MHz, 20MHz, 50MHz and 1GHz). An absolute must for the serious hobbyist and technician.

K 2517 **$145.00**

Automatic Charger Kit for NiCads

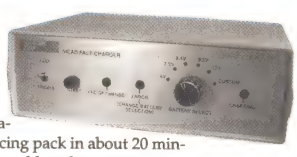
(EA July '89) Get 100's more recharge cycles from your nicads. It's now well known that correctly charging nicad cells greatly extends their service life.
Here is a fully automatic NiCad battery charger that enables differing charge rates as appropriate for AAA, AA, C, D or 9V cells. Once the battery is charged, the unit automatically switches to trickle charge until you switch it off. It is fully featured, yet surprisingly simple. Requires 12V AC Plug Pack.
Features:
- Fully punched and screened case
- Variable charge rate
- Variable timer
- Flexible and simple to use
- Visual display of charge mode
- Nicads cannot be over charged



Keeps Your Nicads in Top Condition!

K 1650 **$39.50**

High Capacity Fast Charger for Nicad Batteries Kit



(See SC Jan '91) This charger is designed to operate from a 12V battery. It can charge 6V to 12V nicad battery packs at up to 6A, or you can custom wire the unit to charge battery packs up to 30V at a reduced current. In operation the circuit will recharge a typical nicad racing pack in about 20 minutes. **Features:** • Fast charge rate • Switch selectable voltage setting in 1.2V steps from 6-12V • Fully punched and screened front panel • State of the art digital circuitry

K 1660 Normally $129.00,

This Month Only **$99.00**

FREECALL 1-800 999 007 PERTH (09) 328 1599

Doc.JH027

24 Range Digital Multimeter



With Frequency Measurement and Capacitance Meter.
Includes frequency and capacitance ranges. With the addition of a built in logic probe and screen hold button it would have to one of the most useful DMM's available today.

This Month Receive a Free Carry Case & Protective Holster Valued at Over $28.00

Q 1035 **$169.00**

Auto Ranging 3.75 Digit Digital Multimeter



Triple LCD Display Includes 2 Digital & 1 Bar Graph.
This incredible multimeter would have to be one of the most comprehensive on the market today. It is capable of doing all the normal voltage, current and resistance readings, as well as capacitance, frequency, minimum and maximum sampling, relating measurements, storing previous readings, limit setting, signal transistor gain checking and is full auto-ranging.

This Month Receive a Free Carry Case & Protective Holster Valued at Over $28.00

Q 1038 **$199.00**

19 Range Digital Multimeter

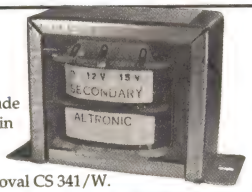


After evaluating 30 or more meters of this calibre we found the Q 1053 to be the best value for money by far!
This 3.5 digit multimeter features a 19 position, easy to use rotary switch for function and range position. Includes AC/DC voltage check, 10A DC current, resistance, diode and a transistor test function. This meter offers many of the features of much more expensive models but at the fraction of the cost.
Ideal for the cash strapped student, or budding enthusiast!

Amazing Meter for Under $30!

Q 1053 Normally $39.95,
This Month Only $29.95

General Purpose Mains Transformers



These transformers have been designed to give a multitude of outputs by either connecting the secondary windings in series or parallel. All models have flying leads 175mm long and all secondary taps are solder tags. Approved to Australian Standard AS 3108. Energy Authority approval CS 341/W.

Ideal for High Current Power Supplies etc!

60VA Type
M 2165 **$26.50**
Output voltages & currents available

Voltage	Current
9V	6.6A
12V	5A
15V	4A
18V	3.3A
21V	2.9A
24V	2.5A

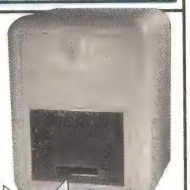
100VA Type M 2170 $29.95
Output voltages & currents available

Voltage	Current	Voltage	Current
12V	8.3A	27V	3.7A
15V	6.6A	30V	3.3A
24V	4.2A		

120VA Type M 2175 $42.50
Output voltages & currents available

Voltage	Current	Voltage	Current
12V	10A	27V	4.4A
15V	8A	30V	4A
24V	5A		

Plug Packs



Our range of adaptors are each fitted with a 1.8M lead, in line socket and M 9014 2.5mm DC connector (different adaptor plugs available as below). Simple polarity setting. All energy authority approved.

Cat. No.	Output Voltage(s)	Max. Current	Normal Price	This Month
M 9002	12V DC	300mA	$15.95	$11.15
M 9004	9V DC	300mA	$15.95	$11.15
M 9005	6, 9, 12V DC	500mA	$22.50	$15.75
M 9022	12V DC	1A	$24.95	$17.45
M 9027	16V AC	1.5A	$29.95	$20.95

30% OFF! Ideal for Those Christmas Toys!

Micron 25 Watt Soldering Iron with De-solder Bulb & Solder

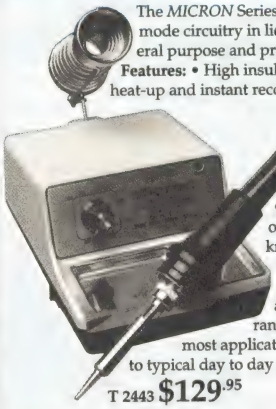


This combo pack makes excellent value for the person starting out. It gives you a lightweight, economical soldering iron witch is suitable for most electronic work including a variety of car and household jobs.

T 2415 **$20.95**
T 2416 Spare Tip to Suit **$2.95**

This Month Includes Bonus T 1245 De-Soldering Bulb & a reel of T 1200 Solder!

Micron Series II Soldering Station



The *MICRON* Series 2 soldering station employs electronic switch mode circuitry in lieu of a mains transformer. Excellent for all general purpose and production soldering.
Features: • High insulation ceramic heating element in both rapid heat-up and instant recovery • Heater insulation of over 100MΩ • A zero voltage circuit ensures no high voltage spikes or magnetic field are present at the tip to damage sensitive components • Continuous temperature adjustable from 250° to 430° C (480° to 800° F) • Grounded power cord Selecting the desired operating temperature is as simple as turning a knob.
Simply choose the operating temperature required for the job and adjust the control to the appropriate setting. With its huge temperature range from 250° to 430° C this iron is suitable for most applications, from delicate double sided PCB's through to typical day to day jobs.

T 2443 **$129.95**

CADIK Professional Gas Iron

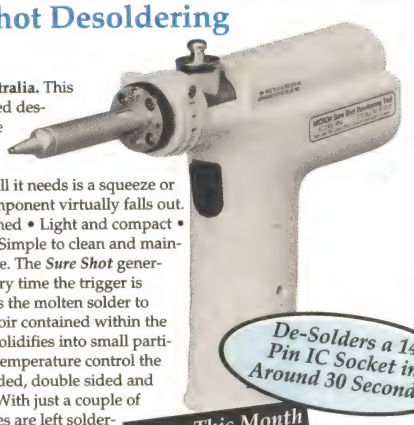


The advanced CADIK Soldering Iron offers a convenience and a range of functions that redefine the limits of soldering.
Features: • See through gas chamber • Built in ignition cap • Uses standard butane gas • Comes with safety bench stand • Supplied with bonus blow torch tip, bench stand and replacement lighter flints
With a sleek, pen like design and self-contained butane power it is easily carried and ready for use anywhere. One single refill of the iron's gas reservoir (from a standard butane refill can) allows up to 60 minutes of continuous use with temperatures ranging from 400°C to 1300°C.

Only $39.95

T 2500 **$39.95**

Micron Sure Shot Desoldering Tool Mark II



Exclusive to Altronics in Australia. This stand alone, fully self-contained desoldering tool makes it a breeze to remove components from any PCB. Even double sided, through hole plated boards. All it needs is a squeeze or two on the trigger and the component virtually falls out.
Features: • Totally self contained • Light and compact • Anti static tip • Easy to use • Simple to clean and maintain • Variable tip temperature. The ***Sure Shot*** generates a high speed vacuum every time the trigger is squeezed. This vacuum causes the molten solder to flow into the collection reservoir contained within the unit. Here the molten solder solidifies into small particles. With its inbuilt variable temperature control the ***Sure Shot*** is ideal for single sided, double sided and through hole plated P.C.B.'s. With just a couple of squeezes of the trigger all holes are left solder-free for easy removal of the component.

De-Solders a 14 Pin IC Socket in Around 30 Seconds!

T 1280 **$349.00**
T 1282 1.0mm Replacement Tip to Suit **$34.95**
T 1283 1.6mm Replacement Tip to Suit **$34.95**

Bonus This Month Receive a T 2490 CADIK Gas Blow Torch That's $29.95 Value for Free!

Bench Stand to Suit
T 1274
$24.95



CADIK Micro Jet Gas Blow Torch
Powered by a common disposable type gas lighter (not supplied), this unique blow torch burns at 1300°C, making it ideal for all types of braising and heavy duty soldering.



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Wireless Diversity Microphone Systems

These professional wireless microphone systems are as used by the industry for stage and studio productions. Featuring stylish good looks and the latest microchip technology they offer outstanding performance and sound reproduction both for voice and instrumental applications. True Diversity Reception means two receivers with separate antennae are employed. An on-board microchip monitors the signal strength and reception fidelity of either A or B receiver and automatically outputs the highest quality signal. Each system includes a receiver unit and a hand held microphone. The receiver operates from 240V AC and simply connects to an amplifier with a line level input. The microphone requires a 9V battery (not supplied).





Two Frequencies Available:
System 1 - 202.5MHz
System 2 - 202.9MHz
Each System Normally

As Used by Professionals for Stage and Studio Productions

$744.00, This Month Only **$544** Complete System

Chassis Mount Panel Meters

Available in 3 physical sizes and a range of ranges. All include mounting nuts, washers and chassis cutout template.

Dimensions:
MU45 Size: 58W x 52H mm Overall.
MU52 Size: 80W x 66H mm Overall.
MU65 Size: 100W x 82H mm Overall.

Cat. No.		Scale	Normally	This Month
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Q 0505	MU45	50µA	$19.95	$13.95
Q 0506	MU45	100µA	$19.95	$13.95
Q 0508	MU45	1A	$19.95	$13.95
Q 0510	MU45	5A	$19.95	$13.95
Q 0515	MU45	10A	$19.95	$13.95
Q 0525	MU45	30V	$19.95	$13.95
Q 0528	MU45	VU	$19.95	$13.95
Q 0530	MU52	1mA	$21.95	$15.35
Q 0533	MU52	5A	$21.95	$15.35
Q 0535	MU52	30V	$21.95	$15.35
Q 0538	MU52	50V	$21.95	$15.35
Q 0540	MU65	1mA	$24.95	$17.45
Q 0550	MU65	100µA	$24.95	$17.45



High-Tech Remote Car Alarm



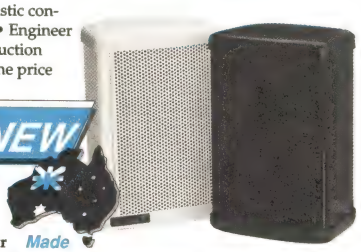
This amazing model features just about everything you could imagine! Multi-function keyring remote control will arm and disarm alarm (and activate central locking if fitted), chirp the horn, turn on the car headlights, panic and even open the boot (if actuator fitted). One remote can control two alarms (in two cars). Other features include starter inhibit, valet mode, central locking interface, flashes car indicators when tripped, auto reset, user programmable options plus much more.

S 5230 **$249.00**

30 Watt Weather Proof Sound Monitors

Ideal for Hi-Fi extension, surround sound or outdoor use.

Features: • Rugged 'Luran S' Thermoplastic construction • Superb black or white finish • Engineer designed in Australia • Excellent reproduction • Superior to imports - yet a fraction of the price • All exterior fixings marine grade stainless steel • Speaker cones treated with special formula to repel moisture



8 ohm 30 Watt
C 0904 White
C 0905 Black

$105.00 each or **$199.00** per pair

4 Channel Economy Mixer

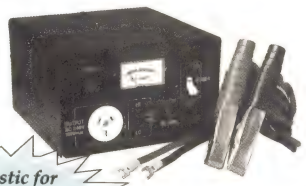
This compact mixer has inputs suitable for microphone, record players, camera audio, CD, Tape, and Tuner etc. Ideal for amateur cinematographers who would like to add their own background music and/or voice overs. Includes inputs for microphone, phono (with magnetic or ceramic cartridge), camera audio and an auxiliary (CD, tape, tuner etc). Features headphone output and master volume control. Requires 9V DC 300mA plug pack.



A 2520 **$119.00**

300 Watt Inverter

This nifty inverter converts 12 Volts DC to 240 Volts AC. Includes an on/off switch and a light & heavy load switch with metered output. Works well with most electrical equipment. Includes heavy duty battery leads to connect directly to your battery.



M 8120 NORMALLY $225.00

This Month Only **$199.00**

Fantastic for Farming, Boating, Camping etc.

Mini Ball-Nose Pliers



Strong serrated jaws. Suitable for holding and griping. Also features flush cutters for cutting larger components. Spring loaded insulated handles.

T 2797 Normally $8.95,

This Month Only **$7**

Relays

These high quality relays can be used with or without cradle socket. Limited stock. Buy now and save! Not available from Altronic Resellers.

Relays Normally $9.95,

This Month Only **$4.95**



S 4220 12V DPDT Relay
S 4225 24V DPDT Relay
S 4235 24V 4PDT Relay

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Standard Delivery & Packing Charge: $4.00 to 500gms, $5.50 500gms-1 kg, $8.00 1kg-5kg. Where possible we process your order the day received and despatch via Australia Post. Allow approx 9 days from day you post order to when you receive goods.

Overnight Jetservice: Up to 3kg is $10.00, 3kg to 5kg is $18.00—We will process your order the day received (if placed before 2.00PM WST) and despatched for delivery the next day. Country areas please allow an additional 24-48 hours.

Heavy Service: All orders of 10kgs or more must travel Express Road—Please allow up to 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs.

Insurance: As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance".

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WOLLONGONG	Newtek Electronics ●	(042) 271620
	Vimcom Electronics	(042) 284400

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Doc.JH027

Construction Project:

Intelligent Solar Battery Charger - 1

This project lets you charge a lead-acid battery from a solar panel, or in fact from any external DC source, at currents up to 16A. It's fully automatic, has an informative LED status indicator and can charge a flat battery. But best of all, a kit only costs around $27...

by PETER PHILLIPS and CONRAD MARDER

Charging a lead-acid battery from a solar panel, or any DC source for that matter, is not so straightforward if you can't regularly monitor the battery's state of charge.

These days, with solar panel prices dropping, there's an increasing number of boaties, campers and many others who use a solar panel to at least maintain the charge on a lead-acid battery. But unless the panel is of very low power, some form of regulation is essential to prevent the battery being overcharged. Overcharging a lead-acid battery causes gassing, which can significantly reduce its life.

And what about charging a lead-acid battery from a mains-derived DC supply? Unless you keep a close eye on the charge of the battery, it's again quite easy to overcharge it. So obviously a circuit that regulates the charge current to a lead-acid battery in response to its terminal voltage is a most useful device.

Over recent times *EA* has published designs for a whole raft of battery chargers, but as readers have recently reminded us, the last time we did a 'better than basic' lead-acid battery charger was sometime in 1971. So this project is somewhat overdue. But before we describe it, first a quick look at some battery charger regulation topologies.

Charging regulators

There are a number of current regulator configurations, which boil down to either a shunt or series topology. The shunt regulator is connected in parallel with the battery, and excess power is dissipated in a transistor or MOSFET. This system can be very efficient, but is really only suitable for small solar panels or a low power DC source.

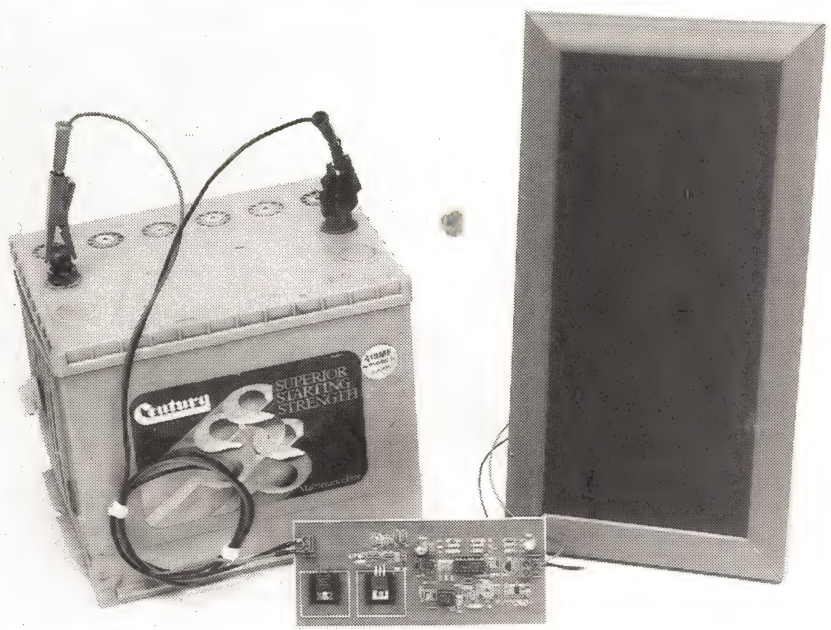
Also, if the battery is charged from a high power source like the charging system of a car or an external DC source, the regulator circuit can be overloaded and possibly destroyed.

Series regulators include both linear and switching types. The linear regulator wastes power, which is important if the power source is a solar panel. A switch-mode regulator is more efficient and converts the DC input voltage to a suitable voltage for charging a battery.

Regulation is by varying the switching duty cycle. However, this arrangement is still not efficient enough for a solar powered battery charger.

A better system is the switching regulator, which unlike the switch mode system, switches the power source on and off as required. This is a very efficient method and can be used with alternative charging methods. The operation of the switching regulator is shown in Fig.1, in which the regulator keeps the battery voltage within a defined voltage window. During time t_1 the battery is being charged. During time t_2, when the battery voltage has reached the upper limit (V_{UL}), the charging source is disconnected from the battery, to stop overcharging. When the battery voltage falls to the lower limit (V_{LL}), the source is reconnected to the battery and charging continues.

The length of t_2 depends on the state of charge of the battery. As the battery charges, t_2 becomes increasingly longer, because the charging current required by the battery reduces. However, if the charge source (solar panel in particular) can't provide as much cur-



A solar panel, or an external DC source, and this battery charge regulator are all you need for a high current, high efficiency, totally automatic 12/24V lead-acid battery charger.

Intelligent Solar Battery Charger - 1

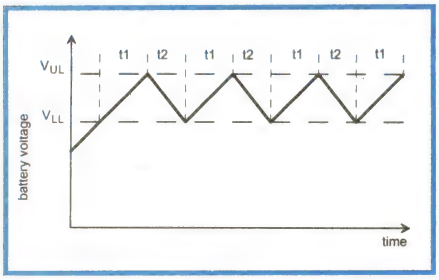


Fig.1: A switching regulator connects the charging source to the battery during time t1, and disconnects it when the battery voltage reaches Vul. During time t2, the battery voltage falls. When it reaches Vll, the charging source is connected to the battery again.

rent as the battery needs to charge, then VUL is never reached.

This regulator

So, as you might have guessed, the operation of this project is based on the switching topology just described. The main reason is to get a high efficiency, so the regulator can be used with a solar panel. As it turns out, the efficiency of the circuit is around 98%, which means the series regulating element (a power MOSFET) dissipates so little heat that even at high charge currents, only a small heatsink is needed.

Another important feature is the amount of power needed by the regulator circuit itself. Because we wanted the unit to be able to charge a flat battery from a solar panel, the panel rather than the battery must power the regulator circuit. By using MOS circuitry, the quiescent current and hence the power consumption of the regulator is virtually zero.

Another feature of the design is the LED status indicator. When a battery is charging, the LED flashes. When the battery is fully charged, and therefore receiving no current, the LED remains on. In practice, for a charged battery, the LED cycles between flashing and fully-on modes, indicating the battery is being 'topped up' to keep it fully charged.

This means you can connect a battery to the charger and forget about it. Leave it for weeks at a time if necessary, as it can't overcharge. It will work with 12-24V gel cells or standard lead-acid batteries as used in cars, trucks and boats. The regulator can handle up to 16A, determined by the rating of the Schottky diode, so this charger is not just for small batteries.

Before we say more, here's a look at some characteristics of a solar panel, as this project is designed to work with a 12V or 24V solar panel.

Solar panels

A solar panel is given various ratings, but the useful ones are its voltage and power. The rated voltage of a solar panel is not its open-circuit voltage however. For example, a 12V panel

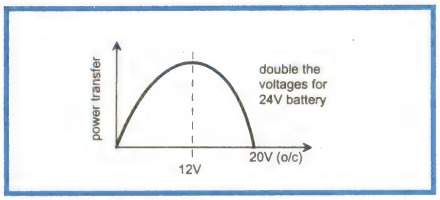


Fig.2: A 12V solar panel delivers maximum power to a load at 12V, but has an open circuit voltage of around 20V.

usually has an open-circuit voltage of between 18V and 23V. But the panel is rated at 12 volts, as this is the voltage at which it transfers most power. A curve showing this is in Fig.2.

The power output of a solar panel is directly related to its size, and individual panels can be connected in parallel to get increased power. The internal resistance of the panels will ensure equal load sharing.

It's important when using a solar panel as the DC source for a battery charger that the regulator has the highest possible efficiency. After all, you want every last milliwatt to reach the battery, with minimal power lost in the regulator itself. Obviously the highest efficiency occurs when the panel is directly connected to the battery, but then you have no protection against overcharging the battery.

In Australia, over a yearly average, there are about five hours of useful sunshine each day. This takes into account the seasons, and those days when there's no sun. So obviously

Using a solar panel

Before being put to work, there are two things to be done with a typical solar panel: connect wires to it and seal it against moisture. Oatley Electronics supply the necessary parts with their solar panels to do this. The procedure is as follows.

Solder a length of red wire to a piece of copper shim measuring about 15 x 40mm. Do this also with a length of black wire. Lay the pieces of copper on the active (coated) side of the panel, one either side (see photograph in Fig.7).

Use a voltmeter to determine the polarity of the output voltage, and arrange the wires so the red wire is the positive lead. Clip the copper strips in place with the clips.

Supplied with the kit will be a sheet of backing glass cut slightly larger than the solar panel. First of all wipe the glass with methylated spirits to remove any oil and grease from the glass.

Then lay the solar panel on the glass, with its active side towards the glass. Now run a bead of silicone glue around the edge of the panel, so the bead forms a complete seal between the panel and the glass.

The idea is to prevent any moisture getting in and contacting the active side of the panel, as this will destroy it.

Also cover the topside of the clips with a thin layer of silicone glue, again to stop moisture tracking to the active surface via the clips.

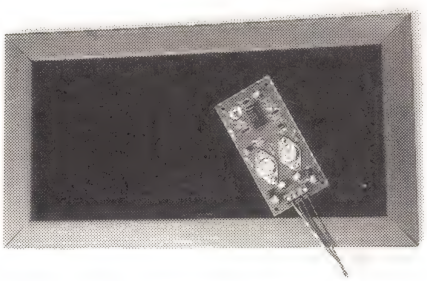


Fig.7: This photo shows the solar panel of Fig.6 with a plastic frame around it to protect the edges, and to improve its appearance. The frame is held in place with silicone glue. The PCB on the panel is the revised solar charger described separately in this article.

To prevent the glass sliding from the panel when the assembly is mounted vertically, it's a good idea to glue the corners of the panel to the glass with a dob of epoxy glue.

Although not essential, to make the panel look the part, buy some plastic angle strip from a hardware shop and use it to form a frame around the assembly. The panel in Fig.8 shows the idea.

Obtaining the kits

Kits of parts for these projects are available from:
Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Fax (02) 579 3955
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.
PCB and all on-board components for the revised solar charger $13
6V 1.6W solar panel to suit revised solar charger..... $11
Battery charger regulator PCB and all on-board components $27
12V 2.5W solar panel $20, or four for $60, giving a 10W system.
P&P .....$ 6

there's good reason to harness this power and use it to charge a battery, particularly if you don't have access to other forms of electricity.

Design problems

Now that you can see the need for an efficient regulator, it's interesting to look at a particular design problem associated with the MOSFET regulator.

Over the years there have been a number of designs presented in electronics magazines for MOSFET-based solar panel regulators, using the switching topology just described. Incidentally, a MOSFET is preferred to a transistor, because of the negligible power required to control it. However, there's a basic problem in some of the published designs, caused by a characteristic of power switching MOSFETs that some designers are either not aware of, or haven't considered.

The basic circuit configuration for some of these solar panel regulators is shown in Fig.3. But have a closer look at the MOSFET. Notice the diode connected internally between the drain and source terminals of the MOSFET. This diode is present in virtually all power switching MOSFETs, although it's often not shown on schematics.

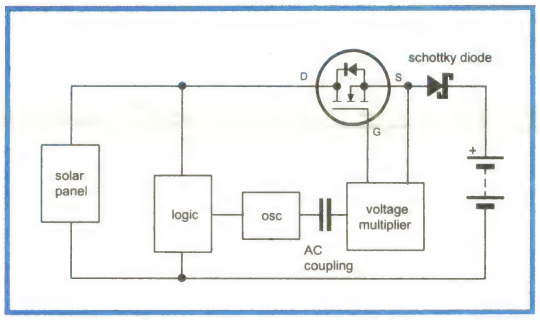
This means that providing the solar panel output voltage is higher by a volt or so than the battery voltage, it doesn't matter whether the MOSFET is 'on' or 'off' — *current is always flowing from the panel to the battery.* That is, the regulator isn't regulating at all!

This internal diode can be an ordinary diode, or it might be an avalanche diode (used to suppress voltage spikes); but apart from audio MOSFETS with a high on-resistance, the diode must be there. Getting around this problem is not easy, as connecting the MOSFET so this can't happen requires a lot of rearranging.

This design

The basic block diagram of our new regulator circuit is shown in Fig.4. It has a logic circuit that allows a high frequency oscillator to either run or stop, depending on the state of charge of the battery. The oscillator supplies an AC signal to a voltage multiplier, which generates a sufficiently high 'floating DC bias voltage' to switch on the MOSFET.

The circuit arrangement is quite different to that of Fig.3, and as you can see, the Schottky diode and the internal diode of the MOSFET are now facing in opposite directions. The regulator can now truly reduce the charging current to zero.



This is the basic block diagram of the project. The internal diode of the MOSFET is now in the opposite direction to the Schottky diode, allowing the battery charge current to be reduced to zero.

There are other advantages as well. The logic circuitry is now powered from the DC charging source (solar panel), not the battery. The main advantage of this is the regulator can be used to charge a totally flat battery. As well, the battery is not discharging into the regulator circuit when, for example, there's no sunlight on the solar panel used with the charger.

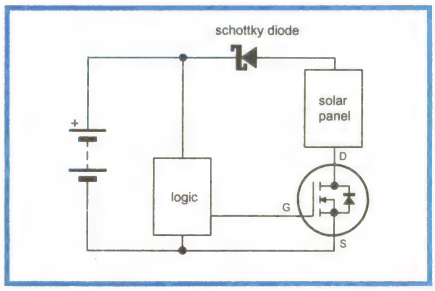


Fig.3: This is the basic circuit of many solar panel current regulators. However, the internal diode across the MOSFET means current from the solar panel to the battery is always flowing, even when the MOSFET is switched off by the logic circuit.

However, the regulator circuit needs a voltage to operate, and if a flat battery is being charged by a solar cell, the output of the solar cell might drop to a point that won't allow the MOSFET to switch properly. This could cause the MOSFET to overheat and fail, particularly with a large solar panel.

Therefore, the circuit has to include protection against a low input voltage. This is not shown in the block diagram, but it is part of the circuit, as you'll read when we present part 2. ❖

Revised solar charger

In February 1992, we presented the design for a DC-DC converter for charging various kinds of batteries from a 6V solar panel. Since then, the designers (Oatley Electronics) have done a few revisions and have produced a professional quality PCB for this project.

The main changes, apart from the PCB design, are component values. The original circuit is shown page 73, February 1992 and the changes are: R1 = 470k, R3 and R4 = 6.8k, R10 and R11 = 470, IC1 = 74C14 (not 74HC14). The PCB design has wider tracks for the main current path. Fig.5 shows a photo of the new design.

Note that this circuit is not a regulator, in that it won't prevent a battery overcharging. However, when used with the recommended solar panel, overcharging won't occur because of the limited output of the panel. But importantly, it allows a 12V battery to be charged from a 6V solar panel, and maintains the charge current even when there's limited sunlight.

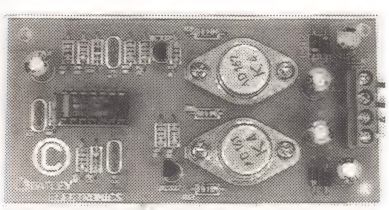


Fig.5

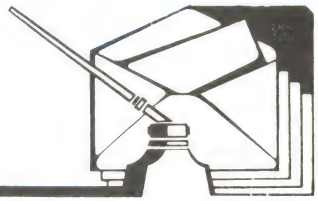
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Information centre



Conducted by Peter Phillips

Associations, blue light, EPROMs and more

Among many things this month, there's a suggested modification to our 1GHz frequency counter, an enquiry related to hydroponics and discussion on the eye's response to different colours. There's also the usual range of questions, suggestions and comments.

In August, I included a letter from a reader seeking information about electronic industry associations he could join. While my coverage of the available associations has since been described as 'pretty accurate', I am pleased to have received more details about ESIA, an organisation I mentioned in my reply. I wasn't sure of the role ESIA plays in the industry, so it's good to be able to set the record straight.

The following details have been sent to me by the Administration Manager of ESIA, and as I said in August, I welcome similar information from other associations to include here.

I am taking the opportunity to write to you and respond to comments made in the August issue of Electronics Australia with regard to associations. The services offered to ESIA members cover many areas not previously undertaken by any industry group. To be brief, I will list only the salient points, which include:

Assistance to technicians setting up a business in the electronics field, and access to a variety of information, including technical data and service manuals. There's also access to accountancy services, industry consultants and manufacturers.

ESIA forms industry working parties to cater for specific needs, such as the Antenna Industry and Pay TV. This includes liaison with government and private training institutions. An award and wage rate service is provided for employers, Trade Nights are held at required intervals and we publish a quarterly Member Information Service.

As well, ESIA is represented on the Standards Australia Committee, the Electrical and Electronic Industry Training Committee and the Department of Consumer Affairs Code Management Committee. Where appropriate, ESIA representatives attend all government and trade seminars so members benefit from 'up to the minute' information.

ESIA liaises with all government departments, it has set up the Domestic Electronic Services Advisory Council for industry and consumer use. It has also set up a (documented) Dispute Resolution Service and provides inspection services for dispute resolution. ESIA has also set up its own training organisation called the Electronics Training Corporation (ETTC).

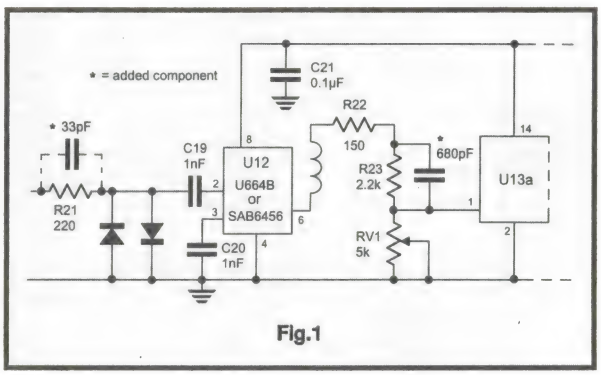


Fig.1

Readers are invited to contact our office by phoning (02) 876 5688 or fax (02) 868 2810 during office hours. Brochures covering the Association's activities will be posted free of charge. Membership is available in all states of Australia and some overseas countries.

The registered office is at 9 Crystal Street, Petersham. 2049. Postal address PO Box 154, Carlingford, 2118. (Ray White, ESIA Administration Manager.)

Thanks for this information, Ray. I'm glad to be able to include details of what appears to be a rather dynamic association. Now to some technical stuff...

Mod to 1GHz counter

The following letter offers a modification to our April '93 1GHz frequency counter:

After completing the 1GHz frequency counter from a DSE kit, I discovered that the display continually read about 1330MHz when the 1GHz range was selected, and the buffer stage was adjusted for best operation.

This appears to be because the SAB6456 prescaler supplied in the kit oscillates when no input signal is applied. Preferring to see all zeros with no input, I set about developing the following modification (see Fig.1) which involves removing (!) the buffer transistor Q4 and using its bias network to set the required DC input level to the following divider IC U13a.

The 5k trim pot can be set to give a 1330MHz reading as before, or by offsetting it a little, a reading of all zeros can be obtained. In this condition all frequencies up to at least 900MHz (mobile phones) are read normally. Also, since only passive components are used, the adjustment is essentially drift free.

If more sensitivity is needed at frequencies above about 100MHz, add a 33pF capacitor across R21. With only an 85mm long aerial connected to input B, the output of a mobile phone is registered on the counter from five metres away! (Phil Allison, Summer Hill, NSW.)

The prototype used a U664B prescaler, and we had none of these problems. However, this doesn't seem to be the case with the SAB6456 device, so thank you Phil for sending us this information. The original circuit for the counter is on page 59, April 1993.

Divide by 50 IC

In August, a reader wanted information about a divide-by-50 IC for a digital clock. Well, here's that information, sent by a reader...

I read your column in the magazine with interest each month and am prompted to offer the following information in response to a request from L.T., Shelley, WA for information on a divide-by- 50 IC. Such a device does exist in the form of an MC14566B from Motorola, and maybe others as well.

It's referred to as an industrial timebase generator, which divides by 5, 6, 10, 50 or 60 with BCD output. It's available from Altronics, Farnell, RS Components and probably others as well. (K.G., One Tree Hill, SA.)

From the data sheet sent to me by K.G., Motorola describe the IC as 'consisting of a divide-by-10 ripple counter and a divide-by-5 or a divide-by-6 counter to permit stable time generation from a 50 or a 60Hz line. By cascading the device as a divide-by-60 counter, seconds and minutes can be counted and are available in BCD format at the circuit outputs.

An internal monostable multivibrator is included whose output can be used as a reset or clock pulse, providing additional frequency flexibility. A pin has been included to allow divide-by-5 counting for generating 1Hz from a 50Hz line.'

So quite clearly, there's the answer. Incidentally, the Altronics 1994 catalog gives a price (each) for the IC of $3.15, so it's cheap as well as versatile. Thanks for this information, K.G.

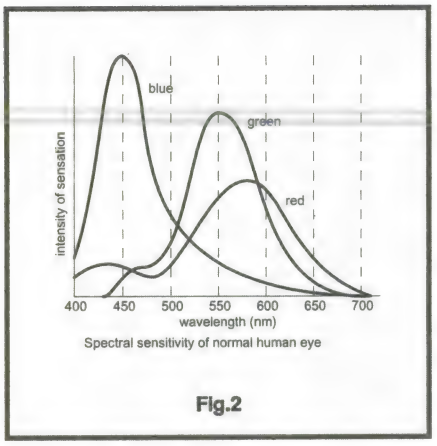
EPROMs and music

The next letter seeks quite a lot of information...

I am 11 years old and in grade 5. I have been doing electronic projects for a year and I'm interested in programming EPROMs. Unfortunately I don't know anything about it. I have checked the local libraries and electronics stores that sell reference books, but I can't find anything about programming EPROMs.

I would like to know how to program songs into an EPROM, what components to use to put the EPROM in a circuit, how much power they need, where their pins connect to, how to get a positive or negative current from the output pins, how much power they give out and what all the EPROM's pins do.

I also want to know how to use an EPROM as a timer (turn on a LED and 10 seconds later turn it off). The EPROM I want to program is type 2732. (Christopher Gunaratnam, Clayton, Vic.)



Spectral sensitivity of normal human eye

Fig.2

I'm always pleased to hear from young readers, and Christopher I think you might be the youngest so far. I'll deal first with your idea to use an EPROM to hold songs. I assume you know that the EPROM simply holds data that controls the rest of a noise-making circuit. So first you need noise-making circuitry that can be driven by the EPROM. Incidentally, an EPROM doesn't produce any power at its output pins, it simply produces a digital voltage, of either 0V or 5V.

A circuit you could use with an EPROM is one I presented in Experimenting With Electronics in the May '94 issue, called a solid-state message recorder. This project is available as a kit and uses a chip-on-board (COB) device that does all the work. The data is recorded in a static RAM, which could be replaced with an EPROM.

Programming an EPROM is not easy, and is usually done with either a dedicated EPROM programmer or a computer-based programming system. We described a PC-controlled EPROM Programmer in the September and October '93 issues. In September 1986 we presented an upgrading for the 1980 EPROM Programmer. There was also a Free Standing EPROM Programmer in January 1982.

As with making music, an EPROM can't be a timer on its own. Instead it needs to work with a microprocessor. A common way to do this is with a microcontroller IC, an IC that has an EPROM combined with a microprocessor. Again we have described quite a few microcontroller projects and development kits such as a Reaction Timer Based on a 68705 Microcontroller in March '94, a PC Programmer for 68705 Microcontrollers in January '94, a Microcontroller Digital Photo Timer in December '93, a complete 68705 Microcomputer in September '93 and an 8051 Microcontroller Prototyping Board in February '93.

Regarding data on the 2732 EPROM, I suggest you contact Altronics, who list quite a few data books for memory ICs. The 2732 device is commonly used and should be included in most data books on memory devices. However Christopher, I don't want to give you the impression that doing all these things is easy. I think you might be aiming a bit high at his stage, unless you have someone to advise you. But there's certainly no harm in reading and getting the information. I wish you every success.

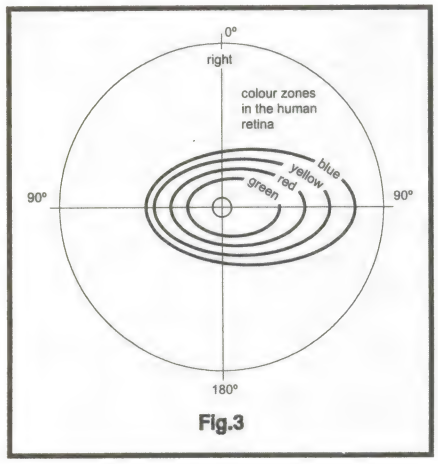


Fig.3

Blue lights

In June I presented a What?? question from a contributor asking why police lights are blue, considering the low sensitivity of the human eye to this colour. The following letter takes us to task on the question and, naturally, provides the answer.

In his What?? question, Mr J. Watson says, 'The response curve of the human eye to colour shows a sensitivity of about 0.3 for blue compared to 1.0 for green.' I believe this statement may be wrong. Please see the spectral sensitivity curve in Fig.2, which is from a psychology text by Stagner and Karwoski, 1952, used for Psychology I and II, Sydney University in the 1960s. Also, see Fig.3 which is the human eye's peripheral vision response to colours.

I've also included a rough drawing of the CIE's Spectrum Locus, an artificial chromaticity diagram. Is it possible that a chart similar to the chromaticity diagram has been quoted by Mr Watson?

If he concluded that the sensitivity of the human eye is based on this artificial chart, then I think this may be a false premise. A chromaticity diagram is useful when designing electronic apparatus which conveys colour information to human eyes. It does not necessarily represent the human eye's response.

While mindful of 'teaching grandma to suck eggs' the following is from psychology: light waves differ in wavelength or frequency, amplitude or intensity and

composition or purity. Variations in frequency give sensations of hue; variations in intensity are experienced as brightness; variations in purity of wave composition are seen as changes in saturation. Attributes of visual sensation then are hue, brightness and saturation. So, all coloured lights, if sufficiently bright, look white. Likewise, with decreasing intensities, colours look darker and approach black.

However, back to the What?? question. Police use blue lights in a number of countries, and a reasoned response to Mr Watson, based on Fig.3, is that human eyes see blue across a wider range of peripheral vision. However, I wonder if this is why blue was chosen anyway. (B.H., Sylvania NSW.)

I'll interrupt your letter here B.H., so I can respond. The rest of your interesting letter follows my comments.

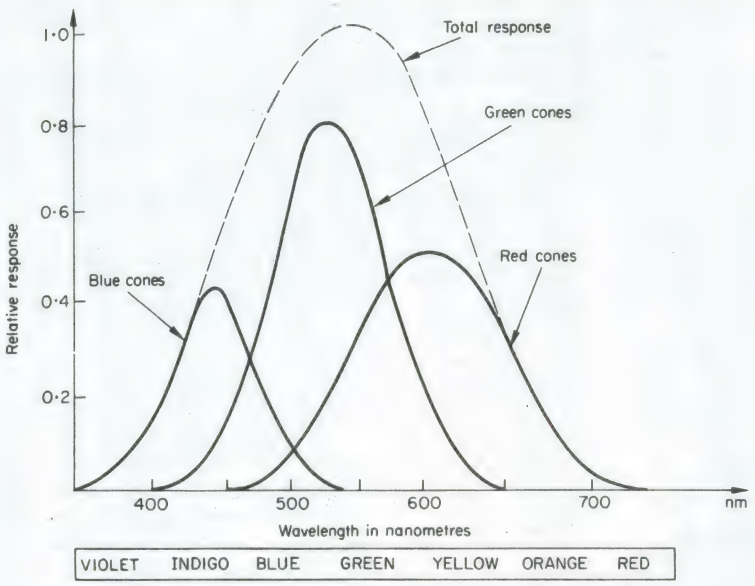
While I realise your letter is aimed at the person who posed the question (Mr Watson), I take the responsibility to reply as I chose to use the question in the column.

In short, I don't agree with the chart in Fig.2 you sent, (which I've redrawn for publication). While I realise I'm disagreeing with a text used by Sydney University, I think I'm on fairly safe ground, as I've referred to a number of texts to make sure of my facts.

The response curves I believe to be correct are shown in Fig.4, which are from the text *Colour Television Theory*, by Hutson (1971). These are obviously very different to those in Fig.2 and show the eye as having a lower response to blue than to any other colour.

Another reference, *Colour Television* by Patchett (1967) has almost identical graphs, and this author says: 'Colour is a physiological sensation of the human eye and therefore involves the response of the eye to different colours. Unfortunately all eyes are not alike and no scientific measurement of the response of an eye can be made in the same way that the colour response of a photoelectric cell can be determined. Therefore the response of a standard eye is used. This was determined in 1924 by the International Commission on Illumination...'

'The eye has the greatest response (i.e., it is most sensitive) at a wavelength of 550nm: a yellow-green colour. The response rapidly drops off at the red end of the spectrum, and even more so at the blue-violet end.' I could go on with a lot more evidence, including the derivation of the luminance equation used in colour television. So, as far as I can determine, Mr Watson is quite correct about the eye having a poorer response to blue than to other colours. I haven't included a chromaticity diagram, as I'm sure Mr Watson hasn't based his question and answer on it. Also, it's rather pointless reproducing this diagram in shades of grey!



Hypothetical relative sensitivities of the suggested three types of cones in the retina

Fig.4

I can't comment on the graphs about peripheral vision in Fig.3. These are quite likely correct, and even the reason for choosing blue as a colour. But I tend to support Mr Watson's suggestion about rod vision predominating at night. Now here's the rest of B.H.'s letter, which is about car brake lights.

Brake lights swamp retina

High-intensity brake lights are a feature of some new cars, or as add-on kits. However, the intensity of these lights does not seem to be regulated by Australian authorities. Potentially, under certain lighting conditions, this burst of high-intensity light may 'swamp' the retina, causing momentary loss of vision and a possible rear-end accident. This is surely the opposite of the designer's intention.

And finally, why are traffic lights red, considering the human eye's sensitivity to red is poor? Good luck Peter, you may have presented a superficially simple What?? question, but the study of color perception is still incomplete and complex.

Interesting comments, B.H., and I understand what you mean. I suppose retina 'swamping' is the same as being momentarily blinded by a bright light, as in a photoflash. I wonder if there are any recorded rear-end accidents cause by this phenomenon. Any comments?

Software tools

The next letter asks for advice about software for technicians.

Over the past few months I have developed a keen interest in electronics, and during this short period I have successfully completed a few of your smaller projects, as well as reading the majority of your magazines back to April 1992.

I have amassed a small collection of tools which includes a computer, and have been looking for any software that I could make use of either as a tool, or as a learning aid. The only product I have seen advertised is 'Electronic Workbench' which with my limited knowledge of electronics, appears quite useful.

I would like to know if this product, or products similar to this are a worthwhile addition to the 'toolbox' and if there are other software packages that you recommend. (D.F., Kensington Gardens SA.)

Electronics Workbench is an easy-to-use circuit simulator which I reviewed in *EA* for March 1992. I have used it many times since, and its library and user base is continually expanding. It's main use is for 'dry testing' a circuit, but it is also a useful learning aid.

Another useful software package for electronics is OpFil, an Australian designed filter program. My review of this program is in the December 1993

issue. Then there's the Protel series of PCB and circuit drawing software. There are other similar programs, but Protel seems to have cornered the market in Australia.

There are also various audio design software packages (refer *EA* July 1994), as well as other function specific packages. Of interest to many computer owners is software that converts a computer into a measuring instrument, or a signal source. This type of software usually requires hardware, either as a plug-in card or a peripheral device.

We often include brief details of these in the magazine. I suggest you regularly scan the New Products, Computer Products and Software Review sections of the magazine.

Hydroponics

Electronics has a role in nearly everything these days, including gardening. Our next letter is about hydroponics, where plants are grown in a liquid nutrient:

I have recently become interested in hydroponics, an activity in which the conductivity of the nutrient solutions is measured as an indication of their relative strengths. The scale commonly used is referred to as the 'conductivity factor' and this scale seems to be an adopted convention by which the conductivity of the solution is measured over a range of 0 to 10 millimhos/cm and then multiplied by 10 to give a 0 to 100 scale. In practice a range of about 0 to 36 (ie, 0 to 3.6 millimhos/cm) or so would be enough.

I wonder if there would be sufficient interest to warrant an EA project or perhaps a few comments on the design and construction of a gadget to measure the 'conductivity factor'. I have not seen a commercial example, but illustrations show the use of LEDs indicating steps of two units each. Perhaps there are other uses for such a device such as an indication of pollution levels. (J.M., Port Macquarie NSW.)

While I know very little about hydroponics, conductivity of a liquid can be measured relatively easily. After all, a conductive liquid is simply a resistance. However, I suspect getting a calibrated reading is more difficult. I agree there is likely to be interest in such a project, and we'll see what we can do.

E-M radiation

We covered the topic of electromagnetic radiation quite extensively some time ago in Information Centre, and now and again I notice articles in the press about it. Here's a letter asking if there's an instrument that can measure electromagnetic radiation.

I have recently become concerned about electromagnetic radiation emitted from electrical appliances. Do you know of a reliable, commercially available device that can monitor the radiation from things like computer screens, TV sets, an electric blanket and so on. Has there been such a device developed as a project? Could such a monitor measure EM radiation from high tension lines? (S.K., Penrith NSW.)

After reading and editing all the documentation sent to me about the possible effects of electromagnetic radiation, I have come to the conclusions that (1) children are most at risk, (2) the greatest EM exposure is from an electric blanket, therefore turn it off before getting into bed. I'm not trying to minimise the possible effects, nor claim an expertise on the topic, but I think the dangers from EM radiation are not as great as some as the emotive literature would have us believe. And if the dangers are as real as some claim it to be, the human race will have to turn to another form of energy.

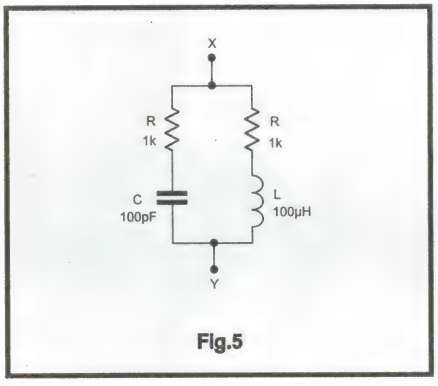


Fig.5

But, is there an instrument able to measure EM radiation? While I can't say where, I'm sure I have seen reference to such a device, possibly in the New Products section in a recent edition of *EA*. However, I wouldn't suggest buying one, as research on EM effects is not conclusive. A more likely health hazard is X-ray radiation from a TV screen, where the easiest solution is not to sit too close.

2SB443 replacement

I'm sure quite a few readers will relate to this letter...

I recently had my old Peak amplifier repaired and the serviceman told me a germanium transistor, type 2SB443 was noisy. I have since been trying to find one, or even a replacement. I am also trying to locate an old 39-ohm oval speaker to fit my Zenith radio. Can you help me? (Peter Brigg, MS 941 Boldercombe via Rockhampton, 4700.)

Turning to my trusty *Worlds Transistor Comparison Table*, the 2SB443 device is a germanium PNP transistor, and possible replacements are types AC122, AC125, AC126, AC151 and 2N1191-94. The 2SB444 is also an equivalent. While all of these transistors are probably no longer made, you might have more chance finding the AC125-126 types.

I've included our correspondent's address in case a reader can help with a transistor or a 39-ohm oval speaker.

Metronome

Our final correspondent has two questions:

Years ago I wrote to you asking for various circuits. Do you still have this service? I am interested in making an electronic metronome, and I wondered if you could advise me whether there is a circuit available for such a device. (A.K., Alstoneville NSW.)

As you can see, we do offer a service on locating or even supplying circuit diagrams of our projects. See the last page of every edition of the magazine for more details. As I've explained in previous issues, letters of this type usually end up on my desk.

Regarding a circuit for a metronome, we have published quite a few. The most recent is one called Beat Me which is a programmable metronome, presented in March 1989. Others are a metronome in November 1987 and in January 1982. We also described a Metronome With Accented Beat in July 1976.

What??

This month's question was sent to me by Rod Steinfeld, of Glen Waverley Vic. I think you'll find this one not only interesting, but rather unusual. Here's the question:

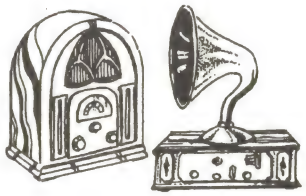
After building the circuit shown in Fig.5, I connected a sinewave signal generator across points X and Y and examined the circuit's behaviour over a large frequency range. Amazingly, I found that at every frequency the circuit was equivalent to a single component. What is the component and what is its value?

Answer to October's What?

The equation is R(root 3 + 1), or 2.732R. As I said last month, I can't supply proof of this answer, although the contributor of the question says, rather tantalisingly, 'there are, of course, many ways to get the answer, so I'll only pose the question'. If someone can send me the proof (assuming it's not too high power!) I'll present it in a future edition. ❖

Vintage Radio

by PETER LANKSHEAR



The Browning-Drake receiver

One of the best remembered radio names from the 1920's is 'Browning-Drake', a receiver which combined simplicity with what for its time was a first rate performance. While most of its contemporaries had production lives of little more than a year, the Browning-Drake design was popular for much of the decade. As with the IBM personal computer more recently, there were also more 'clones' made by others than the official versions...

By the outbreak of World War I, valve receiver technology had advanced to the stage where stable detection and low frequency amplification were possible. However there were limitations to the sensitivity and selectivity of the grid leak detectors that had become standard.

The newly discovered *regeneration* helped, but it became clear that the only way to improve receiver sensitivity was to increase the strength of signals presented to the detector. Large aerials and efficient tuning coils helped here, but the need now was for satisfactory pre-detection amplification of signals. Although the radio spectrum at that time was confined to frequencies below 1MHz, the triode valves of the period could provide very little RF amplification before becoming unstable — especially at higher frequencies, where signals were weakest.

The major problem in achieving useful RF amplification was the bypassing of signals by unavoidable capacitances. Of course, the best solution was to make use of these unwanted capacitances by including them in tuned circuits coupling the valves. However the tuned RF amplifier then ran into another problem. Triode valves have sufficient inter-electrode capacitance that with tuned circuits connected to both anode and grid, there is sufficient energy transferred internally back to the grid to cause them to become vigorous oscillators.

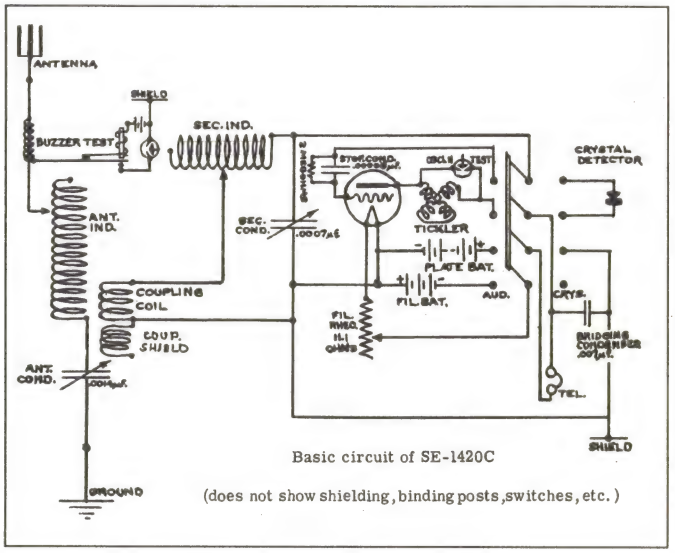
Initially there were two solutions. One was to follow audio amplifier practice and couple a series of valves by means of untuned broadband transformers. This method had some success, but with the valves available at the time, very limited stage gains were possible.

One example was the radio frequency amplifier made by Marconi's Wireless Telegraph Company, which had needed no fewer than six stages of amplification using the baseless high frequency type V24 valve. The only selectivity was provided by an aerial tuner. Although it worked, this method of reception was clearly very cumbersome and expensive, and quite unsuitable for home use.

The alternative method, and of course the ultimate solution to many difficulties was the *superheterodyne*, attributed by Americans to work done in 1918 by Major Edwin Armstrong of the US Army. While much credit is due to Armstrong, it is now clear that the original concept of the superhet was an international effort, with much of the early work being done in France. First though, there were many technical and commercial obstacles to be overcome and it was a good 10 years before these problems, and RCA's licensing restrictions, were overcome sufficiently for the superhet to be anything like widely used.

Naval problems

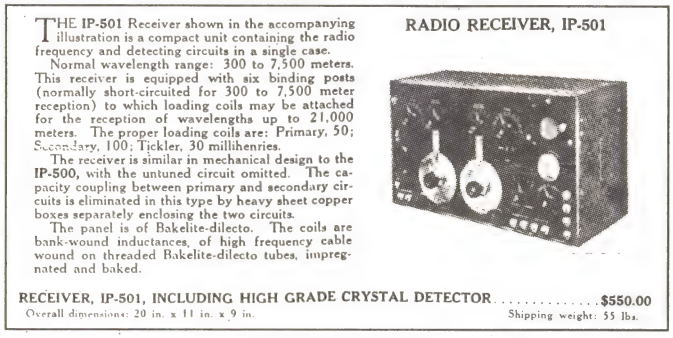
Meanwhile, also in 1918, the US Navy had commissioned their consultant Professor L.A. Hazeltine to design a new receiver, the SE1420. This celebrated receiver, much prized today by collectors, was required to tune from 40kHz to 1.2MHz. The SE1420 (SE stood for Steam Engineering!) provided the choice



Basic circuit of SE-1420C

(does not show shielding, binding posts, switches, etc.)

Fig.1 (left): The circuit for the US Navy's SE1420. The 'coup shield' was developed into neutralising by Prof. Hazeltine.



THE IP-501 Receiver shown in the accompanying illustration is a compact unit containing the radio frequency and detecting circuits in a single case.

Normal wavelength range: 300 to 7,500 meters. This receiver is equipped with six binding posts (normally short-circuited for 300 to 7,500 meter reception) to which loading coils may be attached for the reception of wavelengths up to 21,000 meters. The proper loading coils are: Primary, 50; Secondary, 100; Tickler, 30 millihenries.

The receiver is similar in mechanical design to the IP-500, with the untuned circuit omitted. The capacity coupling between primary and secondary circuits is eliminated in this type by heavy sheet copper boxes separately enclosing the two circuits.

The panel is of Bakelite-dilecto. The coils are bank-wound inductances, of high frequency cable wound on threaded Bakelite-dilecto tubes, impregnated and baked.

RADIO RECEIVER, IP-501

RECEIVER, IP-501, INCLUDING HIGH GRADE CRYSTAL DETECTOR $550.00

Overall dimensions: 20 in. x 11 in. x 9 in. Shipping weight: 55 lbs.

Fig.2 (above): Copied from a 1922 RCA catalog, this shows the IP-501 which was the civilian version of the SE1420. Some of these receivers were in merchant marine service well into the 1930's. Note the weight and price — both huge for a single valve receiver.

of a crystal or a regenerative valve detector, and provided variable coupling between the aerial tuning and detector tuning circuits.

It was essential that there be no capacitive coupling between antenna and detector circuits as, during reception of weak lower frequency signals, this had been found to experience serious interference from nearby 500kHz transmissions.

To eliminate this capacitive coupling, the antenna tuning coil was first isolated from the secondary circuit by enclosing each in a separate compartment of heavy copper sheet. But a coupling coil, in series with the secondary, was needed in the compartment containing the antenna coil to provide the required degree of inductive coupling, and the residual capacitance between these coils left a certain amount of undesired capacitive coupling which tuning could not eliminate.

To cancel this capacitance, Professor Hazeltine placed near the aerial coil an open-ended winding, shown in the diagram of Fig.1 and called a 'coupling shield', so proportioned that the unwanted coupling to the aerial coil was cancelled. As we shall see, this simple solution was later to have an important influence on broadcast receiver design.

Meanwhile, broadcasting had emerged — and with it the demand for easy to use receivers. Early American broadcast receivers usually consisted of a grid-leak detector and one or two audio stages. Regeneration was frequently used to increase detector sensitivity, but many domestic users were insufficiently skilled in its use, causing re-radiation and creating havoc for other listeners.

With the superhet still underdeveloped and tightly licensed by RCA, and the untuned amplifier an impractical complication, a method of stable RF amplification was needed. Professor Hazeltine realised

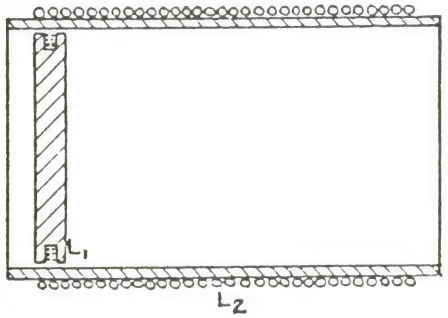


Fig.4: A diagram from a 1924 'Radio Engineering' article, which shows a sectional view of the primary (L1) and secondary (L2) windings of the Regenaformer. Note the position of the compact primary inside the main coil former.

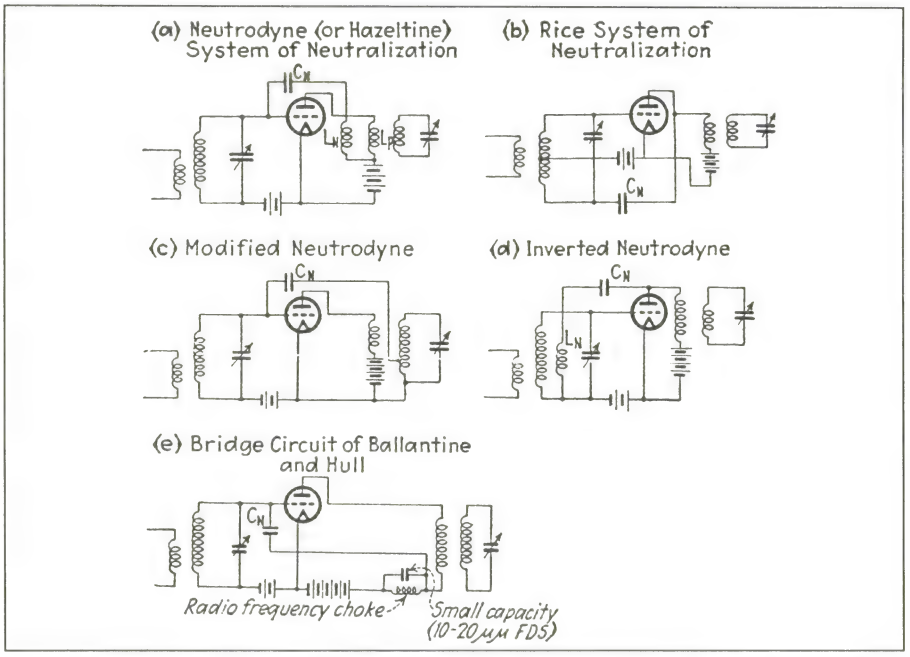


Fig.3: A group of neutralising circuits copied from Terman's 'Radio Engineering'. Each system couples a signal in phase opposition back to the grid. The method shown in (c) was used for the Browning-Drake receiver.

that his method of eliminating capacitive coupling used in the SE1420 receiver could be adapted to neutralise the grid-to-anode capacitance of a tuned triode amplifier. Late in 1922, he designed a successful and stable radio frequency amplifier, incorporating this *neutralisation*.

Hazeltine named his new receiver the 'Neutrodyne' TRF. Incorporating two, and sometimes three neutralised RF stages, a grid-leak detector and two transformer coupled audio stages, it was to become the classic standard American receiver format of the mid-1920's.

With the degree of amplification possible with the multi-stage Neutrodyne, a regenerative detector was not essential — a definite advantage to non-technical users.

Do not install!

Another advantage of the TRF was that RCA held the regeneration patents, and demanded royalties for its use. Some manufacturers had found a way round this difficulty by not actually installing regeneration, but providing terminals with connecting instructions for a feedback winding — but with a warning for the owner NOT to do it!

Receivers using the Neutrodyne principle were still liable for royalties, payable to the Hazeltine Corporation —



Home built Browning-Drake receivers were to be found in all manner of cabinets. This table top chest with lift-up lid was a popular pattern.

which, incidentally, became very wealthy. Many receiver makers, including major organisations like Atwater Kent, resented this and circumvented the problem by introducing resistive losses in the RF amplifier grid leads, or by loading down the grids of the RF stages by applying positive grid bias. One receiver that used this rather cheap and nasty method was the Stewart Warner model 300, featured on the cover of my book *Discovering Vintage Radio*. However, there was little question that a well-designed neutralised tuned RF amplifier gave the best results.

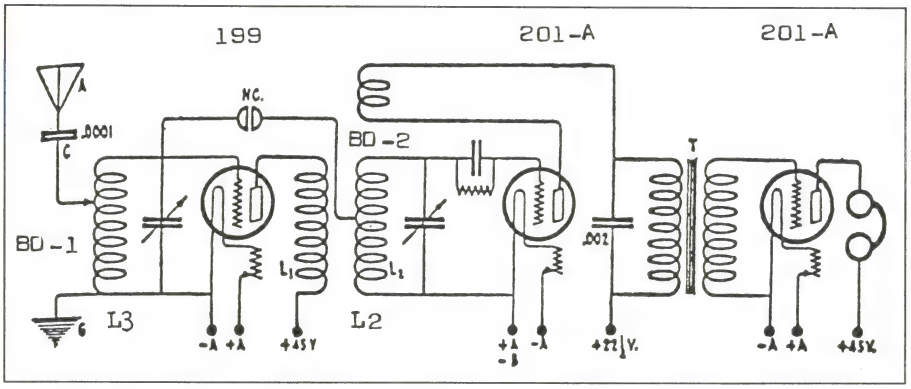


Fig.5: An early circuit intended to demonstrate the effectiveness of the Regenaformer. Glen Browning favoured the small 199 valve for the RF stage, because of its low inter-electrode capacitance.

Simple idea

The basic idea of neutralisation is simple enough. It can be regarded as a form of negative feedback. The capacitive coupling from anode to grid inside the valve is cancelled by externally feeding back to the grid an equal amount of signal — but in the opposite phase.

Hazeltine's phase reversal was obtained by the orientation of the primary winding of the following coupling coil. Several other similar methods of neutralisation, including systems attributed to Ballantyne, Hull, Scott-Taggart and Hartley were also used, and all used a small variable or semi-variable capacitor to adjust the coupling. Neutralisation in receivers became unnecessary with the advent about 1928 of the screen grid valve, but continued to be used with transmitting triodes.

Harvard researchers

In practice, neutralised RF amplifier stages did not deliver the amount of gain theoretically possible. During 1923, at the suggestion of the radio editor of the *Christian Science Monitor*, two men at Harvard University collaborated to study the problem.

One was Frederick H. Drake, a senior student, who had made a mathematical study of the neutralised TRF; the other was Glen H. Browning, a noted Research Fellow, whom Drake persuaded to help him in confirming his theories. Their work verified that the loss of gain was due to unavoidable residual capacitive couplings, between the primary and secondary windings of the RF coils. In the conventional pattern of coil, the primary was wound over the lower end of the tuned winding.

In their research work, Browning and Drake found that there was a considerable reduction in capacitance between the two if the primary was made physically as small as possible.

They settled on the method shown in Fig.4, using a compact coil wound randomly with a relatively small number of turns of fine wire, on a grooved ring mounted inside the main coil former. It was claimed that this method achieved 90% of the maximum theoretical gain.

NATIONAL COMPANY, INC.

ESTABLISHED 1914

Engineers and Manufacturers

110 BROOKLINE ST., CAMBRIDGE MASS.

BULLETIN No. 105

THE NATIONAL REGENAFORMER

(PATENT PENDING)

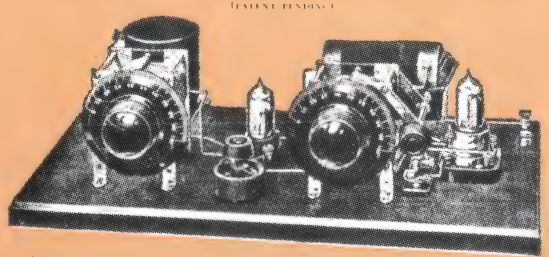


FIG. 1

THE BROWNING-DRAKE RECEIVER USING THE NATIONAL REGENAFORMER

WHAT IT IS

To Glen H. Browning and Frederick H. Drake, of Harvard University, belongs the honor of designing the remarkable new type of Radio Frequency Transformer, known as the National Regenaformer, which has proved so efficient that over 90% of the value of amplification calculated by mathematics was actually produced when the transformer was subjected to laboratory tests. The National Regenaformer is incorporated in a hook up known as the *Browning-Drake Circuit* which has essentially two tubes a radio frequency amplifier and detector (Fig. 1) to which two stages of audio amplification may be added, making a four-tube set for loud-speaker reception.

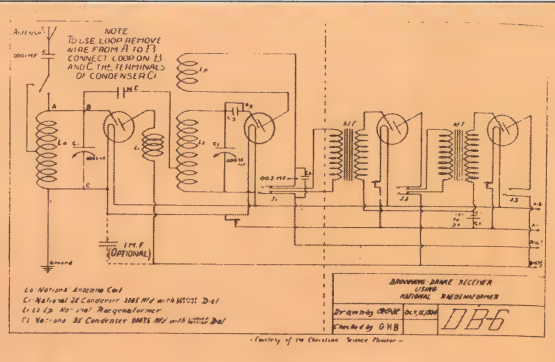


Fig. 193

PROPERTIES OF THE REGENAFORMER RECEIVER

1—It is extremely sensitive, and therefore excellent for distant reception.
2 It is selective enough to cut out local radiocasting.
3 There is no radiation when properly constructed, and consequently no disturbance occurs in neighboring sets.
4—Stations may be tuned in with or without obtaining beat notes. On DX reception the beat note is a great help.
5—Stations come in at definite points on the second Dial, and, therefore, it may be logged for future reference.

CONSTRUCTION

Fig. 1 shows a two-tube "Bread Board" model of the Browning-Drake receiver, while Fig. 3 shows the wiring diagram with two stages of audio amplification added (*Right of dotted line*). The principal parts of this set are embodied in a kit known as the National Regenaformer Kit, consisting of :

1 National Antenna Coil mounted on
1 .0005 National DX Condenser with
1 4" Velvet Vernier Dial
1 National Regenaformer, mounted on
1 .00035 National DX Condenser with
1 4" Velvet Vernier Dial
1 Blueprint of Wiring Diagram
1 Set of Hardware for Mounting.

PRICE OF KIT: **$22.00**

THE NATIONAL REGENAFORMER AND COIL, ONLY . . $7.50

Dealers' Standard Package 20

Fig.6: National's ad for the kitset of parts. The circuit was originally drawn for the 'Christian Science Monitor', which popularised the Browning-Drake receiver. Note that the Regenaformer could be bought separately, and exact details of the audio amp were left to the builder.

Link to National

To confirm their theories, late in 1924 Browning demonstrated a 'breadboard' receiver tuner using a single neutralised tuned RF amplifier and a regenerative detector. The radio press were enthusiastic, giving the Browning-Drake tuner plenty of favourable publicity, for it really did perform as promised.

Smaller and cheaper than the conventional Neutrodyne, and with the improved gain of the RF amplifier plus the regenerative detector, this was a exactly what the home construction fraternity were looking for. The isolation provided by the RF amplifier prevented radiation of any interference from the regeneration. The performance of the Browning-Drake could match the Neutrodyne and if sold as a kitset, no royalties were payable to either Hazeltine or RCA.

By what turned out to be a fortunate coincidence, Harvard is located in Cambridge, Massachusetts — where there was also an enterprising firm, the National Company, making such diverse products as power plant equipment, household products and 'high tech' toys.

National had recently commenced making variable capacitors to cater for the new fad of radio, and were very receptive when Messrs Browning and Drake made approaches about supplying components for their tuner. These were put out as an attractively boxed kit which, as shown in the advertisement reproduced in Fig.6, included two tuning capacitors, two dials, an aerial coil, and the 'Regenaformer'.

The price of $22 was a bit high, but National's products were of first class quality. National went on to make distinguished equipment for amateur and professional use, including eventually the legendary HRO, probably the best known of all communication receivers.

Not a specific circuit

It must be emphasised that the distinguishing feature of the Browning-Drake receiver was not a specific circuit, but the Regenaformer with its special primary winding. This unit, mounted at the rear of the detector tuning capacitor, was an assembly comprising the detector tuning coil, the compact RF coupling coil and the rotatable tickler regeneration control. The Regenaformer could be purchased separately for $7.50.

The prototype was constructed without a panel, on a 'breadboard'. National's kitset diagram left precise details of the audio amplifier to the builder, but recommended two transformer-coupled stages, at that time a practically universal feature for receivers intended for loudspeaker operation.

Late in 1925, Glen Browning formed the Browning-Drake Corporation, to manufacture complete receivers as well as marketing kitsets. Whereas for most receiver makers the somewhat low-fidelity two stage audio amplifier was standard, Browning-Drake built receivers used a three stage resistance and impedance coupled amplifier, with an attendant improvement in audio quality.

Continued popularity

Unlike most contemporary receivers, which were in fashion for a year or two at the most, the Browning-Drake continued to be popular with enthusiasts for the remainder of the decade. 'Official' kitsets using National components were available from B-D until at least 1928. As late as 1930, full constructional instructions were still being published in hobby magazines and annuals — by which time, mains powered versions were being offered.

There were even instructions for building a 'screen grid' Browning-Drake, in which the triode RF amplifier was replaced by a screen grid valve. This development completely missed the point that the definitive feature of the Browning-Drake was the Regenaformer — which, with its special low capacitance primary winding, was unnecessary with a screen grid valve because it needed no neutralisation.

The Browning-Drake was the forerunner of receivers using a single tetrode or pentode RF stage, regenerative detector and audio amplifier — a format which proved to be remarkably durable, especially for amateurs and shortwave listeners. Featured in our January 1990 column, the 1929 Pilot Super Wasp popularised this configuration for shortwave receivers and it was not until the mid 1930's that the communications superhet became available.

The regenerative TRF with a single RF stage actually saw service during World War II as the R1082 receiver, which, with coverage from 111kHz to 15MHz, was part of the T9 RAF aircraft equipment.

Next month, we have some ideas and suggestions for building a Browning-Drake receiver.

Component supplier

I am often asked for addresses of suppliers of components and materials suitable for valve radio repairs.

Brian Smith's Wireless Workshop, of 12 Mansfield Street, Rockhampton Qld 4700 now issues on request a small catalog, which should be of considerable interest to vintage enthusiasts involved in restoration. ❖

Collector's Corner

STC Model 150: Mr Ken Thomson of Oaklands Park in South Australia has one of these receivers, which appears to have been fairly heavily modified. He'd like to get a copy of the original circuit, if possible, so he can restore it. Can anyone help?

AWA Carphone Junior: Mr L.J. Coulthard of Newmarket in Queensland has one of these, serial number 1975, which appears to have been made in 1949. He'd be grateful if anyone can provide a copy of the circuit and/or wiring diagram.

(Send them to us, and we'll forward them.)

DRAKE

R8 WORLD BAND RADIO
100khz-30Mhz Twin VFO
5 filter Band Widths AM FM SSB

SW8 PORTABLE
500khz-30Mhz AM FM SSB
3 Filter Band Widths

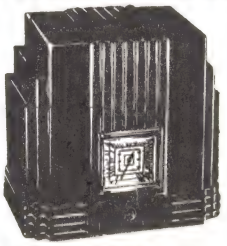
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THE 8051 MICRO CONTROLLER
book includes a simulator disk ($40). ROM loader EPROM Emulator (EA Jan/Feb 92, EA Jun 94) (PCB $30). 8051 Proto-boards (EA Feb 93) (PCB $30). Tantau Australia P.O. Box 1232 Lane Cove 2066 A.H. Ph: (02) 878 4715

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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.

November,1944

Frequency modulation announced by Senator: A few days after our last issue went to press, Senator Amour startled Australian radio listeners by announcing that Frequency Modulation, to be introduced after the war, would render obsolete all existing radio receivers.

But there is no cause for gloom in the statement. In many circles it has been feared that years would pass before Australians would receive the benefit of services which had become a reality in other countries.

Of course, there is a vast gap between Ministerial forecasts and the accomplished fact, but one can look forward with confidence to a brighter technical future.

During the month we had the pleasure of lunching with Mr Murray Stevenson, chief engineer of Station 2UE and returned only a few days previous from a visit to the United States.

Mr Stevenson testified to the interest being displayed in that country in FM and television — both in operation but equally limited as far as expansion is concerned, by the present wartime controls.

November, 1969

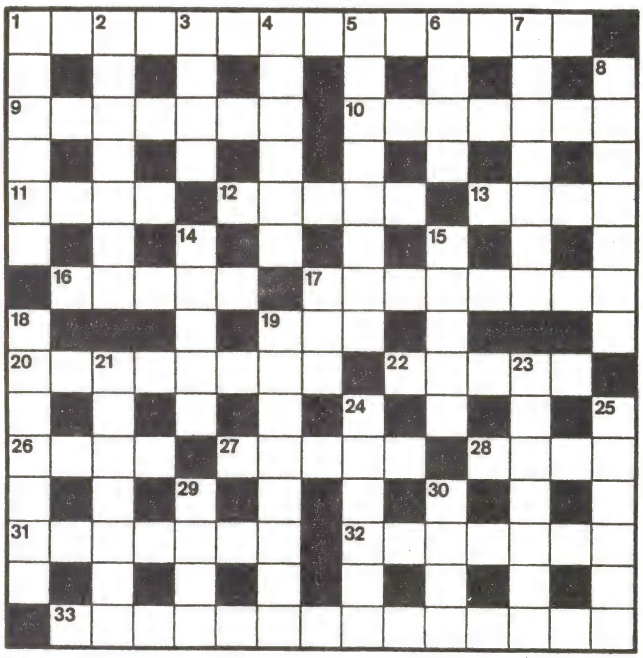
APT receiving system: The New Zealand Department of Civil Aviation is to have two APT (Automatic Picture Transmission) receiving systems installed at Wellington and Fiji to gather satellite weather pictures and meteorological data. The equipment will receive and print pictures (both daylight and infra-red) obtained from the Environmental Science Service Administration and Nimbus weather satellites.

Service station in Vietnam: Australian servicemen in Vietnam will have their own broadcasts from a radio station being installed at Vung Tau. This has been made possible by contributions to the Australian Forces Overseas Fund by the public and industry.

A 500W broadcast transmitter and associated equipment has been supplied by Amalgamated Wireless (A'sia) Ltd, while radio station 2GB has provided the studio desk, consolette and associated items. The Federation of Commercial Broadcasting Stations and the ABC will provide news, music and general tapes. The ABC has assigned Mr Bruce Webber to visit Vung Tau to handle the station's programming. The Army has provided the studio. The station, expected to be on the air daily, will be operated by RAAF personnel and off duty Servicemen.

Message switching: The Department of Civil Aviation will spend $2.2 million on message switching systems to be installed at Sydney, Melbourne and Brisbane. The computer-based message switching equipment will permit the immediate processing of all operational messages relating to flight plans, weather information, and traffic movements of domestic and international airlines. These messages are then sent to any number of centres simultaneously.

EA CROSSWORD



ACROSS

1. Detection instrument for cosmic study. (5,9)
9. Sixth power of ten. (7)
10. Said of a network with no EMF provided. (7)
11. Plural of torus. (4)
12. Definitive term in set theory. (5)
13. Name of aerial invented in 1926. (4)
16. Magnetic unit. (5)
17. Recover (data, etc.). (8)
19. Logical operator. (3)
20. Closed audio system. (8)
22. Integrated circuits. (5)
26. Mechanical devices with eccentric profile. (4)
27. Said of spring with high spring constant. (5)
28. Hereditary factor affected by excess radiation. (4)
31. Printer's style of type. (7)
32. Forming a pattern by erosive means. (7)
33. Electronic instrument for measuring height. (5,9)

SOLUTION FOR OCTOBER 1994

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S		D		T				E		N		L		D
	B	E	T	A	P	A	R	T	I	C	L	E	S	

DOWN

1. Said of a control that sends signals. (6)
2. Inventor (1815 - 89) of chloride of silver cell. (2,2,3)
3. US designer of safety elevator. (4)
4. Name of current affecting weather. (2,4)
5. Early US satellite series. (8)
6. Hyperbolic function. (4)
7. Part of PABX. (7)
8. Measure of performance in electronics. (7)
14. Inventor of electromagnetic motor. (5)
15. Tycho ——, the greatest pre-telescope astronomer. (5)
17. Type of memory. (3)
18. Conducting path. (7)
19. Area adjacent to a busy channel. (5,3)
21. Diaphragms of telephones or ears. (7)
23. Determine future conditions. (7)
24. An EMF is developed in the Seebeck ——. (6)
25. He deviced a counter for radioactivity. (6)
29. An interface. (4)
30. Brand of receiver. (4)

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AUSTRALIAN MODEM MANUFACTURERS' ASSOCIATION

Senior representatives of Australia's modem manufacturers have established a new industry grouping — the Australian Modem Manufacturers' Association (AMMA). Newly elected Chairman, Greg Burns (General Manager, Tronic Bits) commented: "The objective of the AMMA will be the promotion of a financially sound Australian modem manufacturing industry. It will represent the industry with key policy makers, customers and regulators."

Activities of the AMMA will include:

- The education of the Australian modem market;
- The promotion of the local modem manufacturing industry, particularly to Government, regulators and corporate buyers;
- Ensuring that the provisions of the Telecommunications Act are upheld, such that only AUSTEL approved modems are to be sold;
- Representing the industry on technical and commercial matters;
- The collection of reliable statistics on the modem industry; and
- The promotion of ethical behaviour in industry dealings.

Founding membership comprises the seven major Australian modem manufacturers. Affiliate members are Rockwell Telecommunications, the world's largest manufacturer of modern integrated circuits, and their Australian distributor, Tronic Bits. Mr David Stewart of Banksia Technology is Vice Chairman.

JAPAN DISTRIBUTOR FOR NETCOMM MODEMS

Listed Australian data communications developer NetComm has unveiled a new Japanese distribution agreement, projected to earn over $5 million for the company over the next three years.

According to NetComm managing director Chris Howells, the initial three month order has been received and shipments of six advanced technology Australian modem and software products will commence before the end of 1994.



Mr Chris Howells, the managing director of NetComm Ltd.

"The timing of the delivery will allow our distributor to exploit the peak sales period in the Japanese market, which is the largest single information technology marketplace outside the United States," Howells said.

"The Japanese market is currently taking up to five times as many modems as Australian local volumes. As a result of our successful OEM agreement with the Japanese telecommunications giant, NTT, some year ago, Japan is also a market with which we have some experience."

ELECTRONICS BOOMS IN CHINA

The electronics industry in China is currently booming. The first half of this year saw production rise 31.2%, to US$9.5 billion. Total sales of electronic products amounted to US$7.2 billion, an increase of 28.7% over the same period last year.

The Ministry of Electronics Industry has projected the industry to grow at an annual rate of 22% during the next six years. By the end of 2000, production is expected to reach US$69.5 billion, while domestic consumption will amount to US$80.9 billion.

To catch up with foreign competitors, China is devoting greater resources to the development of integrated circuits, telecommunications equipment, computers and software and information networks.

Computer sales jumped 43% to more than US$3 billion last year. Foreign brands accounted for 51% of the market. Sales are expected to rise another 30% this year, with personal computers continuing to dominate the fledgling sector. Analysts predict that the demand for PCs will exceed 550,000 units next year and reach 900,000 units by 1996.

The domestic market leaders are the Legend Group and China Great Wall, but they are facing increasing competition from foreign manufacturers like AST Research, IBM and Compaq, which are setting up service centres in the major cities.

SYNTHETIC POLYMER PROCESSES IMAGES FAST

Imagine a computer operating at the speed of light, digesting information so quickly that today's electronic brains are left virtually in the dust. A remote fantasy? Not according to scientists at UC Santa Barbara's Institute for Polymers and Organic Solids, who have developed an extremely high speed optical image processor, using a new synthetic polymer, which performs calculations a million times faster than today's fastest Cray supercomputer.

"It's certainly not a full fledged computer by any means," says physicist Andrew Hays, one of a team of six physicists and chemists who col-

NEWS BRIEFS

- Reutech Engineering Services (RES) and Australian company ***Stanilite*** have announced an agreement establishing RES as a distributor of Stanilite's telecommunications products in Africa. RES is a subsidiary of Reunert Ltd, a leading South African company in the fields of electronics, telecommunications, electrical engineering and consumer electronics.
- ***A three (or optional four) day training course called Ethernet Networks*** will be conducted by Independent Information Technology Training at Sydney, 20-22/23 May 1995. For more details phone (02) 252 2844.
- Nick Piscioneri has been appointed as Sales Executive for ***Wedgetail Technologies.*** He will be responsible for sales in all states except NSW.
- ***A three day training course called TCP/IP Networks*** will be conducted by Independent Information Technology Training at Sydney, 5-7 December 1994, Melbourne, 12-14 December 1994 and Brisbane 1-3 May 1995. For more details phone (02) 252 2844.

MERCEDES UNVEILS EV PROTOTYPE

Electric drive has the brightest future of all alternative propulsion systems currently under investigation, according to the Mercedes-Benz team responsible for the development of the latest electric vehicle prototypes.

The German engineers point to the stringent Californian exhaust emission standards, which from 1998 will require two percent of production from large scale car manufacturers to be zero emission vehicles. The Mercedes engineers say these standards can only be met with the help of electrically powered vehicles.

The latest electric prototype from Mercedes is based on the popular C-Class. Its external appearance is barely distinguishable from that of a standard model, with only minor body modifications to accommodate the traction batteries, drive management system, on-board charging unit and electric motor. The charging unit and drive management system have been placed under the bonnet, with a battery block and rectifier. An asynchronous electric motor and transmission sit behind the front axle, with a second battery block in the luggage compartment.

As a result, this new electric prototype — the latest product of 25 years of research by Mercedes-Benz — accommodates five people, with only a slight reduction in luggage load space.

In the electric C-Class, the newly developed ZEBRA high energy battery from AEG is being used, to provide an operating range of approximately 110 kilometres in city traffic.

The maintenance free sodium nickel-chloride battery is seen as one of the most promising energy storage products available for electrically powered cars.

The hermetically sealed and thermally insulated battery cells need to be electrically heated, for the optimum electrochemical reaction at 260 to 350°C. A microcomputer takes care of temperature regulation.



AEG estimates a service life of more than 100,000 kilometres for the ZEBRA battery, which they say is four times more efficient than the lead accumulator battery. Mercedes endurance tests have confirmed these estimates.

The asynchronous motor which powers the electric prototype develops up to 35kW, with a maximum torque of 170Nm. Acceleration from 0 to 50km/h is achieved in less than nine seconds, continuing up to a top speed of around 120km/h. The motor is coupled to a fixed ratio, single stage transmission.

laborated on the project. "Rather it is an example of a special purpose computer designed to perform one or more tasks very quickly. And it does that extraordinarily well."

For many years, scientists have realised that there are inherent limits to how fast electronic computers can work, even supercomputers, such as Crays — in part because of limits on the speed of the electrons that carry information through their circuitry.

To get around this hurdle, scientists at many laboratories have been working on devices based not on electrons, but on pulses of light, which can travel at much higher speeds — up to about 186,000 miles per second in a perfect vacuum. Typically, these experiments rely on specialised polymers because they respond much more quickly to light than conventional silicon chips.

In one series of trial runs, the scientists report, they had their device compare very similar line drawings of three early American presidents — Washington, Adams, and Jefferson. It was able to detect their degree of difference in a veritable flash — just 160 femtoseconds, or one sixth of a nanosecond. This may well be the fastest calculation ever performed, says Craig Halvorson, a postdoctoral fellow in materials science who participated in the project.

At the heart of the new optical image processor is a light sensitive polymer that reacts to even extremely slight fluctuations in a beam of light by doubling or even tripling its frequency. Such materials have been synthesised before, but what distinguishes the new polymer is its inherent chemical stability at ordinary temperatures and atmospheric conditions and the ease with which it could be manufactured. Called poly(1.6-heptadiester), the long chained compound was synthesised by UC Santa Barbara chemist Fred Wudl and a postdoctorial fellow, Rulian Wu.

Besides the capability of operating at the speed of light, optical computers like the UC Santa Barbara device, which consists of an array of lasers, lenses and electronic detectors, have another inherent advantage. They can handle large volumes of information simultaneously in a technique known as parallel processing. By contrast, most conventional electronic computers tackle problems by digesting only small bundles of information at a time, one bundle after another.

NEW NATA DIRECTORY

A new edition of the annual directory of the National Association of Testing Authorities, NATA, will prove invaluable to companies needing to guarantee compliance with quality standards.

To help companies gain access to competent suppliers of testing, measurement and calibration services, the NATA Annual Directory provides comprehensive details on locating and contacting the most appropriate NATA accredited laboratory.

The 1994-95 edition covers about 2500 laboratories throughout Australia, each of which has demonstrated to NATA its compliance with international standards of good laboratory practice.

The A4 format, 830 page publication is Australia's only complete guide to accredited laboratories. It is available for $140 (less for standing orders). For further information contact Katherine Edwards at NATA, 7 Leeds Street, Rhodes 2138; phone (02) 736 8222, fax (02) 743 5311. ❖

Software Drivers for our EPROM Programmer

Since we published Glenn Pure's design for a low cost, PC- driven EPROM programmer in September/October 1993, several advanced software drivers for it have become available — one from Glenn himself. Since there has been a great deal of interest in this project, we decided that the best person to evaluate and compare the different drivers was the designer. Here's what he found...

by GLENN PURE

By all accounts, my EPROM Programmer project has proved to be very popular. This isn't surprising, since it provides many of the features of commercial units, but at a fraction of the cost — most suppliers are selling kits for less than $100!

But like any project, it's not perfect either. The main limitation is not on the hardware side, but lies with the software. When *EA* published the project, some simple software drivers written in BASIC were included. While these work well, they are quite limited in what they will do. For the majority of people who are running the software through a BASIC interpreter (as opposed to compiling and linking it into an executable file first), the software is also fairly slow and inefficient, especially for reading PROMs.

I recognised these weaknesses when I prepared the project for *EA*, and indicated at the time that I planned to write a more sophisticated and flexible software driver for the programmer. I completed this late last year. In the meantime, two other people have written software as well. All three provide a much more powerful interface to the programmer, but vary in their features.

All of the packages cost less than $15 including postage, and are pretty good value for money — considering the amount of work that went into writing them, as I can testify! In addition, each comes complete with source code for those who might want to better understand how the drivers operate, or who want to make their own modifications. All of them should run on any IBM PC and require only modest amounts of memory to operate. They will all work on a monochrome monitor, but are better in colour.

I tested each of the packages on both an old 8MHz 80286 machine with a monochrome monitor and a 33MHz 80386 DX machine with a VGA screen. Functional tests were performed to make sure each package was able to read and write properly to EPROMs. The tests included EPROMs needing a single 50 millisecond write pulse, as well as a 2764 requiring multiple 1 or 0.1 millisecond pulses.

Shared features

In terms of the ability of each driver to properly interface with the programmer hardware, all packages performed properly. Importantly, the ability of each driver to send accurate timing signals to the programmer was checked with an oscilloscope. Since essentially all timing is controlled by the software, not the hardware, it is important to check the software performance in this area.

All came through OK, although on 0.1 millisecond write operations, I timed the actual signals at more like 0.12ms for the two drivers that have this feature (mine and the Tronnort package). However, in tests, this did not affect the functional performance of the software to actually program a 2764 EPROM requiring 0.1 millisecond pulses.

The distinguishing feature, therefore, between each of the packages is the flexibility and ease of use, and the features included. As such, the remainder of this review focuses on this aspect.

There are some common features in all three packages. All of them 'remember' some or all of the settings used in the last programming session, and automatically load and display these the next time the software is run. They all have support for different parallel port addresses, should your machine not use the most common LPT1 base address of 378 hex. The user documentation or on-line help in each package contains adequate details on this. Other supported addresses include 3BC hex and 278 hex.

Table 1 shows a summary of the capability of each package. I'll now discuss the salient aspects of each package.

My package

I'll start with the software that I have written, since I know it best! In addition to the EPROM read and write executable files, the package includes the source code in C, a text file containing user instructions and a binary file for performing test writes to EPROMs. The software is simple to set up. Just copy the files to an appropriate directory on the hard disc or run them directly from the floppy.

The 'write' software in my package is the largest executable file in any of the packages (by a small margin), but only requires 75K of RAM. It takes the user through an automatic sequence of events which eventually leads to the write operation being performed (or cancelled, if desired). Hence, it is fairly easy and foolproof to use.

The main start-up screen is simple and contains a list of eight or so prompts for data input (such as starting addresses, etc). There are also two pop-up windows. One of these can be optionally called up by the user to modify the write and verify logic settings — a feature not provided by the other packages. Using this, it is possible for the user to customise the logic levels that the programmer uses on the Chip Enable and Vpp on/off control lines, during the write and verify operations.

Not many will need this feature, but it could come in handy for experimenting with some non-standard devices that require specially tailored logic protocols. There are also three preset options that can be selected from this window, including the programming sequence required to write to EEPROMs (at least those made by SEEQ).

The other window mentioned above automatically appears at the start of programming. It shows the results of the automatic blank check, and progress with the write operation once it commences. After writing is finished, the window can display the contents of individual address locations in the EPROM in any order.

To read data from an EPROM and store it in a file, a separate executable file is provided. This module is very simple. All the user does is input the start address, number of bytes and file name in which to

FEATURE	Tronnort Technology	Double Dutch Electronics	My Software
Write operation timing	Fixed selection: 0.1 millisecond or 1-100 msec (in 1 msec jumps).	Fixed selection: 1, 5, 10 and 50 milliseconds.	Any value from less than 0.1 millisecond to 1,000 msec or more.
Support for multiple write pulses per address (used in newer EPROM programming algorithms)	Yes: Any value from 1 to 100 write pulses per address.	Yes, but user can not change. Permanently coded into the software at a maximum of 20 write pulses per address for all devices.	Yes: Any value can be entered.
Device Type Library	'Generic' library integrated into the package: Contains size and programming parameters for about 16 common EPROM sizes and vintages as well as considerable space to define and save your own device types. EEPROMs not supported.	Limited. User selects from a list based only on device size from 2K x 8 bytes (2716) to 32K x 8 (27256). Write operation timing etc must be separately set in a separate box. EEPROMs not supported.	None. User defines variables for each programming session such as start address, number of bytes to write, write operation timing etc. However, there is a specific option for writing to SEEQ EEPROMs.
Start and Stop Addresses for writing (and reading)	User enters hexadecimal values which can not exceed the last address of the device size currently selected.	User enters hexadecimal values which can not exceed the last address of the device size currently selected.	Any decimal or hexadecimal values can be entered. EPROM and source file start addresses can have a different value.
Data for writing to EPROM	Data is read from a user defined file into a buffer which can be optionally displayed and edited in hexadecimal.	Data is read from a user defined file into a buffer which is permanently displayed on screen, but can not be edited.	User enters a file name. File is opened and read automatically when writing begins. Source data is not displayed on screen.
Read Operation	Integrated into the write software. Results of the read operation are written into the data buffer which can then be saved to a user-defined file (or edited).	Integrated into the write software. Results of the read operation are written into the data buffer which can then be saved to a user-defined file.	Separate program is provided. User defines start address for reading and number of bytes. The data is written directly to a user-defined file.
Data Verify	Menu items for manual verify or compare.	Menu item for manual verify.	Automatically checks only during write operation. (Separate option for manual verify to be added soon.)
Blank Check (makes sure all target addresses in EPROM are set to FF hex)	User can perform at any time from menu.	User can perform at any time from menu.	Automatically performed prior to write operation, with the option to abort if the 'blank check' fails.
User interface	Menu driven. Semi-graphical	Menu driven, semi-graphical.	User is lead through an automatic sequence of text prompts leading to write operation.
Documentation/Help	separate text file	On line (F1 key)	separate text file
Ordering Details (including packing and postage)	**$13 ($15 for overseas) David Jones Tronnort Technology 12 Copeland Rd Lethbridge Park NSW 2770 Phone/Fax (02) 6281223**	**$10 ($15 for overseas) Ron Brandse Double Dutch Electronics 1/56 Spring St Thomastown Vic 3074 Phone (03) 4659270**	**$10 ($15 for overseas) Glenn Pure 66 Crozier Cct Kambah ACT 2902 Phone (06) 2316457**

Table 1: After evaluating all three of the software drivers, including his own, the author provided this table summarising their respective strengths and weaknesses. All three are much easier to use than the original software.

store the results. It also includes the same capability found in the write software to read individual address locations in an EPROM and display them on screen.

Tronnort's package

This software, by David Jones of Tronnort Technology, will appeal to many users because of its comprehensive user interface. It is an integrated package, containing both read and write software in a single module, plus a number of other features including a hexadecimal editor (for those who are game enough to directly modify bytes in a file).

When you receive your disk from David, you will find a similar selection of files to those included with my software, except that the source code is written in Pascal. The disc also includes some batch files, for automated copying of files from the floppy to the hard disc, and some checksum routines.

The main menu is well laid out and displays a comprehensive range of information — to the extent, in fact, that some people might be initially daunted by it. But with a little usage most users should feel comfortable with it. In fact, David indicates in his user documentation that the interface resembles the ones provided with many commercial EPROM programmers.

Instead of taking users through an automatic sequence of events ultimately leading to the write and verify operation, as my software does, this package is menu-driven. In other words, any task can be performed in any order simply by pressing a 'hot key' associated with a menu item. Some menu selections include:

- **Auto Program or Program**: Writes and verifies bytes to the EPROM (Auto Program performs an automatic blank check first).
- **Read**: Reads the selected address range in the EPROM and writes this to the data buffer.
- **Compare, Verify**: Reads data from the EPROM and checks it against the source data for errors.
- **Edit Data**: Opens a window allowing the user to view and edit bytes, in hexadecimal, in the data buffer (both hexadecimal and ASCII values are displayed).
- **Type Library**: Selects generic device size and programming algorithm to be used. Also allows new device types and programming algorithms, to be added to the library and stored.

The menu choices appear on one part of the screen. Another part shows the current settings that have been selected. This information includes device type, programming algorithm and timing, current source

filename and directory and address information for the EPROM. The bottom of the screen displays a status message indicating whether errors have been detected, or the status and outcome of the most recently selected menu operation.

On startup, the data file that was used at the end of the last programming (or read) session is automatically loaded into the temporary buffer for viewing, editing or writing to an EPROM. However, it is wise to check the buffer immediately before doing a write operation (simply by using the Display command) as some commands cause automatic erasure of the buffer. For example, selection of a different EPROM type from the device library will cause the buffer to be automatically erased. The buffer then must be reloaded by using the Load command from the menu.

Reading data from an EPROM is simply a matter of setting the desired address range then selecting the 'Read' menu item. Data is read into the software's data buffer, which can then be stored as any user-defined file.

Just a final word on the checksum feature of David's package. A checksum is a single 16 or 32-bit number which is calculated based on the value and address of every byte in the EPROM, using a fancy mathematical routine. A change in any byte in the EPROM is likely to produce a different checksum, and so this can be used to check the contents of an EPROM for corruption without actually knowing exactly what it was programmed with in the first place.

People who might find this feature useful are those who are checking preprogrammed EPROMs and have been given the checksum value and calculation algorithm by their supplier. However, the most reliable method for checking any EPROM is still to do a byte-for-byte comparison with the original source file.

Double Dutch package

This package was written by Ron Brandse and, like the Tronnort package, is menu-driven. However, it is somewhat simpler and easier for a newcomer to follow than the Tronnort software, although less flexible. The package includes the executable file for the integrated read/write software, and the C source code for this.

Like the software by David Jones, this package first reads the contents of the source file into a data buffer prior to writing to an EPROM. Similarly, the buffer is also used as a destination for data during EPROM read operations. Performing a read on an EPROM will erase the contents of the buffer and replace them with the data just read from the device. The buffer can then be saved as any user-defined file.

The user interface consists of a single semi-graphical screen of information which includes:

- All menu commands for opening and saving files, reading and writing EPROMs, etc.
- Current programming or read operation parameters such as start and stop addresses, write cycle timing and device size.
- A window of data currently present in the data buffer, displayed in hexadecimal.

Status information, including any errors detected about write operations, EPROM reads or blank checks is shown in the top right corner of the screen. On-line help for the various selections or menu items can be obtained by pressing F1 (I have to take Ron's word for this, as this feature was not complete in the test version of the software he provided to me). Overall, it is easy to use and functional.

Conclusions

I don't plan to make any recommendations as to which package might be best, as this is very much determined by what your needs might be. The following comments might help though...

The Double Dutch package is the least flexible in terms of ability to alter programming variables, but it is also one of the easiest to follow and use.

The Tronnort software allows the user to have greater control over the programming process, but might be a little more difficult for new users to follow. Nevertheless, this package has the advantage of providing a wide range of features for reading, writing and editing, plus a basic device library.

My own software is the most flexible in terms of being able to control the programming process while at the same time being fairly easy to use, since it takes users through an automatic sequence of events. However, some users may prefer the menu approach and the more graphical screens of the other two software packages. (However, I am planning a significant revision of my software in the near future, to 'jazz' it up.)

Note that all of the packages are likely to undergo changes or improvements in response to comments from users, and may well have new features by the time this review is printed. Hence, it would be wise to make a quick phone call or two before placing an order. Full address details for all three packages are shown at the bottom of Table 1. ❖

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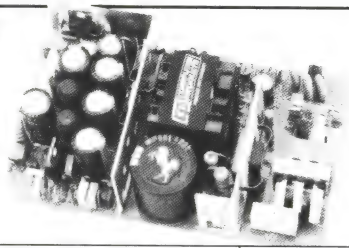
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Model	Output Voltage & Max. Current	Max. O/P Watt	
		Free Air	Forced Air
NFS25-7608	+5.1V,2.0A; +12V,1.5A; −12V,0.2A	25W	–
NFS25-7628	+5.1V,2.0A; +12V, 0.2A; −12V,0.2A	25W	–
NFS40-7607	+5.1V,5.0A; +12V,2.0A; −5V, 0.5A	40W	50W
NFS40-7608	+5.1V,5.0A; +12V,2.0A; −12V,0.5A	40W	50W
NFS40-7610	+5.1V,5.0A; +15V,2.0A; −15V,0.5A	40W	50W
NFS40-7628	+5.1V,5.0A; +12V,0.5A; −12V,0.5A	40W	50W
NFS42-7608	+5.1V,3.5A; +12V,2.5A; −12V,0.3A	40W	–
NFS42-7610	+5.1V,3.5A; +15V,2.0A; −15V,0.3A	40W	–
NFS42-7627	+5.1V,3.5A; +24V,1.2A; −12V,0.3A	40W	–
NFS50-7608	+5.1V,7.0A; +12V,2.5A; −12V,0.7A	50W	60W
NFS75-7608	+5.0V,5.0A; +12V,3.0A; −12V,1.0A	75W	–

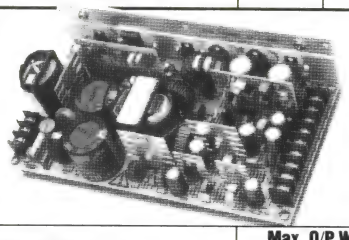
DC-DC Converter

(S) = Single output
(D) = Dual output
(T) = Triple output



Series	Input Voltage	Output Voltage	Max Output Power	Size L x W x H mm
PM600	5V; 12V	5V,0.1A/12V,0.08A(S)	1W	32 x 20 x 10
PM600	5V; 12V	±12V,.04A/±15V,.033A(D)	1W	32 x 20 x 10
A	5v; 12V; 24V; 48V	±12V,0.15A/±15V,0.15A(D)	4.5W	51 x 51 x 10
F	5V; 12V; 48V	5V,1A/12V,0.5A/15V,0.35A(S)	6W	51 x 51 x 10
AFC5	5V; 12V;	5V,1A/12V,0.4A/15V,0.35A(S)	5W	51 x 26 x 10
AFC5	5V; 12V	±12V,0.15A/±15V,0.15A/(D)	5W	51 x 26 x 10
PM900	5V; 12V; 24V; 48V	5V,1A/±12V,0.23A	5.5W	51 x 51 x 10
PM900	5V; 12V;	15V,0.4A/±15V,0.19A	6W	51 x 51 x 10
NFC40	24V; 48V	5V,8A/12V,3.5A/15V,2.8A(S)	40W	56 x 56 x 21
NFC40	24V; 48V	5V,7.5A; ±12V,0.75A(T)	40W	56 x 56 x 21
NFC40	24V; 48V	5V,7.5A; ±15V,0.75A(T)	40W	56 x 56 x 21

Universal Input (90-264VAC) 80W-350W



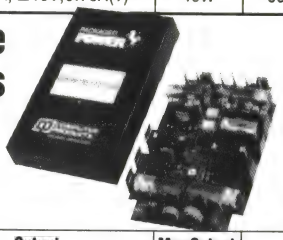
- MTBF > 65,000 hours
- Single output versions available on NFS110 series

Model	Output Voltage & Max. Current	Max. O/P Watt	
		Free Air	Forced Air
NFS80-7602	+5.0V,12A; +24V,2.5A; +12V,3A; −12V,3A	80W	110W
NFS80-7606	+5.0V,12A; +24V,2.5A; +15V,3A; −15V,3A	80W	110W
NFS110-7601P	+5.1V,10A; +12V,5.0A; −12V,1A; −5.0V,1A	80W	110W
NFS110-7602P	+5.1V,10A; +24V,4.5A; +12V,5A; −12V,1A	80W	110W
NFS110-7604P	+5.1V,10A; +15V,5.0A; −15V,1A; −5.0V,1A	80W	110W
NFS200-7601	+5.1V,30A; +12V,8.0A; −12V,4A; −5.2V,6A	–	200W
NFS200-7602	+5.1V,30A; +12V,8.0A; −12V,4A; 24V,3A	–	200W
NFS200-7603	+5.1V,30A; +12V,8.0A; −12V,4A; 12V,4A	–	200W
NFS200-7608	+5.1V,30A; +12V,8.0A; −12V,4A	–	200W
NFS350-7608	+5.1V,50A; +12V,12A; −12V,5A	–	350W
NFS350-7625	+5.1V,50A; +12V,12A; −12V,5A; (Note 1)	–	350W
NFS350-7626	+5.1V,50A; +12V,12A; −12V,5A; (Note 2)	–	350W

Note 1: 4th floating output is adjustable 4.5V-16.5V, 4A
Note 2: 4th floating output is adjustable 15V-30V, 4A
*Absence of "+" or "−" indicates a floating output

Wide Input Range DC-DC Converters

(S) = Single output
(D) = Dual output
(T) = Triple output



Series	Input Voltage	Output Voltage	Max Output Power	Size L x W x H mm
DR	18-36V	5V,0.5A/12V,0.25A(S)	2.5W	32 x 20 x 13
DR	18-36V; 36-72V	±12V,0.125A/±15V,0.1A(D)	3W	32 x 20 x 13
FW	36-72V	5V,1.5A/12V,0.625A(S)	7.5W	51 x 51 x 10
FW	36-72V	±12V,0.315A/±15V,0.25A(D)	7.5W	51 x 51 x 10
NFC15	20-72V	5V,3A/12V,1.25A/15V,1A(S)	15W	51 x 41 x 12
NFC15	20-72V	±12V,0.625A/±15V,0.5A(D)	15W	51 x 41 x 12
ES	18-36V; 36-72V	+5V,1.5A; ±12V,0.31A(T)	15W	76 x 66 x 21
ES	18-36V; 36-72V	+5V,1.5A; ±15V,0.25A(T)	15W	76 x 66 x 21
NFC25	36-72V	+5V,5A; ±12V,1.0A(T)	25W	76 x 76 x 10
NFC25	36-72V	+5V,5A; ±15V,0.8A(T)	25W	76 x 76 x 10
WRU	36-72V	+5V,5A/12V,2.5A/15V,2A(S)	30W	116 x 66 x 21
WRU	18-36V; 36-72V	±12V,1.25A/±15V,1A(D)	30W	116 x 66 x 21
WRK	18-36V; 36-72V	5V,10A/12V,5A(S)	60W	140 x 99 x 23
WRK	18-36V; 36-72V	+5V,5A; ±12V,1.25A(T)	55W	140 x 99 x 23
WRK	18-36V	+5V,5A/±15V,1A(T)	55W	140 x 99 x 23

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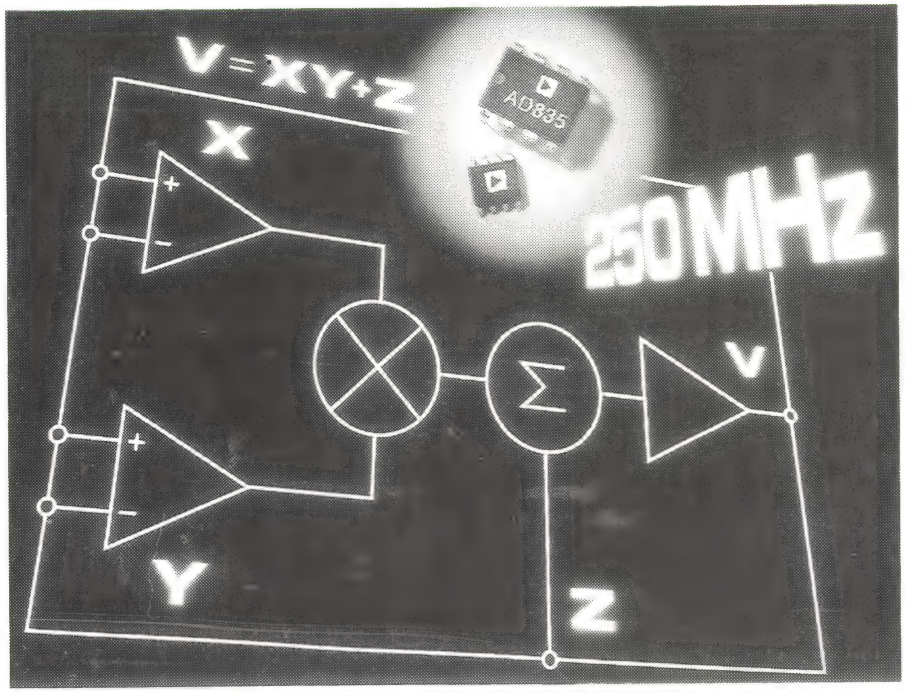
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Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY



250MHz four-quad analog multiplier

Analog Devices has announced its 250MHz four-quadrant voltage output monolithic analog multiplier, type AD835. The device can generate a linear product of its X and Y input voltages with a 3dB bandwidth of 250MHz, which AD claims is 50MHz higher than other available devices.

The small-signal rise time of the device is 1ns, and the full scale (-1V to +1V) rise time is 2.5ns (with a 150 ohm load). Settling time within 0.1% of full-scale is typically 17ns.

The device can perform very high-speed signal multiplication and division, squaring, gain control, modulation and demodulation, as well as phase measurement and detection.

Its differential multiplication (X,Y) and summing (Z) inputs are high impedance nodes that don't need signal conditioning. The output can drive a 50 ohm load to +/-2.5V. The device is suited to a variety of communications signal processing circuits, such as RF gain control, amplitude modulation, voltage controlled filtering and frequency doubling. Video and imaging applications include high-speed keying and channel switching.

For further information circle 274 on the reader service coupon, or contact NSD Australia, 205 Middleborough Road, Box Hill 3128; phone (03) 890 0970.

Instrument amp draws only 350uA

A new general-purpose instrumentation amplifier, type INA118 has been developed by Burr-Brown. It operates with power supplies from +/-1.35 to +/-18V (single supply down to 2.7V), with a quiescent current of 350uA, making the device ideal for battery powered systems.

The IC is suited to applications including bridge, thermocouple, and RTD sensor signal conditioning, laboratory, analytical and medical instrumentation. Its current feedback architecture gives a gain up to 10,000, with a gain of 10 at a bandwidth of 500kHz. A single external resistor sets the gain from 1 to 10,000. Inputs are protected to +/-40V with or without power applied.

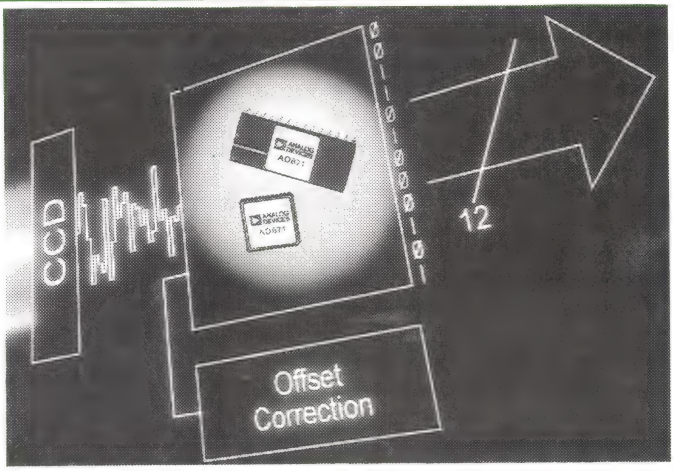
Key specifications include 50uV (max) offset voltage, 5nA (max) input bias current, and 110dB (min) CMRR. The IC is

12-bit ADC runs at 5MS/s

The AD871 from Analog Devices is a 12-bit, 5MS/s analog to digital converter that features a low noise performance at high conversion rates. The RMS noise is 0.16 LSB referred to the input. The ADC is suited to CCD/IR-based image capture and processing applications, as well as general purpose high speed data acquisition and instrumentation.

Image processing applications are especially sensitive to noise, differential non-linearity and distortion, mainly because of the perceptiveness of the eye, and the difficulty in removing these effects. The AD871 features excellent linearity and its guaranteed no missing codes means the signal is free of jumps, glitches or banding.

In CCD systems, the signal usually has a DC offset, which must be removed to capture the full dynamic range of the signal and to avoid saturation. This is done in the AD871 by providing a differential input stage to the data converter, which can be driven by a DAC, under control of the imaging digital circuitry, to null the offset and maximise the converter's dynamic range.



For further information circle 277 on the reader service coupon, or contact NSD Australia, 205 Middleborough Road, Box Hill 3128; phone (03) 890 0970.

available in 8-pin plastic DIP and SO-8 surface mount packages.

For further information circle 275 on the reader service coupon, or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 0824.

Battery powered RS-232 transceiver

The MAX218 is claimed by Maxim to be the first and only dual transceiver to produce true RS-232 output levels when powered from two battery cells. The device can operate from two alkaline, NiCad or NiMH cells and data rates are guaranteed up to 120kbps.

Two receivers are kept active in the 1uA shutdown mode. These receivers can be used to monitor external devices such as a modem that can 'wake-up' the IC when data needs to be transferred. The IC is available in a 20-pin SSOP package, as well as DIP and wide SO packages.

For further information circle 276 on the reader service coupon or contact Veltec, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

Fast SS switch

CP Clare has released a high speed solid state switching device, designated 0AA160. The device is packaged in an 8-pin DIL package (also available in surface mount) and contains two low-leakage form A switches.

The device features a leakage current of less than 25nA, and an output capacitance of less than 3.5pF. The switching speed is no more than 85us. The LED input and MOSFET output are optically isolated and the MOSFET output has a lifetime of more than 15 billion operations.

For further information circle 273 on the reader service coupon, or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766.

Amplifier with on-board opto

Burr-Brown's newly released OPT202 and OPT209 are ICs that integrate a 2mm square photodiode, a precision FET-input transimpedance amplifier and a 1M ohm feedback resistor on a single chip. Photodiode current is converted to an output voltage proportional to the intensity of light striking the photodiode. The bandwidth of the OPT209 is 16kHz and the OPT202 extends to 50kHz.

The devices are suited to industrial applications including medical and laboratory instrumentation, position and proximity sensors, photographic analysers and smoke detectors. By combining the photodiode with the amplifier, problems like leakage current errors, noise pick-up and gain peaking due to stray capacitance are eliminated.

The photodiode responsivity is 0.45A/W at 650nm and its useful response extends to the 300nm ultraviolet range. Other specifications include 400uA quiescent current, 0.05% nonlinearity, and an operating voltage of between +/-2.25 to +/-18V.

For further information circle 278 on the reader service coupon, or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 0824.

16-bit D/A with uP interface

Burr-Brown has released the DAC712, a 16-bit digital to analog converter with a 16-bit digital interface. The device includes an on-board +/-10V temperature-compensated voltage reference, a +/-10V output amplifier and a 16-bit port interface. The device's interface features a 60ns (min) write pulse width, is double buffered and has a 'clear' function that resets the analog output to bipolar zero. The double buffered organisation permits simultaneous updating of several D/As. Gain and offset adjustments can be trimmed by external D/As or by potentiometers. The output amplifier swings +/-10V from dual polarity 12 to 15V supplies. Other specifications of the IC include 13 and 14-bit linearity grades, 14-bit monotonicity and 600mA (max) power dissipation. The device is packaged in 28-pin 0.3" plastic DIP and 28-lead wide body SOIC.

For further information circle 271 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 0824. ❖

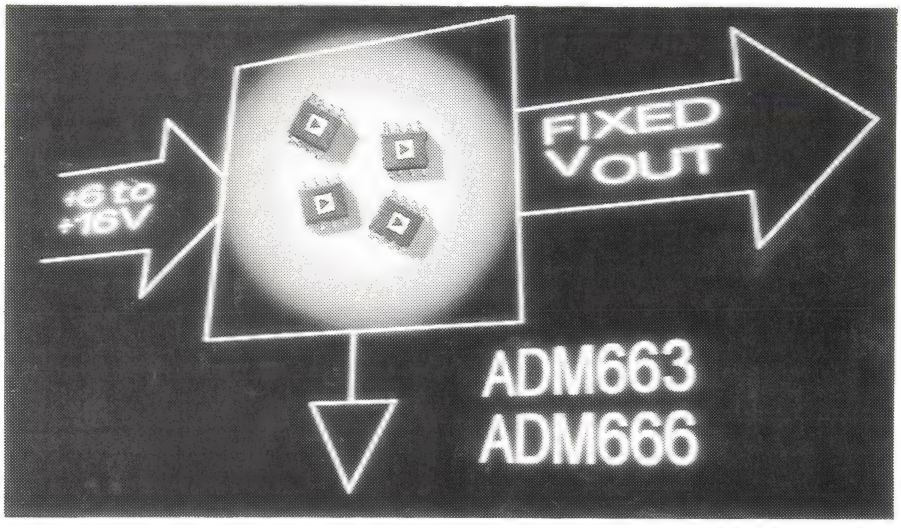
Precision +5V regulators from AD

Analog Devices has recently introduced two +5V voltage regulators, marking the company's entry into the precision regulator field. The devices are the ADM663 and ADM666, and are designed as replacements for the MAX663 and MAX666 regulators.

As precision regulators, they are designed for use in battery powered equipment, test, measurement, computer, audio and telecommunications equipment.

The quiescent current is 12uA maximum, and typically only 6uA. Both regulators can carry more than 40uA, enough to drive an external pass transistor directly. The devices are available in 8-pin plastic DIP or 8-lead SOIC.

For further information circle 272 on the reader service coupon, or contact NSD Australia, 205 Middleborough Road, Box Hill 3128; phone (03) 890 0970.



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READER INFO NO. 38

Power Supplies & Conditioners Feature:

New UPS models from Upsonic

Already well established globally as a market leader in uninterruptible power supplies for computers and similar equipment, Upsonic has just enhanced its position further by releasing a new range of 'A-Series' models. There are six new models specifically designed for workstations and PC's, five for sensitive LAN components such as routers, and five 'true online' models for critical system protection applications.

by JIM ROWE

Four years ago, I reviewed one of the Upsonic low end 'PC Might' range of uninterruptible power supplies for PCs, which had just been released in Australia. The PC Might range set a new standard in cost effectiveness for personal computer UPS's, offering the average PC user what they mainly wanted: the ability to save files and 'back out' of their computer without losing data, in the event of a power failure, at a price significantly lower than previously possible.

The name Upsonic was at that time still relatively unknown in Australia, but its parent company Lumen (based in Taiwan) had been manufacturing UPS's since 1972, and was already one of the leading world suppliers of these products. The main reason why they only became 'visible' in the late 1980's is that before that, their products were all sold to OEM's for sale under their own brands. It was following the wide acceptance of and accreditation of their products by leading computer makers, that they decided to market them under their own brand names as well.



The five members of the 'System True On-line' family in the new A Series range. These 'top of the range' models provide sinewave output plus true on-line operation, as the name suggests.

Since 1990, as you might expect, the company has done anything but stand still. The products are still designed and made in Taiwan by Lumen, but there are now *three* dedicated UPS manufacturing plants which total 540,000 square feet and employ over 500 people. The company is also very proud of the fact that its facilities are accredited to ISO 9000; it was apparently one of the first in Asia to achieve this recognition.

Upsonic is now the 'worldwide master distributor' of the organisation's products, and has facilities in the USA, the UK, China, Germany, South Africa, Japan, Hong Kong and Australia. It claims to have sold around one million UPS products globally to date — an impressive record, in anyone's terms.

The new range

With a total of 16 models in the new 'A Series' UPS range, it's obviously a lot more extensive than the original PC Might series. In fact the new range is made up of three clearly defined product families: the 'Station Standby' models, the 'LAN Intelligent' models and the 'System True Online' models.

The Station Standby models are the most economical of the new A Series, and effectively replace the PC Might series. There's a total of six models in this family, with ratings from 280VA to 2000VA.

Like the earlier models, and as suggested by the name, they are of the 'off line' or 'standby' type of UPS, where the computer or other load is operated normally from the AC mains, and only switches over to the battery/inverter system when there's a mains failure. As with the earlier models this switchover is very fast, though — no more than

four milliseconds, or less than a quarter of a 50Hz mains cycle.

The new Station models also share another characteristic of the original PC Might series: when supplying power from the internal battery/inverter, they provide an AC output of the 'quasi sinewave' type.

In other words, a 'modified square wave' of the type formed by positive-going and negative-going rectangular pulses, with gaps between them to give a rough approximation of a sinewave.

This is a very efficient and cost-effective approach, and as a result the Station models have the most attractive prices — ranging from $357 for the 280VA model to $2490 for the 2000VA model, exclusive of sales tax.

Different enhancements

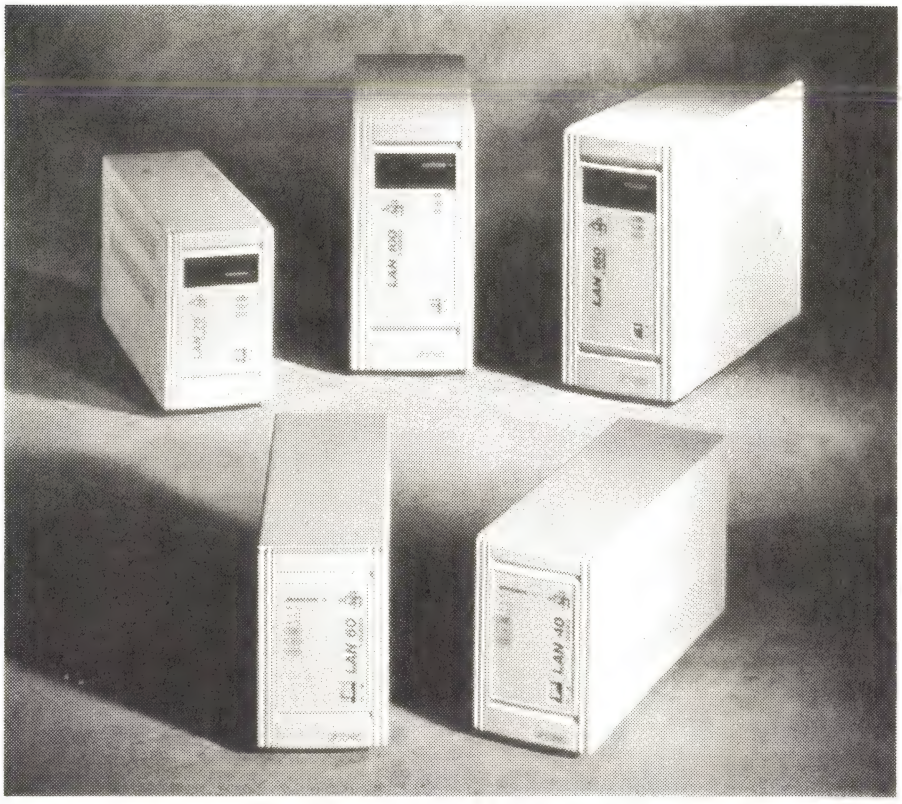
There are quite a few differences between the new Station models and the original PC Might series, but they're all in the nature of enhancements. The lower-power models have a higher power rating, and now all offer a DB-9 computer interface with opto-isolated signalling of 'low battery' as well as AC mains loss, plus the ability to be 'shut down' in response to a command pulse from the computer.

There's now also a 'battery start' button on all models, to allow them to be started up in battery/inverter mode when there's no AC supply present. And finally, the new models are significantly improved in terms of acoustic and electrical noise performance.

Rated audible noise is now only 40dBA for mains operation and 45dBA for battery/inverter operation (around 15dB better than before), while the RFI/EMI performance now meets such standards as VDE871A, IEE 587, IEC 801-2 level 3 and IEC 801-3 level 3.

By the way, the 'hold up' time, or the time that the UPS can supply power to the load from its battery/inverter system when the mains fails, is typically 10 minutes for the Station models. The units 'beep' once a second or so when they're in this mode, to alert the user, and then beep faster near the end when there's only a minute of battery power left. They also turn off cleanly at the end, to prevent equipment damage.

Note that the turnoff point *doesn't* correspond to the battery having been flattened — only that it has been discharged to a safe level for reliable UPS and load operation. The time needed to recharge the battery to 80% from this point is typically four hours, once the AC mains returns.



In the middle of the new Upsonic range are the 'LAN Intelligent' models, which deliver a clean sinewave output but are still of the 'stand-by' type.

Sinewave models

For those who want or need a UPS with 'cleaner' true sinewave output, perhaps for use with critical data communications equipment, Upsonic has produced the 'LAN Intelligent' models. There are five models in this range, still of the off-line type but all offering true sinewave output with a THD of less than 5% at full rated load. Rated load capacity ranges from 400VA to 1500VA.

The LAN Intelligent models offer all of the functions and features of the Station models, but also provide an in-built microcontroller, capable of performing self diagnostics and communicating with the host computer via a true RS-232C serial interface.

As a result they also provide more LED status indicators, especially on the larger models. Of course the sinewave output also provides enhanced RFI/EMI and safety specs. As a result the LAN Intelligent models not only meet all of the standards met by the Station models, but also meet VDE871B, IEC 801-4 level 2 and EN 60950.

Inevitably, though, the additional circuit complexity involved in producing a sinewave output makes these models more expensive, especially for the lower-power units. Prices range from $990 for the 400VA model, up to $2420 for the 1500VA model (again, these are not including sales tax).

The 'hold up' time for the LAN Intelligent models is again typically 10 minutes, with four hours required to recharge the battery to 80% after discharging it to the cutoff point.

The LAN Intelligent models are still of the 'off line' type, of course, where there's a 4ms switchover from mains to battery/inverter operation when the mains fails.

While this is now fairly widely accepted as causing no problems in the vast majority of system applications, some users tend to be nervous about the possibility of their system being reset by switching 'glitches' — especially if they're running high-end file servers and other systems where reliability and uninterrupted operation are crucial. For these users, Upsonic has produced the *third* family in the new A Series: the 'System True Online' models.

As the name suggests, these offer not only sinewave AC output but true on-line operation — where the load is always operating via a 'double conversion' rectifier-battery-DC/AC inverter chain, so there's no load current switching when the mains fails — and hence no switchover time, or risk of 'glitches'.

New UPS models from Upsonic

There are again five models in the System True Online range, with rated load capacity from 600VA to 5000VA. Like the LAN Intelligent models, these models also include an internal microcontroller, giving them self-diagnostic and communications ability. In this case they also feature an 'active bypass' facility, to ensure that when the mains AC returns, the load can still receive full AC power even if the battery has been taken down to 'cutoff' level during the preceding blackout. Needless to say the UPS reverts back to true online operation as soon as the battery has received sufficient charge. The active bypass mode is also used to accommodate loads with high switch-on transients.

Rated 'hold up' time for the System True Online models is typically five minutes at full rated load or 12 minutes at half rated load, with the time necessary to restore 80% of the battery charge again rated at four hours.

Not surprisingly the System True Online models offer particularly good performance in terms of RFI/EMI, surge protection and safety isolation. The three lower-rated models meet VDE 871 class B, while the higher models meet VDE 871 class A — plus of course IEE 587, IEC 555 and EN 60950. All models have a very comprehensive LED or LED/ LCD status display system.

As you'd expect, though, the System True Online models are the most expensive in the A Series range. The 600VA, 1000VA and 2000VA models are priced at $1695, $2695 and $4950 respectively (plus sales tax), with the two largest models designated 'POA'.

Trying them out

Upsonic's Australian office sent us two representative UPS models from the new A Series range, so we could give them an evaluation. One was a Station 60 unit, from the low-end range, while the other was a System 100 unit from the high-end range.

The Station 60 model has a load rating of 600VA/360W, and is therefore the kind of UPS you'd normally use for a fairly substantial single-user PC or workstation. It's a fairly compact unit, measuring 366 x 170 x 114mm, and weighs 13kg.

Tested with a very light 40W lamp load, in battery/inverter mode the unit provided the expected 'quasi sinewave' output — alternating positive and negative rectangular pulses, with a small overshoot spike on their leading edges. The output measured 230V with a true RMS reading meter, but the scope showed a peak-to-peak voltage of nearly 800V. The discrepancy is only to be expected with a waveform of this type, and of course the RMS reading is not all that relevant when the UPS is being used to drive a computer or similar load with a switch-mode supply (which only draws current on the peaks of the half cycles).

The output frequency with the 40W load was a whisker over 51Hz, and when the load was changed to a more solid 350W heater load, it only increased to 51.2Hz. The RMS output voltage fell to 223V, while the peak-to-peak output was 640V.

After allowing the battery to recharge, I tried checking the holdup time — again with a nominal 350W resistive load. The Station 60 supplied power to the load for just over 13.5 minutes, showing that it's rated fairly conservatively. The RMS output voltage fell slowly during that time, reaching 210V just before the cutoff point. The output frequency rose very slightly during the same time, reaching 51.8Hz just before cutoff.

Tried out with a typical 12MHz/286 'AT' level PC system (after again allowing the battery to re-charge), I first tried a random sequence of 20 mains input turn-off/turn-on cycles, to see if the PC could be triggered into resetting. Just as with the earlier PC Might models it didn't trip once, showing that the 4ms switchover time is fast enough to be effectively 'instantaneous' as far as the average PC is concerned.

Finally I did another test of holdup time, this time with the PC as the load. This time the Station 60 held up for just on 20 minutes — more than sufficient for anyone to save their data and 'back out' of their software in a calm and orderly way. In short, then, the Station 60 gave a very good account of itself.

The story with the larger System 100 unit was very similar, only 'more so'. This unit is somewhat larger and more heavy than the quasi-sinewave model, as you might expect, measuring 535 x 253 x 150mm and weighing a hefty 30kg. Here the output proved to be a very clean sinewave, with only the slightest flattening and a faint smidgeon of ripple on peaks. With a 700W resistive load the output measured 240.4V RMS, with the frequency almost exactly 50Hz.

The holdup time of this unit with the 700W load measured seven minutes and 50 seconds, with the output voltage only falling to 238.9V RMS just before cutoff. This is again about 50% better than the rated time, so after allowing the battery to re-charge I tried testing it again with a fairly substantial 486/33MHz system complete with 20" multi-scan colour monitor, desktop scanner and H-P LaserJet 4M laser printer. This resulted in a holdup time of no less than 29 minutes, even when I tried printing out a couple of pages to speed things up (the HPLJ4 draws much more power when printing, than when it's idling).

Needless to say there was no evidence of any switching transients during normal mains-on/mains-off cycling, thanks to the true online operation of this and the other System models.

If you want a really rugged and ultra-reliable 'true sinewave, true online' UPS for your fileserver, then, the System 100 seems an excellent contender. On the other hand, if you simply want to achieve a high level of protection with a standard single-user PC system or workstation, something like the Station 60 would be fine. In both cases your system will keep running in the event of a power failure for more than sufficient time for you to avoid any tragedies...

For further information on any of the new 'A Series' UPS models, contact Upsonic at Unit 1, Block C, Slough Business Park, Janine Street, Scoresby 3179; phone (03) 764 0074, or fax (03) 764 0128. There's also an office in Sydney (phone 416 0643), and in Balcatta WA (phone 240 1933). ❖

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READER INFO NO. 39

Special feature:

Power supplies and conditioning products

225W supplies have four outputs

The Power General FLU4-225 series are four output, 225W enclosed switching power supplies designed to meet international safety standards. The supplies feature autoranging inputs with an input voltage range of 90 - 265V AC (or 200 - 370V DC) and an on-board EMI/RFI filter that exceeds VDE/FCC class B specifications.

Three models provide primary outputs of 5V, +24V, -12V and 5V, or +/- 15V and 5V. Three of the four outputs are adjustable. Standard features include 20 millisecond hold-up time, 5.3kV DC input/output isolation and an on-board input line fuse.

The series provides soft start, indefinite short-circuit protection, overvoltage protection, current limiting and a TTL-compatible power-fail warning signal. Efficiency is better than 65% and the primary output load regulation is 0.5%.

The minimum MTBF is 200,000 hours. Operation is specified over the temperature range of O - +70°C with cooling by natural convection. All models are supplied in a 285 x 64 x 125mm enclosed case with screw input/output terminals and externally available output adjustment controls.

For further information circle 208 on the reader service coupon, or contact Priority Electronics, Suite 4 - 5, 23 - 25 Melrose Street, Sandringham, 3191; phone (03) 521 0266.

BiCMOS power supply controller

Unitrode has released the UCC3889, an IC it claims as the industry's first off-line, transformerless, biCMOS power supply controller that gives 1-2 watts of regulated standby power in step down, bias supply and battery charger applications.

The UCC3889 develops a regulated 12V DC or 18V DC output from a wide input voltage range, typically 100V DC to 400V DC, for off-line applications. Output voltages less than 18V DC can be achieved by employing a simple voltage divider.

The controller uses an innovative topology consisting of two flyback converters in cascade. This technique allows a voltage stepdown from 400V DC to 12V DC with a switching duty cycle greater than 10%.

Also, the number of external components is greatly reduced. The controller needs one switch, three diodes and a few passive components, and operates directly off the AC line. It doesn't need a transformer, and the only magnetics required are two low-cost surface mount inductors.

The control algorithm forces the switch-on time to vary inversely with

Programmable power supplies

Tektronix has introduced four programmable power supply products for users in electronic service, design, education and manufacturing test environments.

The new PS2510 and PS2511 models combine a range of adjustable power output options with keypad testing procedures. Two other models, the Tektronix PS2510G and PS2511G, also have computer connection capabilities, so users can remotely program, control and monitor the supplies.

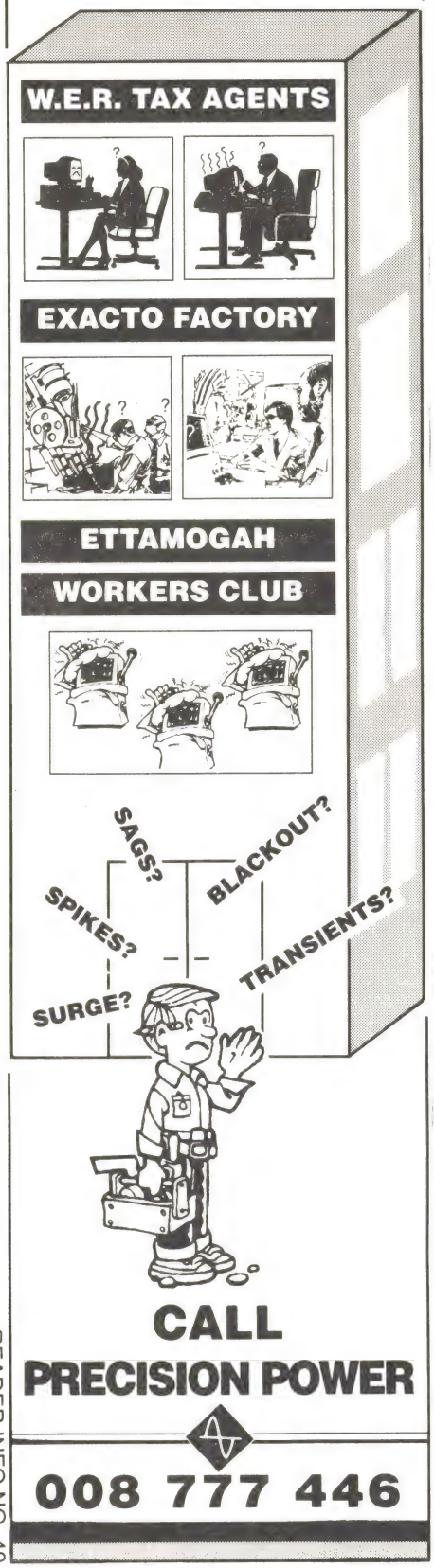
The GPIB-based computer interface supports the SCPI format (industry-standard commands for programmable instruments), allowing the Tektronix power supplies to be incorporated into diverse computing environments. The PS2510 and PS2510G supplies provide an output of 0-36 volts up to 3.5A; the PS2511 and PS2511G have an output of 0-20 volts, up to 7A. All the supplies allow users to program up to 100 different combinations of voltage, current and timing to automate repetitive tests that can help in manufacturing, development, repair, or other processes.

The supplies conform to international safety standards and have been certified by major international safety organisations.

For further information circle 206 on the reader service coupon or contact Tektronix, 80 Waterloo Road, North Ryde, 2113.



POWER PROBLEMS?



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READER INFO NO. 40

the input voltage, and switch-off time to vary inversely with the output voltage, inherently providing voltage feed forward and short circuit protection.

The UCC3889 has a startup current of 150uA and a run current of 1.5mA. Internal control circuitry reduces duty cycle and frequency under low line conditions. Other features include an output capable of sinking 200mA and sourcing 150mA, which provides sufficient power to a MOSFET gate. Package options include 8-pin plastic, 8-pin ceramic and 8-pin SOIC.

For further information circle 209 on the reader service coupon, or contact Priority Electronics, Suite 4-5, 23-25 Melrose Street, Sandringham, 3191; phone (03) 521 0266.

Single output switching supplies

Power General has released a series of single output 80W switching power supplies in compact 100 x 165mm open-framed formats. The supplies, called the FLUI-80 series, are designed to meet international safety requirements.

Features include an input voltage range of 85 to 265V AC, remote sense circuitry for output stabilisation, and an on-board EMI/RFI suppression filter that complies with VDE/FCC class B specifications. Other features are soft start, current limiting, 5.3kV DC input/output isolation and an on-board input line fuse.

Six models provide a DC output of +5V, +9V, +12V, +15V, +24V or +28V. All supplies have extended short-circuit and over-voltage protection and a 32 millisecond hold-up time. Available with the 5V model is a TTL-compatible power-fail warning circuit (active HIGH) with a 5 millisecond minimum interval to shutdown.

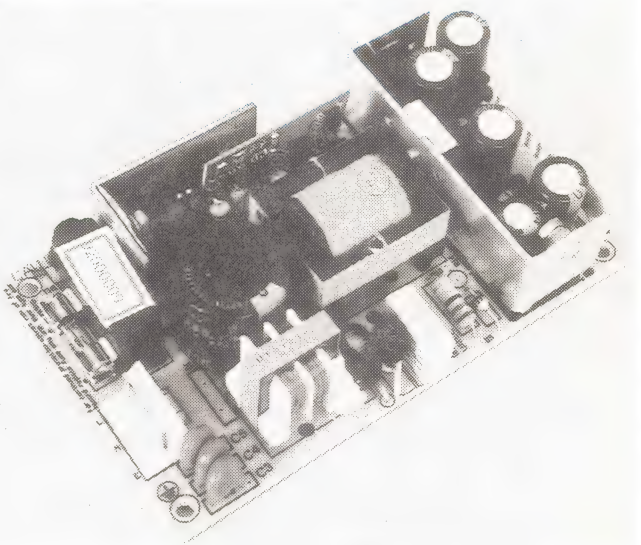
All FLU1-80 supplies are designed to achieve ultra-high reliability. The minimum MTBF (calculated using the parts stress method of MIL-HDBK 217E) is greater that 185,000 hours. Efficiency for the series is nominally 70 - 75%.

Operation is specified over the O - +70°C temperature range with cooling by natural convection. All six models are built on double-sided printed circuit boards and have a maximum component height of 50mm.

For further information circle 204 on the reader service coupon, or contact Priority Electronics, Suite 4-5, 23-25 Melrose Street, Sandringham, 3191; phone (03) 521 0266.

Switch-mode power supply

Universal's UP0403A-01 is a fully Austel approved open-frame switch-mode power supply. It has a universal input of 90-264V AC with 3kV isolation and indefinite short circuit protection, making it attractive for export markets.



The unit meets UL, CSA, TUV and Austel requirements, including VDE/FCC level B EMI filtering.

The device has a footprint of 127 x 76.2mm and is 26mm high. It can deliver a maximum of 40W with outputs of 5V at 3A, +12V at 2A and -12V at 0.5A (triple output model). The unit maintains regulation when the output current is zero.

Other single output models are also available. Input and output is via Molex connectors. This unit is also available in an enclosed plastic case with an IEC connector for input and moulded DIN connector on a fly lead.

For further information circle 202 on the reader service coupon, or contact Alpha Kilo Services, PO Box 180, Lane Cove 2066; phone (02) 428 3122.

Low power biCMOS PWM controller

Unitrode has introduced what it claims as the first biCMOS voltage mode PWM controller IC for use in isolated, high frequency switching power supplies.

The UCC3570 has a startup current of 85uA, a run current of 1mA for efficient off-line operation, and the ability to drive a 1A MOSFET gate at frequencies up to 500kHz. It uses voltage feed forward to give a fast and accurate response to wide line voltage variations, without the noise sensitivity of other methods.

Because of the voltage mode control, the controller features superior performance at light load and minimum input voltage, providing stable PWM operation. Slope compensation is not required, and the circuit contains only one feedback loop instead of two.

Unique to the device is how the voltage feed forward is implemented. The slope of an oscillator ramp is proportional to the input voltage, so that input variations are passed directly to the modulator, bypassing the output filter and error amplifier. The circuit responds within one clock cycle to input line voltage changes, greatly simplifying the loop feedback compensation.

The UCC3570's low power biCMOS processing gives a lower power dissipation, lower junction temperature, longer life, and higher reliability. Additional features include fast current limiting, enabling the device to latch off after a programmable number of repetitive faults has occurred.

For further information circle 207 on the reader service coupon, or contact Priority Electronics, Suite 4 - 5, 23 - 25 Melrose Street, Sandringham, 3191; phone (03) 521 0266. ❖

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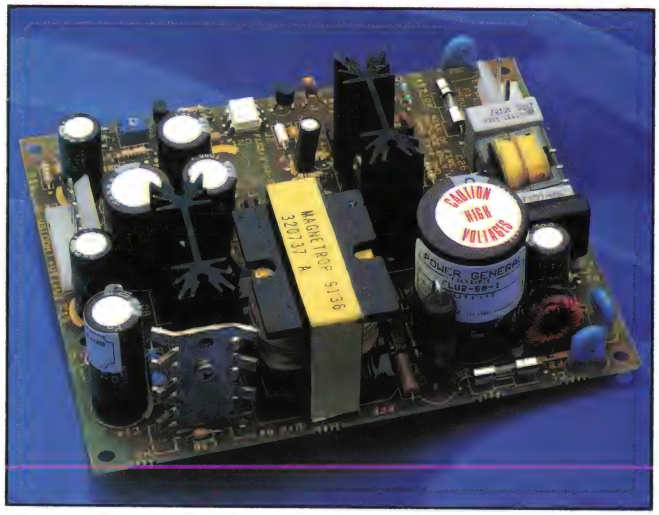
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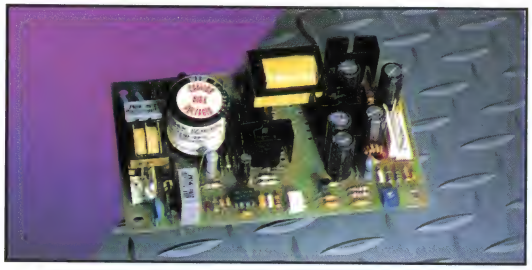
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FLU 2-20 Series

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- UL-CSA-TUV approved
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- 2 year warranty – short circuit protection
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The POWER GENERAL Data Book Listing all product specifications is available on request.

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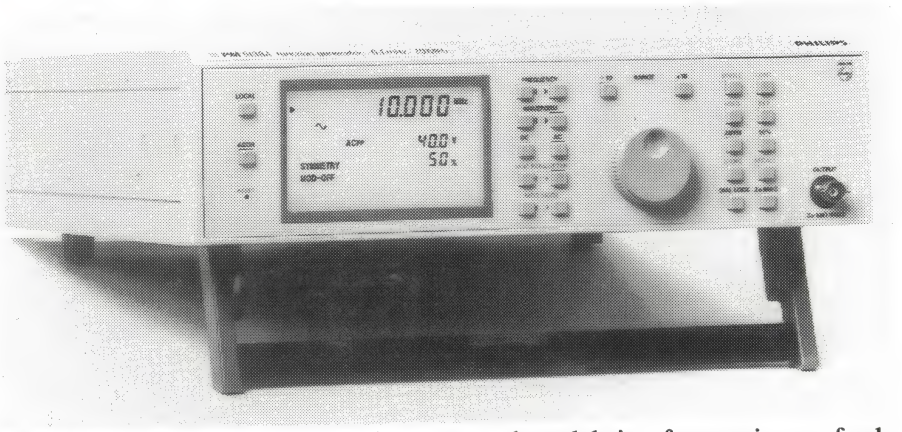
READER INFO NO. 42

NEW PRODUCTS

Function generator with 40Vpp output

Fluke has released a new function generator with a voltage output up to 40Vp-p. Designated the PM 5138A, the generator is ideal for the automotive industry where test signal voltages need to be in the 12-16V range.

Featuring a selectable output impedance between 50 or 600 ohms, the generator allows optimum impedance matching between generator and load. The output of the generator is protected against short circuits and external voltages.



The generator offers a choice of seven standard waveforms. An 'arbitrary' function allows custom test signals created on a PC to be downloaded via the optional GPIB/IEEE-488 or RS-232 interfaces. Using a Fluke digital storage oscilloscope, real life waveforms can be captured and then transferred directly to the PM 5138A, which can then recreate the signal.

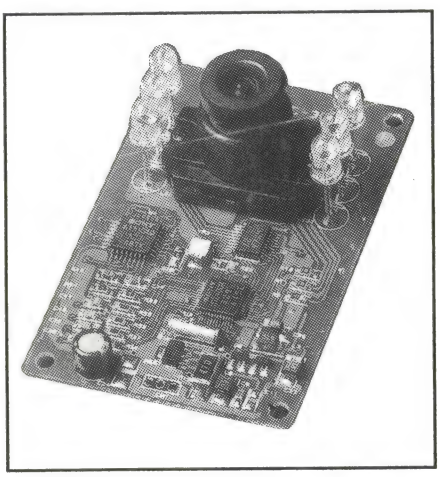
The generator also has extensive modulation capabilities, including AM, FM, PSK, burst, gating, and linear or logarithmic sweep. The modulation source can be internal or external. Internal modulation frequencies are freely programmable in a range of 10Hz to 100kHz.

For further information circle 248 on the reader service coupon or contact Philips Scientific and Industrial, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.

Tiny CCD video cameras

Allthings Sales & Service have released a new and expanded range of CCD Video Camera PCB modules. Their first modules released in 1992 were small at 46 x 70 21mm, however this new range includes a tiny 'Matchbox' sized camera just 32 x 32 x 23mm, with lens and weighing just 20 grams! The modules only require a 12 volt DC supply and can be connected to any standard video input on a TV, monitor, VCR, etc.

Features include Auto-Iris-Exposure with 1/50 to 1/100,000 (10us) second exposure, high resolution 320,000 pixel CCD, vertical reset capability for roll free images when switching between cameras, 8 - 14 volt DC supply range, 100mA max consumption, better than 50dB signal to noise ratio, low light and infrared sensitivity, shock and vibration resistance, standard CCIR PAL 1V p-p composite 75 ohm video output, and low 1.2 watt power consumption. Complete modules are available with wide angle lenses from 2.9 to 4.3mm with a diagonal coverage of 78 to 110 degrees; focus is adjustable from a few millimetres to infinity. Also available are modules complete with infrared light emitting diodes for illumination in total darkness.



The modules are priced from $199.

For further information circle 270 on the reader service coupon or contact Allthings Sales & Services, PO Box 25, Northlands 6021; phone (09) 349 9413 or fax (09) 349 9413.

270V DC 15A latching relay

Kilovac has introduced a 270V DC 15A multipurpose, high reliability power switching relay for space, military, aircraft and underwater applications. Designated the AP44P, the relay is light in weight, small and provides over 2kV isolation across its open contacts.

It is rated for 45A continuous current, with a 60A overload at up to 270V DC. It has a latching actuator, which has 2ms operation and low power consumption. Although the device is a multipurpose relay, it is being used on an earth observation satellite, international space station Alpha and other commercial satellites.

For further information, contact Kilovac Corporation, PO Box 4422, Santa Barbara, CA 93140.

Miniature connectors

Recently introduced by Molex is a range of 2mm wire-to-board connectors suited to a variety of consumer electronics and applications, where miniaturisation gives restricted space for connectors. The system consists of a connector with pre-loaded insulation displacement terminals and a mating shrouded header, for both straight and right-angle fitting to a PCB.

Also available is a cable holder that provides a large target area for assisting with wire insertion into PCB holes, prior to soldering. Polarised for correct assembly into the PCB, the cable holder moves the cable flexure point away from the solder joint to reduce the possibility of fracture.

For further information circle 242 on the reader service coupon or contact Utilux, PO Box 68, Kingsgrove, 2208; phone (02) 50 0155.

Insulated screwdrivers

Cooper Tools has announced the release of its new range of insulated screwdrivers, under the Xcelite brand. Xcelite was founded in 1921 and produces tools known throughout the electronics industry.

The new range includes eight of the most popular sizes, from 2" x 1/8" to 6" x 1/4". Other sizes are a number 1 point Phillips 6", and 3/16" diameter screwdrivers in 4", 8" and 10" lengths.

For further information circle 241 on the reader service coupon or contact Cooper Tools, PO Box 366, Albury 2640; phone (060) 58 0300.

3.2W DC motor

Maxon has recently developed a small, high-efficiency 3.2W DC motor, called the RE016. Coupled with a 16mm planetary gearhead, the assembly measures 16mm in diameter and is 39mm long. The motor uses neodymium magnets and has a low inertia ironless rotor in a moving coil construction.

Precious metals have been used in its brush and commutator segments, to ensure a low starting voltage and to guarantee low contact resistance.

The motor has a claimed efficiency of up to 86% and will operate at speeds up to 7600rpm. The modular system of motor and gearhead provides 150 gearing configurations, with five reduction ratios ranging from 4.4:1 to 1621:1.

The continuous torque rating is 300mN.m, with a short term rating of 450mN.m. The motor is especially suited to battery powered applications.

For further information circle 244 on the reader service coupon or contact M. Rutty and Co, 1/38 Leighton Place, Hornsby 2077; phone (02) 476 4066. ❖

New Electrostatic Safe Soldering Station

THE VERSATILE SA-562E-A

DESIGN FEATURES

- LED heater indication
- Variable temperature control knob
- External calibration ports
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- Flexible, non-burn silicone iron cord sleeve
- Externally fused
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- Closed loop temperature control
- 315°C to 425°C
- Electrostatic discharge safe



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• Heater: Ceramic with Embedded RTD • Cord: 3-Wire, Australian Plug
• Dimensions: 117.5mm x 115mm x 133mm • Shipping Weight: 1.1 kg

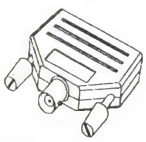
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LOW COST VIRTUAL INSTRUMENTS FOR PCs

The PICO Technology range are unique low cost data acquisition products for IBM PCs and compatibles. Installed in seconds, they simply plug directly into either the serial or parallel port. Each device comes with PicoScope Software (Oscilloscope, TRMS Voltmeter, Spectrum Analyser), PicoLog (Advanced Data Logging software) or both. Also includes C, Pascal and basic drivers to develop your own software.

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- Up to 24kHz Sampling Rate
- Includes PicoScope Software

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ADC-10 with PicoLog $152 + TAX

ADC-11

- 11 Channel, 10 bit Inputs, 0-2.5V
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- Includes PicoScope Software

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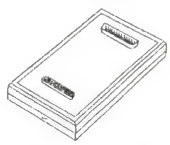
ADC-12

- Single Channel, 12 bit Inputs, 0-5V
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- *Chromatography*
- *Research & Teaching*

ADC-16



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- Includes PicoScope Sofware

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READER INFO NO. 44

Silicon Valley NEWSLETTER



H-P just keeps on rolling...

Hewlett-Packard has reported a quarterly profit of US$347 million on sales of US$6.1 billion. News of the huge profit sent the stock soaring $8.50 a share to US$87.63. H-P's profit was up 28% on a 22% sales gain, for the quarter that ended July 31. The company sold more of its inkjet colour printers in the first half of 1994 than in all of 1992. Even H-P's test and measurement division — which two years ago was bogged down with the problem of converting from defense to mass market customers — reported orders up 29% from the year ago period.

Sales momentum was aided by strong demand for test equipment from the semiconductor and communications industries. Overall, H-P said orders were up 27% from a year ago. The slowest area was medical products, where sales rose 15%.

H-P, the No.1 seller of laser and inkjet printers worldwide, is honing a new market effort aimed at residential computer users. They now are buying half of all H-P inkjet printers, marketed under the Deskjet name. The market has been growing rapidly in response to falling prices.

Cray to develop super spy system

Cray Computers, the struggling spin-off from supercomputer leader Cray Research, has been awarded a US$4.2 million contract by the US top intelligence agency to develop what could be the ultimate spy machine.

The award, by the National Security Agency calls for Cray to develop its 'Cray3/Super-Scalable system', a machine that connects two conventional supercomputer processors with some 500,000 inexpensive special purpose microprocessors that were developed by a government laboratory connected to the NSA.

Although neither the NSA or Cray would specify more details of the deal, it is expected that the spy system will be similar to a system that was recently used by the Colombian government to catch cocaine drug king Pablo Escobar, but much more powerful. That system, provided by the US government, tracked cellular telephone calls in Colombia. The system was programmed to recognise the voice of Escobar who was quickly located when he made a cellular call, and within hours he was mortally wounded in a shoot-out with Colombian police agents.

The new Cray system, analysts speculated, could be used to monitor military and other enemy communications and high speed interpretation of spy satellite photos.

The NSA contract gives a much needed boost to the struggling massively parallel supercomputer industry. Thinking Machines, an early pioneer in MPP systems, has filed for Chapter 11 bankruptcy, and several other vendors have already left the field which is suffering from a lack of broad scale applications software.



At the recent Semicon West Trade Show in San Francisco, GaSonics demonstrated the chip industry's first vertical high pressure chemical processing system — claimed to completely eliminate the use of phosphoric acids for removal of photo resist from the wafer surface.

Software group offers cash rewards

Following the success of a program in Hong Kong aimed at rewarding people who turn in software pirates, a group of US computer software firms is extending the campaign against piracy to Singapore.

Under the program, a cash reward of US$3125 is paid 'for information leading to a successful prosecution of software pirates," according to Bryan Ghows, Singapore vice president of the Business Software Alliance.

The Washington DC based BSA represents several of the largest American producers of software. The BSA estimates nearly US$13 billion is lost each year to theft, out of a global market of US$43 billion. Software theft in Asia was responsible for about US$4 billion of worldwide losses last year. By contrast, counterfeiting in the United States and Canada was judged to have cost US$2.4 billion last year. The worst regional offenders are deemed to be Japan, China, Indonesia, Thailand and Malaysia. Losses in Japan were put at US$2 billion on a piracy rate of 80% of all software sold. China cost US$596 million on a 94% counterfeit rate.

"This new campaign is aimed at people who are concerned about the trade and use of unauthorised software. We hope the reward offer will act as an added incentive for those who wish to uphold the law. The reward applies to people who give us information on end user piracy or people who have pirated software," Ghows said.

IBM to sell art collection

In yet another sign of the lean times at IBM, the Armonk computer giant said it will be selling off the company's corporate art collection, currently valued at around US$45 million. IBM will reportedly auction off most of its collection between now and the end of the year.

The IBM collection was started by

founder Thomas Watson Sr, when IBM purchased about 300 works by American masters. The collection includes some American realist painters such as Edward Hopper and Winslow Homer. Over the past 30 years, IBM has enhanced the collection with abstract works by Robert Motherwell and Helen Frankenthaler.

The art sale was reportedly ordered by IBM chief Louis Gerstner in his continuing effort to raise more cash.

TV chips could bring HDTV quality

Chip maker Zilog has moved to expand its portfolio of chips for the 'Information Superhighway'. The Campbell chip maker announced that it has licensed QD Technology's video enhancement technology, and will jointly develop and market a video enhancement chipset that will be manufactured by Zilog.

These products use advanced digital signal processing techniques to improve the picture quality of a conventional television signal, to a quality that approaches HDTV. Previously marketed for the professional video industry, QD's technology will now be available for the consumer television market.

Ed Sack, chief executive officer of Zilog, said. "We are all eagerly awaiting the day when we can have HDTV in our homes at a reasonable price. In the meantime, the QD technology offers improved video on larger screen TVs to enhance enjoyment of programs where picture quality is an important part of the presentation."

QD's technology converts standard NTSC composite video to near HDTV quality by conditioning incoming signals. Image processing compression eliminates dot-crawl and cross colour to produce a much sharper image. Unlike HDTV, this system does not require a change in broadcast equipment, is available now, and is cost effective.

AMD sues Altera for PLD patent

Advanced Micro Devices has taken a page from Intel's book on stifling competition by filing a lawsuit against Altera — claiming that company's families of programmable logic devices (PLDs) infringe on AMD's patents. San Jose based Altera responded that the lawsuit involving chips which account for 35% of its US$140 million in annual revenue, is without merit and that it will defend itself 'vigorously' against the legal assault.

PLDs are a fast growing segment of the chip industry, which performs repetitive functions for a variety of electronics products ranging from answering machines to displays in fighter aircraft.

W.J. Sanders III, chief executive of AMD, said he prefers to settle intellectual property disputes without litigation but contended that Altera left AMD no alternative except a lawsuit.

Fujitsu buys Lucas multimedia firm

Fujitsu has made several moves to put itself in contention for gaining a position in the market for advanced multimedia and interactive entertainment hardware and services, as the company has agreed to purchase LucasArts Entertainment, one of the companies owned by film maker George Lucas. Following the deal, Fujitsu said it has formed a new division, 'Cultural Technologies' at its US headquarters in San Jose.

LucasArts has developed technology that would allow for the on-line transmission of high quality graphics images over standard telephone lines.

Tatsuzumi Furukawa, who manages Fujitsu's multimedia projects, said Cultural Technologies will use the Lucas Technology to offer sophisticated multimedia on-line services "in advance of switched broadband fibre optic cable infrastructures." Furukawa said Fujitsu expects multimedia products and services to account for as much as 20% of the giant's revenues by 1997. He added that Fujitsu has been a major stronghold in Japan's multimedia market.

The first products from Cultural are expected in 1994 and are likely to be offered through existing on-line services such as America On-line, Prodigy, and CompuServe.

Neither George Lucas or Fujitsu disclosed terms of the deal for the privately held company. Lucas owns or co-owns a number of companies involved in blending computer and entertainment technologies. His best known company is industrial Light & Magic, which provides special effects for many of Hollywood's blockbuster hit movies such as *Jurassic Park* and *Terminator II*.

IDT to put $400M plant in Oregon

Chip maker Integrated Devices Technology has announced its selection of Hillsboro Oregon as the location for construction of a new eight inch wafer manufacturing facility. Plans call for a 190,000 square foot building with a 48,000 square foot class one clean room.

"We selected Hillsboro because of the ideal combination of its location, labour force facility support and excellent environment for employees and their families," said Phil Par, IDT's vice president in charge of the project. "We used a number of criteria to evaluate sites and Hillsboro was clearly the most attractive."

At full capacity IDT will employ 500 to 600 people at the site, and will have invested a total of US$400 million in plant and equipment. The new facility will be capable of producing 30,000 eight inch wafers per quarter.

"IDT is experiencing growth in the markets we service and this facility will ensure that IDT's capacity is sufficient to meet demand for products," said Len Perham, IDT's president and chief executive officer. "Fully equipped, the new facility is projected to more than double our wafer manufacturing capacity and under current business conditions should generate approximately US$400 million in revenue."

Intel announces another chip plant

Continuing its multi-billion dollar spending spree, Intel confirmed it plans to build yet another billion dollar plant. This one will be in operation in Hillsboro in Oregon, by 1998. The company has also announced major new price cuts in the 66MHz side of the Pentium line.

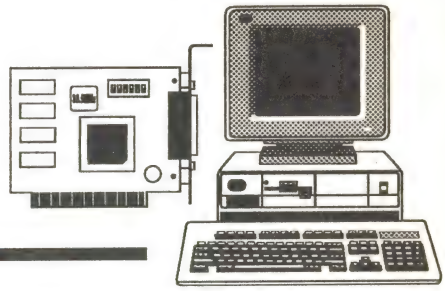
The Oregon plant comes under Intel's expansion program, which calls for spending nearly US$6 billion and creating about 10,000 factory jobs in the next several years. Such spending, including $2.4 billion in 1994 alone, will widen the gap between Intel and its competitors, in Intel's bid to maintain its empire as the world's largest chip manufacturer.

The news came only a week after Intel disclosed that it will expand a plant in Santa Clara with a US$730 million addition. The company wants to double the size of the existing factory and construct a new administration building. The new Oregon plant, estimated at US$1.3 billion, is in addition to the company's plan to invest US$705 million in an existing research laboratory in Aloha, Oreg.

Meanwhile, Intel has announced major price cuts in its Pentium line of processors, a move that will vastly expand the number of Pentium Computers that will retail for less than US$2000. After cutting prices on its entry level 60MHz Pentium chip twice during the recent third quarter, for a total of 38%, Intel has now slashed the price of its 66MHz chips by 30%.

Analysts said the bulk of Intel's price cutting on Pentiums has probably occurred. "I think prices will continue to come down somewhat, but they've already taken the big action on the original Pentiums," analyst Erik Edelstone said. "Intel is trying to make a 'tougher environment to launch your boat into' for its competitors." ❖

Computer News and New Products



Analog LAN tester

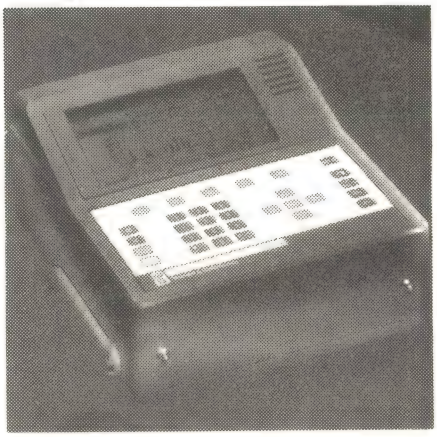
Increasing the useability of a local network for high speed data applications requires ever-increasing test capabilities from LAN test equipment. However, network providers also require the instrument to be portable.

Wandel and Goltermann has announced the launch of the new data line analyser DLA-9 to meet these requirements. This is the latest addition to the company's family of instruments for commissioning, maintaining and troubleshooting analog circuits.

The instrument can be used to test many types of traditional telephone and analog data circuits in the range of 20Hz to 20kHz. As well, the DLA-9 can be used to test circuits for new applications such as high speed data and basic rate ISDN in the range of 200Hz to 200kHz.

Additional applications include commissioning, maintaining and troubleshooting two-wire leased circuits, two-wire switched PSTN circuits and four-wire leased data circuits. The tester can also be used for full channel analog-to-analog measurements on PCM multiplexers, cable selection for ISDN basic rate U-interface and other high speed data applications.

For further information circle 167 on



the reader service coupon or contact Wandel & Goltermann, 42 Clarendon Street South Melbourne, 3205; phone (03) 690 6700.

Barcode and label printers

Astro-Med have announced two new barcode/label printers: models Top Hand 2, a 25mm to 130mm width, 250mm/second high speed label printer, and the Range Boss, a 100mm to 210mm width, 250mm/second high speed label printer.

Both printers feature 300dpi lithographic quality with batch, batch with auto-increment/decrement, and demand operating modes. Most standard bar codes and many fonts are included with the supplied DOS operating software. Windows version software is available as an option.

These new thermal array printers can print virtually any quantity of lithographic quality labels in the office or plant, on a wide variety of substrates such as metallised polyester, plastic and paper.

For further information circle 168 on the reader service coupon or contact Metromatics, PO Box 315, New Farm, 4005; phone (07) 358 5155.

Data control and acquisition software

GENIE is a data acquisition and control software package designed for Microsoft Windows. Its graphical user interface simplifies control strategy and display setups, and lets users quickly develop applications for use with Advantech DAS hardware.

With GENIE's Strategy Editor, users select function block icons from the on-screen library, drag them onto the desktop, then connect them into a flowchart. Each icon represents a complete data acquisition, control or mathematical operation. After the flowchart is laid out, double-clicks on the icons set run-time options such as filenames, alarm limits and PID loop parameters. Data is logged

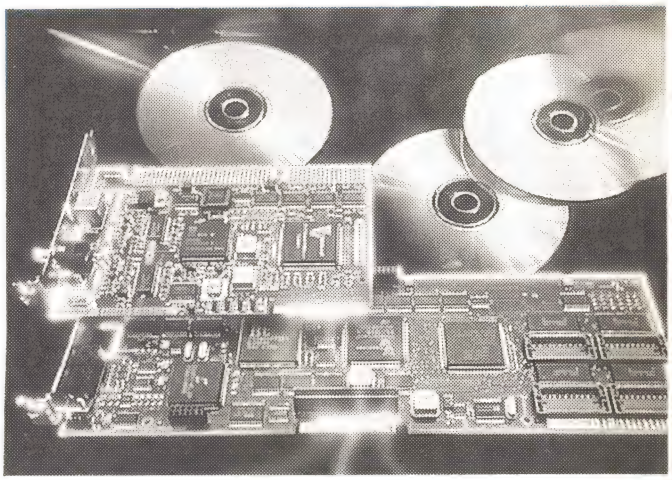
TV quality movies on PC

VideoLogic has introduced a range of new high performance videographics accelerator boards, which allow PC users to take advantage of the growing range of multimedia applications and software movies.

The boards, 928Movie, PCIMovie and MPEG Player are the first of a family of products using technology developed under an IBM and VideoLogic joint development alliance. As well as providing Microsoft Windows acceleration, both 928Movie and PCIMovie employ VideoLogic's PowerPlay32 digital movie accelerator to enable full screen, full motion video playback.

Users can scale postage stamp size video clips up to full screen size without reduction in frame rate or degradation in quality. VideoLogic's PowerPlay32 chip is a proprietary ASIC that improves software video playback (e.g., Video for Windows) by handling multiple video formats, video scaling and Windows management. It applies a patented scaling algorithm called SmoothScale to scale Indeo, Cinepak and Video1 movies to full screen resolutions, while maintaining the frame rate of the original image.

The 928Movie has an optional on board 16-bit CD quality stereo sound system which provides compatibility



with Microsoft Windows Sound System and most other audio systems.

For further information circle 161 on the reader service coupon or contact ACA-Link, 47 Edward Street, Brunswick 3056; phone (03) 388 0477.

SCSI terminator IC

Burr Brown's new REG5601 is an 18-line active terminator that meets all small computer systems interface (SCSI-2) requirements.

On-chip resistors and a 2.9V regulator provide the prescribed 110 ohm termination for low power dissipation and high speed data transmission. It's an alternative device to the popular 5601 SCSI terminator.

The IC can be disconnected from the bus with a single logic control line. Output lines remain high impedance without power applied. Each data line is individually clamped to ground to dissipate negative-going glitches.

Key specifications include: 2.9V current-limited and thermally protected



regulator, power-down mode of 150uA max, and a typical output capacitance in disconnect mode of 10pF.

For further information circle 170 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn, 3130; phone (03) 878 2700.

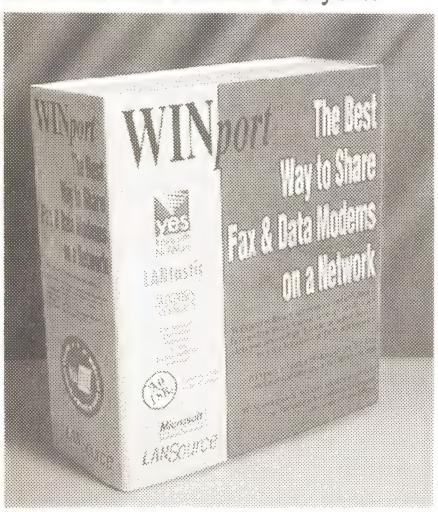
to disk by connecting a file output icon. Viewing of data on the screen in real time is achieved by connecting a display icon.

In the Display Editor, users can create instrument panels, control panels and charts by selecting control icons and dragging them onto the display with the mouse.

For further information circle 164 on the reader service coupon or contact Priority Electronics, Suite 4-5, 23-25 Melrose St. Sandringham, 3191; phone (03) 521 0266.

Fax and modem sharing for LANs

WINport software turns most standard data and fax modems into a shared fax/modem so it can be accessed as if it were attached directly to a DOS or Windows workstation. WINport is both a modem server for data communications and a fax server in one communications platform for an IPX or NetBIOS based network. It makes modems located on any workstation or non-dedicated server on the network available to anyone.



WINport can dial-in or dial-out of the network. On dial-in WINport prompts for selection of the PC to connect to. For dial- out, WINport connects to the first available modem installed on the Network. The program allows sharing of fax/modems installed on a LAN, either with the supplied ViaFAX software or any fax software. System administrators can track fax/modem network user activity, and the 'Spy' or 'Capture' options allow monitoring or diagnosis of communication problems. Pricing starts at $440 RRP for a single fax/modem licence.

For further information circle 166 on the reader service coupon or contact Alloy Computer Products, PO Box 15, Mulgrave, 3170; phone (03) 574 9891.

Large document colour scanner

The new Vidar TruScan CS400 colour scanner can output 24-bit full colour images at 400dpi from documents up to 914mm (36") wide.

The system uses tri-colour CCDs (charged coupled devices) and can dissect the image into user defined colours, or groups of colours. This allows the user to select only the elements of interest from a full spectrum original, such as isolating red-lined annotations from an architectural drawing or picking out highways from an atlas.

The unit can scan a typical AO size document in under one minute at 200dpi and can output greyscale and bi-level formats.

A pie chart display of the spectrum allows users to choose colours, or groups of colours to be captured. This allows the as scanned full colour image to be compressed to any degree from 24 down to four bits per pixel. After establishing

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READER INFO NO. 45

HI-FI
An Introduction

High quality sound reproduction isn't really all that hard to understand, despite the jargon that tends to surround it.

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Federal Publishing Company,
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Alexandria, NSW 2015

colour definitions, extraction is performed in real time as the document is scanned.

For further information circle 165 on the reader service coupon or contact TCG, PO Box 978, Strawberry Hills 2012; phone (02) 698 5000.

Development system for 83C852

Ashling Microsystems has introduced its CT83C852 microprocessor development system. Although it's the smallest 8051 microcontroller in the world, the 6-pin Philips 83C852 Secured Smart Card Microcontroller includes an on-chip cryptographic calculation unit for rapid calculation of asymmetric decryption keys.

This Philips Smart Card Microcontroller addresses hundreds of potential new high volume applications in GSM cards (subscriber identity module), electronic purses, multi-service debit cards, EFT, store cards, set-top boxes, access security, subscription TV, information-on-demand and public health administration (Health Passport).

Developed in cooperation with Philips Semiconductors, Ashling's CT83C852 microprocessor development system provides a complete development-environment for new applications using the 83C852 Smart Card Microcontroller. The system includes an IS07816 format Smart Card probe, probes are also available for the GSM SIM-card (key card) format.

For further information circle 169 on the reader service coupon or contact Metromatics, PO Box 315, New Farm, 4005; phone (07) 358 5155.

LAN cable test set

Structured cable systems are increasingly being installed so networks can operate economically and provide a wide range of services. The cables and components must handle the high data rates (up to 155Mb/s), and the networks must be tested for suitability before put into operation.

To meet this need, Wandel and Goltermann has developed the LCM-5 LAN cable measuring set for determining the physical parameters of balanced and unbalanced cables. The LCM-5 measures the attenuation, near end crosstalk, ACR and impedance of cables and components in the frequency range from 100kHz to 100MHz. Other functions include determining cable length (graphic TDR display), DC resistance, noise, capacity and wire checking.

The LCM-5 consists of a measurement unit, a remote controlled injector and Windows-compatible software. An IBM compatible notebook or laptop PC is required as a controller.

Measurement and evaluation are made using a database which can be used to store user specific instrument settings such as tolerance masks, cable types, test sequences and customer data. This allows the parameters specified in particular standards, (e.g., to demonstrate Category-5 fitness), to be recalled and the measurement made by pressing a button.

For further information circle 163 on the reader service coupon or contact Wandel & Goltermann, 42 Clarendon Street South Melbourne, 3205; phone (03) 690 6700.

Alternative to CD

High performance 3.5" removable cartridge hard disk drives are now available for Unix users. In 105MB or 270MB formatted capacities, these drives provide a removable, expandable storage system for multimedia, desktop publishing and other data intensive imaging applications.

They also provide interchangeability through the use of an embedded servo system and adaptive read channel, and have comprehensive self-diagnostic capabilities and programmable power saving modes.

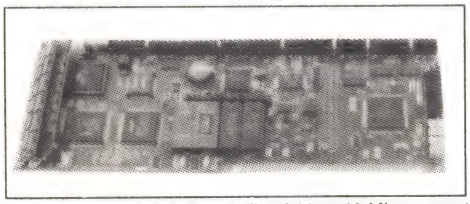
The ANSI ATA/SCSI interface has an access time of 13.5 milliseconds, in a cartridge small enough to fit in a shirt pocket. It offers primary and secondary storage in one drive and a 64KB 'intelligent read' look ahead caching buffer. Data is transferred at the host interface at a rate of up to 4.0MB/sec, and from the head/media interface at up to 2.4MB/s.

The 105MB SCSI disk is priced at $600, and its cartridges cost $135. The 270MB SCSI disk costs $1000 and its cartridge is $200.

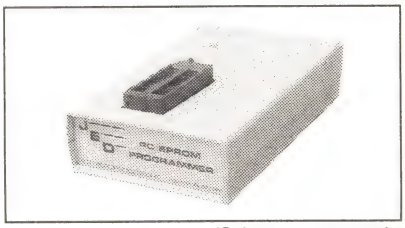


For further information circle 162 on the reader service coupon or contact Graphics Computer Systems, 22 Harker Street, Burwood 3125; phone (03) 888 8522. ❖

Australian Computers & Peripherals from JED... Call for data sheets.



$125 PROM Eraser,complete with timer



The JED AT303/304/305 is a family of 16 to 40 Mhz computers uses 386SX, 486SLC or 486SLXC2 CPUs. It has on-board RAM, PROM or FLASH disks, as well as floppy, IDE and JBUS digital I/O. On board are COM1/2, LPT, KBD. and Mouse ports and optionally COM3 with RS485. Priced from $880 with 1m DRAM. A1 Mbyte FLASH disk is $150.

$300 PC PROM Programmer.

(Sales tax exempt prices)

Need to programme PROMs from your PC?

This little box simply plugs into your PC or Laptop's parallel printer port and reads, writes and edits PROMs from 64Kb to 8Mb.
It does it quickly without needing any plug in cards.

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READER INFO NO. 47

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The Complete Semiconductor Listing – Part 2!

In response to your many requests we are giving a comprehensive listing of the semi's we stock, we suggest you cut this ad out or photocopy for future reference!

Part 1 was last month

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74LS02N	Quad 2 Input NOR	$0.65
74LS03N	Quad 2 In NAND OC	$0.65
74LS04N	Hex Inverter	$0.65
74LS08N	Quad 2 Input AND	$0.65
74LS10N	Triple 3 Input NAND	$0.65
74LS11N	Triple 3 Input AND	$0.65
74LS13N	Dual 4 Inp Schmitt	$0.65
74LS14N	Hex Schmitt Trigger	$0.75
74LS15N	Triple 3 Input AND	$0.60
74LS20N	Dual 4 Input NAND	$0.60
74LS21N	Dual 4 Input AND	$0.60
74LS27N	Triple 3 Input NOR	$0.60
74LS28N	Q 2 In NOR Buffer	$0.60
74LS30N	8 Input NAND	$0.65
74LS32N	Quad 2 Input OR	$0.55
74LS33N	Quad 2 In NOR O.C.	$0.60
74LS37N	Quad 2 In NAND Bfr	$0.60
74LS40N	Dual 4 In NAND Bfr	$0.55
74LS42N	BCD/Dec Decoder	$1.10
74LS49N	BCD-7 Seg Decoder	$2.20
74LS54N	AND/OR/INV Gate	$0.60
74LS55N	DI 4 In NAND Gate	$0.70
74LS74AN	Dual J-K Flip Flop	$0.80
74LS75N	Quad Latch	$1.20
74LS83AN	4 Bit Full Adder	$1.35
74LS85N	4 Bit Comparator	$0.80
74LS86N	Quad Exclusive OR	$0.55
74LS90N	Decade Counter	$1.05
74LS93AN	Binary Counter	$1.20
74LS107AN	Dual J-K Flip Flop	$0.75
74LS109AN	Dual J-K Flip Flop	$0.75
74LS112AN	Dual J-K Flip Flop	$0.75
74LS113AN	Du J-K F/F Preset	$0.90
74LS114AN	Du J-K Pset & Cl	$0.95
74LS122N	Retrig. Monostable	$1.00
74LS123N	Dual Retrig. Mono	$0.90
74LS125AN	Tri-State Qu Bufr	$0.60
74LS126AN	Tri-State Qu Bufr	$0.90
74LS132N	Qu Schmitt Trigger	$0.80
74LS138N	Expand 3/8 Decoder	$0.70
74LS139N	Dual 2/4 Decoder	$0.90
74LS145N	1/10 Decoder Driver	$0.85
74LS147N	10/4 DEC/BIN Enc	$2.30
74LS148N	8/3 Priority Encdr	$6.05
74LS151N	8/1 Mux	$1.00
74LS153N	Dual 4/1 Mux	$0.80
74LS154N	4/16 Decoder	$3.15
74LS155N	Dual 2/4 Demux	$0.55
74LS156N	Dual 2/4 Demux	$0.80
74LS157N	Quad 2/1 Mux	$1.35
74LS158N	Quad 2/1 Mux Inv	$0.80
74LS160AN	4 Bit Dec Counter	$1.30
74LS161AN	Preset Binary Cntr	$0.70
74LS163AN	Preset Binary Cntr	$0.75
74LS164N	8 Bit Shift Register	$0.80
74LS165N	8 Bit Shift Register	$1.00
74LS166N	8 Bit Shift Register	$1.65
74LS169AN	Up/Down Bin Cntr	$2.10
74LS170N	4x4 Register Files	$0.65
74LS173AN	Quad D Latch	$0.80
74LS174N	Hex D Flip Flop	$1.05
74LS175N	Quad D Flip Flop	$1.05
74LS190N	Up/Down Dec Cntr	$1.35
74LS193N	Up/Down Bin Cntr	$1.00
74LS194AN	4 Bit Universal S/R	$1.05
74LS196N	Dec/Biquinary Ctr	$1.90
74LS221N	Dual Monostable	$1.05
74LS240N	Tri-State Octal Bufr	$1.05
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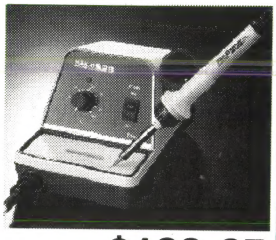
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The Hakko 926 is a super-quick heat-up (3 sec cycle) and fast recovery iron. The built-in ceramic heater maintains temperature to within 0.5°C of the setting. Yes this is an ADJUSTABLE temperature iron covering the range from 200°C to 480°C using a full wave zero-crossing switching system. Meets MIL-STD-2000 and operates at safe 24V.

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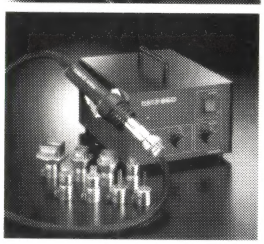
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Specially designed for multi-layer boards and heats soldered joint with great efficiency. Powerful suction – 500mm Hg achieved in 0.3sec with special filter to limit passage of flux and solder. Safety is ensured by the use of static dissipating materials and zero-crossing switching. The 470 provides optimum heat transfer with minimal loss.

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The LM1203 is a wideband video amplifier used in many high resolution colour monitors. In adddition to three matched video amplifiers (70MHz @ -3dB) it also contains three gated differential input black level clamp comparators for brightness control and three matched attenuator circuits (±0.1dB) for contrast control. There's provision for independent gain control of each video amplifier as well as a video input voltage reference.

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TEA2000 PAL/NTSC Colour Encoder

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CQ...CQ...CQ

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MEDICAL LASER: One only water cooled medical laser with selectable outputs: Argon (7W multiline) or Dye laser (1W red). Large water cooled unit with a separate control box and accessories (350kg): **$15,000.**

REEL TO REEL TAPES New studio quality 13cm-5" Agfa (German) 1/4" reel to reel tapes in original box, 180m-600ft: **$8 ea.**

DIE CAST BOXES These large (187x120x56mm) aluminium diecast boxes have several holes drilled in them and have a C&K toggle switch and a 6.25mm phono socket fitted. New units from an unfinished production project: **$4 ea**.

DOME TWEETERS Small (70mm dia, 15mm deep) dynamic 8 ohm tweeters, as used in very compact high quality speaker systems: **$5 ea.** We also have some 4" woofers: **$5**

WELLER SOLDERING IRON TIPS New soldering iron tips for low voltage Weller soldering stations and mains operated Weller irons. Mixed popular sizes and temperatures. Specify mains or soldering station type: **5 for $10.**

SIEMENS VARISTORS 420V AC 20 joule varistors suitable for spike protection in Australian 3-phase systems: **10 for $5**.

40mW IR LASER DIODES New famous brand 40mW - 830nm IR laser diodes, suit medical and other applications: **$90**, constant current driver kit to suit: $10. **LOW COST 1-2 CHANNEL UHF REMOTE** A single-channel 304MHz UHF remote control with over 1/2 million code combinations. Can be expanded to give two channels. The low cost design includes a complete compact keyring transmitter kit (includes case and battery), and a PCB and components kit for the receiver (includes 2A relay contact output!) Tx kit **$10**, Rx kit **$20** additional components to convert the receiver to 2-channel operation (extra decoder IC and relay) **$6.**

INCREDIBLE PRICES COMPLETE SINGLE CHANNEL Tx-Rx KIT: $30, COMPLETE 2-CHANNEL Tx-Rx KIT: $36, EXTRA TRANSMITTERS: $10.

LIGHT MOTION DETECTORS Small PCB assembly based on a narrow angle lens, and even a siren driver circuit that can drive an external speaker. Will detect humans crossing a narrow corridor at distances up to 3 metres. Much higher ranges are possible if the detector is illuminated by a remote visible or IR light source. Can be used at very low light levels, and even in total darkness: With IR LED. Full information provided. The IC alone is worth $16! OUR SPECIAL PRICE FOR THE ASSEMBLY IS: **$5 ea** or **5 for $20**

FIBRE OPTIC TUBES These US made tubes are from used equipment but in excellent condition. Have 25/40mm dia fibre-optically coupled input and output windows. The 25mm tube has an overall diameter of 57mm and is 60 mm long. The 40mm tube has an overall diameter of 80mm and is 92mm long. Their hign gain allows them to produce a good image in approximately 1/2 moon illumination, when used with a suitably 'fast' lens, but they can also be IR assisted to see in total darkness. Our HIGH POWER LED IR ILLUMINATOR kit, and the IR filter are both suitable for use with these tubes. The superior resolution of these tubes makes them suitable for low light video pre-amplifiers, wild life observation, and astronomical use. Each tube is supplied with an 9V powered EHT power supply kit. INCREDIBLE PRICES: 25mm intensifier tube and supply kit **$120.** 40mrn intensifier tube and supply kit **$180.** We also have a good supply of the same tubes that may have a small blemish (which is not in the central viewing area). Blemished 25mrn intensifier tube and supply kit **$65.** Blemished 40mm intensifier tube and supply kit **$90.**

VIDEO TRANSMITTERS low power PAL standard UHF transmitters. Have audio and video inputs with adjustable levels, a power switch and a power input socket: 10-14V DC/10mA operation. Enclosed in a small metal box with an attached telescopic antenna. Range is up to 10m with the telescopic antenna supplied, but can be increased to approximately 30m by the use of a small directional UHF antenna. INCREDIBLE PRICING: **$25**.

TDA ICs/ TRANSFORMERS We have limited stock of some 20 watt TDA Hi-Fi quality monolithic power amplifier ICs: less than 0.01% THD and TIM distortion, at 10W RMS output! With the transformer we supply we guarantee an output of greater than 20W RMS per channel into an 8 ohm load, with both channels driven. We supply a far over-rated 240V 28V/80W transformer, two TDA1520 ICs, and two suitable PCBs which also include an optional pre-amplifier section (only one additional IC), and a circuit and layout diagram. The combination can be used as a high quality Hi-Fi stereo/guitar/PA amp. Only a handful of additional components are needed to complete this excellent stereo/twin amplifier! Incredible pricing: **$25.** For one 240V-28V (80W!) transformer, two TDA1520 monolithic Hi-Fi amplifier ICs, two PCBs to suit, circuit diagram and layout. Some additional components and a heatsink are required.

GAS LASER SPECIAL We have a good supply of some He-Ne laser heads that were removed from new or near new equipment, and have a power output of 2.5-5mW: very bright! With each head we supply a 12V universal laser power supply kit for a ridiculous TOTAL PRICE of: **$89**

BIGGER LASER We have a good, but LIMITED QUANTITY of some 'as new' red 6mW+ laser heads that were removed from new equipment. Head dimensions: 45mm dia by 380mm long. With each head we include our 12V Universal Laser power supply. BARGAIN AT **$170** (6mW+ head & supply ITEM No. 0225B.) We can also supply a 240V-12V/4A 5V/4A switch mode power supply to suit for $30.

12V-2.5W SOLAR PANEL SPECIAL These US made amorphous glass solar panels only need terminating and weather proofing. We provide terminating clips and a slightly larger sheet of glass. The terminated panel is glued to the backing glass, around the edges only. To make the final weatherproof panel look attractive some inexpensive plastic L angle can be glued to the edges with silicone glue. Very easy to make. Dimensions: 305x228mm, Vo/c: 18-20V, Is/c: 250mA. SPECIAL REDUCED PRICE until the end of '94! **$20 ea. or 4 for $60.** Each panel is provided with a sheet of backing glass, terminating clips, isolating diode and instructions.

A very efficient switching regulator kit is available: Suits 12-24V batteries, 0.1-16A panels, **$27**. Also available, a simple and efficient shunt regulator kit, **$5**.

CCD CAMERA Monochrome CCD camera which is totally assembled on a small PCB and includes an auto iris lens. It can work with illumination down to 0.1 lux and is IR responsive: can be used in total darkness with infra red illumination. Overall dimensions of camera are 24 x 46 x 70mm and it weighs less than 40 grams! Can be connected to any standard monitor, or the video input of a VCR. ON SPECIAL: **$239**

SPECIALS BY FAX

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IR 'TANK SET' A set of components that can be used to make a very responsive infra red night viewer. The matching lens, tube and eyepiece sets are from working military quality tank viewers. We also supply a very small EHT power supply kit that enables the tube to be operated from a small 9V battery. The tube is probably the most sensitive IR responsive tube we have ever supplied. The resultant viewer requires low level IR illumination. Basic instructions provided. **$140** for the tube, lens, eyepiece and the power supply kit

SINGLE-CHANNEL UHF REMOTE CONTROL: S.C. Dec. 92, 1 x Tx plus 1 x Rx $45, extra Tx $15.

4-CHANNEL UHF REMOTE CONTROL KIT: Two transmitters and one receiver, **$96**.

GARAGE DOOR - GATE REMOTE CONTROL KIT: Tx $18, Rx $79.

1.5-9V CONVERTER KIT: $6 ea. or 3 for $15.

LASER BEAM COMMUNICATOR KIT: Tx, Rx, plus IR laser, $60.

MAGNETIC CARD READER Professionally assembled and cased unit that will read information from plastic cards, needs low current 12V DC supply plugpack, **$70**.

SWITCH MODE POWER SUPPLIES: Mains in (240V), new assembled units with 12V - 4A and 5V - 4A DC outputs, **$32**.

ELECTRIC FENCE KIT: PCB and components, includes prewound transformer, **$28.**

HIGH POWER IR LEDs: 880nm / 30mW / 12deg. @ 100mA, 10 for $6

PLASMA BALL KIT: PCB and components kit, needs any 240V light bulb, **$25**.

MASTHEAD AMPLIFIER KIT: Two PCBs plus all on-board components: Low noise (uses MAR-6 IC), covers VHF-UHF, **$18**.

BRAKE LIGHT INDICATOR KIT: 60 LEDs, two PCBs and ten resistors, makes a very bright 600mm long, high intensity red display, **$30**.

IEC LEADS: Heavy duty 3-core (10A) 3m leads with IEC plug on one end and an European plug on the other, **$1.50 ea. or 10 for $10**.

IEC EXTENSION LEADS: 2m long, IEC plug at one end, IEC socket at other end, **$5.**

MOTOR SPECIAL: These motors can also double up as generators. Type M9: 12V, I no-load = 0.52A - 15,800 RPM at 12V, 36mm dia, 67mm long, **$5**. Type M14: made for slot cars, 4-8V, I no-load = 0.84A at 6V, at max efficiency I = 5.7A - 7500 RPM, 30mm dia, 57mm long, **$5 EPROMS**: 27C512, 512K (64K x 8), 150ns access CMOS EPROMs. Removed from new equipment, need to be erased, guaranteed, **$4**.

GREEN LASER TUBES: Back in stock! The luminous output of these 1-1.5mW GREEN laser diode heads compares with a 5rnW red tube! **$490** for a 1-1.5mW green head and a 12V operated universal laser inverter kit.

40 x 2 LCD DISPLAY: Brand new 40 character by 2-line LCD displays with built in driver circuitry that uses Hitachi ICs, easy to drive 'standard' displays, brief information provided, **$30 ea. or 4 for $100**.

RS232 INTERFACE PCB: Brand new PCB assembly, among many parts contains two INTERSIL ICL232 ICs: RS232 Tx - Rx ICs. **$8. 12V FANS:** Brand new 80mm 12V - 1.6W DC fans. These are IC controlled and have four different approval stamps, **$10 ea. or 5 for $40. LENSES**: A pair of lens assemblies from brand new laser printers. They contain a total of 4 lenses which by different combinations - placement in a laser beam can diverge, collimate, make a small line, make an ellipse etc. **$8.**

POLYGON SCANNERS: Precision motor with 8-sided mirror, plus a matching PCB driver assembly. Will deflect a laser beam and generate a line. Needs a clock pulse and DC supply to operate, information supplied, **$25**. **PCB WITH AD7581LN IC**: PCB assembly that among many other components contains a MAXIM AD758ILN IC, 8-bit, 8-channel memory buffered data acquisition system designed to interface with microprocessors, **$29**. **EHT POWER SUPPLY**; Out of new laser printers, deliver –600V, 7.5kV and +7kV when powered from a 24V-800mA DC supply, enclosed in a plastic case, **$16**. **MAINS CONTACTOR RELAY**: Has a 24V - 250 ohm relay coil, and four separate SPST switch outputs, 2 x 10A and 2 x 20A, new Omron brand, mounting bracket and spade connectors provided, **$8. HIGH POWER ARGONS**: The real thing! Draw pictures on clouds, big buildings etc, with a multiline water-cooled Argon laser with a few watts of output. Ring for more details.

ARGON-ION HEADS: Used Argon-ion heads with 30-100mW output in the blue - green spectrum, will be back in stock soon, priced at around $400 for the `head' only, power supply circuit and information supplied.

OATLEY ELECTRONICS

PO Box 89, Oatley,

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Three Firsts for Yokogawa!

First handheld DMM with a safety shutter!

True RMS Reading for Vac & Aac, up to 100kHz

- *Super multi-functions include Temperature, Relative, Frequency, dBm, Data Hold, MIN/MAX Hold, Average and Auto Power Off*
- *Automatic alternate display every 3 seconds of Vac and Hz for convenience*
- *Unique shutter mechanism prevents mis-connection of test leads – Leads can only be connected for current measurement when meter is switched to current ranges*
- *Rugged case and circuitry designed to withstand industrial conditions*
- *ADP mode for use with optional plug-in Adaptors covering Temperature, AC/DC Current, Capacitance and Transistor h_{FE}/ I_{Dss} measurements*



Brief Specifications

Safety:	Based on IEC 348 class II
Display	49999 count LCD
Vdc :	500mV to 1000V (0.07%)
Vac (trms) :	500mV to 750V (0.7%)
Adc :	500µA to 10A (0.3%)
Aac (trms) :	500µA to 10A (1.0%)
Ohms :	500Ω to 50MΩ (0.2%)
Frequency :	10Hz to 999.9kHz (0.05%)
Temperature :	-50.0 to 150.0°C (option)

7544 Series



First AC/DC digital clamp meter with 4000 count display and bargraph!

- *High speed auto-ranging or manual ranging*
- *High speed sampling for 40 segment bar graph display*
- *Average, Temperature test, Max hold, Peak hold functions*
- *Sleep mode to reduce battery consumption*
- *Continuity beeper, Data hold, Diode test and analog signal output functions*
- *Battery or AC adaptor operation*

Brief Specifications

Functions :	AC current, DC current, AC voltage, DC voltage, Resistance, Continuity check, Diode test, Frequency, Temperature, Data hold, Peak hold, Max hold, Average, Sleep mode, Analog signal output
Display :	LCD 3.5 digits, max. reading of 4000 (Hz: 9999) and annunciators
Bar Graph Display :	40 segments
Ranges :	Auto or manual ranging
Aac, Adc :	400, 1000A
Vac, Vdc :	40, 400, 650V
Ohms/Continuity :	400Ω, 4kΩ
Diode Test :	2V
Frequency :	10.0-99.99Hz, 100.0-999.9Hz
Temperature :	-50.0 to +150°C (with optional probe)
Jaw Opening Capability:	55 mm ø or 65 x 18 mm busbar
Withstanding Voltage:	2.5kVac, 1 minute

2343 Series

First pocket DMM with 3200 count display and bargraph!

- *Ultra compact size for one-hand operation*
- *Data Hold function*
- *High speed auto-ranging*
- *High speed sampling: approx. 12 times/ sec. for 32 segment bargraph display*
- *Auto Power Off – doubles battery life*

Brief Specifications

Digital Display :	3.5 digit LCD reading of approx. 3200 and annunciators
Bar graph display :	32 segments
Ranges :	Auto ranging
Vdc :	300mV, 3, 30, 300, 450V
Vac :	3, 30, 300, 450V
Ohms :	300Ω, 3, 30, 300kΩ, 3, 30MΩ
Auto Power Off	The meter is powered off 10 minutes after last operation



7536

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