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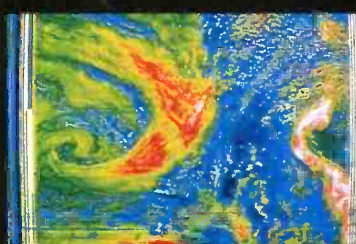

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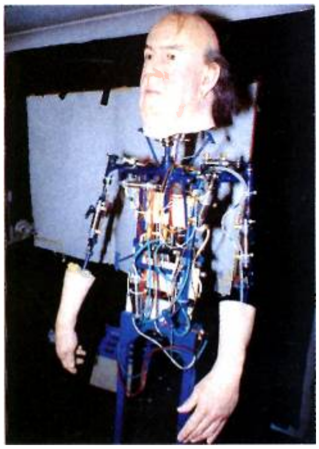
AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Behind the scenes at Warner Bros' Movie World



On a recent trip to the Gold Coast, Barrie Smith learned that many of the 'animatronic' puppets in Movie World's rides and attractions have in fact been designed and made in Australia. Curious, he tracked down their source to Sydney firm Sally Animatronics — and uncovered an interesting story, which he tells this month starting on page 18.

Using your PC to receive weather satellite images

Over the last few months there's been renewed interest in receiving images from weather satellites. This month we feature the first of three articles from Tom Moffat, explaining how to use your PC as the basis for a low cost but high quality receiving setup. The article starts on page 26...

On the cover

Despite its tiny size, Sony's new TCD-D3 'DAT Walkman' recorder offers a standard of performance previously only found in very expensive professional recorders. Louis Challis has just tested this mighty midget, and his review starts on page 8. (Photo by Kevin Ling)

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Projects and Technical

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Columns and Comments

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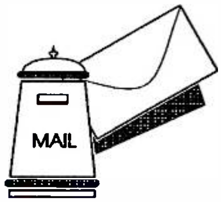
LETTERS TO THE EDITOR



Marantz clarification

I would like to respond to the comments about Mr Marantz contained in the February 1992 *EA* review of the Marantz-branded PM-72 integrated amplifier. It is now 25 years since Mr Marantz (whose given name is Saul, not Sol, as it appeared in the article) was last associated with Marantz-branded products.

The 'gaudy' front panels which Mr Challis remembers date from the 1970's, when Superscope Inc owned the Marantz brand name and used it on mid-fi products made for them at the factory of Standard Radio in Japan —in which they had acquired a substantial interest (the operation is now known as Marantz Japan).

Today, Philips owns the Marantz brand, and it is under the direction of the head of Marantz Japan. Almost all Marantz-branded product is made in Japan, although some lower priced CD players are made in Belgium; all of Mr Marantz's products were designed and built in the US.

There is no corporate continuity between the current owners of the Marantz brand and the original Marantz Co., founded by Mr Marantz, or with the team of engineers and designers he brought together to develop his classic products.

The 'gaudy' front panels are not part of Saul Marantz's body of work, which may be said to span 1952 through 1967, or, to be the Marantz models one through eighteen. Saul's designs for the classic model 7 preamp, the model 9 amplifier and the 10B tuner had faceplates and were anodised in a pale champagne-gold, a very subtle finish that is almost silvery.

Saul Marantz does not only design in gold — his designs for Dahlquist crossovers used a black anodised panel with off-white lettering (in 1972, he was co-founder of loudspeaker manufacturer Dahlquist, Inc., and served as its president until 1978). Most of his new designs for Lineage will use a black and soft silver motif.

The Marantz Co., was never a budget McIntosh; Saul Marantz' products were among the most expensive of their time, with prices that equaled and often exceeded those of McIntosh. It is unlikely that Frank McIntosh's references to 'upstarts' would have referred to Saul, who was a charter member of the Audio Engineering Society in 1948 and was a member of the Board of Directors of the Institute of High Fidelity (IHF). In addition, Saul assures me that he and Frank McIntosh were friendly rivals, and that they frequently socialised at hi-fi shows.

At the Marantz Co., Saul's philosophy was to build the best, not to make 'a better product at a better price' (although this might apply to Dahlquist products during his tenure as President, and is the intended goal of the line of Lineage products to be introduced in 1993).

Today, the classic Saul Marantz products still hold their own sonically. The originals sell in Japan for thousands of dollars and the designs continue to be emulated in Japanese high-end products.

Electronics Australia readers might be interested to know that Saul Marantz served in the US Army transport service out of Australia during WWII, and that he began as an amateur in the audio field.

He had a successful career as a graphic designer and his own firm in New York City before giving it up in his early forties to manufacture his first product; a new kind of separate called a 'control preamplifier', which used an ultra low distribution circuit he developed. He is now 80 and is celebrating the fortieth anniversary of his first product. He has designed, with John Curl, new products for Lineage and is President of the company.

Ed Woodard, Executive VP,
Lineage Corporation,
New York

Comment: Many thanks for your interest, Mr. Woodard, and for clarifying the situation. The impressions gained by both Louis Challis and ourselves, over the years, regarding Marantz, were largely due to what we were led to believe by local representatives.

Young experimenter

I read the section in Forum about young experimenters in the March 1992 issue. I am 17 years old and I am very interested in electronics, and have progressed from modest kits up to making my own PCB's and sourcing parts myself. Yet I fell into a trap!

I commenced a project, a digital thermometer, from a magazine article. I made the PCB, installed the parts. Then I tried to get the main part — the temperature sensor.

None of the electronics stores had it. One spent a great deal of time trying to obtain one for me, but failed.

I then sent faxes to a selection of the bigger electronic warehouses. I never receiver a single reply. I then rang a manufacturer of components — another long distance call — and was told to ring several different places (all over Australia) and I finally found out they are actually still made. YAY!!

Then when I asked where to buy them and how much, I got transferred again, where the secretary (I admit she was very helpful) told me she would find out and ring back.

The next day she rang back and said that they don't have any in Australia, and that they would have to order them from Germany. The minimum order was fifty pieces; I was expected to buy fifty when I only needed one.

I realise I should have checked the availability first, but that's not the point. Everywhere I range I was asked what firm I was with, and when I said I was a student, their interest quickly dropped.

The letter in Forum questions the lack of interest in young people. I would say that young people leave the 'kit' stage, discover how hard it is to get parts and give up in disgust. I won't; I'll take it as a stroke of bad luck and continue my hobby. But the incident has not done much for my enthusiasm.

I have my own oscilloscope and digital multimeter, and I have accumulated quite a few parts. I plan to continue the study/hobby at university. I shall end with a plea — if anyone has a Siemens KTY 10 or Texas Instruments TSP 102 temperature sensor, I'd be glad to buy it off you.

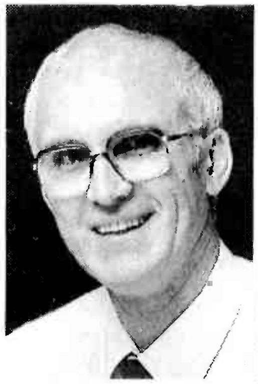
Iain Whyte,
Rockhampton, Qld.

Comment: It's unfortunate that you've had so much trouble getting that sensor device, Iain. It can be very trustrating trying to get single or small quantities of not-too-common parts, even for professionals. According to a recent report from the USA, things are much the same there too. It looks as if dealers and distributors really need to lift their game, doesn't it?

DROP US A LINE!

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

EDITORIAL VIEWPOINT



Australia Post's price hikes: the protest continues

I'm sorry to bring up this subject yet again; normally, I believe a magazine like *EA* should not draw attention to itself and its problems, but concentrate on bringing you information about the world of electronics. My excuse is that Australia Post's price rises aren't just *our* problem. Ultimately they're going to be a problem for *you* as well — particularly if you live in the country.

As well as asking readers to write to their MP, we editors have also written to all of Australia's MPs, protesting against the price rises built into Australia Post's new Print Post service. We wrote to senior executives in AP itself, as well.

Not surprisingly, most of the replies from ALP members said that they were referring the matter to the Minister for Transport and Communications — who, in turn, referred it back to Australia Post itself! On the other hand with a few exceptions, the replies from members of the Coalition have consisted of a two-page letter with virtually identical wording, noting (a) that there is a world-wide reassessment of government involvement in mail services; (b) that it is the Coalition's view that this should also be happening in Australia; and (c) that the Industry Commission is currently conducting an independent inquiry into Australia's postal services, and the Commission's report is eagerly awaited by the Coalition.

Although this third point in the Coalition letter seems to imply that the matter is still under consideration, the reply received from Australia Post's Chairman Mr M.J. Williams makes it quite clear that AP has *no intention* of reversing its decision. One can only wonder, therefore, about the relevance of the Industry Commission's inquiry...

In his letter Mr Williams stresses that under the *Australian Postal Corporation Act* of 1989, AP is 'required to perform its functions in a manner consistent with sound commercial practice and to earn a commercial rate of return on its assets'. One can scarcely argue with the direction regarding sound practice, of course, but presumably the direction to 'earn a commercial rate of return' means that the old idea of providing an important public service has now been superseded by the need to generate revenue.

Mr Williams also claims that the existing Registered Publications service has 'sustained heavy losses for many years', and that these losses 'have had to be subsidised by the users of other postal services'. The Minister has also relied heavily on this same argument, in defending AP's price hikes in the Senate. But don't you find this all a bit glib and convenient? I know I do.

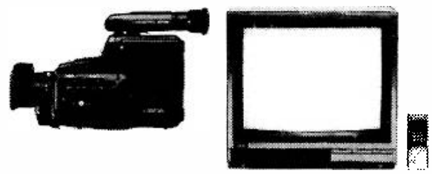
I'd like to see some real evidence, to support that claim of supposed 'heavy losses' and the need for subsidies. If AP makes heavy losses distributing presorted bulk mail that's delivered to its own distribution centres, it must be *incredibly* inefficient.

I also note that AP executives have been doing their best to suggest that under Print Post, price rises will only amount to 'an average of 30-35% across the board'. But this carefully ignores the fact that the new rates are *dramatically* higher for interstate and country deliveries — amounting to a whacking 127% increase for interstate country deliveries! Small wonder that many smaller publishers are seriously considering having to stop offering subscriptions to country readers (the very people who need them most)...

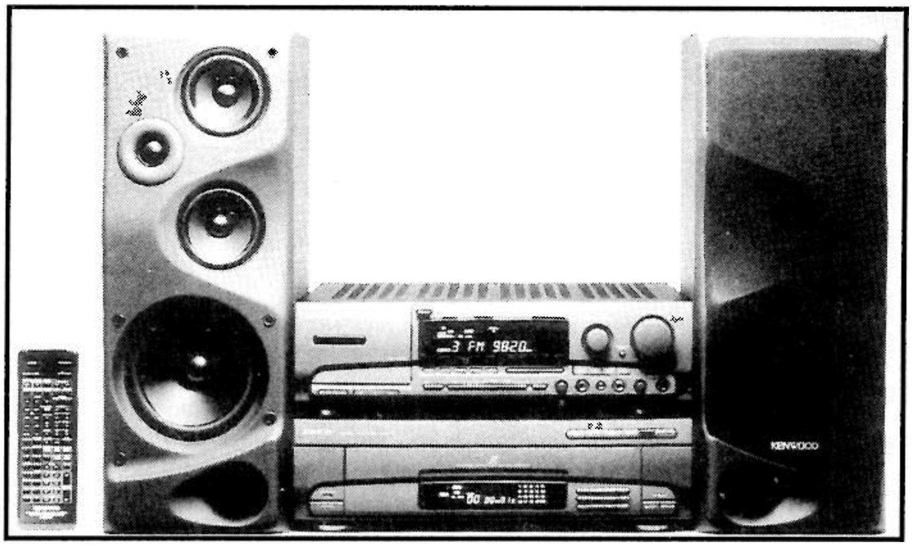
If this concerns you as much as it does me, I'd ask you to write and express your concern to Keith Wright MP, Chairman of the Consumer Affairs Committee in Canberra.

Jim Rowe

What's New in VIDEO and AUDIO



Kenwood reappears in A-V market



Years ago, the Kenwood brand name was well known around the world not only for its car audio, communications products and test instruments, but for its high quality hifi amplifiers and receivers. However although the company continued to make products for the consumer hifi and (later) video markets, for some years these were marketed almost exclusively in its domestic Japanese market. In Australia as in many other international markets, the brandname became associated mainly with amateur radio equipment and test instruments.

Now, however, Kenwood has decided to re-enter the international consumer audio and video markets, and has launched a large range of re-designed A-V amplifiers, receivers, cassette decks, CD players, LaserDisc video players and DAT recorder — together with a complete compact A-V system. It has also demonstrated a prototype write-once compatible CD recorder, which conforms to the newly-finalised Philips Orange Book specification, and is planned for release on the consumer market in early 1992.

The new range of products emphasises Kenwood's traditional committment to high standards of performance and reliability, spanning from the mid-price to the top end of each market area.

A typical example of the new A-V receiver range is the KR-V8540, which provides a total of five power amplifiers — three for left, right and centre front, each with 75W RMS output, and two rear channels each with 15W RMS output. There are also pre-output jacks for an active sub-woofer system.

This receiver incorporates not only Dolby-3 and Pro-Logic surround sound circuitry, but Kenwood's own DSP-logic technology as well — giving an unusually high degree of surround sound flexibility. Three composite video inputs and outputs allow the connection of an external video processor, video dubbing or connection to a video monitor. The synthesised AM/FM tuner has 30 memories, and the unit comes with an IR remote control. The KR-V8540 has an RRP of $1599, and comes with a three year parts and labour warranty.

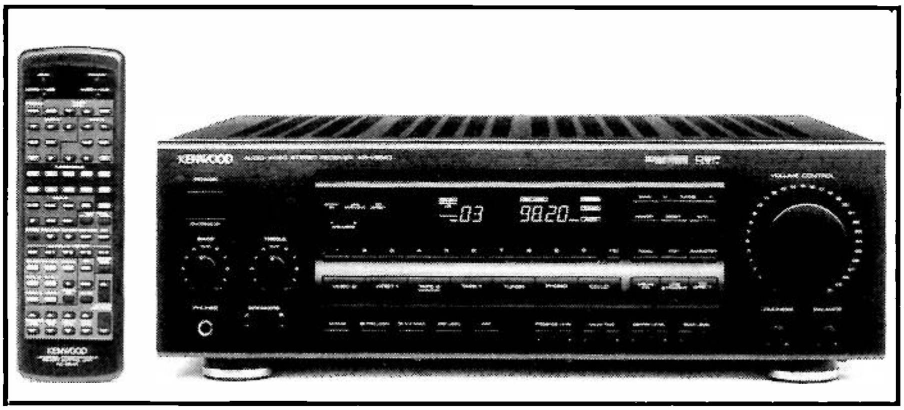
Kenwood's new FV-7 compact A-V system combines a six-channel AM/FM receiver, featuring an integral cassette deck (featuring Dolby B, C and HX-Pro) and both Dolby Pro-Logic and DSP surround sound processing, with an eight-speed laser disc player that can accept all six sizes of CD, CD-V and LaserDisc video discs. It also comes with two compact speaker enclosures which combine three-way front speakers with additional 'surround' speakers.

The FV-7 provides two front power amp channels of 60W each, two 'centre front' channels of 30W each and two rear channels of 30W each. It too is covered by a three-year warranty, and is priced at $3999.

The L-Z14 prototype consumer-market CD recorder demonstrated by Kenwood is fully compatible with standard CD players, using higher power from the scanning laser to change the reflectivity of an organic dye layer inside the green-coloured blank discs, during recording. The system allows a recording time of 64 minutes or more, and tracks on a disc can be recorded at different times until its maximum capacity is reached.

When released early next year, the projected cost of the CD recorder is around $5000. Blank discs are likely to cost between $40 - 50.

The new range of Kenwood hifi and video products are available at selected dealers. For further information contact Kenwood Electronics Australia on (02) 746 1888.



Giant, Seven buy Yamaha 'pro' CDRs

The Giant Production Company, a recording studio in Balmain, Sydney has taken delivery of a Yamaha YPDR601 professional compact disc recorder.

The recorder will be used to produce one-off and limited production runs of custom CD's, on an affordable basis.

The Seven Network has also taken delivery of a Yamaha YPDR601, in addition to an Akai DD1000 magneto-optical digital disc recorder. Both units will be employed during Seven Network's coverage of the 1992 Summer Olympics in Barcelona.

Both the Yamaha recorders and the Akai recorder were supplied by The PA People of Sydney. For further information phone (02) 642 5344.

Sony 68cm CTV uses digital filter

The new Sony KVA2911S 68cm stereo colour television features what Sony describes as a technological leap forward in Trintron picture quality — Black Trinitron Plus.

Central to the very high picture quality of the new set is a special digital comb filter developed by Sony.

This helps to eliminate two perennial threats to picture quality common from analog filters. 'Cross colour', most obviously apparent when thin stripes or colour patterns appear to shimmer on screen, is greatly reduced.

'Dot Crawl' caused by leakage of colour information into the luminance signal, is also dramatically curtailed.

The net result is that colour boundaries are sharply defined, colours themselves are more accurate and picture resolution is substantially improved.

In the KVA2911S, Black Trinitron Plus is teamed with Sony's new Spectrum Sound, which uses special slatted finds to project the stereo sound forward, while the non-directional lower frequencies are allowed to ravel widely into the room.

In addition, Sony has addressed a concern expressed by its customers with a 'reversible' remote control. This features normal buttons which access all functions of the television on one side, and fewer, much larger buttons on the reverse — allowing easy user-friendly access to all regularly used functions even in the dimmest light.

Along with these new innovations, the KVA2911S offers many features from built-in teletext, to front Audio/Video outputs — including an S-Video input for easy connection to a camcorder.

It also has 60 stations preset, on-screen displays and the ability to accept any NTSC (American/Japanese system) video camcorder or Laser Disc player.

The KVA2911S is available throughout the Sony Dealer network at a recommended retail price of $2699.

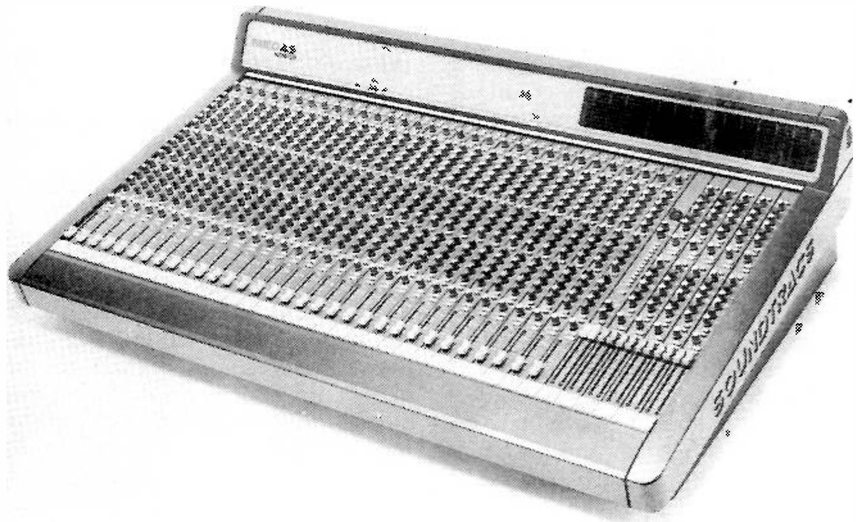
Console for stage monitoring

Soundtracs has introduced the Megas Monitor Console, a complementary product to the Megas Stage console designed for stage monitoring applications. The Megas Monitor is one of a complete new range of low cost consoles from Soundtracs which use the most up to date components, manufacturing methods and audio design technology.

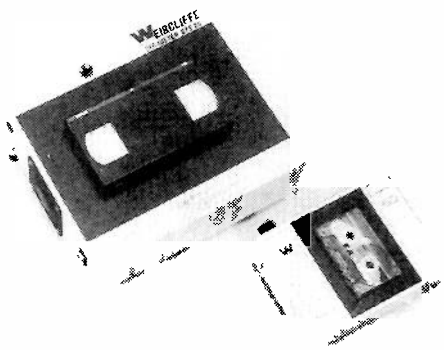
The Megas Mix console offers a choice of three frame sizes which may be loaded with up to 24, 32 or 40 input channels. The Megas Monitor console feature 12 monitor sends for comprehensive stage monitor mixes. In contrast to conventional monitor consoles, all input levels are controlled on linear faders.

All Megas Monitor consoles feature four band EQ on all inputs with a fully parametric EQ on the monitor outputs, and are powered by the Megas Source switching power supply, designed to provide high efficiency with low operating temperatures for enhanced reliability.

Soundtracs professional audio products are represented throughout Australia by Amber Technology. Unit %, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975 1211.



Weircliffe announce economical degausser



The new Weircliffe BTE28 Budget Degausser is intended for the general magnetic media user with the need to erase VHS, audio cassettes, cartridges and reels, data cartridges, and floppy disks, at a budget price.

The BTE28 joins the range of over 200 Weircliffe models and reflects the same high standards of quality and performance for which Weircliffe is renowned in their 25 years of manufacturing.

The BTE28 features a forced air cooling fan and will provide an erasure level of -80dBR.

It is suitable for erasure of media up to a coercivity of 800 oersteds maximum, and has an average throughput of 84 tapes or disks per hour.

For further information, circle 173 on the reader service coupon or contact Amber Technology, Unit B, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975 1211. ❖

SONY'S TCD-D3 DAT 'WALKMAN' RECORDER

This month, Louis Challis had the opportunity to test the very latest Sony 'Walkman' — a full rotary DAT (digital audio tape) recorder, in a compact portable case. As he discovered, its performance is out of all proportion to its modest size...

Just when you thought it was safe to venture back into the hifi store of your choice, Sony upsets the *status quo* and releases the DAT 'Walkman' — a product likely to turn the hifi market on its metaphorical ear! As I sit here writing the start of this review, I'm listening through headphones to this latest of Sony's electronic wonders, and it surely puts every Walkman you've ever seen or heard into the realm of the *passe*.

It's a little more than a month since I wrote about the Philips prototype portable DCC tape recorders that were on show at the Winter CES in Les Vegas. If you read that review, you will realise that the most telling difference between Sony's R-DAT Walkman and its future DCC competitors is that the DAT Walkman uses a rotary head system and relatively straightforward recording and playback electronics, whilst the DCC contenders use a multi-track stationary head system and far more complex electronics.

Of course there are a number of other significant differences, one of the more pragmatic of which being that the Sony DAT Walkman is likely to be on sale in your hifi shop right now, whilst the DCC contender has only just started to reach the factory production lines. But don't hold on to your breath — it may be as much as a year to 18 months before you see the first production models of the DCC recorders.

As you know, the heart of a R-DAT recorder is its tape transport system, which uses a small and extremely well designed and superbly engineered rotary head system, which is very similar to the rotary head in your VCR — but of course much smaller. Obviously the smaller that the tape transport system becomes, then the more delicate and costly it becomes.

As it would appear, the Sony TCD-D3 currently incorporates the smallest rotary head tape transport system that has yet been developed, and although I may have loosely described it elsewhere as a 'toy', such a description is in a practical sense inappropriate. I have used the same term to describe the launches and yachts that some of my well-heeled acquaintances own, as that is the term which their wives also use to describe those costly items.

Head drum size

When Sony released its first battery-operated DAT recorder (the TCD-D10) at the Tokyo Audio Fair in 1987, many people were surprised that they had chosen to incorporate the same basic tape transport system (and rotary head) as they had used in their first consumer DAT recorder — the big mains powered DTC-1000 ES-DAT recorder, which is at least six times the size and more than six times the weight.

It would appear that Sony's management had adopted this conservative approach, as they had baulked at the cost of simultaneously developing a second and somewhat smaller DAT tape transport system.

When I discovered this, I was even more surprised to learn that top management at Matsushita (National/Technics) had taken the opposite approach, and had pushed ahead with the development of a smaller DAT tape transport for *their* portable DAT recorder — which was thus one evolutionary step ahead of the Sony TCD-D10 recorder.

Even though each successive Sony professional DAT recorder released over the next three years incorporated many outstanding new refinements, none of those new DAT tape transport systems was smaller than the Technics model SV-DA10.

Now the TCD-D10, the PCM2000, and I suspect all subsequent Sony DAT machines (until now) all appeared to incorporate a conventional rotary head drum, whose diameter is 30mm. With a head diameter of that magnitude, the designers could get away with a 90° contact angle for the tape on to the rotary drum. But with a dramatic reduction in the size and dimensions of the tape transport system, and particularly with a drum diameter only half of that figure (15mm) an entirely different approach had to be adopted.

As the Sony design engineers soon discovered, the 15mm drum diameter necessitated a 180° angle of contact, which of course generates all sorts of unexpected or unwanted problems. The most critical of those relates to prospective increases in head and tape wear.

To solve those problems, the engineers at Sony had to literally 'turn cartwheels', and as you may have guessed, they have managed to pull a number of rabbits out of the hat to obviate virtually all of those problems that flowed on as a result of their adoption of the tiny 15mm diameter rotary recording head.

Now it's one thing to design and develop a miniature tape transport system, with a natty little rotary head system, but it is a horse of a slightly different hue to miniaturise all the electronics that was initially contained in the DTC-1000ES (which weighed more than 12 kilograms), miniaturise all the functions and components of the TCD-D10 battery operated recorder (which weighed more than four kilograms) and then end up with a DAT recorder which weighs around half a kilogram — and yet provides virtually all the same functions as those recorders. In fact to top it off, they've added quite a few more to boot.

As if that wasn't enough, the TCD-D3 still contains a particularly effective LCD functional display unit. Yet it is small enough to slip into your jacket pocket, or clip onto your belt, so that you can go jogging.

In addition it offers more than twice the

operating time for either record, or straightforward replay that the TCD-D10 offers — Wow!

New LSI chips

How did they do it, you ask? Well the first and most obvious step involved Sony's digital design engineers in the development of some truly outstanding large scale integrated (LSI) circuit chips.

The most important of these cover the D-to-A and A-to-D processing, and the rotary head and tape transport logic control functions. As I discovered from the service manual, these LSI's were also designed to skimp on battery power — so that the recorder can operate on record, or replay, for a full two hours from a single and relatively small Nickel Cadmium battery.

For the recording mode, the TCD-D3 uses two pulse A-to-D chips with 64 times oversampling. In the replay mode it uses a pair of eight times oversampling digital filters and two 18-bit dual converters, to achieve full frequency response. As I subsequently discovered, this is achieved without sacrificing any of its surprisingly good phase linearity or its genuine 90dB-plus of dynamic range.

As if all of this weren't enough, the DAT Walkman also incorporates a Long Play (LP) mode, so that you can conserve tape and literally double the recording time available on each DAT cassette. Admittedly to achieve this flexibility you have to forego a portion of your frequency response — i.e., you only have a 15kHz bandwidth — but this is achieved without losing your 90dB dynamic range or any perceived increase in either the size or complexity of the recorder.

Now over the last 30 years I have laboriously and often painfully lugged portable battery operated professional tape recorders around Australia. The recorders which offered the best performance (such as Nagra IVSJ recorders) typically weigh 20 times as much as the TCD-D3.

In fact because of the need to carry extra batteries, microphones, preamplifiers, spare reels of tape and equally critical items in its front pouch, a Nagra typically weighs in at about 30 times the weight of the TCD-D3.

As I sit at my desk in something of a bemused state, it is apparent that this new DAT Walkman is a 'giant killer'. It offers a frequency response, dynamic range and length of recording time which is infinitely better than any of those other recorders that I have ever owned or used — including all the Nagras, and even the TCD-D10.

As you will find, the DAT Walkman, although only slightly bigger than two packets of cigarettes, provides all of the functional controls and flexibility you'll ever need from a portable recorder.

Control functions

The most frequently used controls — EJECT, REWIND/STOP, PLAY, FAST FORWARD/CUE, PAUSE and RECORD — are located on the front leading edge of the recorder. Although the STOP and PLAY control buttons are reasonably large, all the other controls are fairly small and best suited to those of you who have reasonable manual dexterity. This is not a recorder for the arthritic, or if your hands are large like those of a Sumo wrestler.

On the lower vertical front panel are the POWER ON switch, a pair of buttons for the automatic music search (AMS), the record level control, playback level control, plus buttons for counter mode time, reset, and the START ID. In addition the panel also contains a miniature stereo socket for the headphone plug.

On the left hand side of the panel is a sub-miniature seven pin connection. This remote digital input/output socket is designed to accept a special input/output cable, which allows you to directly record digitally from CD's or other digital sources.

The most novel feature of this socket is that it is suitable for both fibre optic or coaxial electrical cables. As I received no handbook with the unit (only a service manual), not all of these critical issues were fully explained or explored.

On the right hand side of the panel is a

Sony's TCD-D3 DAT 'Walkman' Recorder

A close up of the main control area of the TCD-D3 recorder. The deck control buttons are along the top, while the functional controls such as track search, start ID and recording level are on the front itself.

Along the right hand side of the case are the mike/line input socket, and control switches for input level and recording speed. Also available, as you can see, is a socket for supply of DC to a high quality capacitor microphone.

switch which selects the standard play (SP) or Long Play (LP) recording and playback modes. Below this switch is the miniature stereo socket through which analog line or mic inputs may be connected. The selection of line or microphone source is controlled by a miniature slide switch, and a further switch provides for an additional 20dB of mic attenuation, if required.

As if not to be eclipsed by the professional recorders, a further miniature socket is provided through which a DC supply can be sourced for microphones which require external powering. This feature is one that you'd expect from a PCM 2000, but not from a TCD-D3.

The functional controls are served very well by an unusually clear LCD display, which can be temporarily back lit by pressing the LIGHT button on the front panel. This display shows the program numbers, times, the status of the tape transport, the recording or playback level by means of a calibrated bar graph, or the percentage of maximum recording level.

Last but not least, the battery pack is an unusual rechargeable NiCad battery, which clips onto the recorder or onto its mains operated charger, either independently, or when the power supply is being used to operate the recorder from the mains.

Incidentally, the TCD-D3 offers a choice of three sampling frequencies for record and playback: 48kHz, 44.1kHz or 32kHz. The last of these is used in LP mode, while fairly clearly the 44.1kHz rate is used for direct digital dubbing from a CD.

I should perhaps note here that the recorder incorporates the Serial Copy Management System (SCMS), to limit digital copying to a single generation.

How it performs

If I had any thoughts that the TCD-D3 DAT Walkman would suffer technically by way of comparison with its bigger brothers and sisters in the Sony DAT family, I was soon re-educated during our testing. Not only was the performance good, but in some critical areas it is marginally superior to both the Sony TCD-D10 and the Sony PCM 2000, each of which I have previously tested or reviewed.

As you'll see from the record to replay frequency response curves, the DAT Walkman's performance in the standard play mode is almost ruler flat from 10Hz to 20kHz (+/-0.1dB), is only 0.2dB down at 5Hz, and 3dB down at 2Hz. In the long play mode, the sampling frequency drops to 32kHz and non-linear quantisation is used, most effectively so as to maintain almost the same dynamic range.

The frequency response is still almost ruler flat from 10Hz to 15kHz, where the output drops off — as a result of the extremely sharp anti-aliasing input filter, which blocks the unwanted frequency components like the proverbial 'brick wall'.

When I evaluated the replay frequency response using a pre-recorded Sony DAT test tape, I was gratified to find that the response over the frequency range from 5Hz to 20kHz was even flatter than the record to replay response. The measured response was so close to being a perfectly straight line that it might as well have been drawn by a ruler on the level recorder's chart paper. The replay frequency response is also marginally flatter than either the TCD-D10 or PCM 2000 recorders' response.

Such linearity!

What I did not really expect to find was that, apart from a 0.2dB deviation at -80dB, the record to replay linearity over the full dynamic range was so close to being perfect that it eclipses all the other CD players and DAT recorders that I have so far tested.

With frequency responses as flat as this recorder offers, the only real performance limitations that you face are those associated with the input source, or with your microphones, if you are recording live. As it happens, if you want to achieve source input linearity with microphones that approach the performance capabilities of this recorder, then frankly you will have to spend more money on each of your microphones, than you are spending on your tape recorder.

My testing progressed to an objective evaluation of the LP recording mode capabilities, and I soon discovered that apart from the sharp rolloff at 15kHz (instead of 20kHz), virtually all of the other performance parameters at the low frequency end of the range were almost identical to those of the SP mode.

I again progressed to an evaluation of the record to replay linearity in the LP mode and was gratified to discover that again the performance was almost exemplary, with almost perfect linearity down to -60dB, and a trifle more ripple as we progress to -90dB.

The measured channel separations weren't quite as good as the other objective test figures. The low frequency channel separation is reasonably good, with -73.8dB at 100Hz. At 1kHz this performance is still reasonably good at -70.5dB. By the time the frequency rises to 10kHz, the separation has dropped to - 53.6dB, whilst at 20kHz it is just about acceptable at -47.8dB.

I moved on to the distortion figures, which are predominantly dominated by even-order harmonics between 0dB and -20dB, by which point the THD is still a modest .062%.

Between -30dB and -60dB the odd harmonics start to enter the picture and you can see a gentle rise in the distortion figures, which have climbed up to 0.8% at -60dB, which is significant, but reasonably good.

At input levels below -60dB, the quantisation of noise tends to dominate the distortion picture, and although the distortion is rising, the number of available bits in the signal ensemble neatly intrude and generally inhibit the accurate measurement of the distortion products.

The picture is blurred to a point where it is not wise to attempt to assign true significance to the 'numbers' that are forthcoming. Anyway the distortion is high, but you'd be hard pressed to readily hear it, unless you had badly recorded the programs you'd been collecting.

I examined the data collected at high frequencies, and of course that data dis-

MEASURED PERFORMANCE OF SONY TCD-D3 DAT WALKMAN RECORDER - Serial no. GA-1A7

Frequency Response

Standard Mode	20Hz to 20.0kHz	+/-0.1dB
	2Hz to 22.05kHz	+0.0dB -3.0dB
LP Mode	20Hz to 15.0kHz	+0dB -0.1dB
	2Hz to 15.0kHz	+0dB -3.0dB

Linearity @ 1kHz

TRACK	NOMINAL LEVEL	LEFT OUTPUT	RIGHT OUTPUT
1	0dB	0.0	0.0
22	-1.0	-1.0	-1.0
23	-3.0	-3.0	-3.0
24	-6.0	-6.0	-6.0
25	-10.0	-10.0	-10.0
26	-20.0	-20.0	-20.0
27	-30.0	-30.0	-30.0
28	-40.0	-40.0	-40.0
29	-50.0	-50.0	-50.0
30	-60.0	-60.0	-60.0
31	-70.0	-70.0	-70.0
32	-80.0	-79.8	-79.9
33	-90.0	-90.0	-90.2

Channel Separation - Analog Input

Frequency	Right Channel Into Left dB
100Hz	-73.8
1kHz	-70.5
10kHz	-53.6
20kHz	-47.8

Distortion @ 1kHz

Track Level	2nd	3rd	4th	5th	TDH%
0	-78.1	-	-76.2	-	0.044
-1.0	-75.8	-	-75.2	-	0.055
-3.0	-73.0	-	-81.3	-	0.067
-6.0	76.0	-	-76.6	-	0.052
-10	-72.1	-	-	-	0.073
-20	-74.1	-83.1	-80.5	-	0.062
-30	-83.8	-78.6	-	-	0.029
-40	-	-71.5	-72.4	-70.4	0.076
-50	-66.8	-60.9	-65.6	-61.6	0.26
-60	-53.3	-	-49.8	-	0.82
-70	-	Noise	-	-	-
-80	-	Noise	-	-	-
-90	-	Noise	-	-	-

Distortion @ 100Hz

Track Level	2nd	3rd	4th	5th	TDH%
0	-76.9	-	-76.7	-	0.048
-20	-74.3	-84.9	-80.0	-88.8	0.060
-40	-73.1	-70.4	-73.1	-69.5	0.10
-60	-57.6	-57.2	-49.0	-56.1	0.76

Distortion @ 6.3kHz

Track Level	2nd	3rd	4th	5th	TDH%
0	-77.1	-90.5	-94.6	-	0.042

Wow and Flutter - Immeasurable

played significantly more distortion than the lower frequencies.

As it happens, the human ear can't readily detect those high frequency distortion products, notwithstanding the lesser number of bits, nor the greater approximations that the Nyquist limits impose. As rough as those high frequency signals may look on a cathode ray oscilloscope, or with a sampling CRO, for audio recording they are quite good enough — in much the same way that they are in the CD format.

I checked the wow and flutter, but as I had expected these were immeasurable. The rotary head recording system automatically corrects for almost any abnormality, so that the end result is a virtually perfect recording.

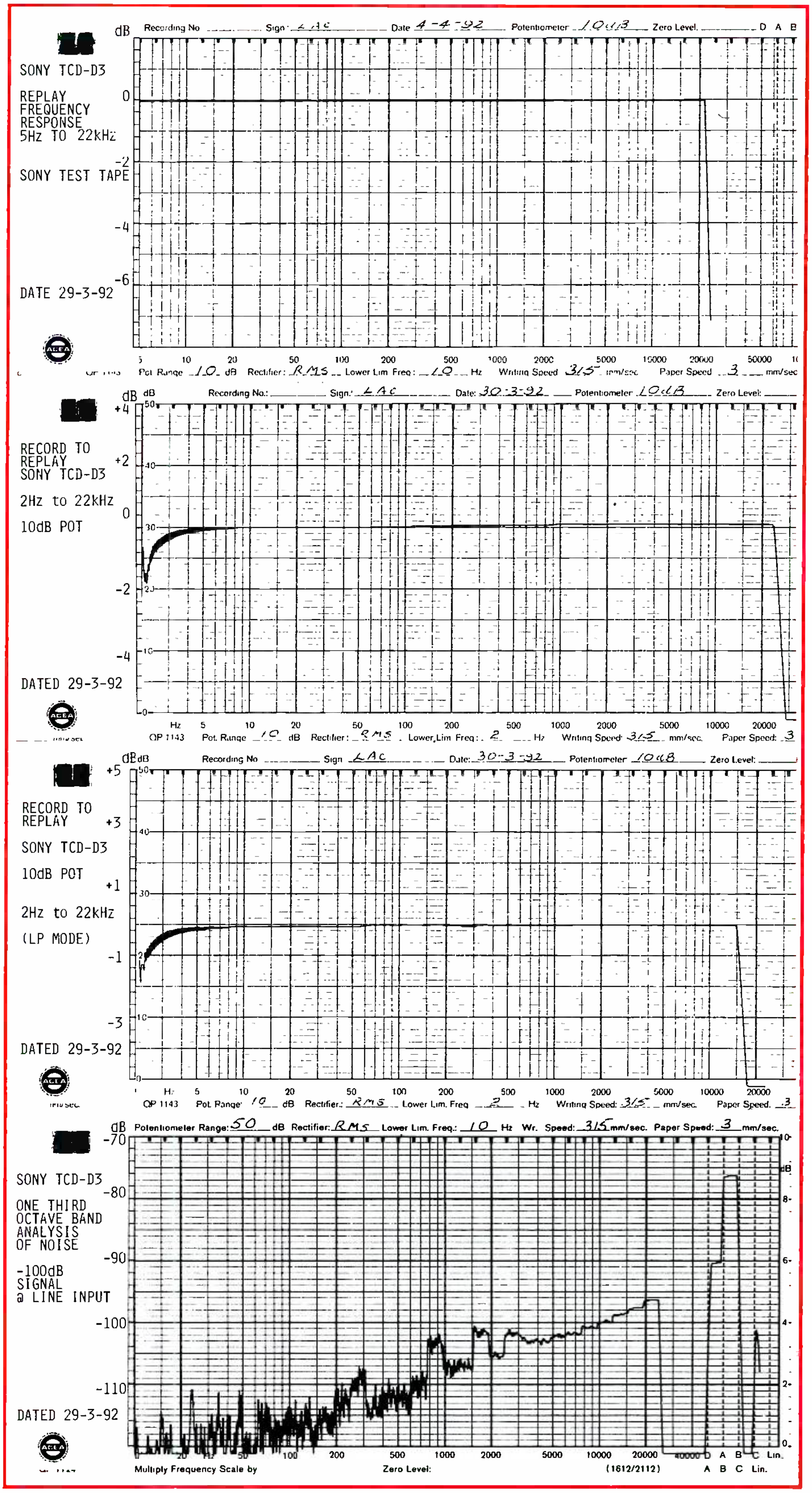
When I measured the one-third-octave band noise figures for the recorder, I was surprised to find that the A-weighted signal to noise was -90dB with respect to 0VU. Which surprised me, as I thought that with 16 bits of resolution to play with, we should have achieved something reasonably close to 96dB of dynamic range. I decided to check where the recorder's *real* limit actually exists. Lo and behold, Sony has placed the peak recording limit precisely +6dB above the 0dB/VU indication — i.e., one whole bit up the scale. With the peak limit that far up the range you are less likely to overload your recorder, because they have literally 'shifted the goal posts'.

Now while that may seem cheeky, it's also reasonably sensible in a machine designed for use by inexperienced people — for whom such limits have no real meaning. The result is that you still have 90dB of dynamic range to play with, together with a further 6dB of headroom to protect you from inadvertent transients (which would sound so disturbing if the A to D processor hits that 'brick wall' recording level limit).

The last test that I conducted was an evaluation of the phase response between the two channels of the tape recorder. The test was relatively straightforward, and it confirmed that the phase characteristics were spot-on all the way up to 10kHz. Then it exhibited approximately 3° of phase angle deviation between the two channels as the input frequency rose to 20kHz.

Listening tests

Having proven to myself that the DAT Walkman is the sharpest little tape recorder that I've ever tested, I progressed with my subjective evaluations. I wanted to find out (a) just how well the recorder



The measured performance curves for the recorder. At top is the response when playing Sony's test tape; then the record/replay response in both standard and LP modes; and finally, the one third octave band noise analysis.

works when copying disks; (b) how well it plays pre-recorded tapes when jogging along the street; and (c) how it performs when recording 'live', using quality capacitor microphones to capture all the sounds produced by a live musician.

The first three disks that I selected as source material were Musorgsky's *Boris Godunov* — with Emil Tohakaron conducting the Sofia Festival Orchestra (Sony Classical 53K 45763). The three disks containing this opera run for close to 220 minutes. To contemplate recording that much music on one DAT tape is only possible if you make use of the LP recording mode. Needless to say, that is exactly what I decided to do.

After having listened to the original three disks, I was surprised to find that the DAT copy was just as enthralling — even though its recording bandwidth was reduced to 15kHz. The LP tape is quite good enough for background listening, and for long journeys of the type which I frequently take by plane or car.

The next disk I copied onto DAT was Eileen Farrell singing *This Time It's Love*, conducted by Robert Farnon (Reference Recordings RR-42CD). The quality of the music and the warmth of the love songs make this an excellent test for audible quality. I set up the CD player and the DAT player in direct synchronisation, so that I could do an A-B comparison between the two sources. It didn't matter how hard I tried, I just could not pick the difference between the CD and the DAT copy, at standard recording speed in straight A-B testing.

I progressed to prerecorded DAT tapes, the best Australian source of which is PC Audio in Brisbane, (phone 07 343 1612). PC Audio markets the Capriccio label, which has an excellent selection of superb DAT tapes from which to select. I obtained four tapes from PC Audio, which included Tchaikovsky's *Swan Lake/The Sleeping Beauty*; *Italian Trumpet Concertos II* featuring Ludwig Guttler playing concertos from Torelli, Vivaldi, Grossi, Aldrovandini and Biscogli, which were my favourites; and two others which were good, but not quite as delectable.

The quality of these pre-recorded tapes was absolutely superb, and frankly I believe as good, if not better than the best CD's you can buy. Although each of the tapes has a record duration of only approximately 60 minutes, I found that with a fully charged NiCad battery I could get close to two hours of straight replay from a single charge — which is quite long enough to encompass a flight from Sydney to Adelaide, and slightly less than the travelling time between Sydney and Auckland.

More importantly during the time that I had the recorder, I found that the DAT Walkman is much better behaved than a normal compact cassette Walkman when jogging — particularly as the jogs that I take never extend long enough, or go far enough to flatten the battery!

My final series of tests involved recording with the DAT Walkman with two laboratory microphones plugged in to record live music (piano playing). The size of the recording system simply puts anything that I have ever previously used for serious recording to shame!

Whilst I may think of the TCD-D3 DAT Walkman endearingly as a 'Toy', and have repeatedly described it in those terms to my family and friends, make no mistake. This is precisely the sort of toy that every 'big boy', or mature and perceptive woman, really aspires to own.

The actual dimensions of the TCD-D3 are 145.8 x 85 x 40mm, and it weighs a modest 630 grams. The quoted retail price is $1599.00.

Further information should be available at Sony dealers, but in case of problems you can contact Sony Australia, 33-39 Talavera Road, North Ryde 2113. ❖

Automotive engine control - 5

In this final article in our series, the author looks at the growing problem of vehicle wiring harness size, and its proposed solution: a multiplexing system, probably with multiple address and data buses. However before this can be fully successful, the industry will have to adopt an agreed system of standards so that all equipment is mutually compatible.

by TONY MERCER

In the previous article, mention was made of the difficulties being faced by manufacturers with regard to the problem of increasing wiring harness size in the modern automobile. With the increasing demands being made on the vehicle for expansion in areas of data communications and control, the harness is starting to reach problem proportions.

If you have been in a modern auto, particularly one of the luxury ones, it may not have occurred to you how the various items are connected to each other. For instance the driver's door can resemble the cockpit of a modern jet liner, with its switches to control the windows and various other paraphernalia of the other doors in the vehicle.

How are the connections made? In current vehicles there is a simple system of a switch, activated device, power source and interconnected wiring (Fig.1).

Even now there is considerable wiring required around the vehicle, even allowing for the limited number of controls required.

In the future there will be a requirement for engine management, driveline control, automatic breaking systems, active suspension, climate control, security, off-line diagnostic and trouble shooting procedures, modern navigation options and advanced entertainment systems — and as a result the wiring harness needed to carry all this information will assume gigantic proportions.

Quite apart from the cost, weight and reliability of this amount of wire, just as big a problem is the physical size.

It is fast getting to the stage where there will be no room for anything in or on the vehicle, including the driver and passengers. (Maybe this is one way of solving the road toll! But I digress...)

There is an effort being made by the wire manufacturers to reduce the size of the wire by using different compounds to make wire that has less resistance (superconductors perhaps), and by the vehicle manufacturers having a closer look at the current carrying tolerances of the wire — trying to overcome the 'overkill' that was previously present.

For example my vehicle has a 10-amp current carrying wire providing power to a fuel pump that draws only 0.5 amps.

Another problem is the vehicle faults that are occurring, which can be traced back to problems with the harness wiring and the connectors used. Field surveys show that 54% of electrical faults are caused by the wiring harness, 12% by the electronics and 34% by non-functioning sensors and actuators.

And then the vehicle stylists enter the picture, wanting greater freedom to design systems that are easily used by the operators and pleasing to the eye. Many of these are being placed on vehicle sections that move (doors etc.), or have some other potential to cause damage to a normal wiring harness.

Multiplexing

As with anything else, modern electronics is coming to the rescue. The scheme being proposed to rectify this and provide for expansion into other, as yet, undreamt-of areas is to replace the wiring with a system that has much fewer wires. This will be known as *multiplexing* and in the immediately foreseeable future new vehicles will use a combination of this and current practices.

In a two-wire multiplexing system, there will be one wire circulating around the vehicle in a loop containing address and data information. A second wire, heavier than the first, will distribute power (Fig.2).

Generally speaking (coverage in greater depth follows; stay tuned folks), a master device controls proceedings and issues addresses and data to slave devices, each of which has a unique address. A slave device will be either an actuator or a sensor. A message is sent that comprises an address field and a data field. This data field will be either a data quantity (magnitude) or a functional mode command depending on the slave.

For instance if an external light is addressed, the data field will be a command to turn it either on or off. But if a an indicator, such as a fuel level meter, is addressed the data field would be a quantity by which the controller wants the needle to move, or the digital display to change.

Let's say the driver has activated his turn indicator lever, to indicate a right

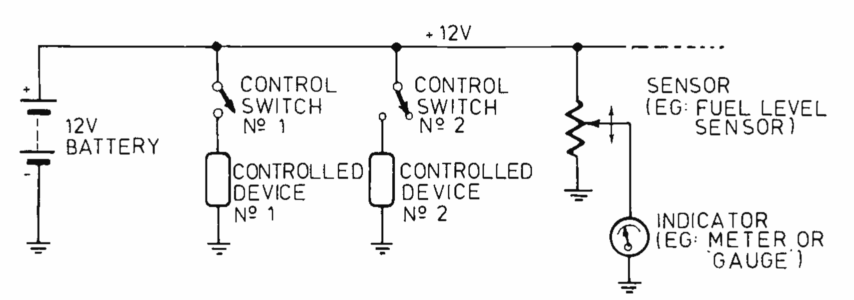


Fig.1

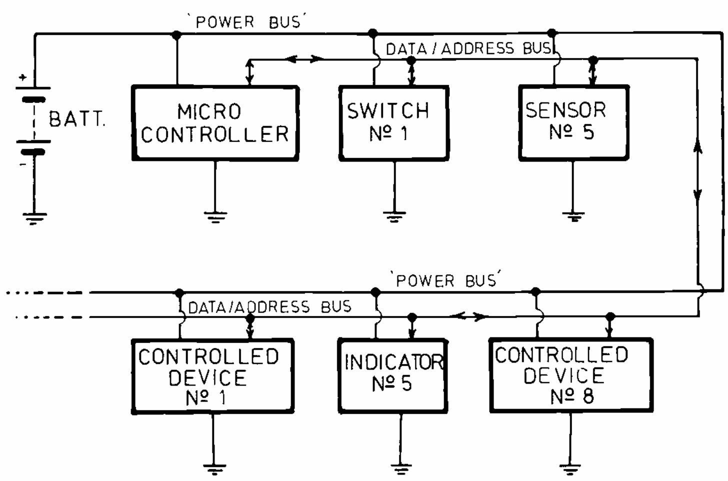


Fig.2

hand turn. The actual turn indicator switch is on the data loop and has a unique address. Periodically the master controller will issue a command to the indicator switch, comprising the address for this switch and a data field which the switch will decode as being a request for status information.

The data bus is then given over to the switch, in order for it to send data to the controller as to its current status.

In this instance the status will be that the driver wants to flash the right hand turn indicator lamps. The controller decodes this, and sets about implementing it by sending a command to the right hand flashing light controllers, requesting them to turn on.

This command will comprise the address fields for the light controllers, and data that is interpreted by them as a request to illuminate.

One way or another, the turn indicator switch is reset, either by the driver or automatically when the vehicle completes its turn, and when the master controller next interrogates the turn indicator switch it sees this and sends a message to the right hand flashers to turn off.

Not so easy...

Now immediately you, dear reader, can see all sorts of problems with this arrangement. For a start the example dealt with a situation that is fairly slow in activity. How fast can a person activate the turn indicator?

What about the other activities that are taking place — i.e., decoding the vehicle speed sensor and displaying that, measuring the oxygen level in the exhaust and presenting that to the engine management computer, etc.

Obviously some activities on the control bus will need higher priority than others. Engine speed can vary quite suddenly and through a wide range, much more so than say the fuel level (unless you drive a car like mine).

You can see that the master controller would have to have some basis on which to decide which device should be serviced next, and that this would depend on such things as speed of data change and relative importance.

While the mass of air entering the engine can vary a lot more often than say switching from high beam to low beam, this does not mean that dipping the headlights should get no priority.

Far more sophisticated systems than this are needed. But the problem does not stop here.

As you might realise, an automotive manufacturer does not make all the components on any particular vehicle. The battery is made by a battery manufacturer, tyres elsewhere, and so too with the instruments and other items of hardware. If a turn indicator manufacturer is going to manufacture an indicator assembly for one vehicle builder, he will need a detailed specification list so that he knows what to build and what it must interface with.

Needless to say this item will be prohibitively expensive if only this vehicle builder uses it. It won't reduce the cost by much if a similar but not identical part is made for another builder.

What this points to is a need for some *standards* to be introduced, so that all the vehicle builders are using a similar system at least at the electrical level.

Standards needed

This was the sort of issue faced by the computer manufacturers during the seventies, when they all realised that there was a need to have a standard so that all their computers could talk to each other.

Out of debates and conferences there occurred a software and hardware standard so that computers could talk to each other, and it is these standards that enable a person sitting at his desk in Australia to access a large database in America or Europe. This standard involved both hardware and software.

Needless to say it wasn't only the computer companies that were engaged in this dialogue. The communications organisations in the various countries were also involved.

Something similar needs to occur in the proposal to establish standards for the data interconnection system in the modern vehicle. And just as with hardware and software standards developed for data communications between computers, so there is a need for a similar standard for data communications between items on the data bus in a vehicle.

In order for compatibility between controllers, sensors and actuators to be arrived at, there will be a standard for such things as the hardware interconnect (the voltage and current levels, or even fibre-optical cable), the data representation (i.e. NRZ, Manchester coding, etc.) and the software interconnect (deciding which device should be serviced next, error correction and data retransmission protocols, etc.).

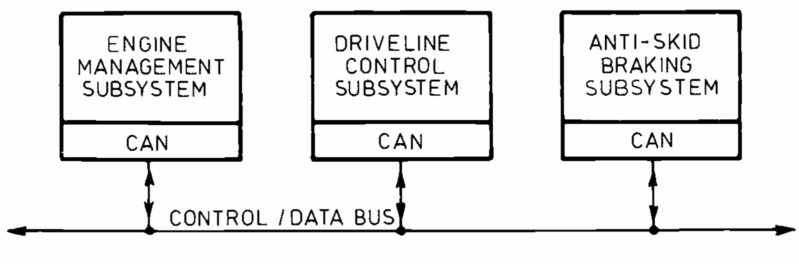


Fig.3

Auto engine control

Because of the immense difference in data speeds between various items on the data bus — such as the difference between turning on an indicator light, say within one second, and the need to read all the engine sensors to compute fuel injection amounts, within 3.5 milliseconds — it seems unlikely that there will be just the one bus.

Multiple buses

Rather there will probably be at least two buses, one for the slower devices and the other (much faster) for the devices with faster requirements.

In fact there is a proposal for three data classes: class A for data rates up to 20 kilobits per second (20kbps), class B for data rates up to 100kbps, and class C for data rates up to 1Mbps (million bits per second).

Class B will handle all the requirements for the slower devices such as turning on and off lights, sensing fuel levels, instrument panel indications and such like, while class C will cater for the communications between engine management, anti-skid braking systems, active suspensions, driveline control etc.

Consequently when full blown multiplexing arrives there will probably be two separate buses involved, one running the class B devices and the other running the class C devices.

When there is a need to bring this together there will be a 'gateway' interface between the two buses. It may be that periodically the drive line control needs to know that the driver is applying the brakes. This data, which is of a slower nature, would be available through the gateway. Just as in the communications standards for computer data interchange, the various proposals for class C data exchange revolve around four or more layers.

CAN system

The following is the proposal put forward by Robert Bosch in Germany, called CAN (Controller Area Network) — see Fig.3.

Fig.4 shows that each layer is an independent block of software that has certain functions, and an interface between the layers above and below.

The integrated circuit to implement CAN is already being manufactured by Intel in America, and is a dedicated microcontroller containing a microprocessor and memory.

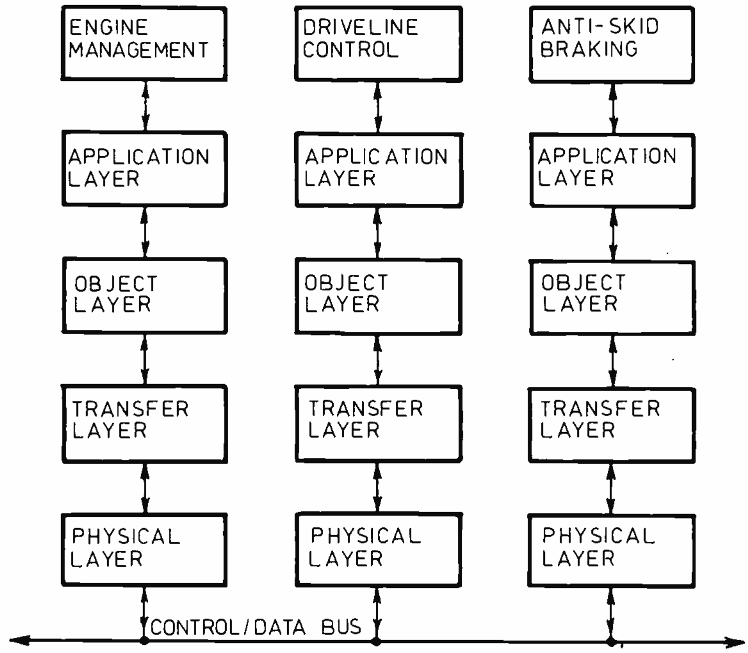


Fig.4

The *application* layer interfaces with the application or device/controller that wants access to the bus, so that it can communicate with other controllers — i.e., the driveline control, transmitting information to be destined for the engine management controller.

The application layer passes data/address information to the *object* layer, where the message is given a priority. It means that the message is configured such that it will not be interrupted if it is the highest priority possible, but can be interrupted if there is a higher priority wanting access to the bus.

From the object layer the data passes to the *transfer* layer, where error detection, acknowledgement and retransmission takes place.

Finally the *physical* layer controls the actual message onto the bus. This layer specifies such things as current and voltage levels and the data format that takes place, along with the actual transfer rate.

The message arrives at the receiver and it advances back through the various levels — physical, transfer, object and applications onto the actual device being addressed.

If I was a manufacturer of an automatic transmission and I had designed a controller that I wanted to be compatible with the CAN format, the specification I would be concerned with would be the application layer — as the other interfaces are being taken care of somewhere else.

But if I was a serviceman I would need a knowledge of the application layer interface and the physical layer, as these are the only two parts that I could get at in order to diagnose a fault.

Conclusions

This finishes the present series of articles on the basic operation of motor car engine management electronics. If any of you would like more information on this subject I could recommend that you read the book *Understanding Automotive Electronics*, by William B. Ribbens and Norman P. Mansour, published by Howard Sams and Company, or the many excellent seminar papers on vehicle electronics produced by the Society of Automotive Engineers.

I am indebted to many people who contributed to the writing of these articles but especially to Albert Schulz of Robert Bosch, for his state of the art knowledge on multiplexing; Tim Sheather of Automotive Electronics for putting me right on how the black boxes are repaired; the many people in Ford Motor company Customer Services, who work above and beyond the call of duty in order to provide technical information to Ford dealer mechanics and Ford product customers especially Peter Killen, Peter O'Malley and Bob Draper.

I would also like to thank Ray Retel, Automotive Studies Lecturer at the Hawthorn Institute of Education, for proof reading the articles and kindly pointing out the mistakes. ❖

Australian 'animatronics' technology:

BUGS BUNNY ON THE GOLD COAST

Although the motto of Queensland's theme park Movie World is 'Hollywood on the Gold Coast', not all of the technology used in the park's rides and other attractions comes from the USA. In fact many of the animatronic puppets have been developed and manufactured in Australia...

by BARRIE SMITH

A visit to the Gold Coast in the frenzy of the Christmas holidays would seem to be a journey of suicidal intent — but if you've got a youngster thoroughly besotted with the antics and appeal of the Warner Bros animation department, a visit to Warner Bros Movie World is mandatory.

With wife and child in hand I made the journey on January 1st — which not only happened to be the first day of the year, but was also the occasion for the six-month-old theme park to break attendance records. By 9.30am some 12,000 people had passed through its doors — which were soon closed.

The 1991/92 tourist season on the Gold Coast was a surprisingly good one, and a spokesman for the Gold Coast Tourist Council attributed much of the credit for the high visitor figures to the Warner Bros attraction.

One can hardly be blamed for 'falling' for the place. There's so much to see — aside from the fun of grooving with your favourite characters as two-metre replicas of Bugs Bunny, Daffy Duck, Yosemite Sam, Foghorn Leghorn and the others stroll, jig and jump among the crowds.

However, slipping cleverly away from the family, I spent most of my time at the 'Looney Tunes Ride' — a water cave complex populated by all the animated gang that has entertained global audiences for the last 50 years.

The ride is an ingenious and highly entertaining cavern of fun, made possible by the clever and skilful use of 'audio-animatronics'.

My reason for spending so much time in the splashing darkness with Elmer, Pepe et al was that the animatronics puppets had been made by a Sydney company — Sally Animatronics (Aust).

After returning to Sydney, I spent a morning with Greg Eccles, MD of Sally at his Dee Why workshop. It was here that I found out more about the company and its unusual 'product'.

About Sally

Sally Animatronics is a majority-owned Australian Company, with a minority shareholding held by Sally USA — based in Jacksonville, Florida.

Tweety Pie in close up, with Sylvester in close pursuit.

Sally USA has been in the animation business for 14 years, involved in projects such as the Universal Studios attraction and entertainments for museums, retailers and theme parks.

As Greg Eccles says, "The link up has been good — we exchange technology, doing all our own design here in Sydney.

Unique achievement

Movie World's 'Looney Tunes' ride pumps 60,000 litres of water a minute. It took 13 months to construct. The concept of the ride is claimed to be unique, and not modelled on any other attractions.

Bugs Bunny tours the Movie World site, in a stretch limo.

Each company has its own way of doing things, so each company is developing all the time.

Originally when we started we worked with their technology, but since then we've actually sent our technology back to the States — our own processes and designs."

Eccles' background is electronics and mechanical design, being at one time chief engineer for Pye/Philips audio and special project design, before moving on to National Panasonic's office equipment division.

Why did he start Sally? Eccles explains: "A colleague of mine had an exhibition company, with a lot of projects for Expo '88 and a big exhibition in Sydney for the BiCentennial, called First State '88. There was really nobody locally doing animation in the the theme park style. Instead of importing the technology from overseas, I was asked would I like to start up the company. I thought it was an opportunity to do something in the line I was familiar with — manufacturing, design and marketing. Sally does take in all those facets."

One of the first animated characters designed and manufactured by Sally was for Fujitsu at Expo '88, which won the corporate pavilion award. Another one of their other early customers was the Old Dubbo Gaol — the characters are placed throughout the gaol, in different cells and outside as well.

The demand for their work is broad: "We have characters which you can preprogram or operate live for a special promotional presentation.

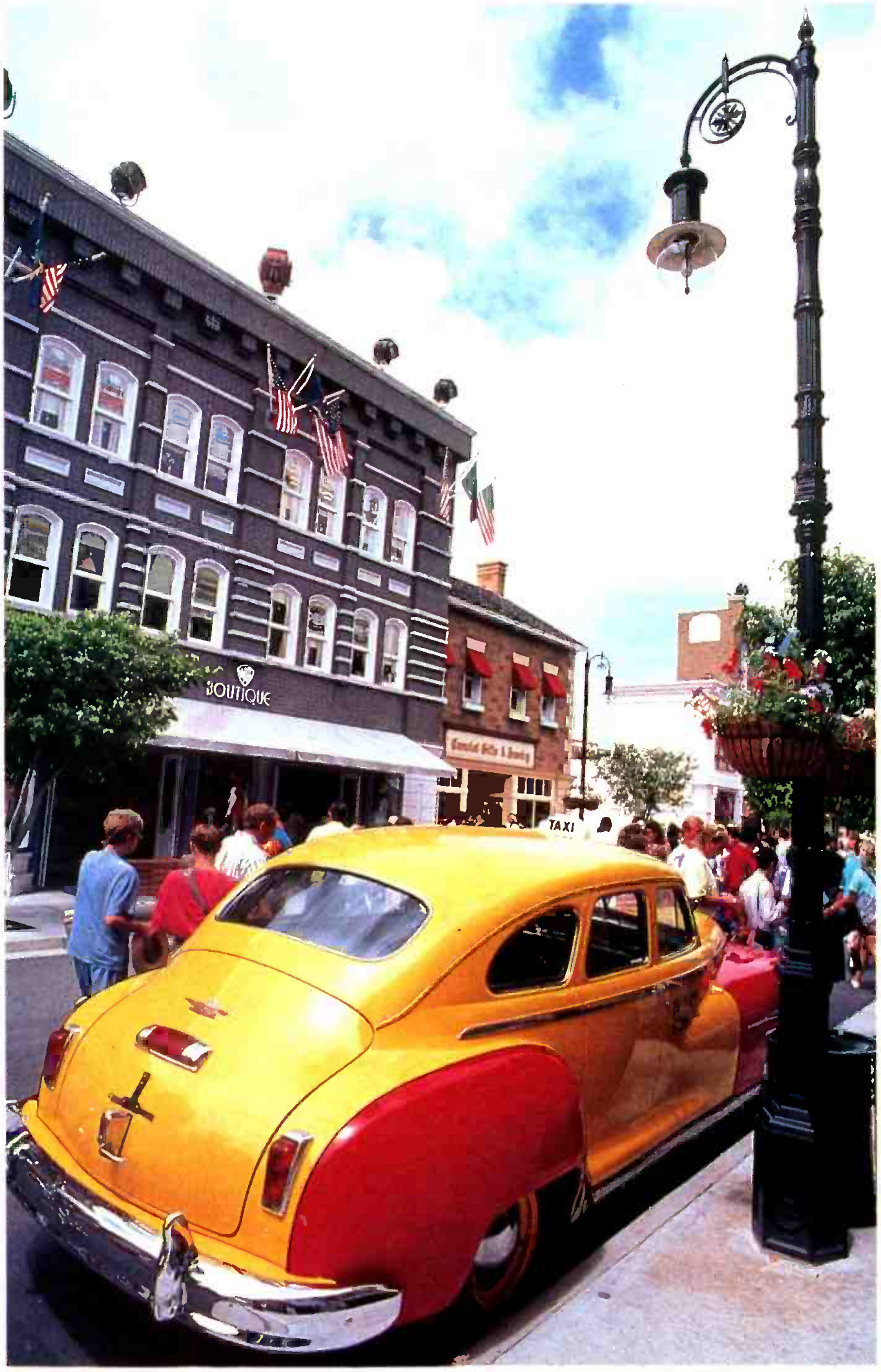
Recently one of our characters did a

Other attractions

If you can tear yourself away from Bugs and the boys, there's a whole movie studio to tour at Movie World.

I enjoyed the Police Academy stunt show, which features some exciting and tight driving, pyrotechnics and a few falling — and flying — bodies to fill in the few quiet parts.

On the Visual Effects stage you can see how the flying scenes from *Memphis Belle* were made. On the Sound Effects stage you can try your hand at effects, dubbing such movies as *Lethal Weapon II*. Over at the Roxy Theatre you can watch classic 3D movie clips, from *Phantom of the Rue Morgue* and Hitchcock's *Dial M for Murder*.



One of the Movie World attractions is a recreation of a New York street, complete with authentic Yellow Cab.

'job' on stage for the State Bank and the Housing and Industry Awards, at the Convention Centre in Darling Harbour."

Sally not only create 'live' people, but produce animals and 'things'.

At Movie World there are two 'dark rides'. One is the Looney Tunes Ride mentioned earlier. It's basically a water ride — housed in a 3,700 square metre building: as you move through the caves you see different scenes.

There's about 80-odd characters in there — Bugs Bunny, Daffy Duck, Pepe le Pew, Foghorn Leghorn, etc. They move and talk, one of them saws down a tree, another fires a shotgun.

The other dark ride is 'Gremlins', with the Gremlins, Beetlejuice and Gizmo characters. Both buildings are large and quite sophisticated. Says Eccles:

"We've done more characters since they opened and will be doing more in the future. We work very closely with Warners."

Making a character

"Producing what we call a humanoid, we begin by creating a specification of the character — deciding on its age, facial expressions, wardrobe and so on. Then we take a live cast of the face; a lot of our faces are taken from live casts. The final expression is sculpted into the face — using clay or plasticene, and the mould is made."

"We then work out the body size. We have different body sizes in stock. The character is then postured, allowing for any movement it may have — it may be a standing or sitting character. We then make the skin, with our own special formula developed in Australia."

"The internal working parts are mainly pneumatic cylinders — acting as 'muscles' — to operate the arms, the heads or the eyes. These are operated in turn by valves turning the air on and off in the cylinders. The valves are operated by a computer program."

"To animate a character we get a 'feeling' after looking at the script of what it has to say and do. The voice track is laid down first. The mouth is then synchronised to the voice. We do this 'live', by running the tape through time and again.

After the voice and the mouth are operating we bring in the movements, one by one to get the total action working: mouth first, then head movements, then the eyes, the body and arm gestures."

Finally, the wardrobe is fitted. Sally's programs the character, finished completely dressed with wardrobe. Sometimes the programming is done at the Sydney studio or sometimes — as with Movie World — on site.

It's very important to get the 'sight lines' worked out, in relation with the audience staging and the background. This helps the characters to relate with the boat-borne audience. Sometimes this can be done in the studio, then the program is edited on site.

Difficulties?

Eccles explained that the human body is a 'fantastic thing', taking millions of years to develop. For Sally to try and duplicate the body's operation with pneumatic cylinders is quite a challenge. He continued by saying the human body is particularly hard to duplicate because we all have a 'reference point' — our own body — with which to compare.

Fortunately, no problems have been found with the Gold Coast's sometimes muggy climate. The figures have been designed to handle the high humidity and heat.

Other problems? The company has now had lots of experience in building these characters so can always face something new. R&D goes on all the time.

Devising the skin material over the last few years is one example: the qualities needed are that it be supple and flexible, look realistic — and be long lasting. Eccles stresses it's not like making synthetic skin for film or TV work, where you can repair it between takes. In the Dee Why company's projects the skin has to remain in position for long periods — even years — and be repeatedly operated for anything up to 10-12 hours a day, seven days a week, 365 days a year.

Sally makes its own eyes, its own wardrobe, makeup and performs hair implantation strand by strand.

A character — such as a Looney Tunes type — may take anywhere up to two months to make, or even go to three months, varying with the animation required.

Installing the characters calls for Sally staff to work with the park designers to select the best position and eyeline, as viewed by the passing audience — and with reference to the other characters. It's like doing a play, with actors on stage. They have their marks on the floor — and the same method is followed.

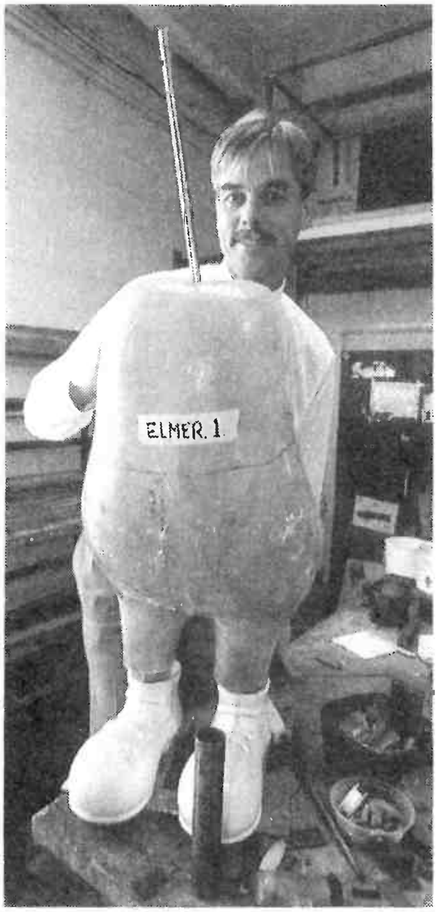
The characters are operated by air pressure, so an air line goes to each. There's also a computer cable and power links, to the computer associated with the valves operating the pneumatic cylinders. In the case of Movie World the

Elmer Fudd's head under construction — the Sally company has achieved high quality synthetic skin.

Readily available, standard pneumatic parts are used in the construction of animatronic puppets.

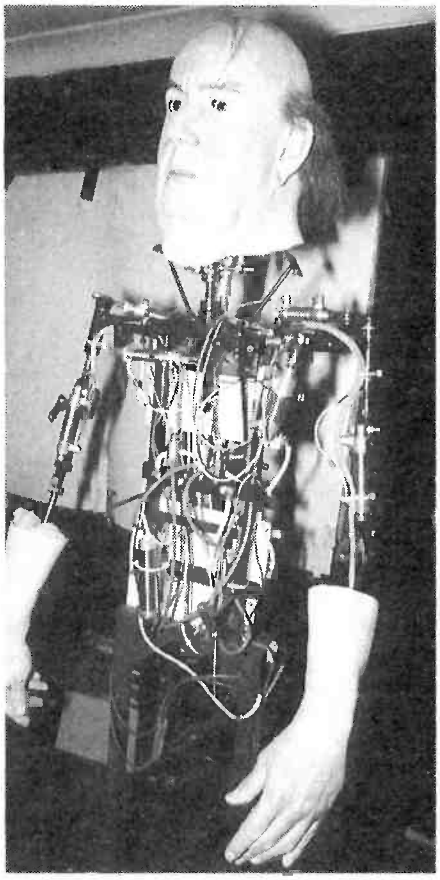
An internal armature for an animatronic puppet being built at the Sally plant.

Bugs Bunny on the Gold Coast



Greg Eccles, Sally's managing director, with a temporarily headless friend.

Greg Eccles and Sylvester the cat — not quite headless, but not fully presentable either. The basic cladding is fibreglass.



One of the Sally humanoids — 'Sir Edward' — with its electronics and pneumatics in place. This kind of puppet can be pre-programmed for action and dialogue, or run as a 'live' figure.

system also controls such things as steam cannons and falling tree trunks, lighting and sound storage cards.

Maintenance?

Considering the models' running hours per week, the average character's reliability is very high. Eccles compares them to the operation of a home appliance or even a factory machine: "The number of hours of maintenance we do would be much lower. Pneumatics has been industry proven, driving a variety of machines for many years. It's very reliable and efficient. We use standard industry parts for cylinders. Some of them are also used in the cotton, wool and printing industries."

Some models that the company has made have been working for four years — so the reliability factor is proven.

Special computer

Computer control is at the heart of all the stunts, gags and laughs the Looney Tunes crew get up to in the watery darkness of the ride. In the Movie World 'dark rides' control is applied to not only the characters, but also the lighting, special effects and audio playback. The whole thing is done through a central computer.

The computer system that Sally uses is an RA Gray computer system from San Diego in the USA, and it is the only one of its type in Australia.

It is a complete Media Production System (MPS) and is designed to facilitate production and editing of complex, fully automated performances.

Initially, the voice track is recorded for a character and the MPS system uses as its reference an industry standard SMPTE time code track, recorded on the same tape as the the audio track within the RA Gray MPS system.

Once instructed to lock onto the time code track during previewing, the MPS system will follow all tape movements — during start, stop and shuttle modes.

The computer system stores the control data (on 8" floppies) which are recorded in real time, and the character's mouth movements are programmed in sync with the audio track.

The next step is to record the other animated movements of the character one by one — e.g. head movements, eyes, hand/arm etc., — until all the movements are set down on the floppy disks, and all synchronised to the time code track.

Once the voice track and the data track are laid down onto the one tape there are no more sync problems. So it doesn't matter if the voice track drifts, the control information is locked to it: the body movements — and lip movements — remain synchronous.

The system is a unique and very powerful one, and can do anything from programmed animation to lighting control to synchronising such things as video discs, or events such as a fountain which suddenly springs to life. The elements can be brought together very neatly and can be controlled all from the one computer rack.

Each of the dark rides on the Gold

Continued on page 32

Moffat's Madhouse...

by TOM MOFFAT

Murphy's Law and the sound man

One afternoon recently, as I was deeply engrossed in some software project, I got a phone call from the licensee of Hobart's Wheatsheaf Hotel. HELP! — not technical help, but musical help.

Twice a month last winter, I'd played at the Wheatsheaf as part of a jazz band called 'Burglar's Dog', and the licensee knew I had an accordion. He'd just brought this Zydeco band 'Hot Tamale Baby' over from Victoria for a two-night stand, and the airline had lost *their* accordion. Zydeco is a musical style from the southeastern part of the USA, becoming more and more popular in Australia. But you just can't do Zydeco without an accordion.

Could I help out with a loan? Sure thing — in return for two free tickets to hear the band, of course).

But I had to bring the squeeze-box to the pub that afternoon, straight away, because the band was just about to undergo their 'sound check'. So it was goodbye computer, hello boozer. I wrestled the accordion into the back of the car and headed for town.

My accordion is an elderly 1950's model. Modern accordions play with a delicate sensitivity, but mine generates a full-throated roar. I suspect it was designed to produce enough volume to work with the unamplified orchestras of the era, and that's the way we've been using it with 'Burglar's Dog' — it can hold its own against such things as a trombone, baritone sax, drums, banjo, and electric guitar, all going at once.

But, as with a 1950's American car, the price you pay for all that power is weight. The accordion is made of solid timber — none of that plastic stuff inside — and it weighs close to 20kg. Even though I weigh over 100kg, I can only play the monster for any length of time sitting down.

When I walked into the Wheatsheaf I met the accordion's new player for the weekend — a lovely slender blonde lady named Su. I told her there was no way in the world she'd be able to make it through a three-hour gig with my accordion; it would crush her flat. At least, if she had to use it, she should organize a chair, or at least a bar stool.

No problem, she said. She slung the straps over her shoulders and squeezed off a couple of tunes standing up ("lovely sound..."). Made me feel like the world's original wimp. Then Su told me of a few recent adventures that made wrestling on stage with a borrowed 20kg accordion seem like small cheese indeed.

Just to set the scene, consider the lineup of the band, as they appear to their audience: On yer left, laideez and gentlemen, one bass guitar player (with no fingers).

Next the sax player (busted leg, in plaster. Someone has decorated his cast with Textacolor blood gushing down the side). In the centre, the drummer (nodding off from time to time). Next Su, who lost her accordion (shoulders beginning to droop a bit).

And on the end, the guitar player (who's actually not there at all — he's in the intensive care ward in hospital; suspected heart attack, 32 years old).

Methinks this band should be named 'Walking Wounded', and its patron should be Murphy. The bass guitar player is Su's husband; he lost the fingers of his left hand in a car accident when he was 17 years old.

He's learned to 'finger' the notes with the stumps; it's almost like every note is a one-finger bar chord. He can't play a normal guitar; strings too small, stumps too big. But on the bass, wow! A most satisfying, powerful, driving style.

The guy on sax made the mistake of jumping over a fence in an awkward way, fracturing his leg on touchdown. Apparently he does a lot of dancing around on stage while wailing away on the alto sax, but this day he was firmly rooted to a bar stool.

The drummer — well, his wife had just had a baby, only hours before the band's Hobart trip. She was late as it was, and had she been any later the band would have been without a drummer for the Wheatsheaf gig. No wonder the guy looked a little 'noddy'. He brightened up that night.

As for the guitar player, his heart problem came as a complete surprise, without any warning at all. When he went down other band members got on the phone, all over Victoria, trying to find a replacement with only hours notice. But no luck — every likely guitar player in Victoria was either busy or couldn't be found. So the band headed for Hobart anyway, hoping to pick up a guitar player locally.

At this stage Su got an idea. "You don't happen to play guitar, do you, Tom?"

Well, as a matter of fact I do, on quite a few 'Burglar's Dog' numbers. But my playing is all finger-style ragtime and blues, as well as the country and western and bluegrass stuff. Certainly not the electric-rock style they were looking for.

The local sound man was working on a 'proper' substitute guitar player, but if he couldn't make it for some reason, I was elected. The other guy did make it in the end, dashing forever my chance at glory playing with a big imported 'mainland' outfit. But he turned out to be the right choice; I fear I would have made a fool of myself.

Ah, the sound man. That's what we're supposed to be talking about, in the first place. The Wheatsheaf Hotel has a fairly sophisticated sound system, set up in a proper 'show room' situation. When a performance is under way, the house lights are dimmed and all seats face the stage. This isn't dinner music; the band is everything — it's a 'show'.

There are stacks of three speakers each side of the stage, standing higher than the performers. Hidden behind the right-side speakers is a six-foot instrument rack containing a bank of large power amplifiers, some preamplifiers, and a small 10-channel mixer.

When 'Burglar's Dog' play the Wheatsheaf, we use the sound system in its normal configuration and and attend to the mixing ourselves. The system is used mostly for reinforcement, amplifying the vocals and the quieter instruments such as mandolin so they blend well with the louder, unamplified instruments such as trombone and sax. Sometimes when there's a particularly large crowd we mike the accordion as well, but only gently.

On nights when mainland acts are appearing, performers like Archie Roach or Tommy Emmanuel, the sound system grows an appendage — a big cable the diameter of a fire hose that stretches to the back of the house and ends in a giant mixer that must have at least 48 channels on it.

During performances the sound man stands at this mixer, always in control. He can't sit down, because the mixer is so big he has to walk to get from one end to the other.

With the Zydeco band's sound check I got to see this monster being set up, and I am now convinced it is an instrument in itself, like a big organ. The players up front are only inputs, which are mixed, modified, and fiddled to produce a sound which is much more than the sum of the individual parts.

The setup procedure began with the drums. The sound man, named Butch, first asked the drummer to continuously pound on the bass drum as he adjusted the mixer controls.

This went on for several minutes and brought back memories of a bad hangover. That drum was pretty damn loud to begin with, but suddenly the sound seemed to lift above reality to dominate the whole room.

Then the drummer went through each drum alone or in combination with the others, as the sound man equalized and adjusted. There were two mikes on the drum kit as I remember, and when Butch finished he seemed to have the whole works floating in space above the dance floor.

Each instrument was then added to the mix in turn: bass, sax, accordion, (still no guitar) and vocals. From where I was standing, each new sound seemed to begin on stage and then be blended in with the amplified product filling the room.

When it was all done the sound man said "OK, lets hear something all together" and thus emerged the most powerful, gutsy, rocky, Zydeco-bluesy sound you could possibly imagine.

But it *wasn't* the sound of the band as I'd first heard them in their natural state, before the sound mix started. The sound was now manufactured, within that big instrument called the 'sound system'. Was it better? I was in two minds about that, but style and commercial reality nowadays pretty well demand that any band worth its salt be 'mixed'.

That night I headed back to the Wheatsheaf, along with my 13 year old son Steven, who'se a bit of a blues freak. He's learning guitar and trombone and keyboards, so I thought a good Zydeco band would give him some inspiration. We took up a table near the stage, and near those big speakers.

When the music started, WHAM! It was like a thunderbolt hitting a few metres away. You could feel that bass drum in your guts, the bass guitar in your chest muscles. The floor shook, glasses on the tables seemed to dance about. It was like a wind came from those speakers, ruffling your hair. My God, Butch, what have you done??

What he'd done, I think, was goose the master gain up about another 20dB above what it was during the sound check that afternoon. But man, that was Music!

It was just what the audience wanted. And these weren't your average pub-rockers either. An American woman sitting next to me had been brought up with the swamp music from Louisiana, and when the Zydeco began she started stamping her feet and yelling, and when everyone else was clapping she'd yell "WHOOO!" and pound her fists on the table.

But not everyone could take it full blast. A group of women arrived, obviously celebrating someone's birthday or something. They took a table right at the front, opposite ours. One of them had magnificent legs, encased in sheer stockings with black spiders embroidered onto them.

She wore a tiny leather mini-skirt and a black leather vest, and she drove certain male members of the audience quite mad. This girl and her friends got up on the dance floor for a couple of numbers, but then the whole lot of them wanted things a little quieter and moved all the way to the back. Pity...

When I finally left this little concert, after only three beers for the night, I felt quite dazed. My ears were ringing, as were my Steven's. We couldn't talk to each other on the way home, simply because we couldn't hear each other. We were both functionally deaf.

The next morning both of us still had ringing in the ears, although not quite as bad. And I for one felt like I'd been in a fight the night before — knocked about.

The experts will tell you that subjecting oneself to such high sound levels will lead to permanent deafness, and they're probably right. Apparently every exposure to that sort of sound power takes just a little bit away from your hearing sensitivity, a little bit that you'll never get back.

Steven and I endured/enjoyed one night of it, but what about the people who go to places like this once or more each week?

I guess some over-protective government types might someday try to ban sound levels over a particular number of dB. This would be sad, because the occasional experience with big overwhelming music power is part of the joy of living. I guess the 'safe' way to enjoy it, as with all things, is in moderation. ❖

Getting weather satellite pictures on your own PC:

LISTENING POST WESAT STATION - 1

Huge numbers of people have built and had great success with Tom Moffat's 'Listening Post' projects, which allow personal computers to be used as low cost receiving terminals for HF transmissions of Morse, RTTY and weatherfax transmissions. Now he's developed a similar low cost, easy to build system for reception of images direct from VHF weather satellites. This is the first of three articles describing the new system — so if you'd like to receive pictures like the one shown on this month's cover, read on...

by TOM MOFFAT, VK7TM

Here is a project that will give you a whole new view on the world. Constantly orbiting overhead are many satellites carrying cameras that look straight down.

The cameras transmit continuously 'live to air' (or should that be 'live to space'?), as they sweep across the earth's surface, producing images of everything below them. The cameras are not 'aimed' as such, they just keep squirting out a never-ending swathe of picture — no matter where they are. Hence the name of the satellites: Automatic Picture Transmitters, or APT's.

The Listening Post Wesat project that I'll describe in these articles decodes APT pictures and displays them in 16-level gray-scale or false colour on the screen of a computer. Operation is dead simple — just as with my Listening Post II weatherfax project upon which this one is based. No fancy menus, no fiddling about, just start the program to begin receiving. Function key F1 toggles between gray-scale and false colour display, F2 flips the picture top for bottom, and F10 ends reception and saves the picture to disk.

The system, although simple, has been carefully designed to produce the very best picture quality using a minimum of equipment. All the satellite pictures shown in these articles were received using the new Listening Post Wesat kit and software. Photographs were taken directly from the screen of a normal VGA monitor. The results compare very favorably with those from professional $25,000 Wesat receivers — but this one only costs $99!

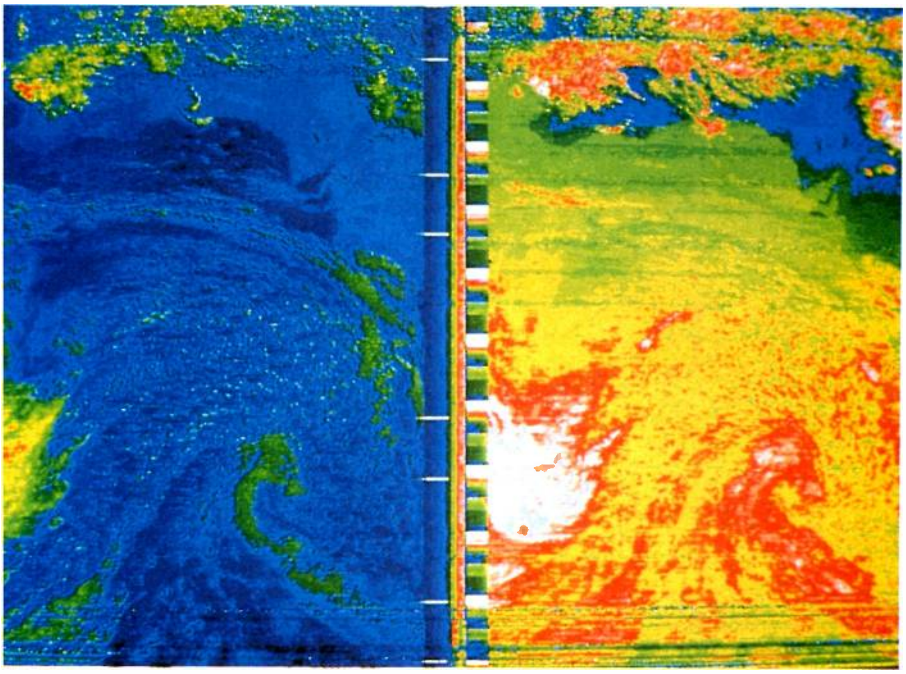


Photo 3: The same scene as shown in Photo 2, but displayed in false colour. Received from an American NOAA satellite, it shows the Great Australian Bight area of South Australia, with a storm down near Antarctica. As with the other NOAA displays, the visible light image is on the left and the IR on the right.

What you'll need

Here is what you will need to make use of the Listening Post Wesat project:

RECEIVER: If you already own a scanner or VHF receiver, chances are it will work fine for weather satellite reception. You must be able to receive signals between 137 and 138MHz, in the 'Wide-FM' mode. This is the normal mode for FM broadcast and TV sound reception. Radios that offer WFM usually let you use it anywhere within the radio's coverage spectrum, not just in the broadcast bands. WFM is provided with all the Icom radios that are promoted as 'scanners', such as the R1, the R100, and the IC2SRA. The full-blown VHF receivers such as the R7100 and the R9000 have WFM as well, of course.

Tandy say their desk-mounted scanners have WFM, as does the long-running Yaesu FRG-9600 VHF receiver sold by Dick Smith Electronics.

I have used the FRG-9600 for satellite

reception, and it works fine. DSE is now selling them out at $799, a far cry from the $1200 or so formerly being asked for them, so an FRG-9600 might be worth considering for satellite reception as well as for general VHF listening.

The specs for the AOR handheld scanners say they will receive WFM. The AOR-3000 scanner not only has wide FM; it has a special bandwidth for APT satellites.

This is not a definitive list of every receiver usable for satellite reception, it's just a mention of a few that should work. APT's use an FM deviation of 15 or 30kHz, which is much too wide for normal 'communications'-type FM, so picture reception with this type of receiver is just about impossible. Wide FM is really too wide, but we have taken steps in the decoder design to cut the bandwidth back at the audio level, so performance using WFM is quite good.

PREAMPLIFIER: Good results are possible by feeding an antenna straight into a receiver, but most scanner-type radios aren't sensitivity champions, and they need a little help. We will discuss various preamp options in the third of these articles.

COMPUTER: In the IBM-compatible world there are two options: for full APT picture quality you must have a VGA system that uses an *analog* type colour monitor. Happily this is the system used in just about every current model IBM-PC compatible.

The analog system uses colour registers to describe what colours are produced from the colour palette. The Listening Post Wesat software loads two tables of its own values into the colour registers, one for gray-scale and the other for false colour.

The false colours are NOT the normal ones the EGA system uses; these look terrible. Instead the colours range from black to shades of blue up through greens and yellow-green to salmon, red, gray, and white. These are the same colours the Weather Bureau uses for their own false-colour satellite picture displays, by the way.

There is another version of the software that produces four-colour pictures on an IBM-PC CGA monitor in 320 x 200 resolution. This doesn't hold a candle to the VGA images. But it does allow the display of weather satellite images on the LCD screen of a laptop computer, and opens the way for shipboard APT reception on yachts and fishing boats. Yet another version for the Commodore Amiga performs pretty much like the IBM VGA version.

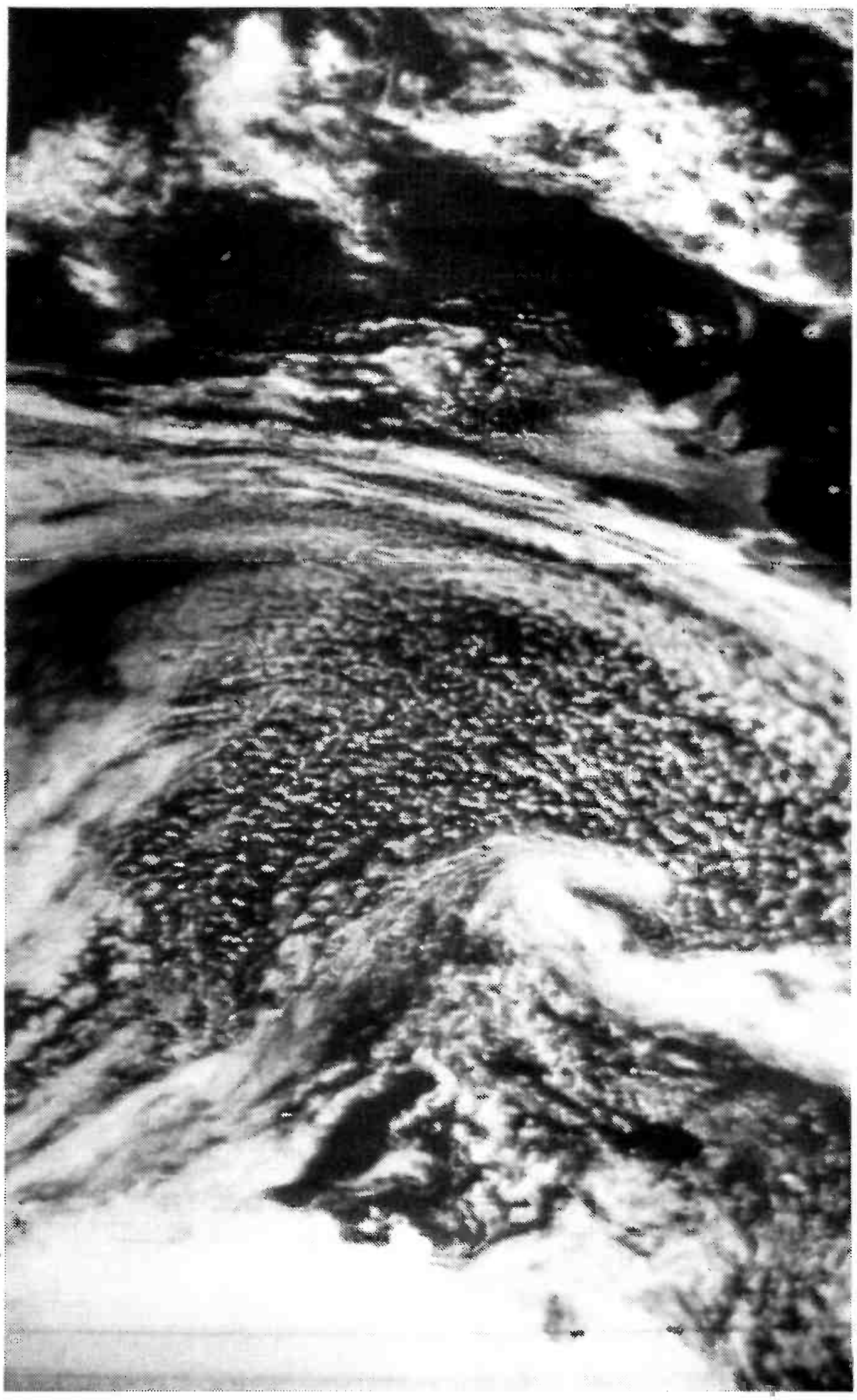


Photo 1: Taken by a Russian 'Meteor' APT satellite, this shot shows the Great Australian Bight area of South Australia (near the top), with a massive storm to the south near Antarctica. Visible at the bottom is Antarctica itself.

ANTENNA: It is *not* necessary to track APT satellites with a directional beam; their signals are strong enough so a non-directional antenna such as a ground-plane can be used. Since we're using 137MHz, which is pretty close to the 144MHz 'two-metre' amateur band, a two-metre antenna can be pressed into service with good results. A simple 1/4-wave whip will work, although a 5/8-wavelength 'gain' antenna will be a lot better.

Some users have mentioned the J-pole as a good satellite antenna. One I've found particularly useful is a scanner antenna sold by ZCG Antennas. This seems to go a fair bit better than the normal ground plane, with fewer signal fades as the satellite goes past.

But all vertical antennas suffer the

same problem with satellites: they can't see straight up.

When the satellite passes directly overhead the signal drops out to just about nothing, leaving a big bar of noise in the middle of your picture.

One quick and dirty way of overcoming the overhead problem is to bend the antenna 30° from the vertical. This fixes overhead response, but still points a dead spot off in a different direction.

For best performance it is usual to use circular polarisation for satellite reception. A way to achieve this is to use two crossed dipoles fed 90° out of phase, an arrangement called a 'turnstile'. A turnstile with a reflector behind it can be pointed straight up to give excellent overhead performance, but it's not so hot out toward the horizon, to receive the satellite when it's far away.

After lots of fiddling around, I have now settled on a *Lindenblad* antenna, an elderly design that was very common on missile test ranges back in the sixties.

The Lindenblad uses four parallel-fed dipoles, to give circular polarization and good sensitivity down to the horizon in all directions while allowing reception directly above as well.

In the third of these articles I'll show you how to build a Lindenblad out of wooden sticks and 300-ohm television twin lead, for around $15.

TAPE RECORDER: Here just about anything will do. Other weather satellite projects I've seen want you to use a hi-fi stereo tape recorder to record the pictures. One channel takes the received signal, while the other records a 2400Hz pilot tone to maintain picture synchronization. This is fine until you start dismembering the family stereo every time a satellite comes over.

Listening Post Wesat derives its pilot tone from the picture signal itself, so it's only necessary to record one channel.

Loss of signal can then cause loss of sync of course, but in practice the LP Wesat decoder uses a very powerful phase-locked loop to hang onto the 2400Hz carrier, even when the picture is too weak to make any sense of at all.

Every satellite picture shown in these articles was recorded with an ancient Aiwa dictation-type cassette recorder, usually running from its own batteries.

The quality of the pictures speaks for itself, but there is one very minor problem in using a dictation-type machine: the automatic volume control (AVC). Since the video signal is a form of amplitude modulation, the strength of

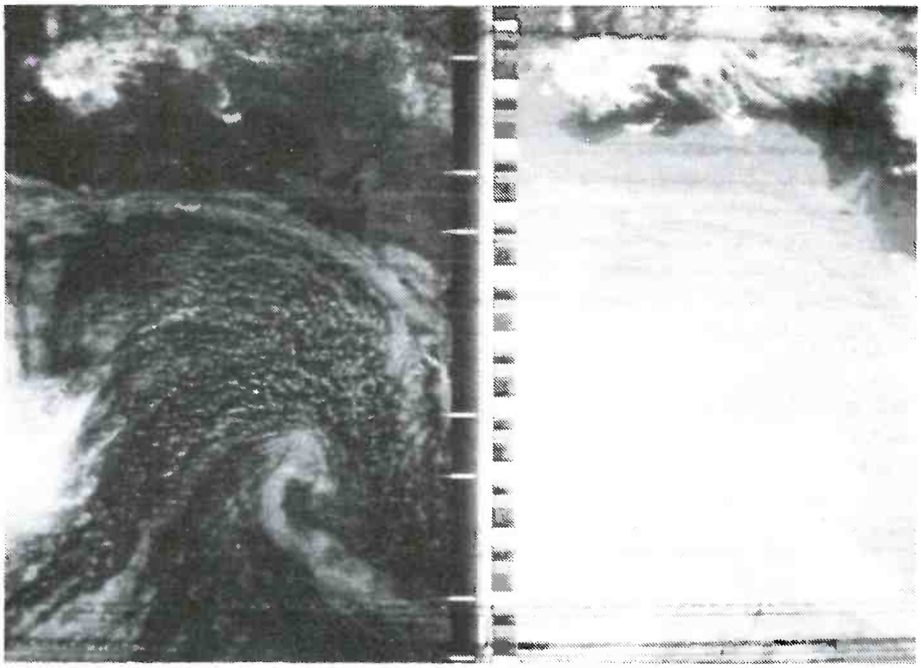


Photo 2: A picture from an American NOAA satellite, showing the same scene as in Photo 1 but taken several hours later. There are two separate images, with the one on the left showing that taken by the visible light camera and the one on the right by the infrared scanner.

signal going onto the tape varies with brightness of the picture.

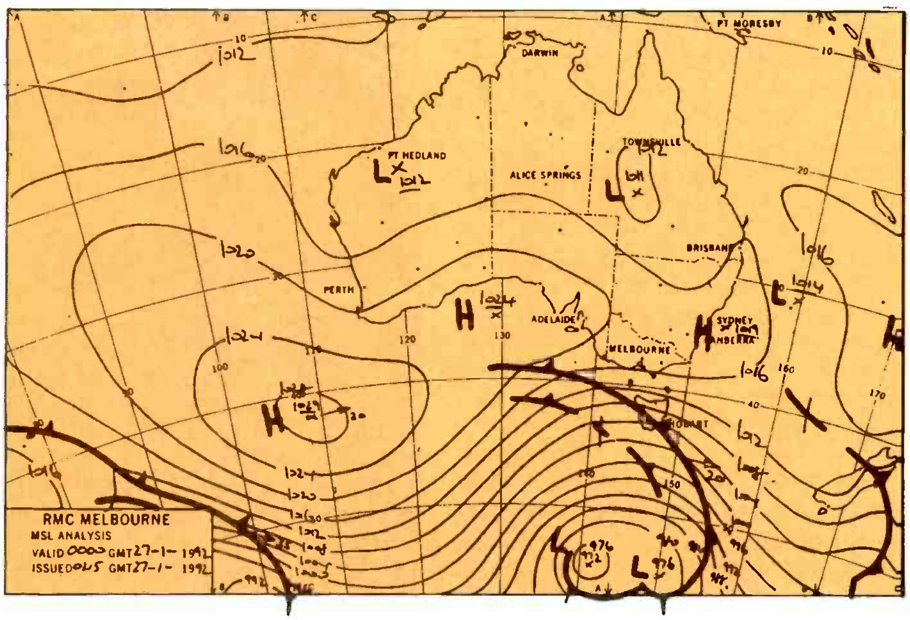
As the brightness goes up, the AVC tries to pull it down again. This manifests itself as a tendency for large dark areas to try to sneak back toward white. There is also a small streaking effect that follows isolated bright patches.

If you're a purist, you can try to find a cheap cassette recorder with a manual record volume control.

As for me, I didn't worry about it. I just made up a voltage divider from the receiver, so that the recorder's AVC came into play only on the strongest audio peaks of NOAA signals, and not at all on Meteor signals.

You can, of course, forget the tape recorder altogether and feed the pictures straight into the computer.

The only problem here is radio noise generated by the computer. I have tried



For comparison, here is an synoptic weather chart sent out by the Melbourne Weather Bureau for the same time, and covering the same area as Photo 1.

live reception with my Toshiba laptop — a noise-free computer — and it works fine. But it is much more convenient just to record the picture and then carry the tape to your computer to play the picture into it.

It is also possible, if your radio has a timer, to record a series of pictures through the middle of the night or when you're not at home. Radios like the Icom R7100 can record five different 'programs', from five different channels at five different times.

The pictures

The Listening Post Wesat project makes use of the so-called 'low resolution' APT transmissions between 137 - 138MHz. Despite this official description, the resolution of these pictures is still much higher than the computer screens available to show them on.

To fit the images on a PC screen 640 pixels wide, we must read only every second incoming pixel, ignoring the others. Still, you must agree that the results are quite stunning. As a satellite passes over, you can see the world as the satellite sees it — continents, islands, oceans, snow, ice, and clouds.

The satellite pictures you see on the TV weather every night show clouds as simple white masses. These pictures come from very sophisticated satellites in geostationary orbit; you get the same view all the time and only the clouds change. The APT's on the other hand work much closer to the action. Clouds are not just white blobs, they become angry roiling masses or swirling pinwheels or lovely textured works of art — all shown as fine quality black-and-white photographs with excellent grayscale rendition. Land masses pop up, sometimes quite starkly, and occasionally you can see the sun glinting off the water. It's the same view you would get from your very own space shuttle.

Photo 1, which comes from a Russian 'Meteor' APT satellite, is an example of the kind of stuff you can pick up with the Listening Post Wesat unit. It's a long picture that spreads over two computer screens. The picture was received at Port Cygnet near Hobart on the morning of January 27, the Australia Day holiday. The antenna was the Lindenblad, the receiver an Icom R7100, the tape recorder the clapped-out old Aiwa, and the computer an ADV brand PC-AT clone with a Trident VGA card and Keller monitor.

The satellite itself passed well to the west. In Tasmania the day was a shocker; the occasional small break of sunshine intermixed with violent squalls of wind and rain. The weekend saw the first test of the new Lindenblad satellite antenna, to be described in the third article. The antenna did not blow apart, nor did its temporary mast collapse, although there were some tense moments as the whole house shook with the squalls.

With APT's the picture begins when you first acquire the signal, and only ends when you lose it. Photo 1 begins in northern Australia, where the continent is graced with warm weather and nice gentle fluffy clouds.

Near the left of the picture the West Australian coastline is visible; Perth is having a nice sunny day. Although there is a bit of murk developing over the Bight, you can see the bottom of Australia and to the right, Spencer Gulf, Kangaroo Island, and the Gulf of St. Vincent. Looks like a nice day in Adelaide too. The image of the mainland seems to end at about Warnambool in Victoria, so Tasmania misses out.

South of Australia, all hell breaks loose with a massive cold blast from Antarctica. In the middle of it all is a hook-shaped cloud structure that is the centre of a big low, spinning around and slinging speckled bits of cloud outward. Each speckled bit is one of those nasty squalls, and they all seem to be headed toward Tasmania!

Below the low, very white and prominent, is the Antarctic continent. The satellite passed right over Porpoise Bay in Wilkes Land. Australia's Casey Station would be on the coast to the left of the picture; the French Dumont D'Urville station would be on the right.

No matter how lousy the weather in the Southern Ocean, the Antarctic coast is almost always in the clear in these pictures. This is because of the 'catabatic' winds in Antarctica. The continent is around 3000 metres high in the centre, sloping down to sea level at the edges. Since cold air sinks, it starts sliding down the ice from the South Pole region and by the time it gets to the sea it could be going at 100 knots or so. This blows the cloud well out to sea, leaving the coast clear but almost always very windy.

Photo 2 is a picture from an American NOAA satellite of the same scene as in Photo 1, but taken several hours later. The picture is in two halves, with the 'visible light' image in the left half and an infrared view on the right.

The pictures are somewhat smaller and less detailed, but the Australian continent stands out better than in the Russian pictures. Because the NOAA satellites orbit somewhat lower than the Meteors, their transmission range is not as great. So it is fairly rare to see Antarctica in NOAA pictures, from receiving locations in Australia.

Photo 3 is Photo 2 displayed in false colour. Note particularly the infrared side; the white at the top of the clouds indicates a temperature of around -70°C (see the IR description below). The blue colour of central Australia indicates

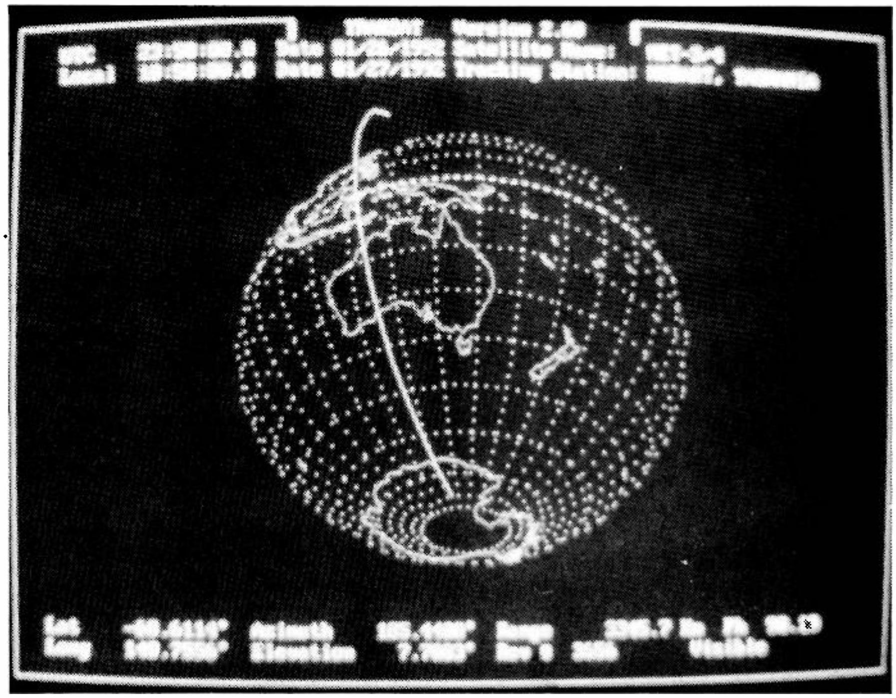


Photo 4: A screen display of the orbit followed by the Meteor satellite when it produced the image shown in photo 1, as plotted by the Tracksat program.

temperatures in the 30's. Coastal areas and most of Victoria are cooler, with a green colour.

Photo 4 is the screen display of a satellite tracking computer program called 'Tracksat' — the thing you use to tell what time the satellites are coming, and where. The photo shows the track taken by the Meteor satellite as it transmitted Photo 1, plotted on a three-dimensional world globe. We'll look more closely at Tracksat and its brothers later in these articles.

Just to put this all in perspective, we also present a synoptic weather chart of the type produced by the Listening Post II weatherfax decoder, valid at exactly the time Photo 1 was received.

The prominent feature is that big low to the south of Australia, a harbinger of nasty weather for Tasmania at least. The photos show how nasty it is, compared with the lovely sunny beaches in Perth and Adelaide.

Now refer to the cover photo, a Meteor picture taken 24 hours after Photo 1 and spiced up with false colour. The previous hook-shaped low centre is collapsing but it's being replaced by what looks like a big fiery pinwheel slinging in from the west. More bad weather for Tasmania!

The Antarctic coast is in greens and reds at the bottom, amidst a few noise lines. One other picture worth looking at is Photo 5, which shows Cyclone Betsy in the process of hassling Brisbane on January 14. This was received before the Lindenblad was built, and thus came in on a 5/8-wavelength 2m amateur antenna mounted on a magna-base on a metal roof.

You can see its performance is somewhat below that of the Lindenblad, with more noise lines and fading in the picture. Still, the big cyclone makes an interesting picture, noise bursts or no noise bursts.

NOAA satellites

The NOAA satellites are controlled by the National Oceanic and Atmospheric Administration in the USA, but they are provided for everyone to use with the minimum of receiving equipment. They were originally intended to provide weather forecasting services to underdeveloped countries. But now the USA populace has got on the bandwagon and everybody wants a home Wesat receiving system. I'm told some American newspapers are now publishing NOAA times and frequencies as part of their daily weather reports.

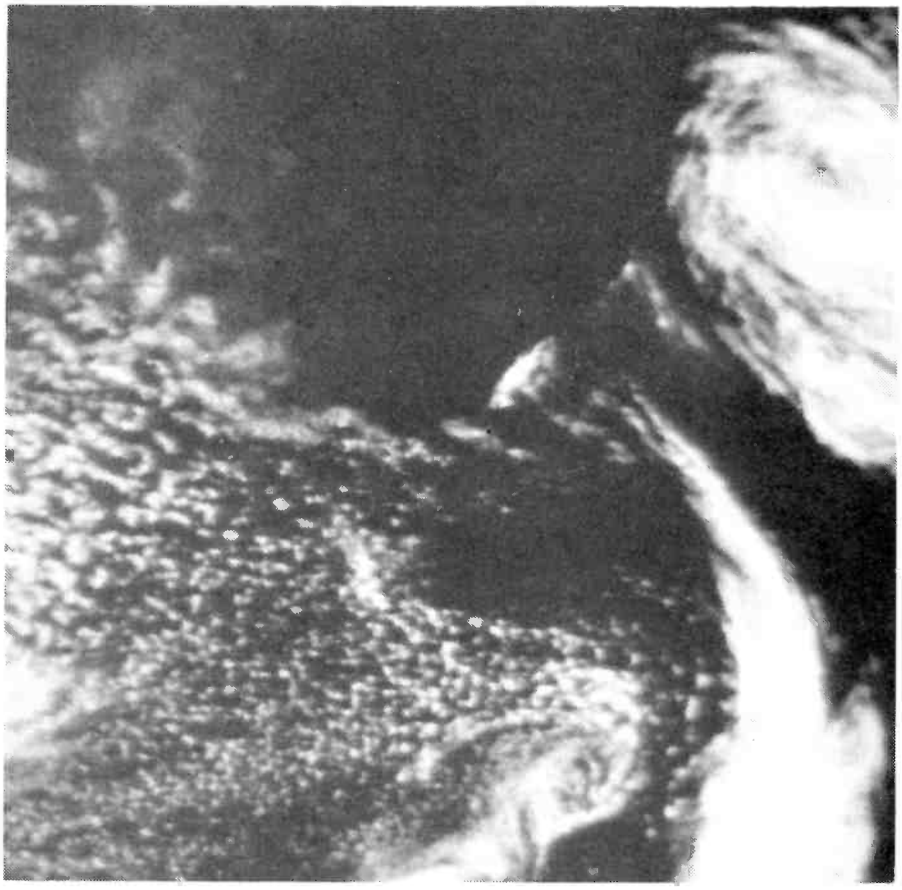


Photo 5: A weather satellite view of Cyclone Betsy in the process of giving Brisbane a battering on January 14th this year.

NOAA data are transmitted on two main frequency bands: S-band microwave at 1698MHz, and VHF on 137.5 or 137.62MHz. Some keen experimenters have tried to receive the S-band transmissions, but it takes at least a three-metre dish and a super-low-noise converter — the real expensive stuff. I've seen the results of some of these schemes and frankly they're not what I would call 'smashing', mostly because of the low signal strength.

On the other hand the 137MHz transmitters deliver a solid five watts to a very efficient antenna, and even given the path losses over 2000km or so, you'll have around one microvolt to work with on the receiving end. With modern receivers this is a pretty healthy signal, and a simple 20dB preamp will turn it into 10uV — a piece of cake!

The NOAA 'video' signal is amplitude modulated onto a 2400Hz audio tone, which in turn frequency modulates the 137MHz radio carrier. Unfortunately the deviation is around 30kHz, six times the deviation of normal two-way radio signals. Hence the need for a Wide-FM receiver.

The 2400Hz tone is derived from the same clock that controls the picture scan rate, so in our receiver we can achieve a perfectly synchronized picture by locking the computer to the 2400Hz tone from the satellite. The Listening Post Wesat unit divides the tone by two, to produce exactly 600 pixels per half-second line of picture on the screen.

On the 137MHz APT signal, infrared and visible images are transmitted as continuous side-by-side strips. Between them are 'telemetry frames' that announce conditions aboard the spacecraft and give calibration patches for the various levels of brightness or temperature.

There are also bursts of sync frequency for both the infrared and visible frames. When you hear these, one goes 'tick' and the other goes 'tock', each twice a second. So when you hear a satellite going 'tick-tock', you know you've got a NOAA.

We may see the NOAA's as flying cameras, but they are really precision measuring instruments. The visible 'camera' is an 'Advanced Very High Resolution Radiometer' (AVHRR). This is basically a very directional, tightly calibrated photoelectric cell. It points straight ahead at a spinning 90° mirror, which bends the cell's line of vision toward the earth.

The mirror is spinning at 120 revs a minute, and each rotation causes the photocell's 'beam' to scan across a slice of ground about two kilometres wide. The satellite of course is moving forward, so each scan line is displaced a couple of kilometres along from the previous scan.

The satellite is continuously taking measurements of the reflectivity of the sun's energy from the ground, but when laid on the screen of a computer, we see the whole array of measurements as a 'picture'.

The combination of the spinning mirror and the satellite's motion provides a raster image like that on a TV picture tube, something like 2000km wide and infinitely long. The 'height' of the picture *we* receive is defined by where we happen to pick up the signal and where we lose it.

The full output of this AVHRR contraption is digitised and then sent down on the S-band link. The 137MHz transmitter is fed the same picture, but its bandwidth is much narrower than the S-band link. So the radiometer output is sampled at a slower rate, at lower resolution, before being put onto the 137MHz transmitter. As you can see, though, the pictures are still of excellent quality.

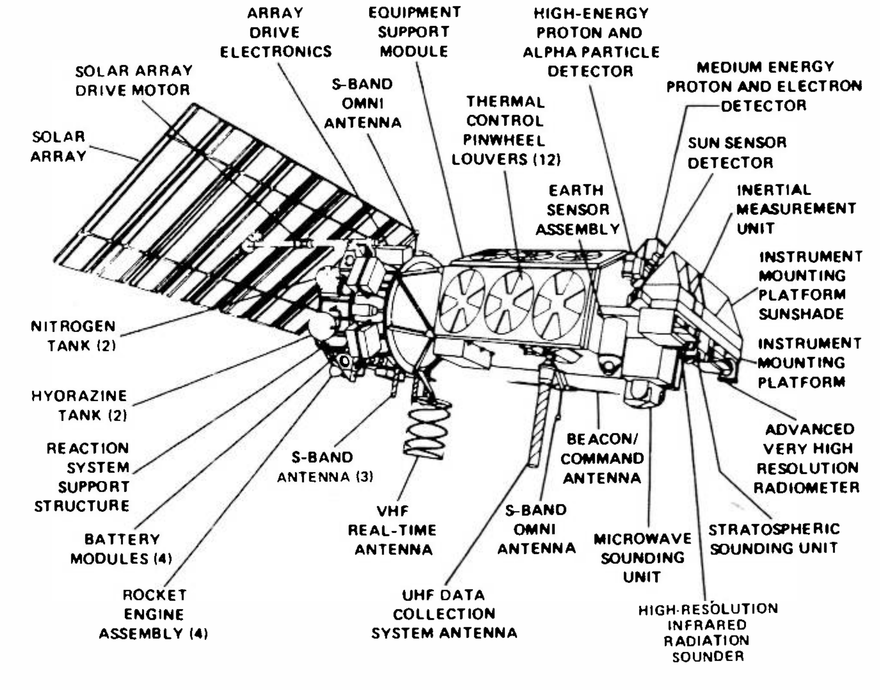
The infrared half of a NOAA picture comes from a High Resolution Infrared Radiation Sounder (HRIRS). This instrument measures temperatures instead of brightness, and the darker the picture the hotter the temperature. Full black indicates +50°C (you sometimes see this over outback Australia) and full white is -70°C, the temperature in some cloud tops.

The infrared data is imaged in the same way as the visible data to produce a picture, but it sometimes looks a bit dull if there are no strong variations of temperature in the one image. If you apply false colour to an infrared picture, each colour will then give a true indication of temperature.

The NOAA satellite is known in the space business as a 'Tiros-N Spacecraft', and a drawing of one is included herein. Not your sleek, cylindrical, gold-plated conveyance here; this baby looks like a flying junk-pile. Or maybe a big bug, about to sting you. At least all the interesting bits are hanging outside, where you can see them!

The spacecraft is about the size and weight of a car, and a solar panel sticks up where one of those trendy aerodynamic 'spoilers' would go over the boot. The panel can be tilted and angled by motors to catch the best sun. In the same area is a rocket motor, driven by nitrogen and hydrazine which are stored in nearby tanks.

TIROS-N Spacecraft



A drawing of the 'Tiros N' spacecraft, as used for the American NOAA satellites. Anything but sleek and elegant, they still deliver some very interesting pictures.

The rocket system is used to keep the spacecraft correctly orientated, and when the rocket runs out of puff we can declare the satellite dead.

At the front of the vehicle, where the headlights would go, are the visual and infrared sensors — looking straight down. There are also other sensors, for experiments conducted aboard the spacecraft in addition to its picture abilities. One very useful feature is the spacecraft's ability to listen for aircraft or boats in distress, on 121.5 or 243MHz, and relay their calls for help.

The various antennas are hung from the spacecraft's belly. The most interesting one to us, the VHF real-time antenna, appears to be a quadrifilar helix, although the specs don't come right out and say so.

This is an excellent choice for a spacecraft antenna; it's circularly polarised (right-hand in this case) and it has good directivity characteristics. A right-hand circular antenna on the ground, such as our Lindenblad, is a good match for it.

The NOAA plan calls for two spacecraft to be in polar orbit at any time, passing a given point on the earth about 12 hours apart to give two daily pictures as the earth rotates beneath them. At the time of writing there were at least four NOAA's operating: numbers 9, 10, 11, and 12. There may be others, but those four are the ones that I've been receiving regularly.

The NOAA 11 and 12 satellites were supposed to replace numbers 9 and 10, but the earlier ones just refuse to die. NOAA's 9 and 10 were launched in 1984 and 1986 with a projected lifetime of two years. The Tiros spacecraft is a very tough little pile of 'space junk'.

Meteor satellites

The Russian Meteor satellites appear to be much more sophisticated than the NOAA's. Instead of simply transmitting weather information to anyone who would care to receive it, Meteor data are specifically aimed at what was the Soviet scientific research effort.

Transmissions are received by Russian ships and research stations around the globe, and then relayed to data processing centres at Moscow, Novosibirsk and Khabarovsk. But since they transmit continuously with frequencies and formats similar to NOAA's, there's nothing to stop anyone making use of their images.

Meteors also transmit both visible and infrared pictures, but not at the same time like the NOAA's.

When they are over sunlit parts of the earth the Meteors transmit visible im-

Wesat Station

ages, and when they are in the dark they transmit infrared. So they switch from one to the other about every 50 minutes.

With the visible transmissions the 2400Hz tone is locked to the picture scan rate as with the NOAA's, but when the satellite goes to IR the locking is disabled — so you can no longer use the tone to lock the picture on the receiving end.

Only the newer Meteors lock the visible picture to the 2400Hz tone, and it is expected that later versions will lock the IR as well.

In general the Meteor visible pictures are of much higher quality than NOAA pictures. If a NOAA scene is flat and dull, you get a flat and dull picture on the ground.

But Meteors seem to have some kind of automatic exposure system, so that there is always maximum white and maximum black in every picture. They always look like really snappy black and white photographs.

Meteor satellites contain both a NOAA-style scanning radiometer and a 'TV camera'. If this is a proper TV camera, and if it is hooked to the APT system, it would explain the excellent quality of almost every Meteor image. Unfortunately information about the Meteors is a little confusing in this regard.

The spacecraft looks more like what we would expect — a cylinder five metres long and 1.5m in diameter. It weighs around 2000kg, twice what a NOAA weighs.

Meteor VHF transmitters usually operate on 137.3 or 137.85MHz, although other frequencies are used on occasion. The FM deviation is 15kHz, half that of the NOAA's but still way too wide for narrow FM receivers.

Meteor transmitters run five watts, and the antennas are right-hand circular polarised, just like the NOAA's. They orbit somewhat higher than NOAA's, 900km vs. 600km, so their ultimate signal strength is slightly less. But due to the higher altitude, Meteor signals can be reliably received from much further away.

Meteor pictures have a square wave for sync, seen as vertical bars, followed by a gray-scale which is handy for setting up the receiving system. The sync signal makes a characteristic 'honk-honk' sound, so if you think you've picked up a flying goose on your receiver, chances are it's a Meteor satellite. All the Meteor pictures in this article were received from the fourth satellite of series three, in other words, Meteor 3/4.

Grateful thanks

This is probably a good place to offer sincere thanks to the Weather Bureau people, in both the Hobart and Melbourne offices, who have given their support in the preparation of this project.

They've tolerated my unannounced visits, answered my silly questions and even let me commandeer their computers — with boundless and good-humoured enthusiasm. Come to think of it I've never met a grumpy weather forecaster. Thanks, fellas!

In the second article, we will discuss the Listening Post Wesat project and kit in detail, along with its software. Then in the third and final article we will look at satellite antennas and preamps, and describe in detail the construction of a Lindenblad antenna from bits of wood and twin-lead TV feeder.

In the meantime if you'd like to get cracking with your own weather satellite receiving system, you can order your Listening Post Wesat kit from High Tech Tasmania, 39 Pillinger Drive, Fern Tree, Tasmania 7054. Be sure to specify VGA, CGA, or Amiga. The cost is $99 for the interface and software, posted in Australia or New Zealand. But money orders or cheques only please — I'm not able to accept credit cards.

(To be continued) ❖

Bugs Bunny

Continued from page 22

Coast houses just one RA Gray computer rack, standing 1.5 metres tall. This is packed with PCB's.

The control room also has 14 video cameras covering the key sections of the ride. The cameras are aimed at the emergency brakes. In the morning setup time the brakes are operated manually to apply the correct boat-to-boat separation, but during the day's operation the control is automatic. Should there be any holdup, emergency brakes are automatically applied.

Movie World founder

A Texan, CV Wood Jr was the main creative force behind Movie World. Now in his 70's, he was actually the first employee of Disneyland Inc. As VP and GM under the late Walt Disney, he supervised selection and purchase of the land for the original facility in Anaheim, California, and was also in charge of planning, financing and construction.

Mr Wood is otherwise known as being the person responsible for buying London Bridge and transporting it to Lake Havasu City in the US. It is understood he took home the 'wrong' bridge, thinking London Bridge was Tower Bridge!

The cameras can show the area where there may be a problem so that technicians, on two-way radio, can quickly go to the spot. Groups go through every minute and half — about 1,500 an hour. Each of the 14 boats carries four rows of three people. During the actual ride the sequences are triggered as each group of people passes.

The action is triggered by the interruption of a light beam, making sure that the audience always see the start of the action. The operating hours are long: 9.30am to 6pm in summer holidays.

'Sir Edward'

In other work, Sally staff had just completed a presentation for the NSW Dept of Administrative Services. 'Sir Edward' — a portly, balding expert — gave a talk on behalf of the department. Eccles explained that a routine like this can go for a couple of minutes. Completely self-contained, the computer could run it all day. These animatronics are ideal for exhibitions and trade launches. They can be operated live, with a speaker working off stage and the computer automatically synchronising the voice.

The eyes and arms can also be made to work or the head turned — all controlled from an off-stage panel or triggered from a pre-recorded tape. ❖

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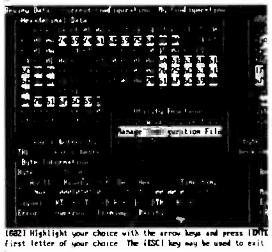

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Despite all of these features, the Sangean ATS-818CS measures only 296 x 192 x 68mm (L x H x D), and weighs only 2kg. It is fully microprocessor controlled, and uses 15 integrated circuits, 61 transistors, 8 FETs, 53 diodes and two LEDs. Operation is from either four 'D' size alkaline cells and three 'AA' size cells, or an external 6V DC power supply.

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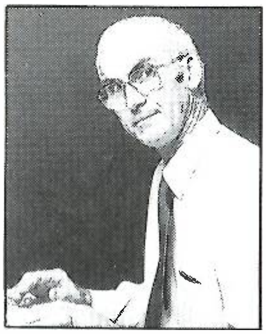
1. The competition is only open to Australian residents authorising a new or renewal subscription to Electronics Australia magazine before last mail on 25.06.92. Entries received after closing date will not be included. Employees of the Federal Publishing Company Pty. Ltd., Dick Smith Electronics, their subsidiaries and families are not eligible to enter. 2. South Australian residents need not purchase a subscription to enter, but may enter once by submitting their name, address and a hand drawn facsimile of any coupons to the Federal Publishing Company Pty. Ltd., P.O Box 199 Alexandria, NSW 2015. 3. Prizes are not transferable or exchangeable and may not be converted to cash. 4. The judge's decision is final and no correspondence will be entered into. 5. Description of the competition and instructions on how to enter form a part of the competition. 6. The competition commences 25.03.92 and closes last mail on 25.06.92. 7. The draw will take place in Sydney on 29.06.92 and will be announced in a later edition of Electronics Australia. 8. The prizes are: 20 x Sangean ATS-818CS radios, valued at $399 each. Total Prize valued at $7980. 9. The promoter is the Federal Publishing Company Pty. Ltd., 180 Bourke Rd, Alexandria NSW 2015. Permit No. TC92/0000 issued under the lotteries and Art Union Act 1901; Raffles and Bingo Permit Board No. 92/0000 issued on 00/00/92; ACT permit no. TP92/0000 issued under the Lotteries Act 1964; NT permit No. 92/000.

FORUM

Conducted by Jim Rowe



More on dangers from E-M fields, and still more ways of gilding the hifi lily

There have been a few letters with comments about the subject of possible health risks from things like bedside clock radios, which we raised in the March column. I've also had a few more missives from readers on the subject of products or services claimed to improve the performance of hifi systems and components — I suppose we haven't upset the hifi dealers for a few months now, so it might be safe to open the subject again!

Last time we discussed things like 'super cables' and other supposed 'hifi enhancement products' in these pages, you might recall, it produced quite a pained reaction from various hifi product dealers and distributors. A number of them claimed in essence that we were simply unable to recognise subtle differences in sound quality, and therefore quite unjust in dismissing their products as little more than expensive hokum.

Many such arguments tend to reach a stalemate position, where the skeptics conclude that those in favour of the products concerned are kidding themselves and/or being duped by the marketing hype, while the defenders claim that the skeptics either have cloth ears and wouldn't recognise good sound if it metaphorically fell on them from a great height, or else have sound systems that are so poor that small improvements cannot be detected.

In fact sometimes it seems that by definition, the only people who can hear the subtle effects of some of these products are those who have purchased the most expensive and elaborate sound systems (plus of course the dealers who seem to come up with an endless stream of ever-more-esoteric enhancement products, to supposedly make them better).

One might almost think that having the money to buy the most expensive kind of sound system automatically endowed a person with enhanced audio accuity, elevating them from the ranks of we ordinary mortals into the rarified region of the platinum eared elite. After all, what use is having lots of money if it doesn't allow you to feel superior to the *hoi polloi*?

Something tells me, then, that simply by raising the subject again this month, I'm going to stir up a familiar hornet's nest once again. Still, it's a risk that needs to be taken, judging by the letters that keep on arriving...

Before we do so, though, there have also been a few letters in response to the brief discussion of possible health risks from things like bedside clock radios, in the March column. You may recall that the subject was raised by reader 'G.S.' from Albury, whose neighbour's GP believed that bedside clock radios were linked to cases where patients developed brain tumours. Rightly or wrongly, I linked the story to the growing concern about the possible health risks of low-level low frequency electromagnetic fields, from things like HV transmission lines, pole-mounted transformers and electric blankets.

One of the readers who responded to this topic was Mr K.H. Weichselfelder of Hawthorn in Melbourne, who has contributed to Forum on previous occasions. Mr Weichselfelder enclosed a cutting from a recent item in *Engineers Australia*, describing studies being carried out by engineers of the US Electric Power Research Institute, in Lenox, Massachusetts.

The study concerned has involved construction of a special 'clapboard' house, and using it as a testbed to analyse the fields present due to wiring and appliances. This was done because an earlier study, using a sample of 50 existing homes, generated data that proved too complex to analyse.

Apparently what the study has shown so far is that fields in a typical home are determined not only by the wiring and appliances in the home itself, but also by radiation from neighbouring homes, telephone lines and water pipes.

The correlation between the resulting complex field structure and the health of a home's occupants is still clear, it seems. However the *Engineers Australia* story also refers to other epidemiological studies carried out in the USA, which showed a correlation between exposure to ELF (extra-low frequency) fields and the incidence of leukemia in children. It also points out that these results have been disputed.

Apparently the World Health Organisation has recommended that although nothing can be concluded as yet about the effects of ELF fields on humans, 'efforts should be made to limit people's exposure to levels as low as can reasonably be achieved'. Which sounds rather like the response I recommended myself in the March column, I think you'll agree.

Anyway, my thanks to Mr Weichselfelder for sending in the clipping concerned.

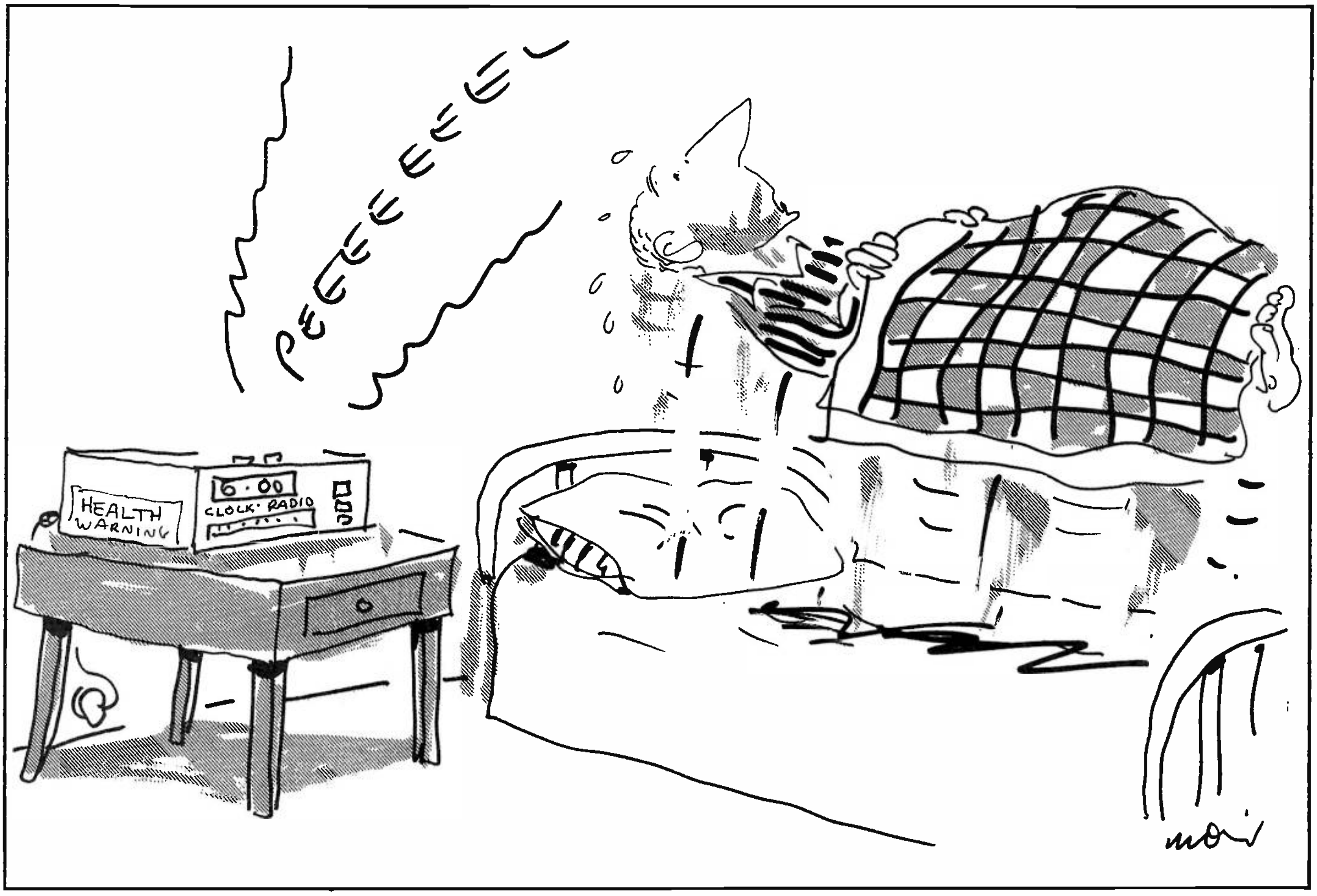
More skeptical

Another reader who responded to the item concerned was Mr William Hanna, of Woomera in SA. Mr Hanna takes a fairly skeptical line, as you can see, but nevertheless one that raises a number of interesting points:

I write not to 'heap scorn' on the idea that low level E-M fields may have an adverse cumulative effect, but to suggest that, even if there IS a risk, it will be very difficult if not impossible to prove. You have given some of the reasons yourself.

The problem will be in establishing a 'control group', for any study. Who in the world lives as you and I do, with the sole exception that they are not exposed to low level E-M fields?

Perhaps the best way to conduct the study would be to examine instead those persons who live as you and I do, but who are regularly exposed to very HIGH



E-M fields — e.g., workers in the electrical power generation and distribution industries. This would be analogous to feeding laboratory mice the equivalent of hundreds of cans of diet soft drinks per day, to see if low levels of artificial sweetener can lead to cancer.

If it cannot be established that a cumulative exposure to high level E-M fields is dangerous, then surely one should stop worrying about exposure to low level fields. Have any of the power utilities performed such studies? Do insurance companies have actuarial statistics for power workers?

As for electric blankets, it would seem that the greatest effect that the blanket would have, would be to frustrate the body's natural mechanisms for thermoregulation — which could lead to subtle changes in metabolism, with unknown consequences. At least it would be possible to test this theory, by warming one's bed to the equivalent temperature by non-electrical means for a few decades.

In the case of high voltage power distribution lines, it would be wise to study first the effects of the socio-economic conditions of those who 'choose' to live in their vicinity. Or perhaps high voltage power lines could be strung across say Double Bay, and the effects studied.

Lest you think that I am poking fun at this issue, let me point out that I spend a portion of my working day in front of a large colour graphics display and almost always listen to music with headphones — so I am exposed to considerable risk if there is anything to this.

I have also, however, worked in an oil refinery, and I have no doubt that whatever the risks of low level E-M fields may be, the established risks associated with hydrocarbon emissions are orders of magnitude greater. That is among the reasons why I choose the (relatively) clean air of the outback.

Thanks for your comments, Mr Hanna. I agree that there are great difficulties in coming up with any conclusive evidence about the risks of E-M fields, because of the difficulty in finding a suitable control group. I also agree that we're talking here about relatively low level risks, compared with others in our developed industrial society.

Like you, I'd be interested to know if the power utilities or insurance companies do have any statistical evidence about the health of power industry workers, because this would indeed seem to be relevant here. Mind you, they might not be too eager to release this kind of information, even if it exists. I seem to recall cases where employers — including government-owned employers — have been in possession of horrifying statistical evidence of this kind, and have gone to great lengths not only to deny the existence of this information, but then to prevent access to it once its existence became known.

There seems little doubt that this occurred in the case of asbestos, for example. Long after the links between asbestos and diseases such as mesothelioma were firmly established, and quite damning statistics had been accumulated by medicos and insurance companies, people were still being allowed to work with asbestos and without proper protection.

I like your subtle way of suggesting that other factors need to be taken into account in assessing the effects of HV transmission lines. Of course they do — but all the same I don't like your chances of being able to string such a line across Double Bay!

Finally, I'm not entirely sure that if high level E-M fields were shown to have no significant health risk, this would allow us to conclude that low level fields were 'even safer'. I seem to remember reading somewhere (perhaps in *New Scientist*?) that some influences can be non-linear in their effects on living cells — so that high doses for relatively short times might actually be less dangerous than much smaller doses presented for quite long periods.

Another skeptic

Moving right along, another reader who responded to the topic was our frequent contributor and critic Keith Walters, of Lane Cove in NSW. And if you thought William Hanna was pretty skeptical, you ain't seen nuthin' yet, folks. Here's part of Mr Walters' missive:

The basic idea itself (that clock radios cause brain tumours) isn't all that ridiculous. It is, at least, theoretically possible. What IS ridiculous is the notion that, of all the thousands of scientists and doctors studying the medical records of millions of cancer patients throughout the western world, not one of them would have noticed a sudden and dramatic (and unexplained) increase in the incidence of brain tumours in the last twenty years (which is when clock radios began to proliferate). There's certainly been nothing to that effect in the science journals I subscribe to, anyway.

Even if researchers WERE able to show an apparent causal link between clock radios and cancer, why do you jump to the conclusion that it must be caused by magnetic fields?

A simpler and more likely explanation would be that it's due to some kind of chemical carcinogen. A possible culprit could be the phenolic resins used in making PC boards — these are what give electronic appliances their characteristic 'electronic' smell. Because they tend to run warm, and they're on all the time, clock radios would be continuously emitting such vapour.

It's not hard to imagine how the prolonged deep breathing of someone sleeping could introduce such a substance into the brain. In fact that's about the only way it COULD happen.

That is, assuming that the problem really does exist!

As for the references to things like mercury, tobacco, lead paints etc., the fact is that most of these things were introduced in the 19th century or earlier. At the time, scientists were well aware of the toxic nature of these substances, but considering the number of things you could die from in those days, the additional hazard involved was probably considered negligible!

Well, there you are. According to Mr Walters, it's highly unlikely that there's any connection between brain tumours and clock radios — because if there were, it would have been noticed long since by one of those hordes of eminent medicos or scientists. And even if there was a connection, it couldn't have anything to do with low level E-M fields; quite clearly the only possible culprit would have to be emission of phenolic resin vapours!

It must be nice to be that sure of one's knowledge, mustn't it? And how could I have been so stupid as to think that low level E-M fields might be one possible factor linked to brain tumours?

That being the case, there seems little more to say about this subject for the present. So let's get back to that perennially thorny subject of hifi enhancement products...

Laser cleaner?

Coincidentally, it turns out that Keith Walters has also sent in a different letter, on this very subject. So in view of the fact that he has so confidently and effectively closed one subject for the time being, I propose to make him responsible for re-opening this one:

A couple of months ago, an acquaintance returned from a long stay in Japan, bringing with her (against all advice) a rather large and expensive 'Ghetto Blaster', which included a CD player.

This is of no particular interest, but one of the 'accessories' that came with it intrigued me — a CD 'Laser Cleaning Disc'.

It looks just like an ordinary CD. The instructions were entirely in Japanese, which she doesn't read terribly well, but apparently you're supposed to use it much the same way you would a VCR cleaning tape.

It took me a full day to realise that that was surely impossible! How can you clean the bloody laser lens with a compact disc?

If the disc was covered in something like chamois leather, it might be theoretically capable of doing the cleaning. But if that was the case, as I understand it the laser assembly wouldn't go anywhere near the damned thing! After all, one of the major advantages of the CD system is that, theoretically at least, nothing ever touches the disc surface.

The only way I could see that this could work would be if the CD was made a lot thicker than usual, which would make the focus servo tend to position the laser lens so that it touched the clear plastic on the underside of the disc. If the plastic was soft and pliable, it might be capable of cleaning the lens, but this certainly wasn't the case with the one I saw!

Am I missing something, or is this another 'Green Pen' scam?

I have recently put my old Sanyo CD player into semi-retirement, after six years of faultless service. It was still working faultlessly, despite being (as I subsequently discovered) full of carpet fluff! This was entirely without the benefit of laser cleaning of any kind...

Far be it from me to suggest that *you'd* be capable of missing anything, Keith — after all, I'm the dill who thought there might just be a possible link between clock radios and brain tumours!

As it happens, though, I do find myself agreeing with you on this one. (Could it be that you're finally getting through?)

Like you, I really can't see how the supposed laser cleaning disc could possibly work, if it is indeed no thicker than a normal CD and apparently made of the same fairly hard polycarbonate material.

I suppose there's always the possibility that it's designed to develop a strong electrostatic charge, and attract the fluff up from the laser lens — like a comb attracting hairs or little pieces of paper, in dry weather? Or perhaps the disc is made from a special formulation, so that it somehow acts as a laser amplifier itself, reflecting back down a vastly stronger IR beam — so that it actually *burns* the fluff from the lens?

Seriously, though, it does sound as if it's another of those products that seem to abound in the audio/hifi industry, to appeal to the gullible and the unwary. Whether you call them a 'gimmick' or a 'scam' depends largely on the difficulty of disproving the marketing claims made for them.

But presumably in this case it would at least be a relatively *low cost* gimmick or scam. A mitigating factor which seems to apply rather less in the case of the 'enhancement product' that our next correspondent has discovered...

'Cleaner power'

The reader concerned is Brian Wallace, of Thornleigh in NSW, and the item which attracted his attention is not all that different from some others we've looked at in the past:

The attached advertisement appears to be genuine, and not a lampoon as my boggling eyes had at first supposed. Have we reached the giddy limit with the super-cable nonsense?

To ask only the most obvious question arising from the drivel claimed, why stop with the 'dusty road' between the power outlet and the gear? Why not re-wire the whole bloody house? It would be worth it (only $199 a metre plus), when you can HEAR the difference!

YOUR HIGHWAY TO SUPER SOUND

The noticeable improvement in sound that specially-developed power cables can make in a music system has only recently been recognised by audiophiles. The traditional use of standard zip cords or other cheap rubber and plastic coated cords with mass-produced plugs can only be compared to supplying power to your equipment via dirty, dusty roads.

Each of THE POWER CORD contains four twisted pairs of wire fashioned from high-purity copper running in parallel and encased in ELECTROCOMPANIET's premium dialectric. Of technological interest is the fact the THE POWER CORD field is self-cancelling. As a result, THE POWER CORD reduce radiated hum, common mode noise and high frequency noise from entering your system. Hum morever, is prevented from radiating back from your equipment. The conductors are heavy-duty, high current components selected for the demanding uses that discriminating music lovers put upon their systems. The sophisticated composition of this cable is further evidenced by the fact that optimum sonic results require 72 HOURS of usage before the full benefits can be appreciated.

Is that too long to wait for the distinctly better sound from your system and a budget-fitting price that delivers the cleanest and best power to your components? We think not. THE POWER CORD may well be the most significant and least expensive upgrade you can make. $199.

The advertisement to which reader Brian Wallace draws our attention, from a prominent local hifi dealer's recent catalog.

But wait — how good are those wires out in the street?

The gullible audiophile seems to be a sitting duck. But isn't it time those patently silly claims — which rival the patent medicine ads of last century — were put to the consumer watchdogs?

It's all the sadder when [the hifi dealer concerned] *has pretentions to an international reputation.*

Thanks for drawing our attention to the ad concerned, Brian. As you can see, I've reproduced it here so that readers can judge it for themselves. But I have deleted your reference to the actual name of the dealer concerned, with the idea of protecting both of us from possible legal action. You never know; from what I've gathered about the libel laws in various Australian states, neither objective truth nor acting in the interests of the public's good carry a great deal of weight at times.

Not an advertiser...

By the way, the dealer responsible for the ad is NOT an advertiser in *EA*, so in deleting their name I have no hidden commercial axe to grind. I can't remember them taking ads with us in the past (although they may have done), and I suspect it's unlikely they'd advertise with us in the future. If the comments we've made in the past about super cables and the like haven't deterred them for good (along with most other hifi dealers), I imagine this month's column will really clinch it!

Despite this, though, and just before I comment on the actual claims made in the ad itself, I think it might be worth considering that hifi dealers like the one concerned are quite possibly under a fair bit of commercial pressure to both stock and endorse many of these products — regardless of what they may think about them privately.

Commercial realities

In the real world, we all have to make a living, and the harsh realities of commerce can often make it very costly to 'stick to one's principles' and only stock or endorse those products which one is absolutely certain are kosher. If *you* don't stock them and the punters are determined to buy them, they'll go to someone who has them — and while they're there, they might well buy some of the other things that they could have bought at your store!

So perhaps we shouldn't be too hard on the hifi dealers. Things have been pretty tough for most of us, for the last few years, and there can't have been too many people buying top of the range amplifiers and speaker systems.

That said, I have to agree that the ad concerned does seem to reach new heights of technological gobbledegook. Like Mr Wallace, I find the suggestion quite incredible even that owners of the most expensive systems will achieve a 'distinctly better sound' merely by replacing the last metre or two of the power wiring, stretching all the way between the power station and their system, with a piece of supposedly super-high quality cable. Let alone the rest of us, with somewhat more modest systems and ears!

In a sense, of course, the claims made are basically the same ones that have been made for those 'super' speaker and interconnecting cables — the emphasis on 'high purity' copper and 'premium' dielectric, and esoteric methods of construction. There's also that emotional stuff about 'heavy duty, high current components selected for the demanding uses that discriminating music lovers put upon their systems'.

Relatively remote

The problem is, as Mr Wallace implies, that even if there *is* any faint technical justification for the extravagant claims made for 'super' speaker cables and interconnecting cables, none of this justification seems capable of applying even remotely to a power cable. At least speaker and interconnecting cables are directly in the signal reproduction chain; the power cable is relatively remote from it, and only one short link in the overall power delivery chain.

Of course having 'four twisted pairs of wire fashioned from high purity copper, running in parallel and encased in premium dielectric' certainly won't do any harm. But as for it supposedly providing a 'noticeable improvement in sound', compared with a standard $5 mains cable, that's a different matter.

We're told that it's of 'technological interest' that the cable's field is self-cancelling, and that as a result it reduces radiated hum, common-mode noise and (prevents?) high frequency noise from entering your system. Also that hum is prevented from radiating 'back from your equipment'. This may indeed be of some interest, but what on earth does it all mean?

To be honest, it sounds pretty much like what we used to call 'dah-dum', when I was a kid. (That was the polite expression for bovine excreta, back in the 1950's.)

For a start, even a standard $5 power cable tends to have very little external field, because its two main conductors already run closely in parallel and are generally lightly twisted. As a result, their magnetic fields also largely cancel each other. The stray AC field around the cable is already so small, compared with that produced by the rest of your house wiring, that the possible advantage of substituting a fancier 'four twisted pairs' cable is likely to be immeasurably tiny — even in terms of the fields near your system, and assuming these could play a significant role in influencing the final sound.

How such a short length of fancy cable could attenuate common-mode noise on the power line totally escapes me, I confess. Nor can I see how it could possibly provide any significant attenuation of high frequency noise, unless it had a dramatically higher capacitance between the active and neutral lines.

Heavier conductors

And as for that implication that its heavier conductors allow it to cope with the heavy currents drawn by an audiophile's system, that's *really* 'interesting' from a technical point of view. Even a high-powered class A stereo amplifier, with say 100W output per channel and relatively low electrical efficiency, isn't likely to draw more than about five or six amps from the 240V line. So a standard cable rated for 10 or 15 amps should be capable of coping with the demand easily — even if it does use 'ordinary' Mount Isa copper (which is very pure anyway, I gather).

You can argue that the *speaker* cables need to have fairly stout conductors, because they're delivering power at a low impedance and the peak currents can get quite high. But the mains cable is handling only a bit more power, and at a much higher voltage level — so the current is proportionally smaller.

Finally, there's that wonderful blarney about the cables needing '72 hours of usage before the full benefits can be appreciated'. Is this the time needed for those delicate little high-purity copper crystals to settle themselves down, and deliver their virtuoso best? Or is it perhaps the time needed for gullible purchasers to have forgotten what the sound was like with their previous power cable, and hence convince themselves that the $199 was well spent?

More likely, I suspect, is that it's a subtle attempt to discourage potential buyers from asking for an A-B comparison in the dealer's shop.

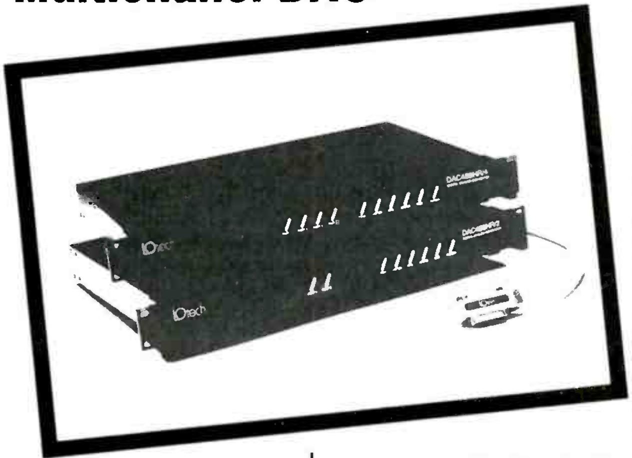
Sorry folks, but all told the $199 super power cable does seem even closer to snake oil than those fancy speaker and interconnecting cables. I'm inclined to agree with Brian Wallace, that products like this should be referred to our consumer protection authorities.

And that's about all the space we have available this month, I'm afraid. I still have a long letter dealing with people and firms who claim to achieve dramatic improvements in the performance of CD players, by making a few small modifications to them. But I'm afraid that will have to wait until next time.

I hope you'll join me then. ❖

PRODUCT HIGHLIGHT — New from 10tech

IEEE 488.2, 100 kHz, 16-Bit Multichanel DAC



The 100kHz, 16-bit DAC 488HR digital to analog converter (DAC) offers IEEE 488.2 programmability and up to 4 isolated analog output channels in a 1.75-inch rack-mountable package. The unit features the capabilities of several traditional IEEE 488.2 instruments at a fraction of the cost. For example the DAC488HR's step, burst, waveform, and continuous-trigger modes enable it to provide stepped voltages like a precision voltage source, long arbitrary waveforms like an arbitrary waveform generator, or sine, triangle square, and sawtooth functions like a function generator.

High Resolution, Multiple Channel Analog Output

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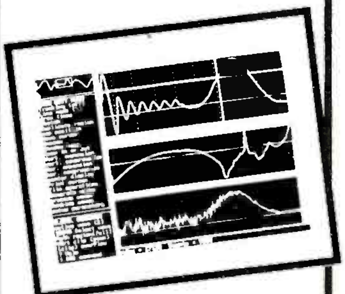

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27128-20	7.55	128K	200ns	21V	28
27128-25	7.25	128K	250ns	21V	28
27128A15	4.95	128K	150ns	12.5V	28
27128A20	4.45	128K	200ns	12.5V	28
27128A25	3.75	128K	250ns	12.5V	28
27128AOTP	2.35	128K	250ns One Time Prog.	12.5V	28
27C128-15	5.65	128K	150ns CMOS	12.5V	28
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27256-20	4.95	256K	200ns	12.5V	28
27256-25	4.45	256K	250ns	12.5V	28
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27C256-15	5.75	256K	150ns CMOS	12.5V	28
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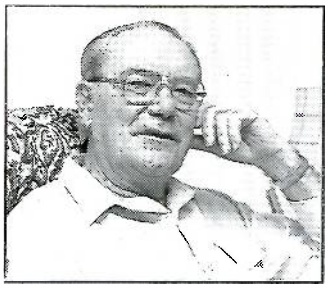


When I Think Back...

by Neville Williams

'Smithy' and the Southern Cross - 1
The vital supporting role of two-way radio

If the epic flights of (Sir) Charles Kingsford-Smith helped showed the way for today's national and international airlines, they also served, with the co-operation of contemporary 'wireless' amateurs and enthusiasts, to demonstrate the dependance of all such services on two-way radio communication and direction finding. But let's turn back the clock to the period before wireless became airborne.

In so doing, I should perhaps acknowledge initial prompting and assistance in the preparation of this article by Aub Topp, VK2AXT, librarian of the NSW Division of the Wireless Institute of Australia. Having researched the subject for a number of WIA Sunday morning broadcasts, he lists the following references in amateur radio literature: *QST* for August 1928, p.21; *Break In* for July 1979, p.280; *Popular Radio & Aviation* for May 1929, p.10; and *Break In* for March 1972, p.55.

In respect to dates, details and continuity, my task was simplified when I came across a paperback biography entitled *SMITHY, the True Story*. Written in 1976 by Ward McNally, it was purportedly based on information supplied by Mrs Mary Tully, the former Lady Kingsford-Smith; Mr Graham Kingsford-Smith; and others who knew Smithy personally, including the late Sir Gordon Taylor.

For the illustrations, and extracts from the *Sydney Morning Herald* I am indebted mainly to the John Fairfax Group, Sydney, while the Macquarie *Book of Events* provided a handy cross-reference to people, times and places..

In actual fact, I needed little prompting to 'Think Back' on this particular subject, having been fascinated by aeroplanes from boyhood. Heaven alone knows how many toy biplanes I whittled from scrap wood, and how many hours I spent poring over the pages of the technically orientated *Modern Boy* magazine. I still remember their adventure serial, based on the exploits of an English school kid who had unlikely access to an ancient Farman biplane.

And I was delighted beyond measure when the authorities, whoever they were, carved an emergency landing strip out of the bush a few hundred metres from our family home, in Bargo on the NSW southern highlands. About 80-odd kilometres south-west of Sydney, it became a staging point for pleasure flights and trainee pilots and every kid in the district would race to the strip on their bikes for a closer look whenever a plane landed.

One even obliged by stalling above the town and executing a genuine upside-down crash landing, after not quite clearing the treetops!

One of the visiting pilots turned out to be a distant cousin, and at his invitation, our family met up with him a few weeks later at Sydney's Mascot aerodrome. There, my kid sister and I were strapped into the second cockpit of a traditional biplane, for an all-too-brief flip around the area.

Years later, I was the guest in an ancient twin-engined De Haviland DH-84 biplane on shark patrol, as it lumbered off the same 'drome and circled Sydney's major surf beaches.

When I mentioned this to *EA*'s former amateur band correspondent, Pearce Healy, he warned me not to confuse the DH-84 with the DH 'Dragon Rapide', which had tapered wingtips, as compared with conventional square tips on the -84.

He knew, he said, because, as a long-

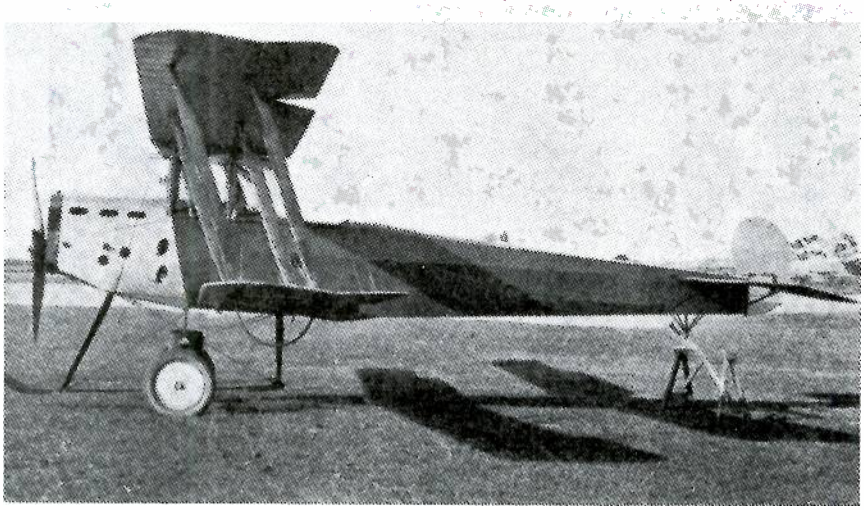


Fig.1: One of the first planes ever to be assembled in Australia, by AA&E in Mascot: the Avro 504/Dyak with a water-cooled Sunbeam engine and duralumin-covered steel-frame wings. It was in biplanes like this that Smithy honed his skills.

time employee of De Haviland in Bankstown NSW, he had been involved in producing the first-ever set of wings for locally made DH-84s!

A grassy paddock...

As I recall Mascot aerodrome in the mid 1920's, it was just another grassy paddock, reached by an unsealed road and bordered by a post-and-wire perimeter fence and a pipe-and-wire vehicle gate. You left your Dodge or Hupmobile or T-model Ford on the grass fringe outside and wandered in to look around.

As I remember, there were no aircraft parking aprons, taxiways or sealed runways and no pretentious buildings — just a collection of fibro and corrugated iron structures that would not have been out of place on a rural property. The smaller ones were presumably private hangar/workshops. With hindsight, one of the larger ones could have been the Australian Aero Clubhouse; another, a factory where AA&E (the Australian Aircraft & Engineering Co Ltd) assembled and serviced Avro designed aircraft.

From *Sea, Land & Air* magazine (April 1, 1921) I gather that, by then, the above factory had been operational for about nine months, adopting what had formerly been a cow paddock as an aerodrome, with one side fringing a river on which it would have been possible to land seaplanes.

At the time the *Sea, Land & Air* article was prepared, using components imported from A.V. Roe & Co in the UK they had assembled two Avro 504-K biplanes with Le Rhone (110hp) engines, and two others with Clerget (130-hp) engines. They were also in the course of completing four Avro 504/Dyaks, differing from the others in the use of a Sunbeam 100hp water-cooled engine and steel-frame wings covered with thin duralumin sheets (Fig.1).

According to the author, AA&E had successfully fabricated some components including propellers from Australian materials and, for outback use, had devised a handyman repairable wood-based landing gear and an engine 'cranking' handle, similar to that fitted to cars, in the cockpit in front of the pilot. My mind boggles!

Mascot was still home for planes of this general ilk in the mid-1920's: ordinary 'moths' with a single pair of wing struts on either side of the fuselage, and 'big' ones with two sets of struts on either side.

There were no large planes in sight on the day our family chugged up to the gate in our old 501 Fiat. We looked up war ace 'Bunny' Hammond, whom we had met on our local landing strip; but of the already notable Charles Kingsford-Smith there was no sign.

Fig.2: At the end of World War I, Smithy was demobilised from the RFC as a Captain (Training), with a Military Cross earned over the battlefield of Europe. At the time of his death he was recognised as Air-Commodore.

Perhaps it is appropriate to add, with hindsight, that I would have found little or no wireless equipment on the one-time cow paddock that was to become Sydney's principal airport — now congested with electronics. Within the planes, communication was by hand signals, notes or speaking tube; communication with the outside world was non-existent — or at best, visual.

I recall an experimental night mail flight that was arranged about this same time to some destination south of Sydney.

In the absence of electric power, and as the local garage proprietor, my uncle was commissioned to set up oil drum flares around the Bargo landing strip.

At a certain time on the appointed night, he had to light sufficient flares to identify the strip for the approaching plane. If the pilot gave any indication that he wished to land, the remaining flares were to be lit without delay!

But enough of my ramblings. Sufficient to say, that this was the world of aviation in which the redoubtable Kingsford-Smith grew up and gained his wings.

Born unhyphenated

According to Ward McNally, the future aviator was born in Brisbane to Mr and Mrs William Smith in February, 1897. Their sixth son, he was baptised as Charles Edward Kingsford.

Five years later, the family moved to Canada, where they found themselves in a street with seven other families by the name of Smith.

To avoid confusion, they added their youngest son's christian name to the family surname — so that he became Charles Kingsford-Smith, a name retained throughout adult life.

When the family returned to Australia, 'Chilla' ultimately attended Sydney Boys' Technical High School, representing his school in both football and tennis. On leaving school, he found work with the Colonial Sugar Refining Co as an apprentice electrician, becoming a reportedly speed-crazy motor cyclist at about the same time.

Prevented from joining the armed forces until his 18th birthday, he ultimately enlisted in the AIF and underwent training in Singleton, NSW. He was thereafter drafted to Egypt and Gallipoli — ending up, after evacuation from Gallipoli, as a motor cycle despatch rider in France. He was so obviously at home on a machine that he was selected to train as a pilot for the RFC (Britain's legendary Royal Flying Corps).

Writing home to his parents, he said, *inter alia*: "I have already discovered one thing about flying ... that my future, for whatever it may be worth, is bound up with it. Flying has a great future, just you wait and see."

After a period of service as a combat pilot, during which he was awarded the Military Cross by King George V in person, Flying Officer Charles Kingsford-Smith was appointed as a flight instructor. This was before his 20th birthday. Perhaps it was just as well.

Fig.3: This montage was prepared by TAA in 1962, on the 34th anniversary of the trans-Pacific flight, to draw attention to the fact that the Australian Government airline had carried its 50,000th passenger. They, along with ANA and others had given practical expression to the dream of Smith, Anderson and Ulm.

While he found the life of a combat pilot to be one of excitement and challenge, he pro-fessed to being sickened by the wholesale slaughter, particularly when he had been called upon to strafe enemy columns on the ground. Aerial combat, man to man, was one thing; seeing his machine gun bullets ripping into men on the ground was quite another. It haunted him.

At the end of 30 weeks, he was granted leave to revisit his homeland and, wearing the first heavily braided RFC uniform to have been seen in Australia, attracted immediate attention. He soon tired, however, of being cast as a recruiting role model and became impatient to rejoin his unit in England.

Ironically, however, and perhaps with intent, he was despatched to Britain via the USA, which had just entered the war.

Once again he became the centre of attention; but having in mind the implications of America's welcome involvement, Kingsford-Smith went along with the recruiting rallies and even vowed to

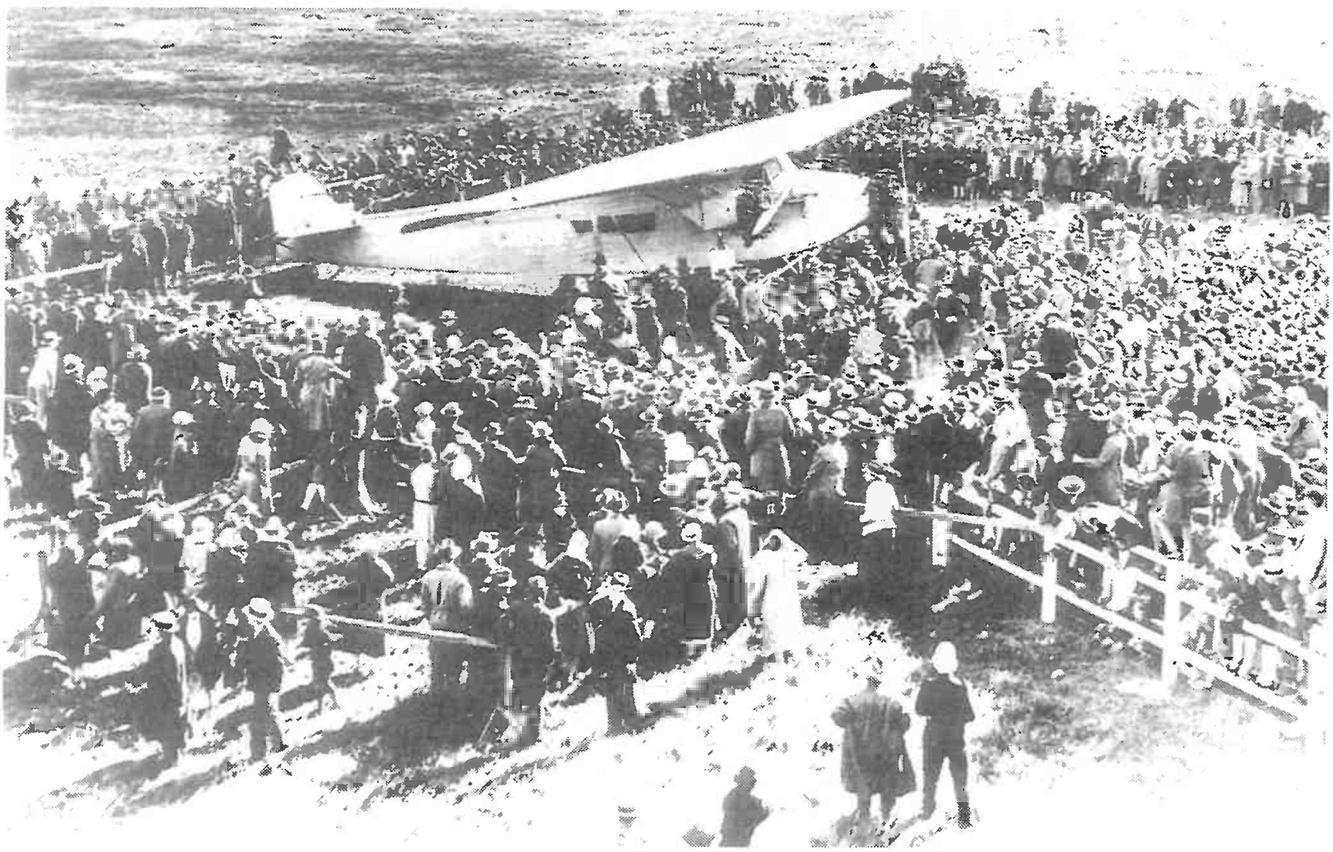


Fig.4: Welcome home! Arrival of the Southern Cross at the Eagle Farm aerodrome in Brisbane, at the end of its epic flight across the Pacific in 1928.

return when the Kaiser had been put in his place.

Back in England, with the rank of Captain-instructor, his job was to test and lecture the graduating pilots at the various training centres — an assignment to which he was eminently suited.

Back in Civvy St

In November 1918, it was all over. But just when Kingsford-Smith was to return to Australia, he linked up with two other Australian pilots, Rendle and Maddocks.

Between them they bought a couple of surplus DH6's and went into the charter flight business. It wasn't a success, however and the three friends decided that their best bet was to trade-in their DH6's on a twin-engine Blackburn Kangaroo — in order to go after the £10,000 prize being offered for the first British aircraft to fly from England to Australia in less than 30 days and before December 31, 1919.

Unfortunately, for reasons best known to himself, Australia's then Prime Minister Billy Hughes ruled out their nomination.

This left 'Smithy' with a deep resentment and a near obsessive determination to demonstrate pilot skills that Hughes had so publicly questioned. It was the first of several set-backs which he was to receive at the hands of Australian politicians.

As it turned out, the prize went to two other military pilots, Ross and Keith Smith, with J.M. Bennett and W.H. Shiers, who covered the distance in a Vickers Vimy in 29 days, arriving in Darwin on December 10.

Three weeks later, Smithy was back in the USA, virtually broke and looking desperately for a flying job. The only one available was as a freelance stand-in and stunt pilot, principally for the Universal Studios in Hollywood.

It proved to be a scary job, even for an ex-fighter pilot and Smithy came uncomfortably close to death when he was required to climb out of the cockpit of an Avro biplane and dangle from the wing, hanging onto a strut.

Distinctly disillusioned, he was glad to exchange the job for a place in a 'flying circus' — especially when he saw a fellow stunt flyer incinerated nearby after a crash. Death on the battlefield was something one had to accept; death on a movie lot was something else.

The flying circus might have been a success, except that its promoter 'shot through' with the takings. So it was that an even more disillusioned former RFC Captain found himself back in his homeland, with only two American dollars in his pocket — this time with a burning ambition, somehow, to establish Australia's first commercial airline.

But it wasn't to be, because on his arrival he found that an old friend from the RFC, Lionel Lee, had already established the 'Diggers' Aviation Co Pty Ltd'. Unwilling to set up in opposition, Smithy sought and was given a job with 'Diggers', barnstorming around country shows for whatever wages the enterprise could affort to pay.

Following a couple of minor mishaps they parted company and Smithy joined West Australian Airways, which had been founded in November 1921 and granted a mail contract servicing major centres north of Perth.

For Smithy, the new job fostered an affinity for 'outback' communities, and developed his skills at flying long distances 'against the clock'. It was also at WA Airways where he met Keith Anderson, a younger but highly skilled pilot, who shared his emerging ambitions to blaze new trails and establish new records in the process.

Rocky road to fame

Sensing their enthusiasm, WA pastoralist Keith Mackay offered to back the two men for a trans-Pacific flight. But ironically Mackay was killed when a charter plane crashed on his way to Perth to get the project under way.

Smithy and Anderson reacted to the news by resigning from WA Airways and taking over a promising garage and cattle-trucking business based at Carnarvon in WA. The venture exposed them even further to the rough-and-tumble of outback living and saw Smithy married, if only briefly, to his first wife Thelma. They were a popular couple but incompatible and separated without recriminations.

(Five-odd years later, Smithy was to meet Mary Powell on a return voyage from Britain to Australia. She subsequently became his second and very supportive wife and, ultimately, Lady Kingsford-Smith.

She bore him a son, Charles junior, who was too young to have known his father in person. Some years after her husband's death, Lady Mary married a Canadian businessman Allen Tully, becoming a resident of the USA and Canada).

But, if Smithy's first marriage didn't prosper, the trucking business certainly did. When sold in November 1925, it yielded enough for the partners to make a down payment in Perth on two Bristol aircraft.

They promptly flew the two planes to Sydney, carrying three paying passengers between them — a venture which attracted a gratifying amount of media and public attention. The flyers were sufficiently encouraged to announce, on their own account, that the same team of Kingsford-Smith and Anderson were now planning to conquer the Pacific!

But fate took a hand when they met up with Charles Ulm, who immediately professed his wholehearted support for such a venture. While lacking the flying skills of the other two, as a man of about Smithy's age, he appeared to have a good head for planning and organisation. Very soon, the twosome became a threesome.

In short order, Ulm convinced Smithy that he and Anderson should capitalise on their epic trans-Australia flight with an attempt on the around-Australia record. At the time this stood at 22 days.

Anderson felt that they should press ahead with the trans-Pacific project, and expressed himself so strongly about this that it was Ulm who climbed into the Bristol with Smithy and slashed the record to just over 10 days — a figure which Anderson failed to match in a belated attempt to regain his lost initiative.

NSW Premier Jack Lang was lavish in his praise of the trio but, when called upon to back their proposed transpacific flight with a government grant, came up with a meagre £1000. Even so, Smithy, Anderson and Ulm left on the *SS Tahiti* in July 1927, with the fervent hope that they would be returning by air.

By this time, Smithy appeared to have conceded control of their day-to-day business affairs to Ulm, with Anderson being none too happy about this intrusion.

'A Never-to-be-forgotten Experience'

'The genius of Kingsford-Smith is that he contacted the right people in San Francisco, which resulted in good radio arrangements for the *Southern Cross*, with elegant equipment, augmented by the talent of of a keen, competent operator, James Warner.'

'The night before the take-off Smithy and Warner told San Francisco amateurs: "Just stick by us and we'll make it interesting for you".'

'The Unites States Navy, and commercial stations in the USA, Hawaii, Fiji, Australia and New Zealand kept watches for KHAB. However, news about the flight was eagerly sought by the news media from amateur sources, showing that official arrangements were not complete in themselves.'

'Numerous US amateurs contributed, including those in Hawaii. Coordination and leadership (of the amateur fraternity) at San Francisco was provided by 6CZR. Others specially active included Australian 5HG and Fanning Island 1AJ.'

'Many New Zealand amateurs copied KHAB, including 1AN, 1FQ, 2BG, 2GA and 4AE. Warner's commentary made reception a thrilling, never-to-be-forgotten experience.'

(By Tom Clarkson, ZL2AZ, in *Break-In* March 1972)

PR disaster

In the USA, Smithy was offered sponsorship by a large oil company in the Dole air race between California and Hawii. But this was turned down, because he considered the plane offered to him as 'sub-standard'.

Resenting his remarks, the oil company publicly denounced him — implying that he was a 'little Australian with a big line of patter who lacked what it takes in the real world of flying'!

Needless to say, the very public put-down did nothing to assist his quest for backing for the Pacific flight. As it turned out, Smithy's assessment of the plane was validated when it crashed during the race, its pilot surviving by sheer good fortune.

To make matters worse, in an apparent effort to distance himself from the 'socialist' Lang, the new conservative premier of NSW, Thomas Bavin, disowned earlier NSW government support for the Pacific flight and called upon the trio to return by ship. His statement was widely reported in the Australian press and relayed to the USA.

Despite the setbacks, Smithy managed to get enough support to make a down payment on a tri-motor Fokker mono-plane, which had been used by the Arctic explorer, Hubert Wilkins. All it needed was a thorough overhaul and three new Wright Whirlwind motors!

These were ultimately donated by Melbourne's Sidney Myer but, as the three men worked tirelessly on the plane, the Australian press had a field day debating the planned flight. Sir Keith Smith, one of two brothers who had won the England/Australia race in 1919, strongly backed Smithy.

However, Australian aircraft designer L.J. Wackett described the project as 'madness' and deplored their choice of an aircraft with Germanic connotations as 'an insult to Australia's war dead'. Smithy, who had personally faced the Germans in the skies, dismissed Wackett's observations as 'crap'!

But the tensions and frustrations had taken their toll within the team, and after what Smithy later described as 'one hell of a blow-up', Anderson walked out and returned by ship to Australia.

With the plane finally restored and recommissioned, Smithy took aboard a huge load of fuel and came within four minutes of breaking the world record of 52 hours for sustained flight. The effort, including a gut-wrenching takeoff, restored his battered credibility and ultimately set the scene for the trans-Pacific flight.

At long last, with the support of American banker Andrew Chaffey and backed by millionaire shipbuilder Alan Hancock, Kingsford-Smith and Ulm set about preparing for the flight, enlisting two Americans as crew members: navigator Harry Lyons and radio operator James Warner.

Finally, emblazoned with the name *Southern Cross*, the Dutch-built FVIIb-3m Fokker took off from Oakland airfield in California on the morning of May 31, 1928, heading for Wheeler Field in Hawaii.

Fig.5: Photographed on their arrival at Mascot, Sydney, the men who made the first-ever crossing of the Pacific by air. From left: James Warner, Charles Ulm, Charles Kingsford-Smith and Harry Lyon.

Radio equipment

For this venture, Smithy saw to it that his plane carried on-board radio equipment and an experienced operator. Over land, the pilot and/or navigator could have a reasonable expectation of checking topographical and other sightings against a map — and in the event of a forced landing, there was a reasonable chance of finding open space on which the plane could put down.

But over thousands of kilometres of featureless ocean in clouded and unfavourable weather conditions, it was all too easy for dead reckoning navigation to put them sufficiently off course to miss an island destination altogether.

Even in those early days — in radio terms — two-way communication plus the possibility of D/F (direction finding) fixes from ships and shore stations could provide invaluable assistance to the on-board navigator. In those days, most such communication was by means of Morse code and most of the communicators were either professionally trained ship/shore maritime operators, or self-trained amateur operators or enthusiasts. It was on these groups that the crew of the *Southern Cross* had to rely for support during the first ever trans-Pacific flight.

Described in amateur literature of the day as a keen, competent operator, 'Jim' Warner had spent the time leading up to the flight checking out the equipment and enlisting the San Francisco amateur fraternity to monitor transmissions from the plane. He sought also their co-operation in alerting amateurs across the Pacific, and in New Zealand and Australia. The *Southern Cross*'s callsign for the flight was to be KHAB.

Transmissions on medium wave (600m, 500kHz) would serve mainly for communication with ships at sea and to provide possible assistance with navigation. The bulk of the traffic, directed to amateurs and to possible commercial stations, would be in the high frequency band around 33.5 metres (8.95MHz) — a frequency accessable at the time to amateur station operators.

For the most part, Warner said, traffic would be statements about the plane's progress and time and position information, which the amateurs were encouraged to keep progressive notes of — presumably in case the plane was forced down in the ocean.

Some of the messages would be 'addressed' to contracted newspaper interests in San Francisco and Sydney, being therefore copyright; many, however, would be prefixed with 'QST' (meaning 'calling all stations'), for unrestricted use by the recipients.

As described in *Break-In* magazine (June, 1928) and *QST* (August, 1928), the high frequency equipment was constructed by Ralph Heintz 6XBB of San Francisco, the transmitter being a tuned-grid tuned-plate oscillator built around a 50W tube. Power was to be supplied by two wind-driven AC generators, bolted to the outside of the fuselage.

A characteristic of the equipment was that a 250-500Hz generator ripple produced a continuous modulation of the carrier, the ripple frequency being affected both by the overall speed of the aircraft and by short-term turbulence in the slipstream.

Warner's practice was to 'screw down' the Morse key between messages, so that a recognisable signal would be available — indicating that the plane was still airborne and giving some clue to the attitude (climbing, diving, etc) and prevailing flying conditions.

The uninterrupted signal provided an incentive for continuous monitoring, and offered the further advantage that receivers could be kept properly tuned to the transmitter — thereby minimising the risk of a message being missed. In fact, mis-interpreting the generator ripple, quite a few non-technical listeners claimed that they had been monitoring the sound of the engines!

In-flight problems

As to the journey itself, the first six hours of the run to Hawaii were uneventful. But then they encountered a strong headwind that threatened to exhaust their fuel supply. Fortunately, the headwind disappeared as darkness fell and, around midnight, the *Southern Cross* landed at Wheeler Field, to be greeted by a huge crowd which had been following its progress by radio.

Wheeler Field was too short to permit a take-off with a full load of fuel and, after a checkover with the help of the local US Military Command, the plane was flown to Barking Sands preparatory to its departure for Suva. It was to be an eventful leg.

Three hours after take-off, Warner discovered that one of the wind-driven generators had burned out — severely limiting his ability to receive signals. Since Warner had warned other amateurs that his workload and conditions generally might prevent him from engaging in two-way working, he was less disturbed than he might otherwise have been by the failure.

Instead, he concentrated on reporting the plane's progress and position, confident that amateurs and other stations around the Pacific area would be keeping watch. Shortly afterwards, a smear appeared on the windscreen which looked like escaping oil. But much to the relief of all aboard, it turned out to be a condensation effect.

Next they ran into a violent electrical storm and Smithy, at the controls, gave an unsought demonstration of the great pilot that he was. Some time later, they encountered a second storm and, this time, with Smithy trying to snatch a few minutes rest, it was Ulm's turn to copy Smithy's techniques in dodging the blackest clouds, while not losing track of the course they were supposed to be flying.

Three hours later, they had left the clouds behind and there was the celestial *Southern Cross*. They were in the southern hemisphere. Ulm recorded the fact in the logbook, and reached for a thermos of hot coffee — only to discover that the flasks had ruptured during all the buffeting, and that the coffee on board was cold and sour.

They couldn't even smoke, because a distinct smell of petrol suggested that a fuel leak had developed somewhere and a match might well ignite more than a friendly cigarette!

Suva to Australia

Thirty-three hours after leaving Barking Sands, the crew looked down on the Fijian Islands and at 3.30pm, the plane touched down at Suva's Albert Park. There they were welcomed by a huge crowd and Sir Eyre Hudson, the British High Commissioner and Governor of Fiji.

Ironically, after 33 hours in an unpressurised plane and exposed to the unattenuated roar of the three Whirlwind motors, none of the crew could hear a word that was being said. Nor could they know that messages being flashed to newspapers around the world would be telling their readers that Smithy and his gallant crew had written their names indelibly into aviation history.

After resting and checking over the plane, it was flown to nearby Naselai Beach for re-fuelling and the takeoff for Brisbane.

After a night of rain, the like of which Smithy professed never having seen before, they flew into a fine, sunny dawn — crossing Australia's eastern seaboard adjacent to Ballina in northern NSW.

As they approached the coast after such a night, Warner had asked "Are there any direction finding beacons?" The answer was "No" — as the navigator, he was on his own!

There was never any risk of them not encountering the Australian coast but, after passing through a violent storm and a night of blinding rain, they still ended up over 100km south of their intended course — a graphic indication of the uncertainties of trans-ocean air navigation at the time.

As it was, a short time later they set down on Brisbane's Eagle Farm airport, to be greeted by a massive crowd. As in Hawaii, everyone had been alerted to their pending arrival by local broadcast stations (Fig.4).

The *Southern Cross* had covered 11,767km over the Pacific ocean, in an actual flying time of 83hrs and 35mins. Its Whirlwind motors had revolved about 34 million times 'without missing a beat'. Smithy had been at the controls for 52 hours and Ulm for 31.

Back in Sydney on the following day (Fig.5), they were met by another huge crowd at the Mascot airport and welcomed by Governor-General Lord Stonehaven and NSW Governor Sir Dudley de Chair. Premier Sir Thomas Bavin, who had sought in vain to frustrate the attempt, was discreetly absent.

Loud in their praise of Smithy's leadership and ability, Lyon and Warner booked their passage home by ship.

Because it was the first and most vulnerable of Smithy's trans-ocean flights, the Pacific crossing was the one which most clearly evidenced their dependence on wireless communication — and the key role played by amateur operators on the occasion.

While many amateurs monitored the later flights, their participation appeared not to have been organised to anything like the same extent.

It was made abundantly clear, however, to the Australian and New Zealand Governments if not to others around the world, that aviation was no longer about two-seater biplanes flitting around the countryside at the whim of their owners. In no time flat it would involve mail and passenger airliners at least as big as the *Southern Cross*, flying to regular schedules interstate and overseas. They would need official communication facilities and navigation aids, similar to those being set up for shipping.

Writing in *QST* magazine, official organ of the American Amateur Radio Relay League, in August 1928, J. Walter Frates (6CZB, Oakland, California) pointed out that it was primarily the amateur fraternity that had maintained contact with the *Southern Cross* on its historic flight. In his article 'Following the Southern Cross to Brisbane' he says:

When commercial and 'non-amateur' stations had either long since given up or were having difficulties on the Pacific coast (of USA), amateurs in San Francisco and Oakland were still listening to the steady drone of the transmitter and comfortably copying the signals, until KHAB reported itself beyond the Loyalty Islands and within a few hundred miles of Brisbane, where daylight intervened and the burden of communication was taken up by Australian and New Zealand amateurs, some of whom had been copying the signals since the first night out of Oakland. (See also panel)

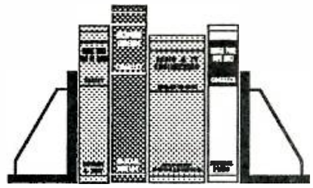
While Walter Frates' comments were intended to emphasise the role of amateur operators, by implication they also emphasised the technical limitations and the operational inflexibility of the professional monitoring stations at the time.

As pictured in the story of Sid Newman (*EA*, January 1991, p.50) the AWA shortwave transmitter at Pennant Hills, NSW was one commercial installation that helped to maintain contact with the Southern Cross.

Pictures appearing in this article have been provided by the Feature Bureau of John Fairfax & Sons Limited.

(To be continued)

NEW BOOKS



The audio art

THE ART OF RECORDING, by William Moylan. Published by Van Nostrand Reinhold, 1991. Hard cover, 235 x 160mm, 260 pages. ISBN 0-442-00669-1. Recommended retail price $87.95.

The author of this book teaches a 'Sound Recording Technology' program at the University of Massachusetts. The concepts and exercises presented in the book reflect the development of this teaching program.

The aim of the 'Art of Recording' is to define the artistic aspects of audio recording and to look at the broad and fundamental concepts that make music and audio recordings qualify as art.

The 12 chapters are divided into three main sections: the artistic aspects of the audio recording medium; the artistic elements and the recording process; and the evaluation of sound in audio and music recordings.

So Part 1 explains the physical nature of sound, and the artistic elements which are the mind/brain's interpretation of the perceived parameters of sound. Part 2 then treats the recording production. Traditionally, the recording process was to capture reality. Through modern technology, it can now also create the illusion of a new world — the sound can be shaped to enhance a musical message, through editing, mixing, overdubbing etc. And finally Part 3 shows how to evaluate and analyse the sound, and develops a vocabulary to allow communication in objective, rather than subjective terms.

The book is a very thorough, technical textbook, which supplies a wealth of information, suitable for the audio recording professional or a student preparing for the industry. While the information is all there, I did find that it was presented in a rather dry and repetitive style.

The review copy came from Thomas Nelson Australia, 102 Dodds Street, South Melbourne 3205. It is available from major bookshops. (P.M.)

Electronic terminology

A REFERENCE GUIDE TO BASIC ELECTRONICS TERMS, by F.A. Wilson. Published by Bernard Babani, 1992. Soft cover, 200 x 130mm, 474 pages. ISBN 0-85934-231-X. Recommended retail price $21.30.

How often do we encounter a technical term not fully understood, one which we have forgotten or which we never really got to grips with. Well, this book, plus its companion title, *A Practical Guide to Practical Electronic Terms*, goes a long way to helping out.

It explains hundreds of terms, from a simple five-line definition of the 'Newton', to a five-page explanation (with diagrams) of 'Amplitude Modulation'. Where necessary, basic mathematical treatments are also included. Obviously the level of explanation is tailored to the term itself.

The book is aimed at electronics engineers, students and enthusiasts, as well as those working in areas like science and medicine which now require some understanding of electronics.

I found it to be a very useful reference. But I suspect that, while very handy as a refresher, it might be too concise to explain the more technical terms to those completely unfamiliar with them. However, it would certainly give a good introduction; and the book's cross referencing system to associated terms gives other areas to pursue.

So, if you want to know the definition of a term, its SI unit, the different types of transistors, or you need some explanation of any other basic electronic term, then this book is for you.

The review copy came from Federal Publishing, PO Box 199, Alexandria 2015. It is available by mail order from this address. (P.M.)

Problems in electronics

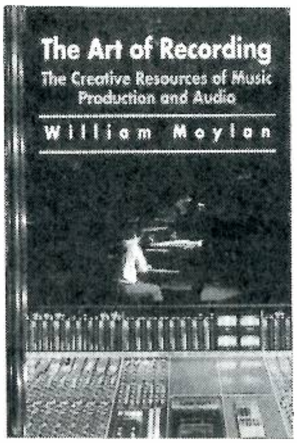
FIELDS, WAVES AND TRANSMISSION LINES, by F.A. & T.M. Benson. Published by Chapman and Hall, 1991. Soft cover, 235 x 155mm, 354 pages. ISBN 0-412-36370-4. Recommended retail price $56.95.

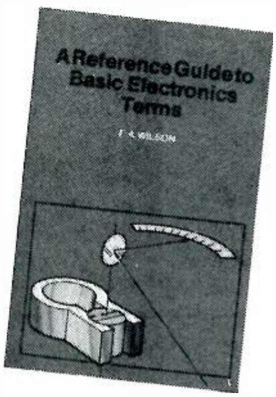
This book is a development of previous editions of *Problems in Electronics with Solutions*. It no longer attempts to cover a complete undergraduate engineer's electronics course, but just one important section of such a course. It is still based largely on problems collected over many years and presented to undergraduate engineers. Such a list of problems plus solutions should be useful for both undergraduates and teachers.

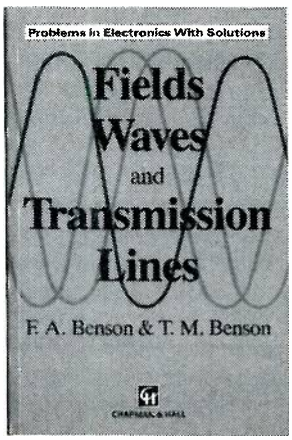
Part 1 covers theory and problems: electromagnetic theory, transmission line theory, waveguides, impedance transformation and matching, microwave networks and antennas and propagation. Part 2 then gives solutions for the problems in Chs.1-7. A list of symbols used, and other references, is also given.

The book should be a very useful supplement for those studying in the field.

The review copy came direct from Chapman and Hall, London. Chapman and Hall are represented in Australia by Thomas Nelson, 102 Dodds Street, South Melbourne 3205. The book should be available from major bookshops. (P.M.) ❖







THE SERVICEMAN

Puzzling problems, presented by a pair of power supplies

This month I have a couple of interesting stories concerning faults in power supplies — both of which involved considerable time and effort to track down their causes. One story comes from my own workshop, while the other is a contribution from a reader — who deserves a medal for successfully tracking down a problem in the most complicated power supply I have ever seen.

We'll start the ball rolling with my own tale of woe. By way of a preamble, most servicemen that I know are avid collectors of lists. They might collect lists of transistor equivalents, or lists of useful addresses. But more than anything, they are likely to collect lists of 'servicing tips'.

Several manufacturers issue lists of faults (and the cures) for the various models in their range. Then professional associations such as TESA and TETIA also issue lists, compiled for their members. And some servicemen compile their own lists, or trade service tips among their colleagues.

From all of this you might wonder why some faults still defy logic. Surely someone, somewhere, must have come across just about every fault that it is possible to find. And if it has been found, why does one need to find it all over again?

Well, the fact is that the same fault can sometimes cause quite different symptoms and a serviceman can spend a lot of time looking for a cause, when the answer has already been published in one of the aforementioned lists. All of this philosophising came about because of an AWA television that came into my workshop recently. It was a model C620, a 22" lowboy using the 'G' chassis.

Bewildering symptoms

The set was still working, but showing as many different symptoms as I have ever seen at one time on any set.

For starters, the picture was considerably smaller than the screen — being about 75mm in at the top and bottom, and on the right hand side. On the left, it was in by about 25mm. Then, the raster was suffering badly from pincushion distortion. All four sides were bowed inwards to quite a considerable degree.

Yet another symptom was a total lack of convergence. The convergence controls worked, but could not produce a converged picture no matter what adjustments were made.

Another symptom was that the screen was rather too bright, with low contrast and weak, washed out colour. Coupled with the bright screen was a vivid display of flyback lines in all three colours, rather that the usual white.

The final, but by no means least symptom was that the bottom of the picture was folded up. So, when that display was presented to me, I shuddered and turned quickly to my book of lists.

The AWA G chassis has been quite a reliable model. Over the years it has introduced a few characteristic faults but generally, it has been the kind of set that servicemen enjoy working on. But because of its reliability, there have not been so many service tips in the various lists that we consult. I have gathered all of the lists that come into my workshop into one book and I have only about 30 tips on the G chassis — hardly enough to encompass the type of fault described above.

None of the service tips in my book covered all of the symptoms listed above. One tip mentioned some of them: *excess brightness, low height and vertical foldup*. The brightness and foldup fitted the fault, but low height was hardly an accurate description of a raster that was small all over.

And there was no mention of the convergence and contrast problems. The cause of this fault was given as 'No 150V rail. R581 open circuit'. But as the symptoms didn't fit the present fault, I decided that it wasn't a readymade cure for the problem before me, and I went ahead with the usual faultfinding procedure.

There was actually one other symptom that I haven't mentioned, one that encouraged me to ignore the service tip described above. It was a most objectionable smell that permeated the inside of the cabinet. It reminded me of the old practical joke where one connects an electrolytic capacitor back to front across a power supply. The cap explodes and spreads a foul-smelling residue all around the workshop.

The smell convinced me that a faulty electro was going to be either the cause, or a valuable guide to the cause of the trouble. And since most electrolytic explosions are associated with power supply rails, the various rails would be as good a place as any to start my investigations.

The G chassis has four supply rails, labelled B1, B3, B4 and B5. (I can't find B2, though I have searched thoroughly. I don't believe there is one!)

The main rail from the power supply is labelled B4 and is set at 110 volts. The rest of the rails are derived from the line output stage — B1 is the 800V screen supply for the picture tube, B3 provides 150V for the video output transistors, and B5 is the 20V rail which supplies the small signal parts of the chassis. Altogether, not such a large section of circuitry to get around. Or so one might think...

Plugs and sockets

One thing I can say about the G chassis, it is not under-designed. It's got more of everything you ever expect to find, and in particular, it's got plugs and sockets — quite a few of them.

As a for-instance, the B4 rail goes through no less than five plugs and sockets between the power supply and the line output transistor. It goes in and out of the main board, in and out of the yoke plug, in and out of subsidiary boards before finally reaching its destination. It's a nightmare to trace on the circuit diagram, and even worse to trace through the chassis itself.

Fortunately, in this case I didn't need to do a lot of tracing. The 110V rail was present, although a bit higher than it should be. It responded to adjustment, but setting it at 110V did nothing to alleviate the symptoms.

I checked the 800V rail, and found it exactly correct. I assumed that the 20V rail was OK, since the small signals were quite normal. That left only the 150-volt rail, which was not so easy to check at its source.

The component which supplies B3, diode D575, is tucked away on the mother board hard up against a metal bracket across the chassis, and it is buried under various leads to some of the aforementioned plugs and sockets.

It was easier to check the voltage on the collectors of the video output transistors. Had this been close to normal, I could have rightly assumed that B3 was correct.

But it wasn't normal — it was down to 110 volts, the same as the main supply rail, although I didn't connect this fact to the symptoms until later.

Anyway, I was faced with four rails to investigate. So I set about trying to link the observed symptoms to a common source, that is, to one of the rails. The pincushion distortion seemed to be as good a place as any to start, since I have found in other designs a narrow picture often accompanies PCC distortion.

In the G chassis all of the PCC circuits are carried on a small sub-board fitted to the righthand side of the cabinet. These have been known to go dry-jointed and even to catch fire, so inspection of the board is worthwhile every time the cabinet back is removed. This time a very thorough inspection found nothing out of place.

PCC fault?

Apart from the possibility of a dry joint, I was mindful of PCC and convergence failures in other sets, where a power transistor shorts out and does nasty things to the picture.

I spent some time looking for the PCC transistor on the PCC board, but I found nothing. Then I tried the tube convergence board, but still nothing. It seemed as though this G chassis had no PCC transistors and no convergence transistors.

I did find a few diodes, but none of them were so badly off-spec as to be able to cause the terrible picture that the set was producing. (In fact, the C620 differs considerably from the usual run of G chassis sets. When I eventually found the specific circuit diagram for the 620, I could see that the PCC and convergence boards were completely different to those shown on the 'generic' diagram. There were also other, minor changes around the line output stage — probably to accommodate the different PCC and convergence boards. It's a trap that I must bear in mind for future tussles with the G chassis.)

After all that, I realised that I couldn't blame the PCC or convergence circuits for the low B3 voltage; so I had to find another reason. And I reasoned that if there was nothing much wrong with the rail at the coal-face end of the line, then the other end would be the next place to continue looking.

As I have mentioned, the source of this rail is a diode that's hard to find and awkward to reach. I decided that the thing to do would be to remove the chassis entirely from the cabinet and set it up on the bench, under a good light.

This had the added advantage of disconnecting and removing most of the plug and socket cabling that hid much of the top side of the chassis.

I think I counted 21 plug and socket sets that had to be removed before the chassis was freed from the cabinet. This also involved removing the line output transformer and EHT doubler, and other circuitry mounted on a tall assembly at the right hand end of the chassis. Underneath this were another three unsuspected plugs and sockets. (I'm sure the total was 21, although I will stand to be corrected!)

With the chassis on the bench, I realised that I wasn't going to see much for all the thick dust that had accumulated over the years. So I took the whole lot outside, along with my long-bristled 'de-dusting' brush. A few strokes with the brush, and an upside-down shake soon revealed the top of the board in all its pristine glory. And there, right where I would have expected it, was the cause of all the trouble.

Culprit revealed

It was D575 alright, the source diode for B3, the 150V rail. It was a UF-2, a high voltage selenium diode in a small red plastic pot. The plastic pot and much of the epoxy that had sealed the diode were badly burned and the whole assembly bulged outward, as though it had been subjected to considerable internal pressure.

So that was it. In fact, the foul smell that I had noticed earlier was really burnt selenium, not a cooked electrolytic.

I replaced the diode with a BYX55/600, a much more reliable diode than the UF-2, then replaced the burned out R581 — a 4.7-ohm fusible resistor that forms part of the filter on the rail. I checked the two electros involved, C475 and B581, but they were quite OK.

Getting all the plugs and sockets back together again was not a job to be recommended, but it was eventually finished and the chassis was pushed back into the cabinet.

At switch on, up came a perfect picture, right out to the edges of the screen. There was no sign of pincushion distortion; no sign of foldup.

The brightness had come back to a normal level and all traces of the flyback lines had gone. After that, all that remained was to make a note in my book of lists, to the effect that an open circuit

Fault of the Month

JVC 7650 VCR

SYMPTOM: No go after replacing fuse F4. Machine would load OK, but on unloading the capstan motor would run flat out. The power on/off switch would stop this, until the tape was reloaded; then the same symptom would occur.

CURE: Replace D13 and Q18 (2SC3070), Q11 (2SC2655) and Q15 (2SC2877). If any of these are found to be burnt, look for burnt PCB track leading to collector of Q15.

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

THE SERVICEMAN

R581 can make a far greater mess of the picture than the simple set of symptoms listed in the original service tip.

And before I leave the subject, I should comment on one unusual aspect of the story. How could we have an overbright picture when the 150 volt rail that powers the video output transistors was obviously not present?

As far as I can work out, the 150 volt rail is really a 40 volt supply 'parked' on top of the 110 volt rail. So when R581 went open, the 110V took a roundabout route to the output transistors and managed to flog up some kind of picture.

The fact that the tube cathode voltages were low caused the overbright picture, while the flyback blanking probably originated in the B3 circuits that weren't working. All the other symptoms can be traced back to the lack of 150 volts, in one way or another.

But what a performance for just one little diode and resistor! And what a difference in symptoms, for what was ultimately the same fault!

Story number two

And now for a contribution from a reader. It comes from M.M., of Cohuna in Victoria. After you hear the tale, you'll probably agree with me that it's a good thing there aren't many of this model around. M.M. writes:

This story concerns a VCR that is not so common around my neck of the woods. It was a Sharp VC387 and the customer brought it in a few weeks ago and told me that (1) it had no clock display and (2) the picture kept going blank whilst he was watching a TV program through the VCR.

At first, this sounded like the two faults were related, but as I was about to find out, they were not. So down to business.

On removing the cover, I inspected the numerous PCB's for any liquid spills or cracks due to heavy handling. None were apparent, so I removed the front escutcheon and bottom cover. A further inspection revealed no more than the previous one had done, and at this stage I referred to the circuit diagram.

To begin with, I decided to concentrate on the 'no clock display' fault, as it was obvious that the digitron display was completely off.

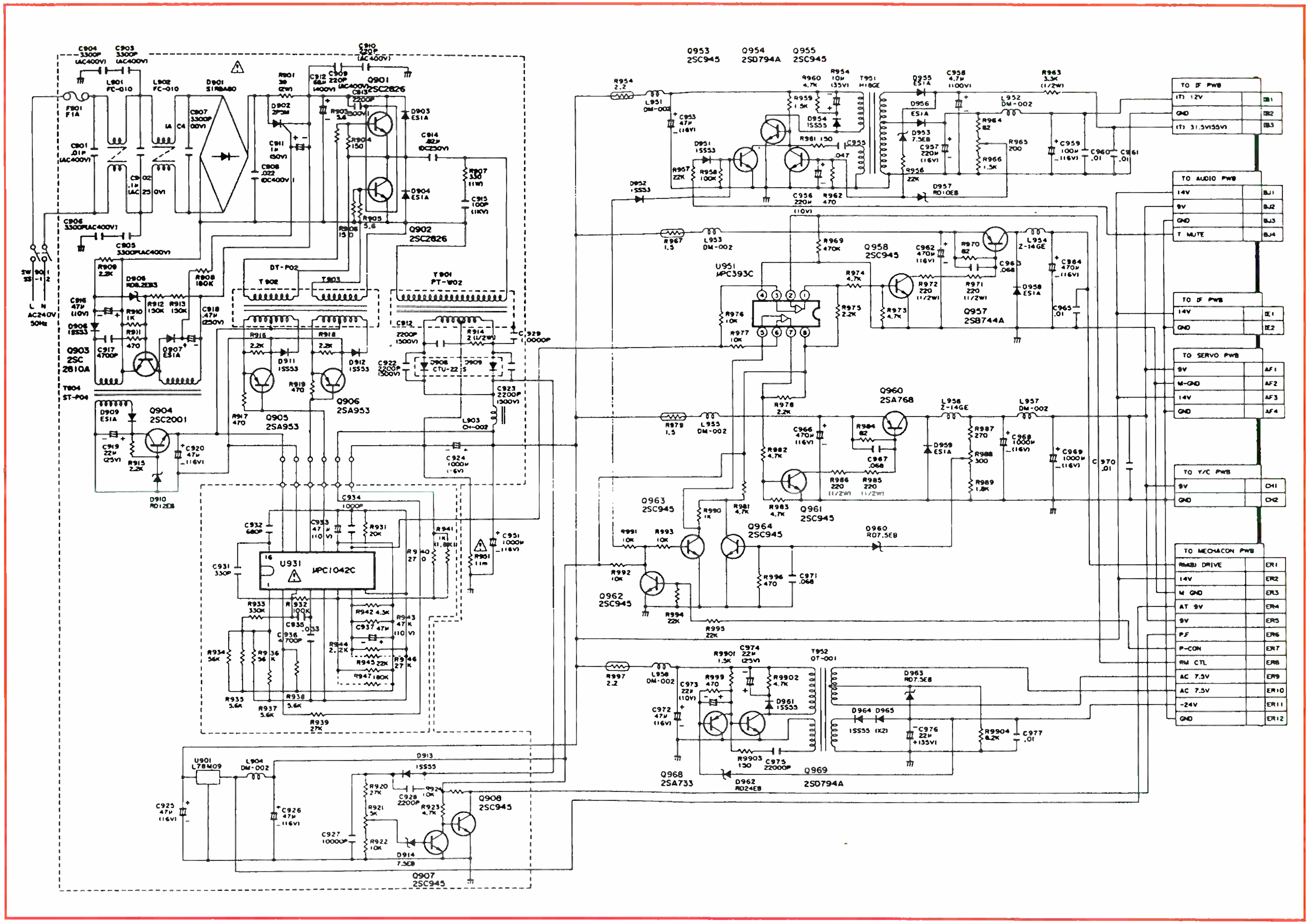
From the circuit it could be seen that the digitron heater element derived approximately 7.5V AC from the switch mode power supply. Checking the appropriate pins revealed zero volts, thus explaining the loss of the display. The fault was obviously in the power supply module, which in this model is contained in a heavy diecast box and not very easily extracted from the VCR.

After removing the Y/C board and numerous wiring loom plugs from their sockets, the power supply unit was duly opened. A quick check revealed the missing voltages were indeed due to a power supply fault. Tracing the circuit also revealed that the negative 24 volt supply was also missing.

The 7.5V AC and the -24V DC were derived from the output of T952, wired in a self-oscillating mode. Transistors Q968 and Q969 provided the drive, and subsequent checking revealed Q969, a 2SD794A, to be open circuited between base and emitter.

I decided to replace the two transistors along with the four electrolytic capacitors in that circuit, as past experience has shown these small capacitors go low in value, especially in warm environments.

After replacing the components, the power supply was tested and the voltages were once again present. The wiring loom and PCB's were refitted and the VCR switched on, to show a full working display. The machine was then put on test with good E-E and VCR playback pictures. The covers were reinstalled and the machine left to run



The schematic for the power supply section of a Sharp VC387 video recorder, as discussed in this month's second story. No — we haven't made a mistake — all of this circuitry is only for the VCR's power supply section.

in E-E mode, connected to a monitor in the corner of the workshop.

I went on to tackle some other work while keeping an eye on the monitor and sure enough, about one hour later the screen went white — indicating no video information was reaching the RF modulator. Just on a hunch I tried checking connector 1B on the tuner/IF PCB.

This should supply 12V DC to the PCB from the power supply module, but on measuring it only 2.5V was present. After removing the power supply module for the second time, the correct voltage had reappeared.

I decided to leave the supply running with metering leads connected, and after about another half hour the fault reappeared. This time the circuit involved was the 12V rail AND the 31.5V tuning supply.

Due to the thermal nature of the fault, I felt that blanket replacement of semiconductors in the drive circuit was warranted. But the fault persisted and even applications of freeze could not reveal the culprit.

At this stage I was getting a little anxious, as the time spent on the job was well in excess of what I had estimated to the customer. I rang the customer and explained the problems I was facing. I felt that I would eventually solve the puzzle, but I needed his OK to proceed. This was readily given and I returned to continue the battle with the monster.

On a hunch, I decided to replace T951, as this seemed to be a likely suspect and was one of the few components left untouched. After ordering the part and a period of waiting, the transformer was installed.

Reassembled and soak tested, with fingers crossed, the voltages remained rock solid. A general service and clean were all that was required now, and with that done the customer was called to come and pick up his machine. His only remarks were that the machine had never been serviced or looked at since new and he was not surprised that so many faults were present.

All I can say is that M.M. deserves a gold medal for sorting out that lot. I don't know how much of the circuit diagram the editor is going to be able to print, although I hope it is the whole lot.

It will take you a long time to work your way through to the section M.M. was working on. This must be, without doubt, the most complicated power supply ever built into any domestic or commercial product.

If my count is right, to produce five DC rails (9V, 12V, 14V, 31.5V and -24V) and one 7.5V AC rail, this supply uses no less than five chopper circuits, based on transformers T901, 902/3, 904, 951 and 952; and four series regulators, using IC's U901 and U931, and transistors Q957 and Q960.

It contains, beside the transformers mentioned above, some (give or take a few) 20 transistors, one thyristor, 28 diodes, two integrated circuits and heaven alone knows how many resistors, inductors and capacitors.

I have never seen so complicated a power supply, and I hope that I never come across a fault in this particular model. As I said earlier, M.M. deserves a medal — and every cent of the fee he will get for telling us this story. Thanks, M.M.

Contributions welcome

Before I close this month's column, I'd like to remind you that we are always interested to receive reader contributions for The Serviceman.

We would prefer the stories to be typed, with double line spacing on one side of the paper, but hand written contributions are acceptable if they are clear and again, double spaced.

If you use a word processor to write your story, you can submit it on a computer disc. We can accept IBM, Apple, Amiga and BBC Micro formats, and probably other formats if we are really desperate.

Finally, if you have a story to tell but don't feel like writing it down, you could record it onto an audio cassette tape and send that in. Providing that you tell the story in full detail, we can transcribe it into our computer.

Remember, though, whether your story is written, typed or spoken, you need to describe the symptoms clearly and then trace your faultfinding process from start to finish. Then close with an explanation of why the fault caused the trouble it did.

Don't forget to tell us the make and model of the equipment you were working on, and give the component numbers involved so that we can follow your procedures.

A circuit diagram is useful but not essential. We have access to most of the service manuals covered in these stories. We look forward to hearing from you.

That's all for this month. I'll be back next month with some more stories from the service bench. ❖

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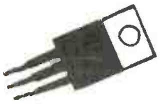

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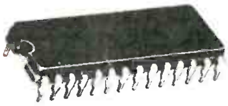

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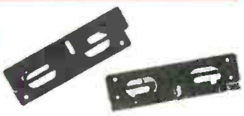

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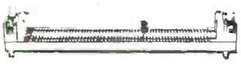

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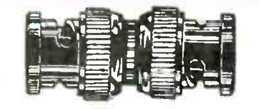

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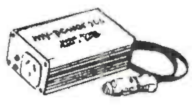

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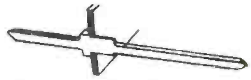

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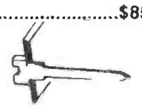

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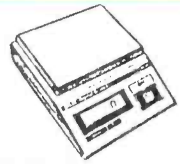

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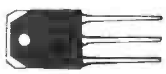

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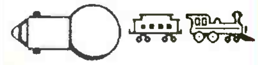

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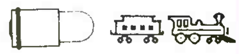

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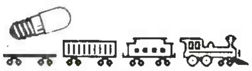

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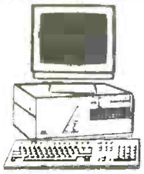

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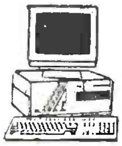

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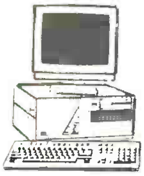

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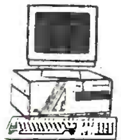

80386-33 CPU 64K CACHE ON BOARD MEMORY
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57Mhz LANDMARK SPEED TEST
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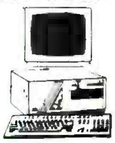

80386-40 CPU 64K CACHE ON BOARD MEMORY
1 MEG RAM EXP TO 16 MEG
65 Mhz LANDMARK SPEED TEST
85 MEG HARD DISK 12ms ACCESS TIME
1.2M JAPANESE BRAND F.D.D
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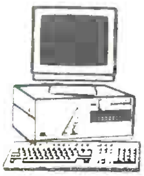

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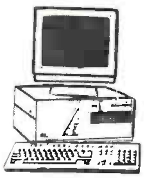

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Suitable for prime-good signal reception area. This antenna is used for installation on houses, flats and, because of installation simplicity, on caravans and boats.

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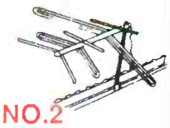

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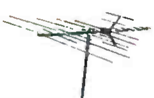
Suitable for medium-fringe signal reception areas with good front to back ratio.

18 ELEMENTS

L10972........$109.95



AS 60 UV

VHF Channels 0-11
UHF Channels 28-39
Suitable for fringe signal reception with improved front to back ratio and high gain on VHF.

22 ELEMENTS

L10974........$119.95

AS 20 UV AND AS 20/5 UV

VHF Channels 0-11
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UHF Channels 36-69 (AS 20/5)
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13 ELEMENTS

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A16150 Normally..$95.95

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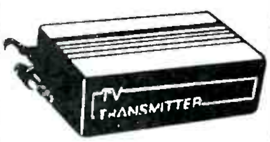

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BASIC ACCURACY: 0.5%DC
DC VOLTAGE: 0-1000V
DC CURRENT: 0-20A
AC VOLTAGE: 0-750V
AC CURRENT: 0-20 A
RESISTANCE: 0-20M OHMS
TEMPERATURE:-20°C - 1200°C
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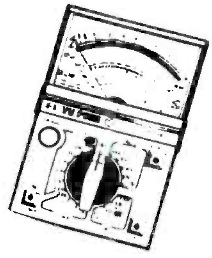

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DC Current: 0-0.05, (50uA) 2.5, 25, 250mA
• Resistance: 0-2K, 20K, 2M 20M ohm
• Load Current: 0-150uA, 15mA, 150mA
• Load Voltage:0-3V
• Volume Level: -10- + 22dB - + - 62dB
• DC Current Amplification Factor: (hFE) 0-1000

ACCURACY
• DC Voltage & Current: Within +/-3% f.s
• Resistance: Within =/-3% 0f arc.
• Battery: 1.5V (um-3) 2pcs. 9V (oo6p) 1 pc
• Fuse: o.5A, 5O x 20mm
• Diode: 4148 x 2
• C.C: 0.04uff x 50V
• Size: 147 x 99 x 57mm
• Weight: 400g approximately

Q11020..............$59.95

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• DC Current: 0-10A
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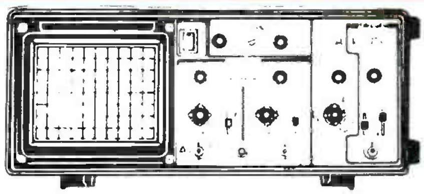

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• Magnifier: X5 at all times.

TRIGGERING
• Sensitivity Int: 1 Div or more Ext: 1Vp-p or more.
• Source: INT, CH-B, LINE or EXT
• Triggering Level: Positive and Negetive, continuously variable level; Pull for Auto.
• Sync: AC, HF Rej, TV (each + or-) at TV Sync. TV-H (line) and (frame) sync are switched automatically by SWEEP TIME/Div switch.

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• Deflection factor: 5mV to 20V/ Div on 12 ranges in 1-2-5 step with fine control
• Frequency response: DC to MHz (-3dB)
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• X-Y operation: X-Y mode is selected by SWEEP TIME/ Div switch.
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OTHER SPECS: • Weight: 7Kg Approx • Dimensions: 162 (H) x 294(W) x 352(D)mm.

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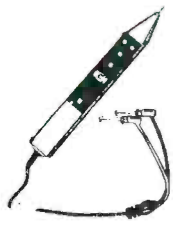

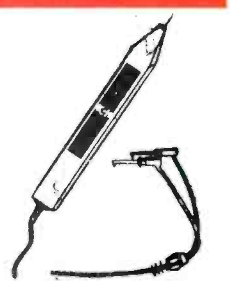

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Circuit & Design Ideas

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.

Audible temperature and oil alarm

I installed this circuit in my 1978 Gemini after realising that, while driving in heavy traffic, I was glancing at the instruments only about once per five minutes (or even longer).

In those minutes, a blown radiator hose or failed oil pump could result in a destroyed engine. (On a bright summer morning, even an oil pressure warning light could easily go unnoticed.)

The main problem in my car, and probably in many others, is how to connect an audible alarm to the temperature gauge without interfering with its operation. The needle of the gauge itself is driven by a tiny bimetallic-strip wound with a resistance wire heater, which responds to the current flowing through it and the temperature-sensing NTC thermistor mounted on the engine.

Because this arrangement makes the gauge inherently sensitive to ambient temperature, it is fed from a so-called 'voltage regulator', which is really a second electrically-heated bimetallic strip in the instrument housing. This continually opens and closes a pair of contacts connected to its own heater — it is this pulsed voltage which drives the temperature and fuel gauges. Hence this circuit uses IC1a to compare a voltage, derived from the gauge/temperature sender voltage divider, with an adjustable reference voltage. When correctly set up, this results in a pulsed 12V output from IC1a, which drops to zero when the engine temperature exceeds the preset limit.

The pulsing 12V from IC1a holds the 22uF capacitor charged, and its voltage is compared with a reference value of about 7.5V by IC1b, whose output remains low under normal conditions. The 1M/22uF combination gives a long time constant of about 15 seconds. This is necessary to avoid false alarms, because the instrument 'voltage regulator' is extremely erratic, and can disappear for several seconds at a time.

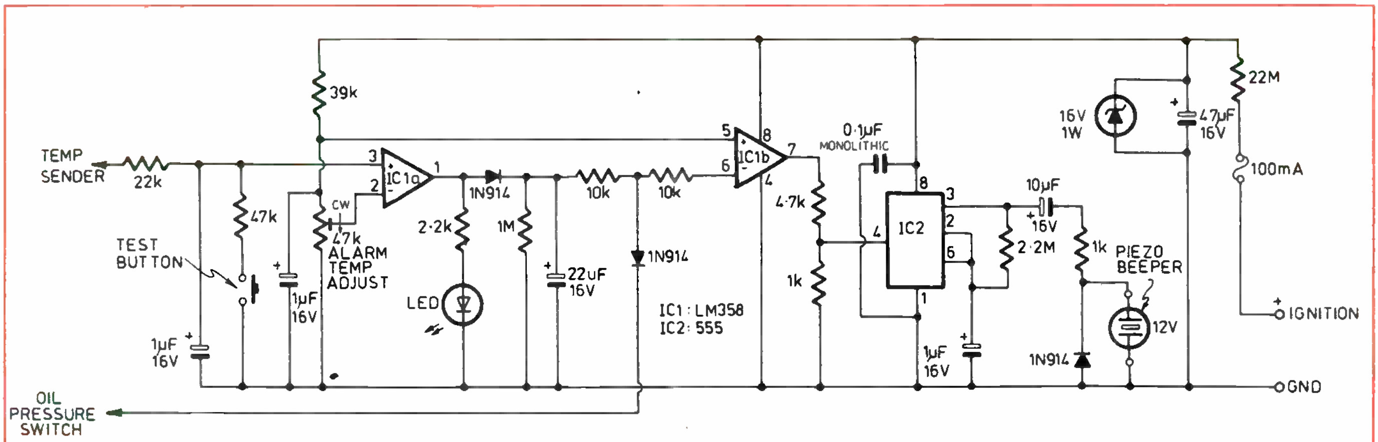
If the oil pressure warning switch closes, it instantly has the same effect as the 22uF capacitor discharging. Both result in the output of IC1b going high, which allows IC2 to begin oscillating at one cycle every few seconds. Because IC2's output is coupled via the 10uF capacitor to the piezo beeper (Dick Smith catalog No. L-7024, in my case), this produces an attention-getting, but reasonably pleasant, 'chiming' sound.

The 16V zener diode is there to prevent potential damage to the ICs from the transient voltages which inhabit car electrical systems.

The setup procedure is simple. Turn the alarm temperature pot fully clockwise, and then, with the engine at normal operating temperature, turn it anticlockwise until the LED stops flashing, and then turn it back a small amount clockwise. This process may require some 'fine tuning' to compensate for engine temperature variations in very hot or cold weather.

The test button is optional. It simulates an excessive engine temperature which should stop the LED flashing and give an alarm about 15 seconds later. I've found it provides an interesting diversion while waiting for the traffic lights to change!

Bob Parker,
Carlton, NSW $45



DREAMED UP A GREAT IDEA?

If you have developed an interesting circuit or design idea, like those we publish in this column, why not send us in the details? As you can see, we pay for those we publish — not a fortune, but surely enough to pay for the effort of drawing out your circuit, jotting down some brief notes and popping the lot in the post (together with your name and address) and send them to Jim Rowe at -

Electronics Australia,
PO Box 199,
Alexandria, NSW 2015

Modified Funway doorbell

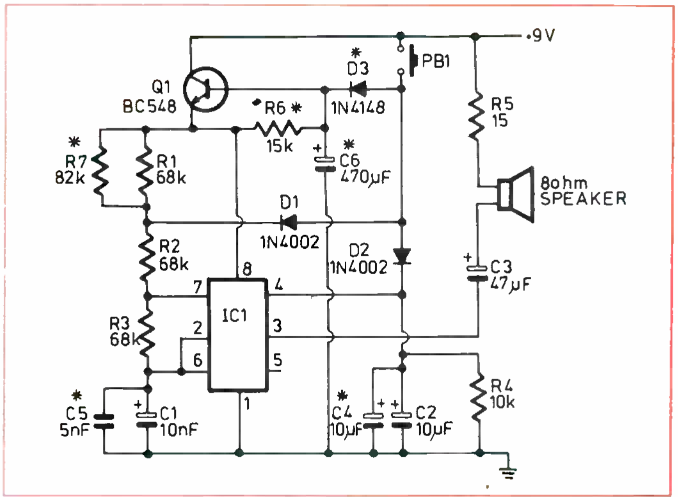
Recently, I built the 'Ding-Dong Doorbell' kit, featured in the Dick Smith book 'Funway into Electronics', volume 2. I was not satisfied with two aspects of it, so I modified them.

Firstly, the circuit draws a significant current all the time (i.e., even when the pushbutton isn't pressed) — in the order of around 7mA. This would completely flatten the battery in only a few days. And secondly, the 'ding-dong' sound produced by the unit was 'out of tune' and a bit irritating. The operation of my modified circuit is as follows.

When PB1 is pressed, C6 immediately charges through diode D3. This provides bias for transistor Q1, which is wired as a current amplifier, providing current to the IC. When the pushbutton is released, transistor bias is maintained by C6, which has only to deliver a very small current, due to the high gain of Q1, to provide power for the 'dong' sound. This capacitor then discharges, eventually cutting off Q1's conduction. Resistor R6 assures that the collector-base leakage current will not allow Q1 to conduct. The 'ding-dong' sound was made more pleasant by adding C4, C5 and R7. (These added components are all marked with an '*'.)

It is easy to modify an existing circuit, as these components are simply added in parallel. They can easily be soldered on the track side of the PCB. To add the circuit around Q1 involves cutting one track on the PCB. If you are building the circuit from scratch, select the combined value to replace the pairs of components, R1/R7 (39k), C1/C5 (15nF) and C2/C4 (22uF).

Ron Steinfeld,
Glen Waverley, Vic **$30**



On/off lighting switcher

This circuit is designed to give manual control to the 88RW12D triac controller-board published in *EA* (August 91). This board was designed to be controlled by computer output, with an MOC3021 opto-coupled triac driver used to provide isolation. But I use manual switching to control lighting via these boards. In my case, the triac boards sit up in the lighting rig, and switching signals are conveyed over light duty cables to the triacs. This way the mains runs are very short, and all the mains wiring is up in the rig. Only minimal cabling is required to the lighting operator.

My controller consists of two momentary-action switches which latch an output 'on' or 'off' as required. An added feature (and the reason for the complexity of the circuit) is that a second press of the 'off' switch will turn the output 'on' for the duration of the press. This feature is very useful in party/band/theatrical lighting where a very quick, or controlled 'flash' is required.

The circuit uses a 4027 dual JK flipflop, a 4043 quad RS flipflop and a 4011 quad NAND gate. Package economy can be realised when building in multiples of four circuits, which conveniently corresponds to the number of circuits on the *EA* 88RW12D board, with which it is designed to mate. Note that an earlier version of this board, 88RW12C, was published in *EA* in Feb. 89. In this version, the triac is activated by a negative signal, not the positive one used by the revamped 88RW12D board. The output of my controller would have to be inverted to mate with the earlier version.

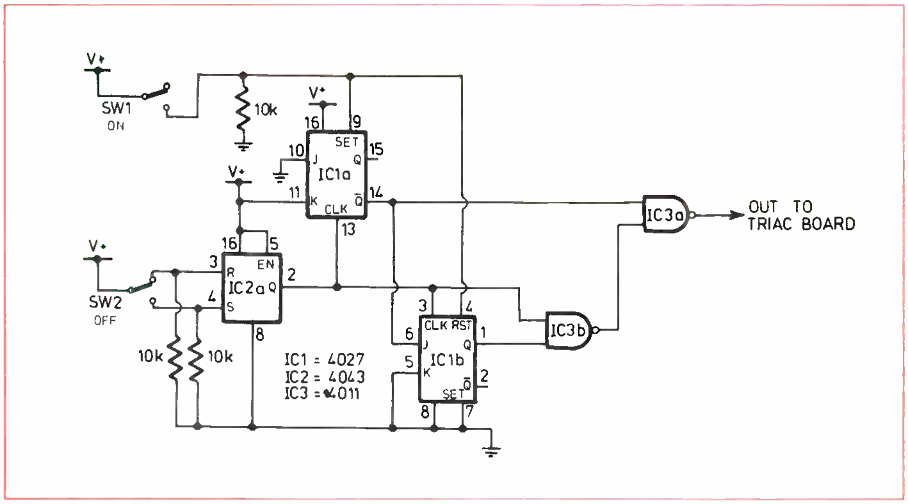
The channel is turned on by pressing the 'on' switch SW1. This 'sets' IC1a and 'resets' (clears) IC1b. No debouncing of the switch is required — you can't turn it any further on! The (low) Q-bar output of IC1a is NANDed in IC3a with the (high) output of IC3b, resulting in a logic 1 on the output of IC3a. This turns on the opto-coupled triac.

Pressing the 'off' switch SW2 turns the channel off. Because of its dual purpose, the 'off' switch must be debounced, which is performed by IC2a. The positive edge of IC2a's output clocks both JK flipflops, and because of their different JK inputs, it turns IC1a off, but has no effect on IC1b. Since the Q output of IC1a is now low, the NAND network turns IC3a's output off. Note that while a capacitor could have been used to provide the de-bounce, it would not be as reliable as the flipflop option, and in a theatrical application for instance, reliability is critical.

On the next press of the 'off' switch, the JKs are clocked again. IC1a remains reset, while IC1b sets, due to the high which appeared on the latter's J input after IC1a reset. The pulse from PB2 is NANDed with the high Q output of IC1b, so the main output comes on for the duration that the 'off' switch is held pressed.

Further presses of the 'off' switch have no effect on the flipflops, but through the NAND network, they will continue to turn the output on while SW2 is pressed. A press on the 'on' switch SW1 will toggle both flipflops, resetting the circuit to a latched-on output. Both switches I used were momentary-action, SPDT PCB-mounted versions. In the Farnell catalog they are Nos.145-213 and 145- 214. The different numbers designate different colours only.

Greig Sheridan,
Ashfield, NSW **$40**



Construction Project:

LOW COST 1MHZ PULSE GENERATOR

Here's an updated and improved design for an easy to build, general purpose pulse generator. It offers many of the features found on expensive commercial generators, but at a fraction of their cost. You can use it for fast evaluation of wideband amplifiers and filters, adjusting the frequency compensation of scope probes and other attenuators, and of course troubleshooting and development work in digital circuits.

by JIM ROWE

The idea for this project came a few weeks ago, when I was testing another project I'm currently working on. I needed a reliable source of both single pulses and continuous pulses of varying amplitude, to check out part of its operation. It reminded me that there was one test instrument my home workbench has lacked for quite a while: a general purpose pulse generator. They're not the sort of instrument you use every week, but when you *do* need one, almost nothing else will do the job...

Today's commercial pulse generators are far too expensive to consider for personal use, of course. And few of us need their 100MHz-plus frequency range and sub-nanosecond rise and fall times, in any case. That tends to leave only one option — building one yourself.

Long-time readers will no doubt recall that we've presented general purpose pulse generator designs in *EA* in the past. But when I looked back through our files, the last one was in November 1979 — over 12 years ago. Although this was an attractive and very cost effective design at the time, with some quite innovative circuit ideas, it has inevitably become a bit dated in the intervening years. With the benefit of hindsight it also turned out to have a couple of shortcomings, particularly by modern standards.

It was clear that if I wanted to build a small pulse generator for my own workbench, one that took advantage of the latest devices and was really cost effective, I would need to develop a new one myself. So I put the other project aside for a couple of weeks, and came up with the design presented here.

I make no great claims of originality for the design. It is based fairly closely on the one of November 1979, but with various changes and enhancements — virtually all of which are designed to improve its performance and/or reliability.

For example modern 74HCXX devices are now used instead of the 74CXX devices in the original, to achieve a 10:1 increase in frequency range and a similar reduction in rise and fall times. Similarly an additional chip is used, allowing the provision of things like fully debounced pushbutton triggering for reliable 'single shot' operation, and a 50Ω output for the scope trigger output as well as the main output.

The nett result is a very handy generator which has a frequency range of from 1Hz to 1MHz, plus single-shot; a pulse width adjustable from 350ns to 100ms; adjustable delay on the main output, relative to the scope trigger output, and variable again from 350ns to 100ms; output pulses which can be varied in amplitude from 1V to 10V peak (no load), with an output impedance of less than 50Ω and rise and fall times of around 4-5ns; a choice of either positive- or negative-going output polarity; and selectable AC or DC coupling on the main output. In short, a level of performance that makes it more than adequate for most general purpose pulse testing.

Despite this upgraded operation, the new instrument still involves only five low-cost ICs and a small power FET, plus the smallest available power transformer. Everything fits in a standard plastic case, with most of the circuitry on a compact PC board.

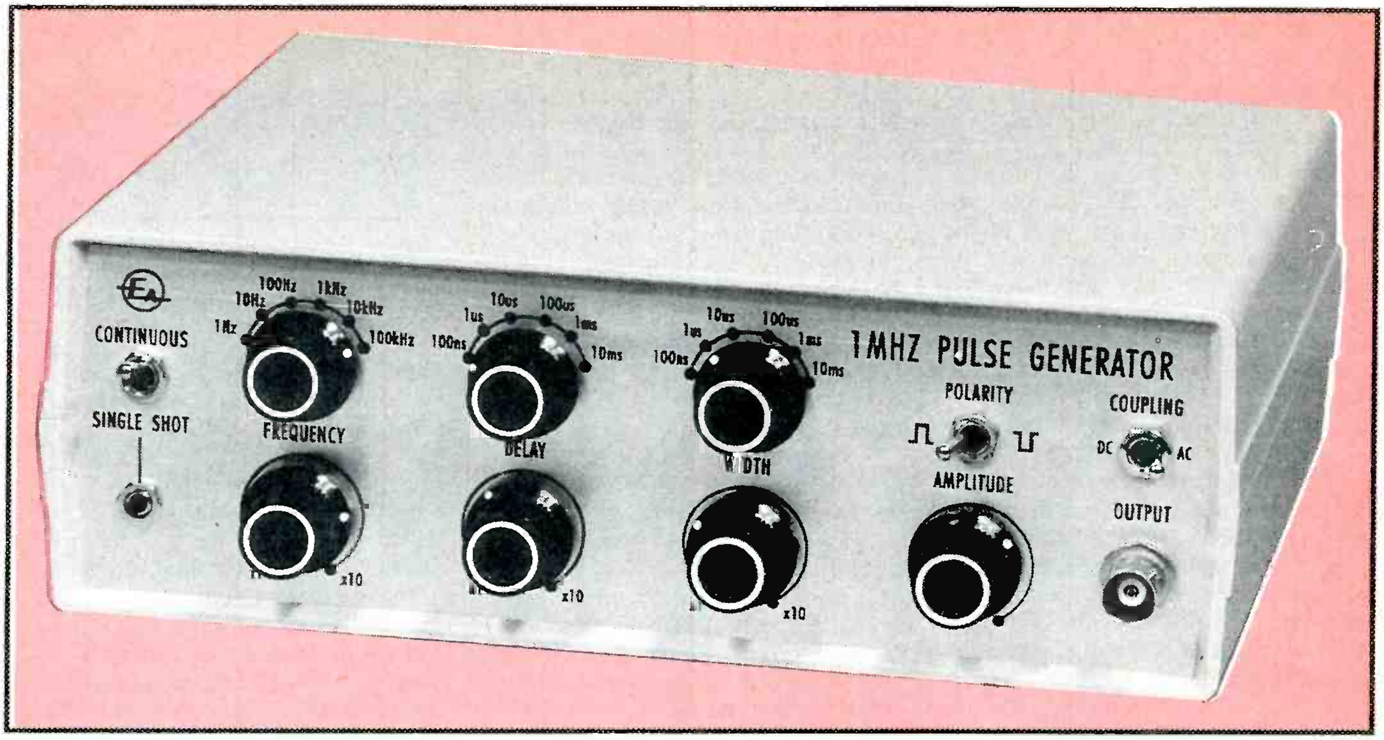
And by my rough calculations, it should all cost no more than about $80 — a tiny fraction of what you'd pay for a commercial generator.

Circuit description

The basic pulse repetition rate in continuous mode is set by a simple relaxation oscillator, built around Schmitt inverter U1a (U1 is a 74HC14 hex Schmitt inverter). The frequency of oscillation for this type of oscillator is determined by the feedback resistance and the shunt capacitance from the input to ground. In this case switch S1 selects different values of capacitance, to set the six required frequency ranges in decade steps, while VR1 is used to adjust the feedback resistance over a ratio of slightly greater than 10:1, within each range. This gives continuous frequency coverage from slightly below 1Hz to slightly beyond 1MHz.

Switch S2 is used to select either the output from U1a for continuous operation, or that from U1b when single-shot operation is required. U1b and U1c are connected as a simple R-S flipflop, with their inputs connected to each side of the pushbutton PB. This ensures that only a single pulse is generated when PB is pressed, regardless of any 'bounce' in its contacts (and all mechanical switch contacts bounce).

The triggering signal selected by S2 is fed to the A-bar input of U2a, which is one half of a 74HC221 dual non-retriggerable monostable. Each time it is triggered by the selected signal, either continuously or a single time, U2a produces a pair of output pulses — a positive pulse at the Q output, and a negative pulse at the Q-bar output. The width of both these pulses is identical, and is deter-

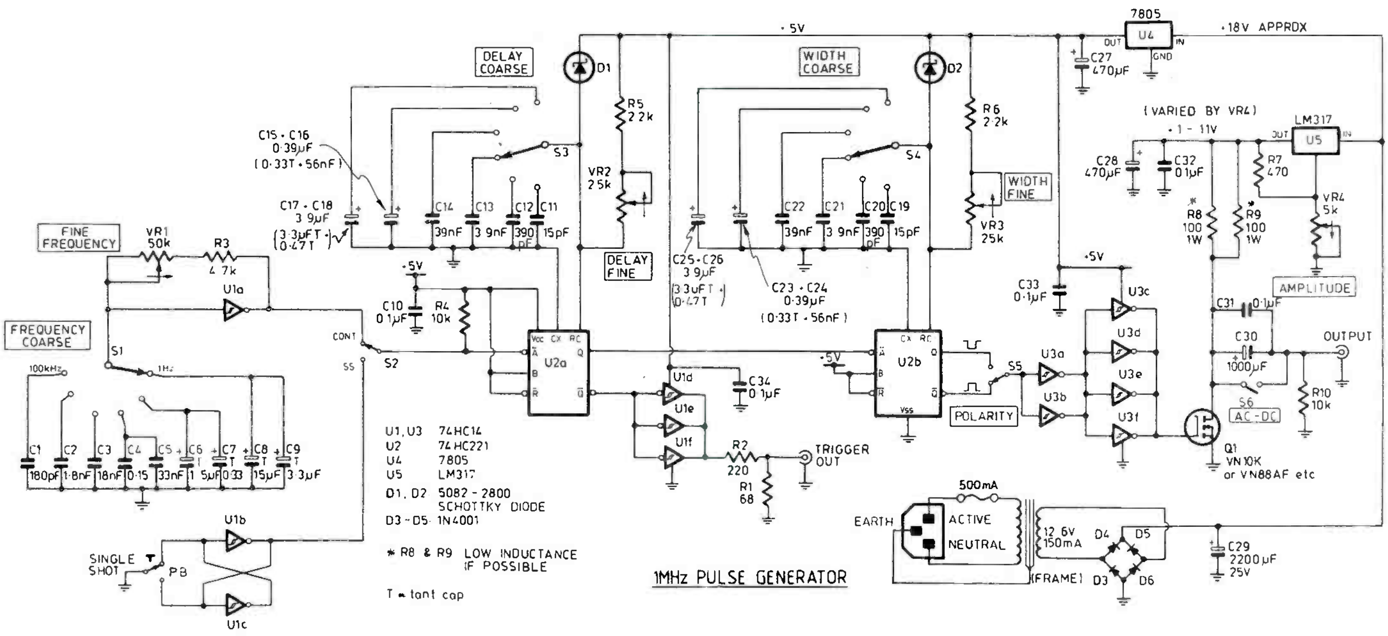


mined by the capacitance between the RC and Cx pins of U2a, and the resistance from the RC pin to the +5V rail.

As before, a series of capacitors are selected by a switch (S3), to provide six ranges, while variable resistor VR2 is used to vary the resistance over a ratio of about 12:1 within each range. These controls form the 'coarse' and 'fine' controls respectively, for the effective *delay* between the scope trigger pulses and the main output pulses. How this occurs should become clear shortly.

The pulse from the Q-bar output of U2a is fed through paralleled inverters U1d-f, which buffer and invert it to produce a positive pulse. This is then fed to resistive divider R2/R1, to form the scope triggering signal. The divider both protects the buffer inverters, and also provides a 50Ω output impedance to minimise cable ringing. (The trigger pulse amplitude is approximately 1.1V p-p.) The output pulse from the Q output of U2a is taken directly to the A-bar trigger input of U2b, the other half of the 74HC221. This connection ensures that U2b triggers on the *negative-going* or 'trailing' edge of the pulses produced by U2a, so that U2b triggers at the *end* of the pulses from U2a, while the scope will normally be triggering from the *start* of the pulses (assuming it is set for positive-edge triggering). It's in this way that the variable-width pulses produced by U2a are used to produce the variable output pulse delay.

U2b is connected in virtually identical fashion to U2a, to again produce pulses of adjustable width. Here switch S4 is used



Here is the schematic. As you can see, it uses only five ICs — of which two are voltage regulators. The output stage uses a power MOSFET transistor to generate pulses of adjustable amplitude, with short rise and fall times.

Pulse generator

to select the range capacitors, while VR3 varies the resistance — and because the pulses from U2b are used directly to generate the output pulses, the two controls thus become the 'coarse' and 'fine' adjustments for the *width* of the output pulses.

By the way, Schottky diodes D1 and D2 are to protect the internal circuitry of the 74HC221 from damage due to stored charge on the larger timing capacitors, when the +5V supply rail drops (i.e., when the generator's power is removed).

You may have noticed from the pictures that the front panel of the generator shows the shortest delay and width ranges marked as '100ns', whereas earlier in the article I noted that the shortest achievable delay and width are in fact about 350ns. The limit is actually set by the 74HC221, presumably due to internal capacitance, and significantly shorter delays or widths cannot be achieved by further reducing the values of C11/C19. All that this does is give VR2/VR3 a slightly disconcerting nonlinear action, wherein the minimum delay or width occurs not when they are fully anticlockwise, but at a point before that.

Despite the discrepancy the shortest ranges have still been marked nominally as '100ns', because the delay/width values achieved at the 'x10' end of the pot travel for these ranges is around 1us.

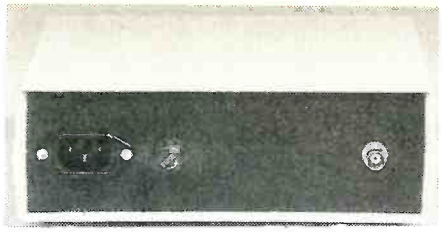
Switch S5 is used to select either the Q or Q-bar output pulses from U2b, as these provide a choice of either positive- or negative-going polarities respectively. (Note that the schematic suggests the opposite, but this is because there is a polarity reversal in the rest of the output circuit, and the small symbols indicate the corresponding *output* pulse polarity.)

At the output of U2b and S5, of course, the pulses are of fixed amplitude (about 5V p-p) and of relatively low power. The remaining signal circuitry is used to provide power amplification, and also to allow the amplitude to be varied between about 1V and 11V p-p.

The output stage itself is virtually the same as that in the 1979 design, with an enhancement-mode power FET (Q1) used as the high speed current switching element.

Q1 can be either the Supertex VN10K device currently available from Dick Smith Electronics, or the Siliconix VN88AF which is available from firms such as Jaycar and Altronics. The lower rated Siliconix VN66AF and VN46AF would also be quite suitable, if available.

Despite their relatively low cost, the VN10K and the VN88/66/46AF devices are all capable of switching up to 500mA of current through 50Ω loads, with typical rise and fall times of around 4ns. This makes them ideal for our purpose here. Although the VN10K device comes in a TO-92 package and the other devices in a TO-202 package, luckily they also have

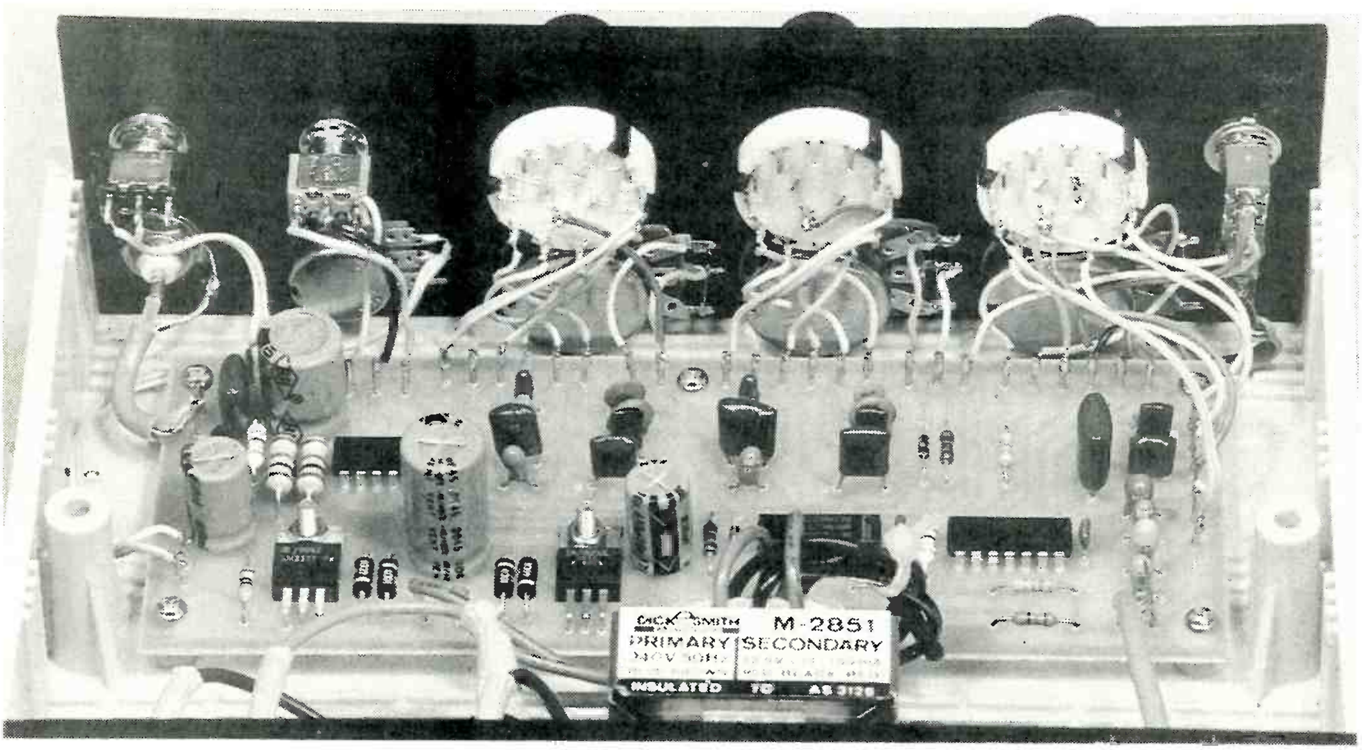


Here is the rear view. At left is the IEC mains input connector and fuse holder, while the connector at right is for the scope trigger output.

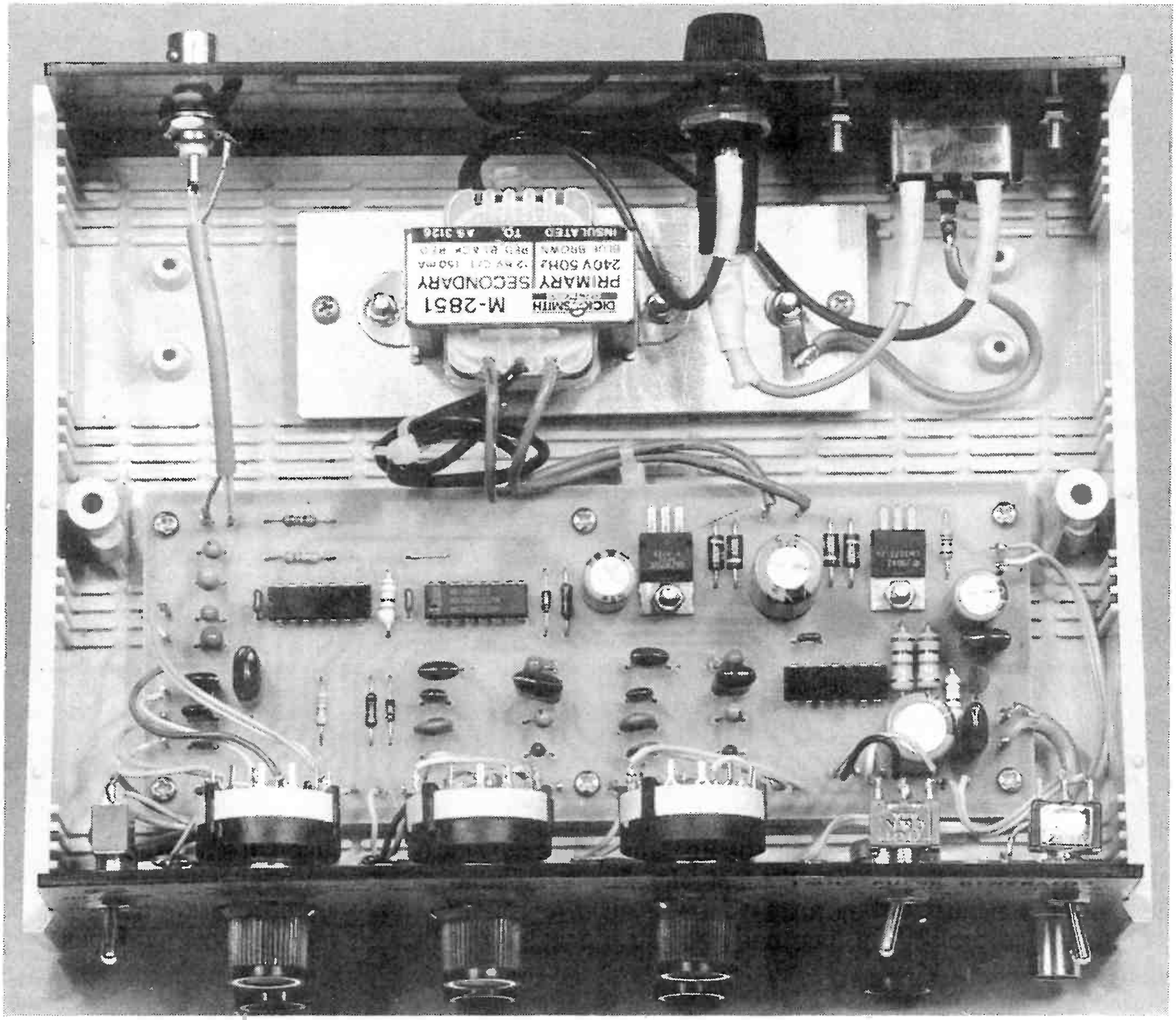
virtually the same pin configuration. Q1 is connected as a shunt switch, essentially across the output, with paralleled drain load resistors R8 and R9 establishing the generator's output impedance. Q1 is turned on and off by the pulses from S5, fed to its gate via the inverters of U3 (another 74HC14 Schmitt inverter).

The reason for using inverters U3a-f in the configuration shown is to prevent loading on the selected output of U2b, and also to drive Q1's gate from a suitably low impedance. This counter-acts the effect of Miller (drain-gate) capacitance within the FET itself, and ensures that we achieve the fastest switching. To avoid the need for high power compensated output attenuators, the adjustable output pulse amplitude is achieved by simply varying the drain supply voltage fed to the power FET.

This is done using U5, a readily available LM317 adjustable regulator. Variable resistor VR4 is used to vary the effective



This view inside the case shows the front panel control and the wiring from them to the PC board.



An overall view inside the generator, showing where everything goes. Note the small plate of sheet aluminium used to mount the power transformer, and the insulating sleeves over all of the 'live' mains connections.

drain voltage for Q1 between about 1V and 11V, giving the same approximate range in unloaded peak-peak output pulse amplitude. Note that for minimum overshoot, undershoot and ringing on the output waveform, R8 and R9 should be non-inductive resistors.

However suitable resistors are not easy to obtain, and standard 1W composition types will probably have to be used by most constructors. Typically these will result in about 10% over- and undershoot, plus a small amount of ringing, when the generator output is loaded with a matched non-inductive 50Ω load.

Output coupling capacitors C30 and C31 are used to block the DC component across Q1, when required. C31 is connected in parallel with C30, to shunt the latter's internal inductance. S6 shorts them both out when the negative peaks need to be clamped at close to earth potential, while R10 acts as a bleed resistor to allow charging of C30-31 when there is no DC load.

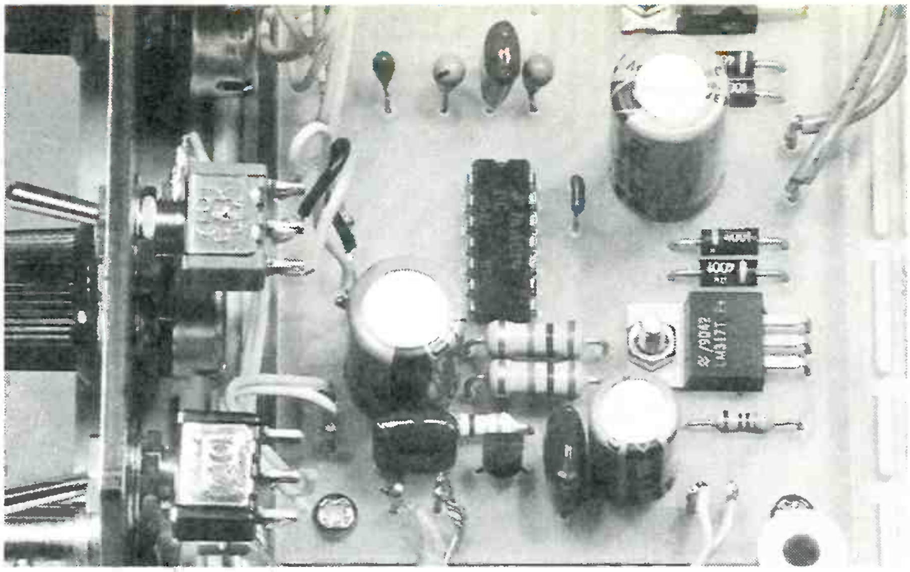
Power supply for the generator is provided by a low cost 12.6V/150mA transformer, feeding a bridge rectifier using diodes D3-D6, and reservoir capacitor C29. This provides an unregulated voltage of about +18VDC under typical no load/low loading conditions. Regulator U4, a 7805, is used to derive the regulated +5V required by U1, U2 and U3, while U5 feeds the output stage.

I should point out that strictly speaking the 150mA rating of the '2851' transformer used is not quite high enough. Ideally a transformer with 200mA or higher rating would be preferred, because the peak current drawn by the output stage for maximum output amplitude is around 200mA, and as a result the average current rises above 150mA for output pulse duty cycles less than 50% with a 50Ω load, or 25% when the generator is unloaded.

In practice the 150mA transformer not only runs at quite a low temperature, but rarely seems to limit the generator's performance. In fact the only small complication is that when the generator is loaded with 50Ω and called upon to deliver pulses with a duty cycle of less than 50%, the maximum loaded output tends to limit at a little over 5.3V p-p — with a small amount of 100Hz ripple modulation evident on positive peaks. This is of course due to droop of the +18V unregulated rail, as a result of the transformer's regulation. For most people this isn't likely to be a problem, but if it worries you, it can be obviated by using a transformer with a higher rating.

Most of the readily available 1A-rated '2155' types will in fact fit into the generator's case, if you wish, although they're somewhat larger and more expensive. Intermediate sizes are actually available, if you look around, and as you'd expect these are generally neither as large nor as expensive as the 1A size.

Jaycar Electronics carries a 500mA unit (MM-2013), while Perth supplier Altronics also stocks both a 300mA unit (M 2852) and a 500mA unit (M 2853). I haven't tried any of these intermediate sizes, but they would probably be quite suitable.



A close up of the output stage section of the generator PC board. Note the two one watt resistors R8 and R9, mounted a few millimetres above the board to allow better cooling. On the other hand, FET Q1 is mounted as close as possible to the board (without stressing its leads), to minimise lead inductance.

Construction

As you can see from the pictures, the complete generator fits into a standard plastic instrument case measuring 200 x 160 x 70mm (or 200 x 160 x 65mm). With the exception of the controls, connectors, power transformer and mains fuse holder, all of the components mount on a printed circuit board measuring 166 x 64mm and coded 92pg4.

This mounts horizontally just behind the front panel, with short lengths of hookup wire used to make most of the interconnections. The only exceptions are the connections to the main and trigger output connectors, which use short lengths of 50Ω coax.

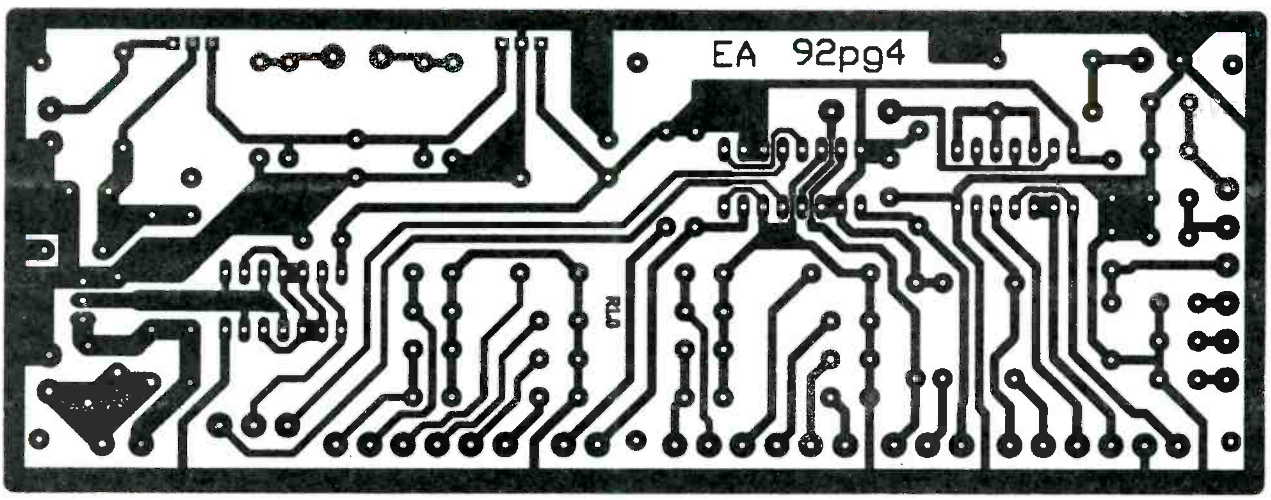
To make all of the off-board connections easier, I recommend the use of PCB or 'matrix board' pins. These allow the complete PCB assembly to be wired and mounted into the case, before the interconnections are made. A total of 42 pins are required. Note that there is a single short wire link on the PCB, just to the rear of C10 and U2.

Fitting the components to the PCB should be quite straightforward if you use the overlay/wiring diagram and photographs as a guide. As usual it's a good idea to fit the low profile parts such as resistors and diodes first, followed by the capacitors and finally the ICs and power FET — taking care with the orientation of all polarised parts such as diodes, tantalum and electrolytic capacitors, and of course the ICs and FET.

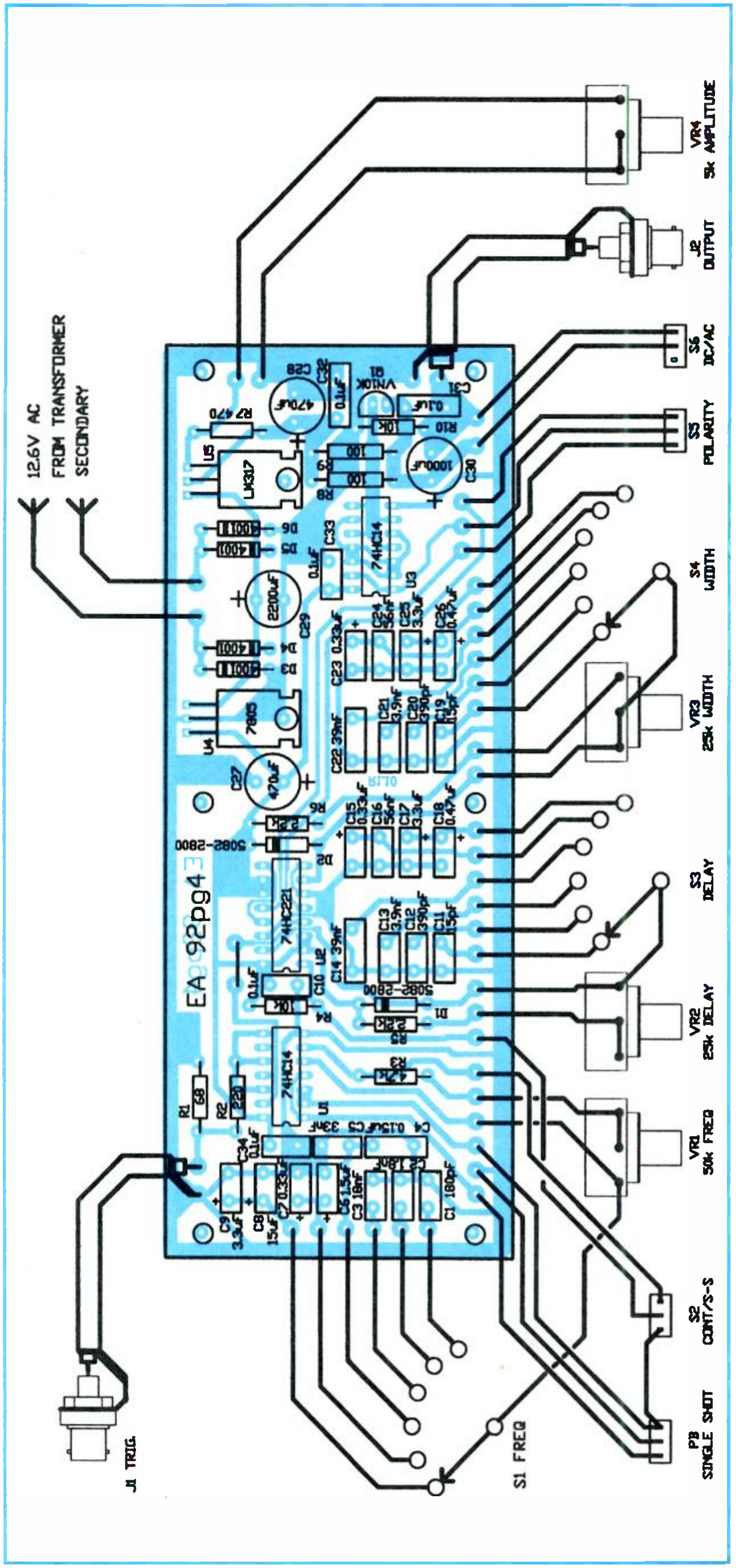
The only on-board components which become warm during normal operation are the two 1W resistors R8 and R9, together with the output stage regulator U5. The latter needs no special heatsinking, as its dissipation is quite low, but I recommend fitting R8 and R9 so that their bodies are about 3mm above the top of the PCB, to allow easier convection cooling. Don't mount them any higher than this, though, because this will increase lead inductance and degrade the output stage performance.

Needless to say the output FET Q1 should also be fitted quite close to the PCB, to minimise its lead length. The same applies to most of the small components, especially the IC supply bypass capacitors (C10, C33 and C34), C31 and C32, and all of the smaller timing capacitors.

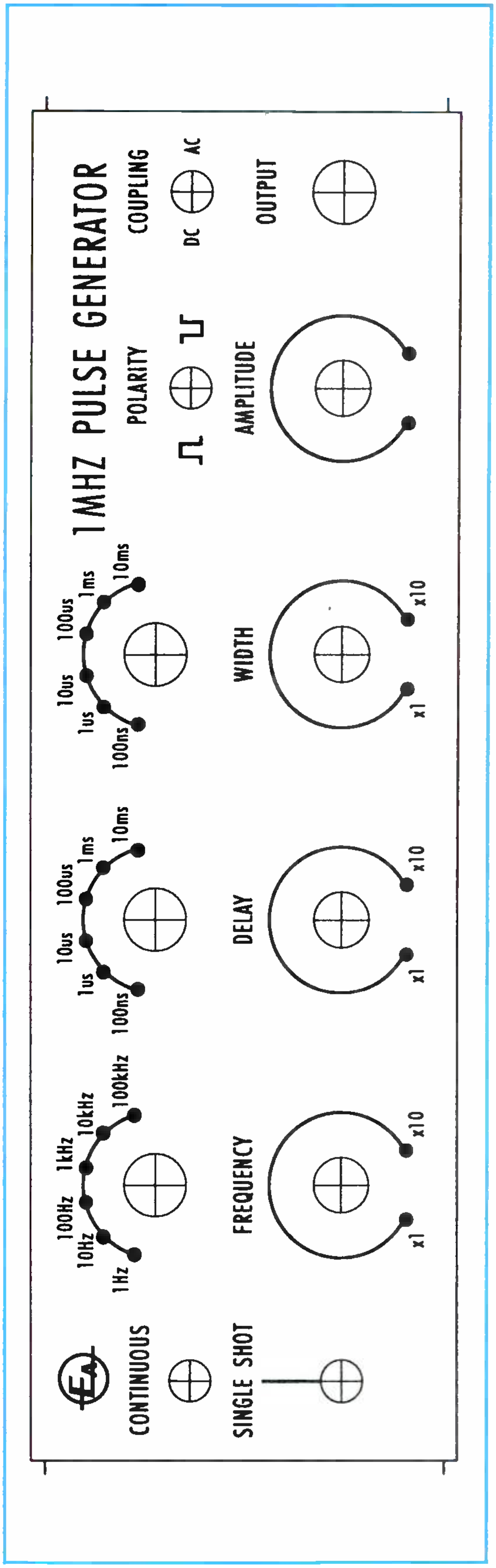
By the way if you're using a VN88AF



As usual here is the PCB pattern, reproduced actual size for those who wish to etch their own board.



Use this overlay/wiring diagram as a guide to both placing all of the components on the PC board itself, and making the connections to the off-board components.



Here is the front panel artwork actual size. The small marks at each end indicate where the panel is aligned for the Dick Smith Electronics case, which is shorter in height than that sold by Jaycar and Altronics.

power FET for Q1 instead of the VN10K, it should be orientated so that its side with the chamfered corners faces *inwards* — i.e., towards R10.

The same applies to its lower-voltage equivalents the VN66AF and VN46AF, should you find yourself with one of these.

All of the generator controls fit on the front panel, along with the main output connector. I have produced artwork for the front panel, which can be used to produce a 'Dynamark' (Scotchcal) dress panel for a professional look.

Note that the artwork is designed to suit either of the plastic instrument cases currently available, one of which is 70mm high and the other 65mm high. The short lines at either end of the artwork indicate where the top and bottom of the shorter front panel are aligned.

To prepare the front panel, I recommend drilling and reaming all of the holes first, using the various switches, pots and connector as guides. Then fit the Dynamark panel carefully, after which you can trim its edges and cut its holes to match those in the plastic panel. Then, after cutting the various control shafts to length and removing all burrs, you can fit the controls and connector — taking care not to scratch the Dynamark panel when you tighten the fixing nuts.

It's quite easy to make the connections between the PCB and the front panel controls with the PCB already mounted in the case, providing you've used PCB pins. First the front panel is laid face down, immediately in front of the case, and short lengths of hookup wire used to make the connections to the four pots and the pushbutton.

The output connector can also be wired up to the PCB pins near C31, using a short length of 50Ω coax and noting that the earth braid of the coax connects to the PCB pin nearer Q1.

Then the front panel is swung up, and maneuvred into its correct mounting slot in the lower half of the case. This allows the connections to be made to the switches on the upper half of the front panel. Use the shortest practical lengths of hookup wire for the higher frequency ranges and shorter delay/width ranges, to minimise wire inductance. Similarly keep the leads to S5 and S6 reasonably short, for the same reason.

The rear panel components and power transformer can be fitted last. I have used a panel-mounting IEC mains plug to simplify the mains wiring, as you can see. This mounts on the rear panel along with the fuse and the trigger output connector (at the far end).

The power transformer is mounted on a small plate of 1mm aluminium sheet, measuring 110 x 40mm. This is fixed into the bottom of the case via self-tapping screws, like the PCB, and the transformer mounted on the plate in turn using 3mm machine screws, star lockwashers and nuts. Also attached firmly and separately to the plate is a solder lug, again using a 3mm machine screw, star washer and nut. This allows the transformer frame to be reliably earthed, for safety.

I elected to earth *only* the transformer frame, by the way. The generator circuitry itself is allowed to 'float', as this generally causes fewer problems when using it for testing equipment. This approach does rely on the primary/secondary winding insulation of the transformer to ensure your complete safety, and virtually all types currently available are rated to withstand at least 3.5kV. However if you wish, the earthy side of the generator output can be wired back to the earth lug on the transformer mounting plate — which should ensure complete safety.

The connections to the lugs on the mains connector, fuse and transformer primary (if this doesn't have captive leads) should all be fitted with insulating sleeves to prevent any chance of accidental contact when the case is open. The sleeves also prevent accidental contact by any of the low voltage wiring, should it come adrift. The insulating sleeves can either be of tight-fitting varnished cambric, as visible in the pictures, or heatshrink plastic.

After fitting the transformer and rear panel, and making the mains wiring, don't forget to connect the 12.6V secondary leads to the PCB input pins near C29. The unused secondary centre-tap of the transformer is fitted with a short sleeve over the end, coiled up out of the way and held in place with a small nylon cable tie.

The trigger output connector is also wired up to the PCB pins near C9 — and note that in this case the 'earthy' pin is that nearer the corner of the PCB.

Testing it

Your pulse generator should now be complete, and ready for the next step: connecting the power and ensuring that it is operating as it should. But before doing so you may want to check your wiring carefully, just to make sure everything agrees with the wiring diagram. A mistake could result in a ruined IC or other component...

Assuming all seems to be OK, first set up the various controls as follows. Frequency coarse switch, fully clockwise (100kHz); delay and width coarse switches, fully anticlockwise (100ns); frequency, delay and width pots, fully anticlockwise (x1); amplitude pot, fully anticlockwise. Switch S2 should be set for continuous operation, and S5 for positive polarity. (S6 is not critical.)

Now connect both the main output and trigger outputs to the two inputs

PARTS LIST

Semiconductors

4 1N4001 or similar diode
2 5082-2800 Schottky diode
1 VN10K or VN88AF power MOSFET
2 74HC14 hex Schmitt inverter
1 74HC221 dual monostable
1 7805 fixed 5V regulator
1 LM317 variable regulator

Resistors

All 1/4W 5%: 68Ω, 220Ω, 470Ω, 2 x 2.2k, 4.7k, 2 x 10k
2 100Ω 1W (pref. non-inductive)
1 5k linear pot
2 25k linear pot
1 50k linear pot

Capacitors

2 15pF NPO ceramic
2 180pF NPO ceramic
2 390pF NPO ceramic
1 1.8nF metallised polyester
2 3.9nF metallised polyester
1 18nF metallised polyester
1 33nF metallised polyester
2 39nF metallised polyester
2 56nF metallised polyester
5 0.1uF met. poly or monolithic
1 0.15uF metallised polyester
3 0.33uF solid tantalum
2 0.47uF solid tantalum
1 1.5uF solid tantalum
3 3.3uF solid tantalum
1 15uF solid tantalum
2 470uF 16VW PCB mtg electrolytic
1 1000uF 16VW PCB mtg electrolytic
1 2200uF 25VW PCB mtg electrolytic

Miscellaneous

1 Plastic case, 200 x 160 x 70(65)mm
1 PC board, 166 x 64mm, code 92pg4
1 Power transformer, 240V to 12V at 150mA or more (see text)
3 Single pole 6-position rotary switches
1 SPST miniature toggle switch
2 SPDT miniature toggle switch
1 SPDT miniature pushbutton
2 BNC sockets, single hole panel mounting
1 IEC mains plug, panel mounting
1 Cartridge fuseholder, panel mounting
7 Small instrument knobs

Front dress panel, to pattern supplied (or silk screened and punched front panel); rectangle of 1mm aluminium sheet, 110 x 40mm; two lengths of small diameter 50Ω cable, about 75mm long; solder lug; 7 x 3mm machine screws, with nuts and star lockwashers; varnished cambric or heatshrink sleeving; insulated hookup wire, solder, etc.

Using pulses for testing

Pulses are well suited for convenient testing of analog circuit performance, because a perfect pulse consists of two instantaneous 'step' transitions, and in theory a circuit requires an infinite bandwidth to convey these faithfully. In addition, such transitions tend to provide a 'shock' stimulus for circuits, triggering them into oscillation if they have a tendency towards instability.

Of course there is no such thing as a perfect pulse. Real-world pulses tend to resemble the diagram, with such characteristics as finite rise and fall times (each measured between the 10% and 90% points), overshoot and undershoot, ringing and tilt or droop. However even pulses with these known shortcomings can be used for circuit testing — by taking careful note of the way they are changed by the circuit.

Essentially, the rise and fall times are indicators of a circuit's bandwidth. The usual rule of thumb is:

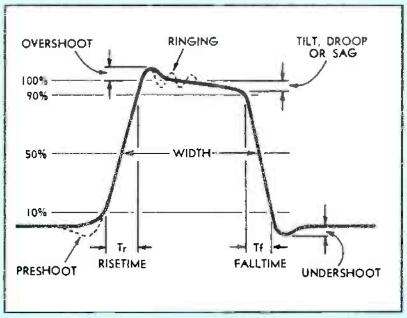
$$Fo = 0.35/Tr$$

where Tr is the rise time or fall time, and Fo is the frequency at which the response falls to -3dB. If Tr is in microseconds, Fo will be in megahertz. So a rise time of 3.5us implies a bandwidth of 100kHz, a rise time of 35ns a bandwidth of 1MHz and so on.

In practice, however, the pulses used to test a circuit already have a finite rise and fall time (about 4ns with the generator described here). In addition, the oscilloscope used to observe and measure the pulses will also have its own rise and fall times, associated with its deflection amplifier bandwidth (and knowing the scope bandwidth, its rise and fall times can be found from the above expression). The rise and fall times observed and measured on the scope will therefore correspond to the *resultant* of all three: the generator, the circuit and the scope.

It turns out that the resultant rise and fall times in such a situation are given by the square root of the sum of the squares of the individual rise times:

$$Tr = \sqrt{(T1^2 + T2^2 + T3^2)}$$



where Tr is the (observed) resultant rise time, T1 is the input pulse rise time, T2 is the circuit rise time and T3 is the scope rise time. So if we know the rise time of the input pulses and that of the scope, that of the circuit under test can be easily calculated.

Of course if the rise time of the input pulses and the scope are both quite short compared with that of the circuit, the resultant will be very close to that of the circuit itself — and the simpler first expression can be used.

As well as being a measure of circuit bandwidth, the rise time of pulses can also indicate the circuit's *slew rate* — how fast its output voltage can change (usually quoted in volts/microsecond).

The degree of tilt or droop present in the pulses after they have passed through a circuit can also be used to judge the low frequency response of the circuit — the poorer the low frequency response, the greater the tilt.

Similarly overshoot and undershoot of the pulses, where present, indicates a peak in the high-frequency response of the circuit; while ringing indicates that the circuit has a tendency towards instability and oscillation. How rapidly the ringing decays is a measure of the circuit damping and stability margin.

So in short, a pulse generator can tell you quite a bit about an analog circuit — quite apart from its use in testing digital circuits.

of a two-channel scope, if one is available, with the scope's triggering set for positive-edge operation, and from the channel fed with the trigger pulses. If only a single-channel scope is available, connect the main output to its Y input and the trigger output to its 'Ext Trigger' input.

Just before applying the power, connect a DMM or multimeter so it can monitor the unregulated DC voltage at the cathode of either D4 or D5. Then turn on the power, and quickly check that the meter reads around 18V.

If this is OK, quickly also use the meter to check the voltage on the +5V line (at say the cathode of D2), and on the adjustable voltage line (at the end of R8 or R9, nearest U5).

The latter voltage should be around +1V with the output amplitude pot in its fully anticlockwise position. If all seems well so far, try turning up the amplitude pot with the meter still monitoring the voltage at R8/R9. The voltage should be adjustable up to a maximum of about 11V.

Assuming that all voltages are in order, you can now turn to the scope. Here you should be greeted with a display of pulses about 350ns wide, and at a repetition frequency of close to 100kHz.

If you are using a two-channel scope, you should be able to see both the trigger pulses (fixed at just over 1V p-p) and the main output pulses (variable between about 1V and 11V p-p, with no load connected, and starting just after the trailing edge of the trigger pulses).

The apparent rise and fall times of the main output pulses will depend on your scope, of course. With a scope having a bandwidth of 100MHz or better, they should appear to be close to their correct value of between 4 and 5ns. Scopes with lower bandwidths will show them as being rather slower (see box). If you turn up the 'frequency fine' pot, you should be able to increase the repetition frequency to just over 1MHz.

Similarly if you turn up either the delay or width pots, the trigger pulses or main output pulses should increase in width accordingly — with the start of the main output pulses varying with the width of the trigger pulses. Note, though, that as the delay and width controls are advanced, you'll need to reduce the frequency to prevent control interaction. For example if you have the frequency set for 1MHz, corresponding to a period of 1us, you can only set either the delay or width controls for values up to 1us — otherwise every alternate pulse will be lost, and the frequency will jump by default to 500kHz.

This is a fairly standard requirement for virtually all pulse generators. The rule of thumb to remember is that for correct operation, the delay and width settings must be less than the period corresponding to the repetition frequency. If all seems well at this stage, you can check the remaining frequency, delay and width ranges. Then try the action of the pulse polarity switch, which should cleanly invert the output pulses.

Also the output coupling switch; in the DC position this should fix the negative peaks of the output pulses at very close to zero volts, while in the AC position the pulses should 'float' at a level where their average value is at zero volts. In the latter position the level will vary, depending on the pulse duty cycle (set by the frequency and width).

At this point only one more thing should be left to check: the single-shot operation. Check this by switching to 'single shot', whereupon the pulses should disappear from the scope display. Then press the single-shot pushbutton, and you should see a single output pulse each time the button is pressed. (You may need to set the scope for 'normal' triggering rather than 'auto', to see the pulse clearly, and also set the generator's pulse width fairly long, so that the scope timebase can be slowed down to make the single sweep more visible.)

If you find that the pulses are not generated when the button is pressed, but instead when it is released, this is merely due to the connections to the button being transposed. To remedy the problem, simply transpose the connections to the two outer contacts of the button — or easier still, transfer the lead from switch S2 over to the pushbutton's other outside lug.

And that should be it. If you now fit the upper half of the case, your pulse generator should now be complete and ready for use. ❖

Construction project:

New high quality sub-woofer enclosure

Enjoy a new dimension of clean, powerful and extended bass response from your hifi system, with this novel sub-woofer design. It uses a rugged 200mm driver in a specially-designed bandpass-style cabinet, and can be built for a fraction of the price of equivalent commercial units.

by ROB EVANS

Many readers will have noticed designs for sub-woofer enclosures popping up in the pages of *Electronics Australia* over the years, and will probably be aware of just how much a hifi speaker system can be improved by the addition of a dedicated low-frequency unit. In general, the smaller the size of the existing speakers, the more the apparent improvement in the system's low-end response when a sub-woofer is added.

The two most recent designs, published in August 1982 and September 1989, were based on relatively standard *vented* enclosures where the speaker radiates directly into the listening area, and the resonant properties of the cabinet/vent combination control and extend the low-frequency output.

This time-proven arrangement works well, with both designs offering impressive low-frequency characteristics relative to their size and cost.

In practice however, there tends to be a distinct limitation in the *acoustic* quality of this type of direct radiating sub-woofer, which you only really notice when the speaker's cone excursion becomes substantial. In this case the speaker starts to suffer from cone flex and other non-linearities due to the larger stresses involved, which in turn produces quite audible overtones or harmonic energy outside the sub-woofer's normal range of frequencies.

Unfortunately, the effect can be quite clearly heard at higher power levels, and tends have a corrupting influence on the overall sound.

By the way, the fact that the higher frequency signals have usually been restricted by some form of low-pass filter *before* being applied to the sub-woofer is of little help here, since the anomalies are produced by the speaker itself in response to the low-frequency drive signals.

This problem is really only a *limitation* in the design, rather than a fatal flaw, since the effect will only become obvious above a certain volume level — or as mentioned above, for large cone excursions. Nevertheless it's worth noting that by the nature of acoustics, the speaker's cone displacement will be greatest at the lowest frequencies — exactly where a sub-woofer is operating. So if you tend to listen at medium-to-high volume levels, there's a strong chance that these effects would come into play.

As you've no doubt already guessed, it was this line of thinking that led us to consider other styles of design for our new and updated sub-woofer project.

The most obvious way to reduce the amount of cone travel at a given sound pressure level (SPL) is to use a much larger driver or a greater *number* of drivers, which due to the advantage of sheer cone surface area, can 'pump' the required amount of air with far less movement. Unfortunately, this in turn would mean that to maintain the required low-frequency response (say, down to less that 40Hz) we would need to use a much larger vented enclosure, which is really far too cumbersome and costly to suit most of our needs.

With that idea knocked on the head, it soon became clear that some kind of more progressive design would be called for, if we were to enhance the sub-woofer's performance without a substantial size or cost penalty. Fortunately, an very effective answer was waiting in the latest version of Chris Strahm's LEAP software, thanks to it's ability to develop and fully analyse a *double-tuned bandpass* enclosure.

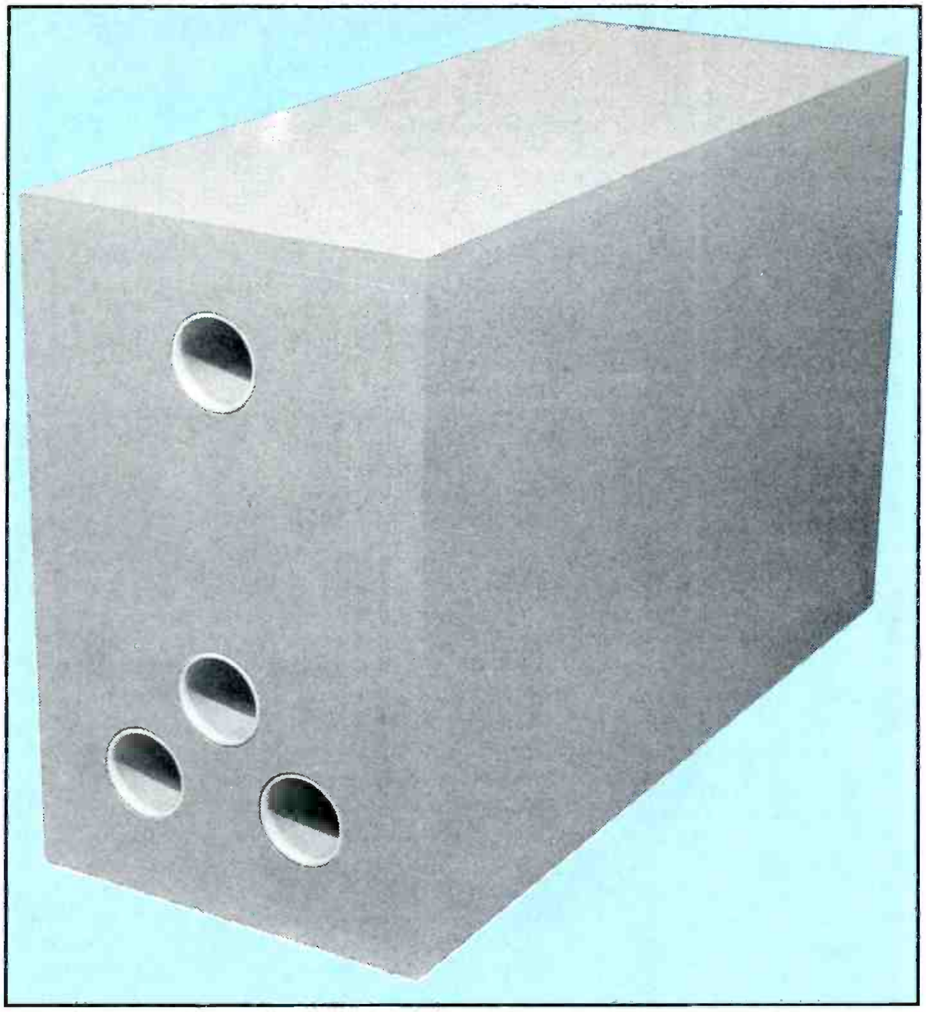
Incidentally, LEAP is an acronym for Loudspeaker Enclosure Analysis Program, and is distributed by ME Technologies at Dyers Crossing, NSW — phone (065) 50 2254 for more information on this powerful computer-based design software. The bandpass enclosure that it can now analyse is a relatively new development in loudspeaker system design, and offers a number of potential performance advantages for sub-woofers in particular.

The bandpass design

As you can see from the associated diagrams and shots of the final enclosure, the bandpass arrangement has the speaker simultaneously driving TWO vented cabinets of quite different internal volumes — one on each side of the cone. In our case the smaller cabinet is driven by the rear of the speaker cone, while the larger box receives energy from the front of the driver. The two boxes are effectively driven in push-pull.

In a normal vented enclosure, a Helmholtz resonator is formed by the air volume in the box (analogous to a spring) and the mass of air in the port. This is then driven by energy from the speaker cone, which has its own resonant properties in a given cabinet, resulting in two coupled resonant systems.

Without diving into the maths of this relationship — there have been volumes written on the full analysis of vented enclosures, mainly based on the work of A.N. Thiele and Dr Richard Small — it's perhaps sufficient to say that in a properly designed vented enclosure, the coupling will both control the driver's resonance and assist the acoustic output below this



Not a speaker to be seen! The new sub-woofer uses two coupled vented enclosures sharing a single driver (mounted inside the box), and radiates sound via four tuned ports. Note that this shot of our prototype was taken during its development, and the two upper ports are not in their final positions.

resonant frequency. It's interesting to note that at these lower frequencies, most of the acoustic output is supplied by the port itself, in response to a relatively small movement in the speaker cone.

In this situation the cabinet is virtually acting as a pure Helmholtz resonator, where the speaker cone is the driving force and the port is the output. In fact it's not unlike an acoustic transformer, in that a low impedance driving force (the speaker) is coupled to a high impedance load (the outside air), enabling a small movement over a wide area (the cone travel) to produce a large movement in a smaller area (the movement of the air in the port). The end result is that for a given acoustic output (SPL), we have much *smaller* cone excursions.

This is in fact the effect used to advantage in the bandpass style of enclosure. Assuming for the moment that there is no interaction between the cabinets, we can think of the speaker as driving two Helmholtz resonators, each with its own tuning and relationship with the resonant properties of the driver itself. In the case of our sub-woofer, the resonators are tuned to around 33Hz for the larger rear cabinet (which is driven from the front of the speaker), and about 75Hz for the smaller front cabinet.

In theory then, we would expect the acoustic output to be the sum of two peaks, one at 33Hz and the other at 75Hz, with a substantial sag in response between these points corresponding with a much larger cone travel. Of course there is in fact a great deal of interaction between the two cabinets via the speaker cone, which as you can imagine, has a complex set of characteristics in itself.

It's at this point that the inner workings of the bandpass enclosure can no longer be dealt with in such a simple way, since these interactive relationships throw up a whole new range of variables which will effect the system's overall characteristics. Fortunately however, LEAP takes all of this into account and makes very accurate predictions of how a bandpass enclosure will react with a particular speaker.

By using LEAP's ability to fully analyse our proposed cabinet, it was a simple matter to determine that the speaker's cone travel was indeed very small at the two tuning points, but only increased by a moderate degree though the intermediate frequencies. While the cone travel will also drop to a low level at the cabinet (Helmholtz) tuning point in a *vented* enclosure, the average excursion over the area of interest (say 40Hz to 100Hz) was much lower in the bandpass design.

The bandpass enclosure also offers a natural high-frequency roll-off at frequencies above the upper tuning point, presumably due to internal cancellations between the energy in the two cabinets. This too is quite an advantage for a sub-woofer, since the unwanted frequency range (say, above 150Hz) is already severely attenuated before any electronic filtering is applied. This in turn allows the use of a filter which may have only a moderate slope or is set at a higher frequency, resulting in less phase anomalies and other audio side-effects.

Since the sub-woofer's natural high frequency roll-off appears to be due to some form of internal cancellation, it's hardly surprising to find that there are a number of recurring peaks in the output at much higher frequencies, since the energy is likely to be in-phase at some point. In fact LEAP predicts these effects, and shows the first peak occurring at around 1kHz with an amplitude that is around 20dB less than the energy in the 'fundamental' area. Further peaks occur at higher frequencies, but with even less amplitude.

All this really means is that despite the bandpass enclosure's inherent (and very handy) low-pass filter effect, we should still use an external filter in the signal chain to reduce the available energy in the mid-range area. By the way, LEAP also predicts the likelihood of standing waves occurring inside the tuning ports at higher frequencies, which is further evidence of the need to reduce the level of any input signals which may promote these effects.

The driver

While any number of loudspeakers can be made to work in a bandpass enclosure, with varying degrees of success, the driver for a modestly-sized sub-woofer should have parameters which fall into a defined range. Namely, it should have a low free-air resonance (say, less than 45Hz), a moderate Qts (less than 0.5), and a reasonably small Vas figure. These values will mostly effect the low-frequency extension, the smoothness of the response, and the size of the required cabinet, respectively. In fact, these guidelines are valid for both bandpass *and* normal vented enclosure designs.

Our search for a suitable driver ended with a rugged 200mm unit imported by Jaycar Electronics, who market the speaker as intended for sub-woofer applications — although there's no reason why it couldn't be used in more conventional speaker systems.

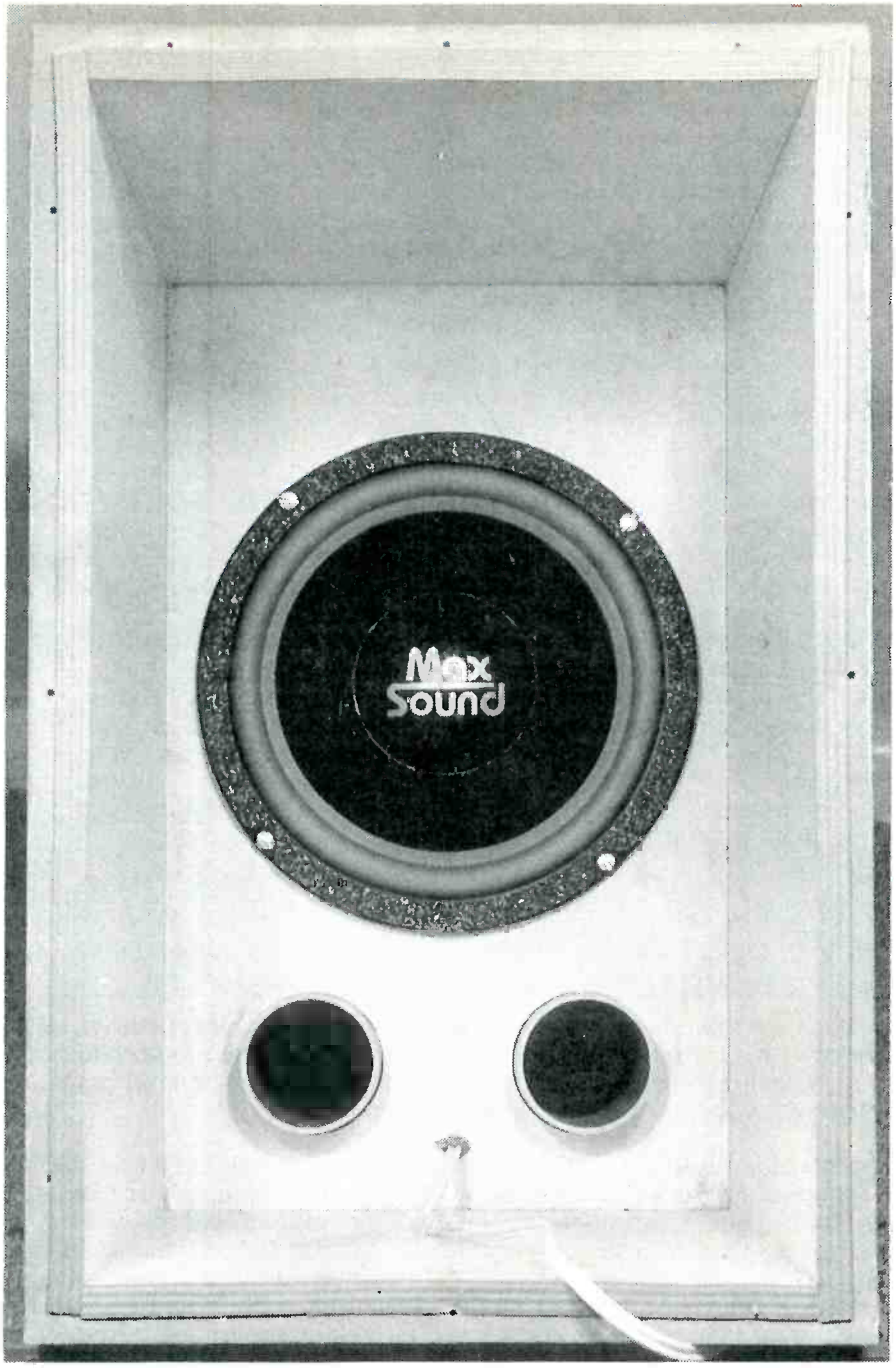
The driver concerned carries the brandname 'Max Sound', and is currently listed in the Jaycar catalog as CW-2150. It sells for $99.50, and as this is the main outlay for the sub-woofer the overall cost therefore compares very well with commercial equivalents.

Jaycar kindly sent us a sample, and after some testing we found that it offered a free-air resonance (Fo) of 41Hz, a Q-factor of 0.44, an 'equivalent compliance volume' (Vas) of 45 litres, and a very respectable efficiency figure of around 90dB (for 1W at 1M). Physically, the driver sports a large magnet assembly, a generously sized voice-coil, a compliant butyl rubber suspension system, and a power rating of 80W RMS. All in all, this was quite suitable for our needs.

While the three main parameters mentioned above (Fo, Qts and Vas) can be used to derive the design for a suitable vented enclosure without too much trouble, the bandpass enclosure and its complex tuning interactions is really quite different story — it would have required many days of trial and error testing to arrive at a suitable cabinet. Needless to say, we left this up to the computing power of LEAP, which considers some 20-odd speaker parameters in its enclosure analysis routine.

By the way, these parameters can be calculated by LEAP itself using impedance data imported from its sister software/hardware package LMS (Loudspeaker Measurement System) — which as it happens, is also available from ME Technologies. With this system, all you need to do is let LMS measure the speaker's impedance curve in both free-air and a sealed cabinet of a known volume, then transfer this information to LEAP — which subsequently processes the data. And bingo, you have a full set of parameters...

After some fine tuning with LEAP, we arrived at a final bandpass enclosure design featuring a 14 litre front compartment and a 38 litre rear space, which offered more than acceptable performance for its modest overall size. Further testing with LMS on the completed sub-woofer indicated that it has a smooth and extended bass response, covering the range from 35Hz to 120Hz within 3dB.



A view inside the enclosure's rear cabinet showing the ends of its two ports, and how the speaker mounts into the baffle board. Note how rubber sealing tape has been fitted to the end of the box to form a gasket for the rear panel.

When correctly setup with an existing stereo system we found the sub-woofer to be particularly pleasing to the ear, with the bass sounding very clean and extended, and showing no evidence of doubling or stray upper harmonics — it was as if the original speakers had suddenly been swapped to much larger and higher quality units.

We also noted the sub-woofer's high sensitivity and ability to handle high power levels without fuss.

In fact the room seems to set the upper power limit rather than the speaker itself, since we found that the sub-woofer would happily keep producing more and more very low-frequency energy in response to an increasing drive level, to the point where bits and pieces in (and of) the room started audibly vibrating, moving, and generally contributing to the sound! Suffice to say, it should have more than

The sub-woofer's frequency response measured in a typical listening room — you really coudn't ask for better....

enough acoustic output to suit a typical domestic stereo system.

The enclosure

As you can see from the assembly diagram, our bandpass enclosure is a rather more complicated arrangement than the equivalent vented cabinet, and not surprisingly it will be slightly more time consuming to construct. However, if you have anything more than the most basic woodworking skills and tools, and use a little patience and planning, you'll have the cabinet together in short order.

The prototype enclosure was constructed from 19mm high-density particle board (known as MDF in the trade), using simple butt joins between the panels rather than the more complicated mitred or recessed methods. We found that if each join is both glued *and* screwed together, the cabinet will be both sturdy and air-tight, without the need for sophisticated joinery or additional cleats and bracing — and above all, it makes for a much simpler construction technique.

However, note that all of the above assumes that the actual panels have been cut with a reasonable degree of accuracy and have clean, straight edges which are at 90° to the main surface.

If you don't have the skills or facilities to produce reasonably true panel cuts, your local timber merchant (where you may have purchased the board) or joinery shop should be able to help. In this case, take in a plan showing the exact size of each panel and how they might be cut from a standard sheet of particle board, then ask the staff to make the cuts for you on their resident table-top saw. There's usually a small charge per saw-cut, but in our opinion it's worth every cent for the accurate results.

Once the timber has been organised, cut the holes in both the baffle and front panels as shown in the assembly diagram (Fig.1). Note that there are a total of six holes for the vent tubes, which should be cut with a hole-saw (the type which fits into your power drill) for the neatest results. Double check that the outside diameter of your '50mm' pipe is indeed 56mm when choosing the cutting blade size, since the tubes should ultimately be a firm fit inside their respective holes.

At this stage you can also cut the four lengths of PVC pipe, for the vents themselves. As shown in Fig.1 there are two 105mm long, and two 240mm long. Make sure you cut the ends squarely, and remove all burrs with a small file. It's a good idea also to gently round the inner edges at each end of the pipes, to minimise air turbulence effects.

Next, glue and screw the cabinet together as shown in the diagram, while paying particular attention to the position and angle of each joint. Note that the screw heads should be countersunk below the timber surface so that they can be filled to a smooth finish at a later stage, and that the rear panel is only attached by screws (no glue) so it may be removed for access to the driver.

To ensure that the final enclosure will be quite air-tight, run a bead of glue along each of the inside seams and smooth it in place with your finger. Similarly, the vent tubes should be well sealed to the inside face of the panels with glue or sealant. Also note that the tubes should be positioned so that their ends are flush with the front panel surface, as shown in the assembly diagram.

At this stage you might like to fill the screw head indents with a suitable wood filler, smooth and sand the surface, then paint the enclosure in some unobtrusive color — chances are that you'll want the final result to look as inconspicuous as possible. With the woodworking finished, you're now ready to install the speaker and wiring, and perform a few preliminary checks.

Before the driver is screwed in place, a length of heavy-duty speaker cable should be passed through a hole in the baffle board so as to reach the speaker's terminal posts, since they are facing toward the *front* of the cabinet. The hole should then be closed around the cable with sealant, while checking that the lead is positioned so that its respective ends can reach the speaker terminals and the rear panel connector.

Then place a square of acoustic wadding material (Innerbond or similar) in the front cabinet against the front panel — this should be roughly the size of the panel itself, and can be tacked in place so that it won't interfere with the front vent tube inlets. A gasket should now be formed around the inside perimeter of the speaker's mounting flange, using window or door sealing tape (the waterproof type is best), and the driver temporarily placed in position to check the fit.

In our sample driver, the terminal posts were too close to the frame's mounting flange (that is, less than 19mm) and fouled the edges of the baffle hole. This was cured by simply bending the post's metal mounting lug on the speaker frame.

Once you are satisfied with the position of the terminals, connect the wiring and mount the driver in place using large self-tapping ('PK') screws, or bolts and captive nuts. During this procedure, make sure that the speaker cable doesn't end up resting on the back of the speaker cone, and check that the mounting screws are fully and evenly tightened.

Finally, the speaker connector can be mounted on the rear panel and the internal wires attached. Then tack another section of acoustic wadding to the rear panel's inner face, fit a sealing tape gasket around the box mating surface, and screw the panel in place.

Setting up

If you are running the sub-woofer with a recommended crossover system such as the *EA* Sub-Woofer Adaptor (published in May 1989), the setup procedure is quite straightforward — up to a point...

In this arrangement, you simply run a

set of light-duty speaker cables from your main amplifier to the adaptor's inputs, then connect its output to a suitable amplifier, which in turn drives the sub-woofer.

Due to the large number of acoustic variables in a typical listening environment however, fine tuning the system's response for the best overall result *can* be quite an extended process. It really just depends upon how fussy you are about the response in a particular area of the room, such as your favourite listening chair.

The simplest and quickest method for arriving at a reasonable balance between the levels of the main speakers and the sub-woofer, is to just wind up the level of the sub-amplifier until the system's overall low frequency response sounds both extended and smooth. If you detect a noticeable peak in the response around the frequencies where the sub-woofer takes over from the main speakers (say, in the 100Hz region), try reducing the roll-off point of the sub-woofer adaptor's filter to say 80Hz. Note that this would normally be set to the frequency where your main speakers begin their natural bass roll-off, which would be in the range of 100Hz to 130Hz for most 'bookshelf' speakers, for example.

If you wish to take a more objective and scientific approach to setting up the system, you'll need some kind of test equipment to measure the relative sound pressure level (SPL) within the room at various (low) frequencies. A quite simple, but nevertheless effective setup is to use the combination of an audio oscillator, a reasonably high-quality microphone, and a standard tape recorder. Here, the oscillator is used as the system's signal source and is swept through the low-frequency area of interest, while the microphone's output level can be monitored on the tape deck's level meters.

With this arrangement, you can make repeated tests while adjusting the adaptor's frequency and level controls for the flattest overall low-frequency response. If you find that there seems to be a hole in the response around the 'crossover' region, even when the two ranges are obviously overlapping, chances are that the sub and main systems are out of phase.

The phase relationship between the two systems can be checked by tuning the test oscillator to their 'crossover' region (say around 120Hz), and noting the overall SPL with the sub-woofer wired with normal, then reversed polarity connections.

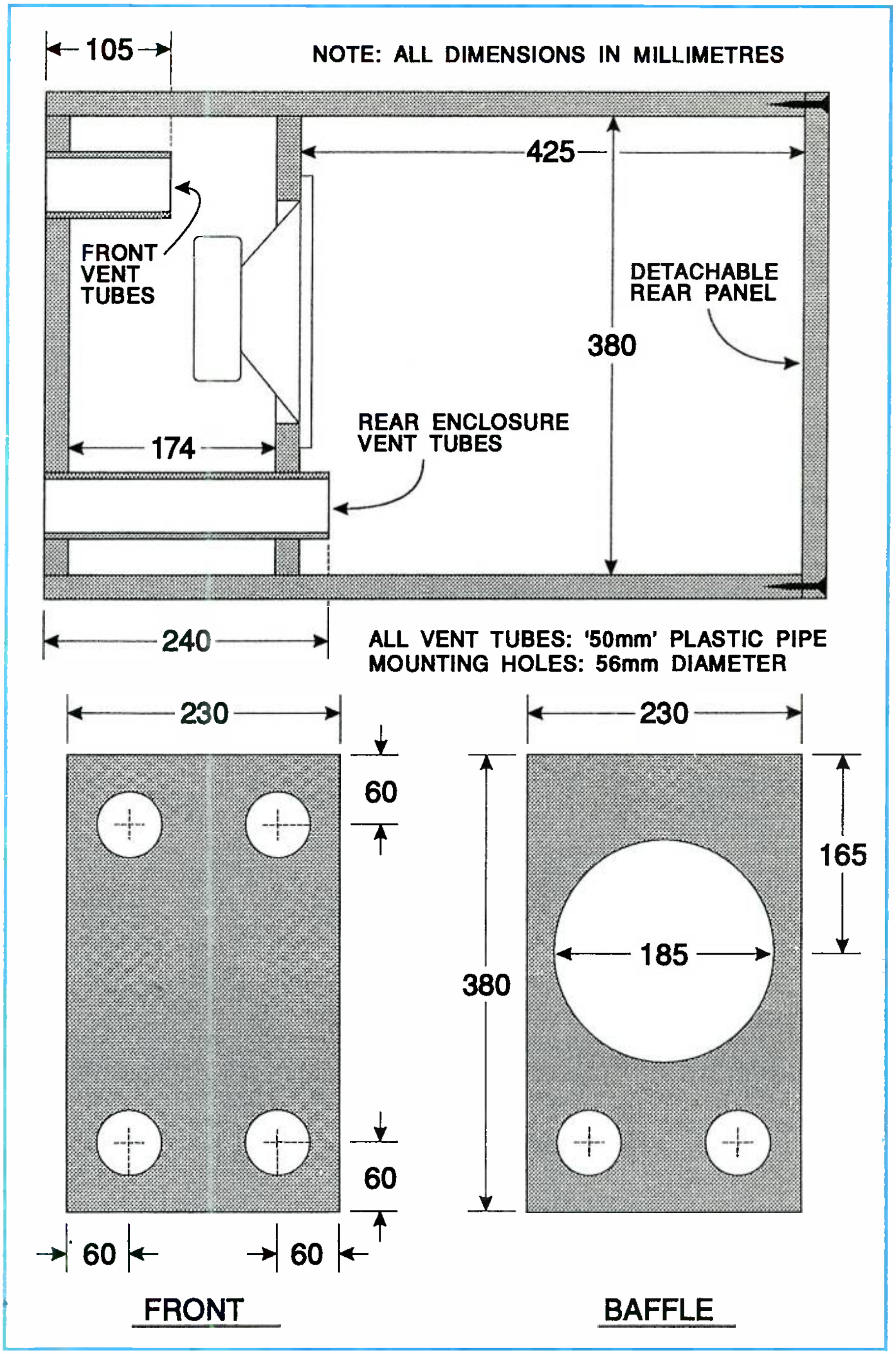


Fig.1: Closely follow this construction diagram when building the enclosure. The two cabinet volumes and the spacing between the ports and their individual lengths are all critical to the sub-woofer's final performance.

The highest reading should occur when the two speaker systems are operating *in phase*. If this then produces a substantial peak in the overall response, you may need to reduce the overlap between the output of the main and sub-woofer speakers as detailed above — that is, reducing the adaptor's low-pass filter roll-off point.

While the above methods for adjusting the sub-woofer to main speaker balance work well, you will still have to contend with (or simply accept) the effects of your room itself. This is because a typical listening room will invariably have both the volume and shape which tends to promote low-frequency standing waves, which in turn produce peaks and dips in the system's bass response. And to compound the issue, these 'hot and cold' spots will occur at different frequencies, depending upon where you are standing in the room, and importantly, where the sub-woofer itself has been placed.

So all in all, once you've set the sub-woofer's upper cut-off frequency and

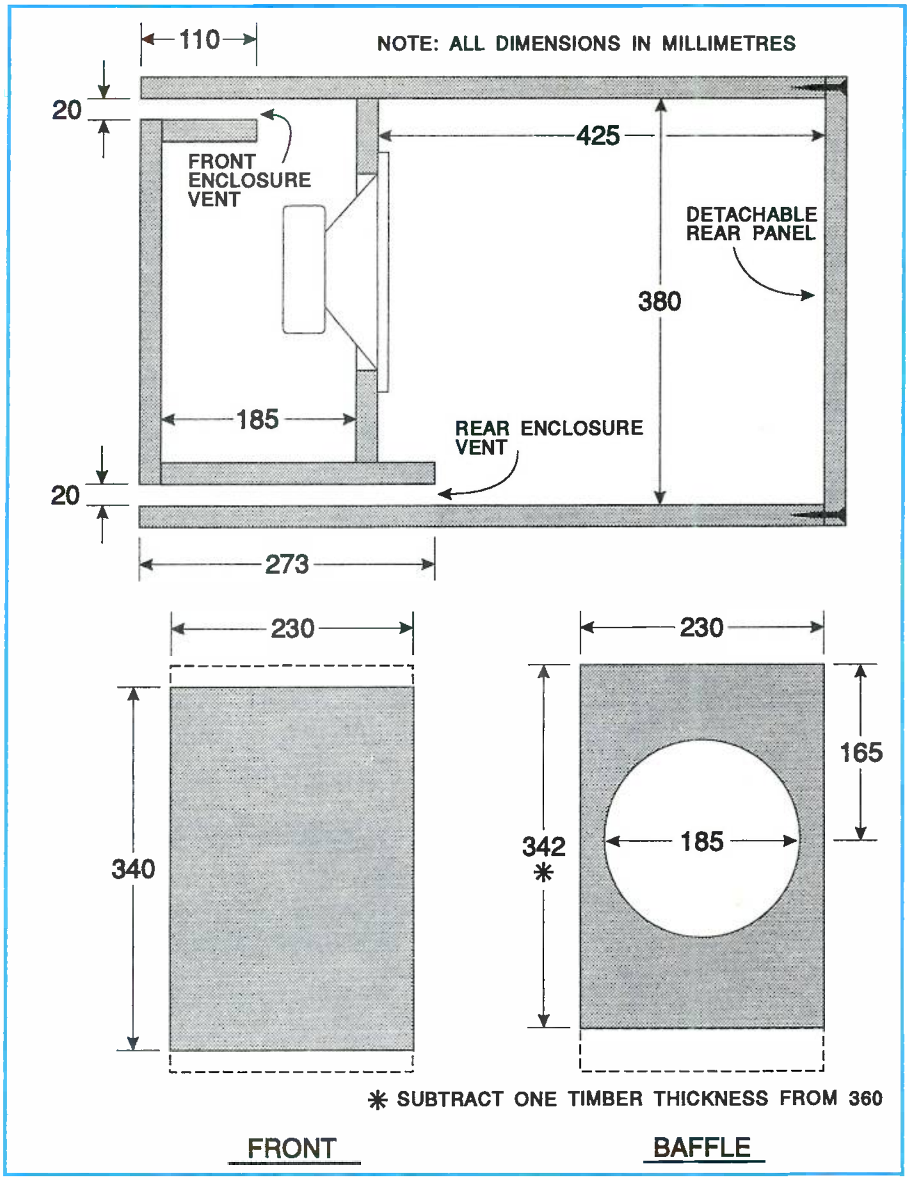


Fig.2: An alternative design to that of Fig.1, which uses shelf-type vents rather than tubes. Its performance is the same, but the cabinet is slightly larger due to the increased distance between the front panel and the baffle board.

drive level, it's a matter of fine-tuning these adjustments and experimenting with different sub-woofer locations. In this respect, you should find that the enclosure is best placed on the floor with the rear cabinet vent tubes at the bottom, and positioned away from the corners of the room. Mind you, if you find that the very low bass frequencies are still a little light-on, moving the sub-woofer closer to a corner of the room may help. Here, the floor and two walls effectively become an extension of the cabinet, and tend to promote the very low frequency energy. If you overdo it however, the resulting sound can become rather soggy and bass-heavy.

As always, the bottom line is how *you* like to hear your music, so the final system 'tuning' will depend upon your listening habits and music preferences. The one fact that *is* consistent however, is the extra depth and dimension that the sub-woofer will add to the sound of your system.

Alternative versions

As you may have already spotted in Fig.2, we've also presented an enclosure design based on simple shelf-type ports, rather than the pipe system as shown in Fig.1. Since the port openings appear as two simple slots in the front panel, some constructors may prefer this less conspicuous arrangement.

This alternative cabinet uses a couple of extra sections of panel instead of tubes to form the vents. It offers the same performance as the standard design, but may however be a little more fiddly to construct. Note that the distance from the front panel to the speaker baffle has been increased from 174mm to 185mm, to allow for the increased volume occupied by the rear vent where it passes through the front enclosure.

These shelf vents have a slightly larger opening area than their equivalent tubes (as in Fig.1), and consequently must be a little longer to preserve our original cabinet tuning. So if you elect to build this alternative design, take careful note of the overall length of the two shelf vents as shown in Fig.2.

There may also be some constructors who would prefer a sub-woofer enclosure that can 'stand on its end', as it were. That is, a cabinet design with same basic shape as presented, but where the ports radiate from the 'side' of the box (the longest dimension) and the rear panel becomes the base. While this arrangement has the advantage of taking up far less floor space, the cabinet will tend to poke its head up above the surrounding furniture — perhaps an acceptable compromise when space is tight.

If you wish to pursue this approach, note that the distance from the front (now top) panel to the baffle will need to be reduced from 174mm to 167mm, since the rear (bottom) cabinet vents tubes will no longer pass through the front (top) cabinet. Instead, the rear (bottom) vent tubes should now be installed in the bottom cabinet itself in a more conventional manner, so that they 'fire' into the room through one of the narrower side panels (that is, the one that measures about 650mm x 268mm).

The vent tubes for the top cabinet should also be installed in this same panel, but near the top of the box of course. As in our original design, each set of ports should be around 110mm apart, and the pairs positioned about 80mm from the top (the 105mm tubes) and bottom (240mm tubes) of the cabinet.

While there's a whole range of other cabinet shapes we could discuss, we feel that these three basic choices should cover most people's needs. It's important to note that the cabinet volume(s), port length (that is, tuning) and port positioning will all effect the sub-woofer's performance, and must be as close as possible to our specifications.

Once you have completed and installed the sub-woofer, you will find that the effort has been well worthwhile. The sub-woofer will add a new and often spectacular dimension to the sound of your existing system, with the bass output remaining clean and well defined right up to the highest volume levels. If your house has any structural problems, they might become apparent sooner than you think... ❖

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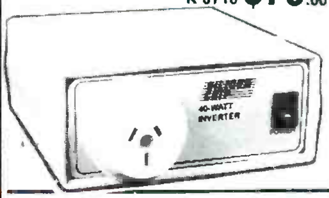

This fantastic little unit is ideal for use with incandescent globes, (note this model inverter will not run fluorescent lighting) electric shavers, small radios and some plug pack operated devices, ie charging cordless drills and other rechargeable battery appliances etc.
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(SC Jan 1992)

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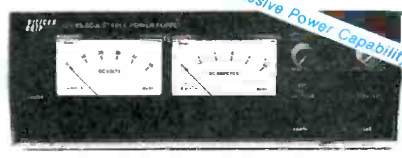

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Now you can solder anywhere with this new gas soldering iron. ***Features*** • See through gas chamber (no more guessing how much gas is left!) • Built in ignition cap • Uses standard butane gas • Comes with safety bench stand • Supplied with 2mm soldering tip and blow torch tip • Adjustable temperature from 400°C to 1200°C • Can be easily refilled with standard butane lighter gas • Replacement tips are less than half price of some other brands!

REPLACEMENT TIPS ALL $4.95 ea

T 2451 Replacement 1mm Conical Tip	T 2455 Replacement Exhaust Port
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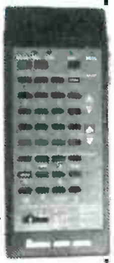
Universal Remote Control



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Ideal for amps, power supplies etc!

These cases have generous ventilation slots on both the top and bottom panels, a myriad of mounting posts are provided for PCB's and 'extra tough' mounting posts are included for securing transformers. Massive size: 355 x 250 x 122 mm.

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H 0491 Black Case
H 0492 Blue Case

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T 2440 Normally ~~$159.95~~, This Month Only **$139.95**

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With the introduction of our new range of rack cases, we have sacrificed the old stock at below cost! This means fantastic savings for you — our valued customer. Please note stocks are limited - no back orders.

1 Unit — All $25
H 0404 Grey

2 Unit — All $30
H 0405 Grey
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A 2210 Normally ~~$229.00~~

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Replace that old Dial Tuner!

This fantastic tuner is the ideal add-on to any sound system. Can be used as background music source in restaurants, shops etc or any PA application. Also a great upgrade for the home Hi-Fi.

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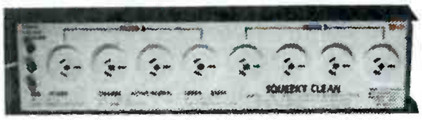
Squeeky Clean Mains Filter



New 8 Way Model At The Old 4 Way Price!

P 8170 **$289.00**

Save your precious and expensive computer hardware and hi fi etc from the power surges, spikes and lighting. A must for anyone who doesn't want their equipment blown up! New 8 way model contains two power filters.

Two Channel Pro Power Amp 90 Watts Per Channel

This stereo amp is ideal for background/foreground applications. Fantastic for restaurants, shops, disco's, aerobics, PA sound systems and home.
• 90 watts RMS per channel minimum into 8 Ohms from 20 to 20,000Hz with less than 0.05% THD • 2 large power meter indicators • EIA Panel with handle device • XLR socket for speaker terminal • Output relay to eliminate turn-on and off transients • Dimensions: (W x H x D) 482 x 92 x 295mm • Weight: 10.5kgs • Ideally suited to A 2210 stereo tuner.

A 2040 ~~$625~~ This Month **$539.00**

300 Watt Inverter

Amazing Low Price!

M 8120

$249.00

TURN 12V DC TO 240V AC.
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C 0641 8 Ohm
C 0643 16 Ohm

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Our Top Selling 17 Range Digital Multimeter for an Amazing $39.95

With quality and features you would expect only on expensive meters the Q 1056 represents excellent value for money.

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AC Voltage: Ranges 200V, 500V
DC Current: Ranges 200mA, to 10A
Resistance: 5 Ranges 200 Ohm, to 2M Ohm
Diode Test: Test Current 1.0mA
Test Voltage 3.2V Max
Battery Test: Ranges 1.5V, 9V
Loaded Current: 1.5V 100mA, 9V 6mA

Q 1056 Normally ~~$49.95~~

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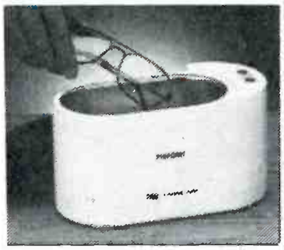
ALTRONIC COMPONENTS

Pin Point Ultrasonic Cleaner



Awarded the Good Product Design Award for CETDC in 1987. This fantastic Ultrasonic Cleaner can earn its cost a hundred times over in cleaning Computer Connectors, PCB's, Switches, Relays, Jewellery, Glasses, Watches etc.

A 0100 Normally ~~$109~~.00

This Month Only **$175.00**

Altronics Aviation Headset

• High performance noise attenuating earphones • Noise cancelling microphone • Cushioned head pad • Super sturdy • Great performance • Superb, professional pilot's headset will last a lifetime with reasonable treatment • Includes standard aircraft jacks.

Why Pay $400 or More??

Fantastic new model includes improved microphone and shielded cable, allowing even better performance! Now better value for many than before. Over 2000 already sold Australia wide.

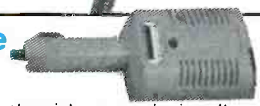
C 9070 **$189.00**

Noise Cancelling CB Type Mic

New stylist model, with simple one handed operation. Uses standard button mounting. Complete with approx 1.5m curley cord. Fantastic for CB's, amateur radio enthusiasts etc.

C 0335 **$27.95**

Car Voltage Adaptor



This handy unit simply plugs into your car's cigarette lighter socket and presto! Gives you switchable 3, 4.5, 6, 7.5, 9 and 12V DC at up to 800mA. Includes a range of output plugs. Reversable polarity. Great for pocket TV's, radios, portable CDs etc.

M 8150 **$16.95**

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New model just arrived! 80 x 80 x 25mm. Ideal for amps, power supplies, computers and just about anything else that requires effective cooling. Exceptional value for money.

F 1050 **$17.50**

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Simply brilliant Mylar stereo headsets and dynamic mic combination.

Speaker Specifications: 20Hz-20,000Hz, 32 Ohm, 3.5mm stereo jack, 6.35mm stereo jack adaptor.

Microphone Specs: Dynamic type, 300 Ohm, 100 Hz-15,000Hz -80db @ 1 Khz, 3.5mm Mono Jack

C 9055 **$44.95**

Portable PIR Alarm

• A ready to go system, no installation required • Fully automatic operation, very user friendly • Large coverage area • Portable or wall mounted • Long life 9V battery operation (battery not included) • Battery low warning • Lightweight, compact and attractive.

S 5305 ~~$69~~.00, This Month **$49.00**

High Performance Crossovers

These models consist of only high quality components. PCB mounted quick connectors for easy and reliable wire connection.

2 Way, 80 Watts RMS

Crossover Frequency: 3.5kHz
dB/Octave: 6dB

C 4005 **$11.95**

2 Way, 150 Watts RMS

Crossover Frequency: 3.5kHz
dB/Octave: 12dB

C 4007 **$26.95**

3 Way, 80 Watts RMS

Crossover Frequency: 600-800Hz/5kHz
dB/Octave: 6dB

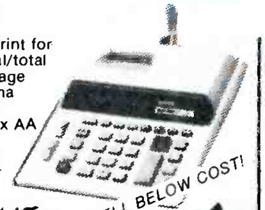
C 4006 **$20.95**

3 Way, 150 Watts RMS

Crossover Frequency: 600-800Hz/5kHz
dB/Octave: 12dB

C 4008 **$49.95**

Casio Two Colour Printing Calculator



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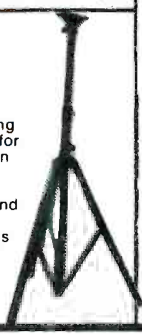
X 2125 Normally ~~$149~~.95

WELL BELOW COST!

Exceptional Value at **$69.00**

Super Heavy Duty Tripod

SAVE OVER COMPETITORS PRICES!



This great new model holds an amazing range of equipment. With rubber feet for sure and stable grip. Anti-sway bars on legs prevents wobbling. Adjustable height from approx 1 to 2 metres. Lightweight aluminium construction and collapsable for easy transportation. Removeable mounting plate makes this tri-pod ideal for amplifiers, speakers, lighting etc.

C 0520 **$129.95**

'D' Series Connectors

		Was	This Month ea	10 Up ea
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P 3040	DB9 Male straight PCB connector	$1.95	$1.75	$1.60
P 3050	DB9 Female straight PCB connector	$1.95	$1.75	$1.60
P 3090	DB9 Backshell Cover	$1.95	$1.75	$1.60
P 3100	DB15 Male solder connector	$1.75	$1.55	$1.40
P 3110	DB15 Female solder connector	$1.75	$1.55	$1.40
P 3120	DB15 Male 90° PCB connector	$2.50	$2.25	$2.00
P 3130	DB15 Female 90° PCB connector	$2.50	$2.25	$2.00
P 3140	DB15 Male straight PCB connector	$2.10	$1.90	$1.70
P 3150	DB15 Female straight PCB connector	$2.10	$1.90	$1.70
P 3190	DB15 Backshell Cover	$2.20	$2.00	$1.80
P 3200	DB25 Male solder connector	$1.95	$1.75	$1.60
P 3210	DB25 Female solder connector	$1.95	$1.75	$1.60
P 3220	DB25 Male 90° PCB connector	$2.95	$2.65	$2.40
P 3230	DB25 Female 90° PCB connector	$2.95	$2.65	$2.40
P 3240	DB25 Male straight PCB connector	$2.50	$2.25	$2.00
P 3250	DB25 Female straight PCB connector	$2.50	$2.25	$2.00
P 3290	DB25 Backshell Cover	$2.50	$2.25	$2.00
P 3310	Spacer Screws pk 10	$4.95	$4.45	
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Learn about SMD's by building this

'PHONE RINGING' SOUND SIMULATOR

Here's a little project that has been specially designed to provide a 'hands on' introduction to surface-mount devices. All of the parts fit on a PC board large enough to allow careful hand soldering, and obtaining the components isn't a problem because a complete kit of parts is available at low cost. The finished board generates a convincing simulation of a telephone ringing.

by COLIN MITCHELL and DAVID HALSE

Although surface-mount technology (SMT) is rapidly gaining popularity with large manufacturers, it has hardly made an entry in the hobbyist area.

The reasons for this are twofold. Surface mount components are difficult to obtain at the best of times, especially in small quantities. But more importantly, they are so tiny that manual handling is *almost* impossible.

When you see them you will see what I mean — they are so small that the slightest puff of wind will blow them off the workbench. If you have poor eyesight, it may be out of the question; but for the rest of us, it's a challenge worth investigating.

Normally, a circuit using SMD's (surface-mount devices) would be too small and fiddly to build by hand and couldn't be presented to beginners, but we have attempted to make this project as simple as possible by spacing it out and identifying the components so that almost anyone can put it together.

To help you even further we have put together a kit, and when you buy one you will appreciate the features of surface mount and the problems we had in putting the project together.

The first problem we encountered was sourcing the components. We contacted more than 15 suppliers who sell SMD's to get details of price, size and availability. From the information we collected we had to go to five of them to buy the parts! Some had one item, others had a few more and all in all it was a time consuming exercise...

But the difficulty in locating the parts was not the only problem. The variation in costs was also considerable. Some suppliers had low prices but no stock, while those with high prices had plenty of stock — isn't it always the way?

If we were in a position to buy large quantities, bulk prices would have helped, but this is not possible when you are just starting out and need small quantities.

The other factor controlling the price is the value of the component. High-value capacitors and electrolytics are considerably more expensive than low values. To keep costs down, it is important to be able to design a circuit around the cheapest components. That's why we have used 1uF for the largest capacitors.

Now that we have done all the spade-work, we want you to try SMT for yourself and put this project together. When you do, you will learn how to identify, solder and handle these tiny components and see why we say 'Surface mount has not been designed for manual assembly'.

Tiny size

Surface mount is in many ways the transition between the components we know today and those of tomorrow. As far as designers are concerned, SMT is only a temporary, intermediate stage to assist in reducing the size of a product to bring it on the market as soon as possible — while the circuit is further developed and perfected.

The aim of a designer is to put all the circuitry into a single custom-designed chip. But going from conventional componentry to final design is often not possible in one step. Sometimes it requires a few intermediate stages, requiring custom chips plus a few discrete components. To do this, it is convenient to use surface mount.

The products of tomorrow will be designed around a single dedicated chip with only the need for batteries, switch and speaker etc. We can see this already with calculators, watches, LCD games, cameras and many more brilliantly designed products. In most cases these contain a single dedicated chip and nothing more!

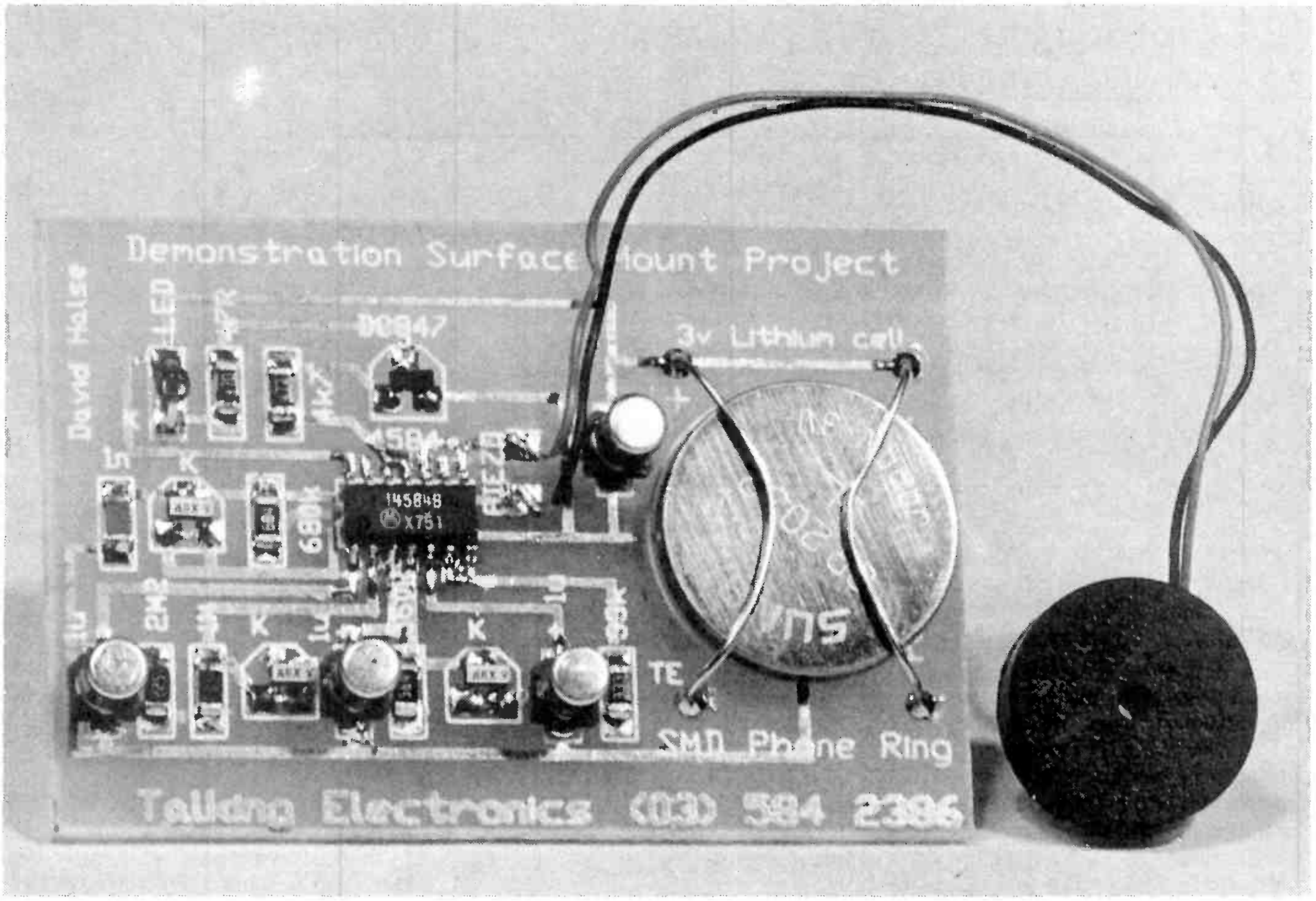
There are still a lot of other devices in the transitional stage and these are currently using SM technology to reduce the size.

As the demand for a particular product increases, the cost of re-designing the circuit (and the chip) becomes economical. Eventually everything is incorporated into a single chip and the evolution is complete. This is the way surface mount is assisting designers to bring out new products.

It's difficult to know how long surface mount will be around, but just like everything else, it will eventually be outmoded by a radical new approach. Until this time comes, there will be a demand for engineers to design and work in this field, and new openings are appearing all the time.

We really shouldn't be presenting a 'hands-on' project for SMT, as it has been specifically designed for robot handling, where 'pick and place' machines take components from carriers, spools, hoppers, tubes, etc., and place them on a PC board at a really amazing speed and with great precision. But if you intend to design projects in this medium, it's absolutely essential to know how big they are, so that you can get some idea of the space it occupies and how the board will turn out.

It's also essential to know how the devices are attached, and the process of



soldering so that you can design the board correctly.

Since SMT boards are normally wave soldered, it is important to place the components at 90° to the action of the wave, so that they do not form a 'shadow' and prevent the solder from touching the pads. This also applies to placing components in the shadow of taller components, and there's 100 other tricks you have to learn.

But if you want to start, here's your opportunity. There's nothing like experiencing it first hand, and if you put a kit together you can at least say you have got off the ground.

About SMT assembly

Since there are no leads on surface-mount components, we do not need any holes in the board (for multilayer boards, holes are required to join one layer to the next — they are not for the components) and the components can be loaded at impressive rates of something like 3600 devices per hour, for a single head pick and place machine.

To prevent them dropping off the board before the soldering process, tiny drops of glue are used and this keeps them firmly in position so that the boards can be turned upside-down for wave soldering. Although SMD's are more expensive than conventional components, the higher cost is offset by the savings in board space, loading time and neatness of the final design.

This is where SMT wins hands down. A surface-mount project looks much smarter and more up-to-date than a conventional design. The size of the board can be reduced by up to 50% and this makes it very attractive for products that need to be compact — such as cameras, video machines, computers, and almost any other item you can think of.

Some new chips are only available in SMD form, and this forces manufacturers to take on the new technology. This is exactly what happened to us. The speech chip for our new solid-state tape recorder project) is only available in surface mount, and this forced us into the new technology. The same is happening in design laboratories all around the world and in fact, SM is seeing a growth rate of 15% per year, with much of the new growth taking place in the high-volume, high-technology area.

The range of components is increasing too, and already we have surface-mount coils, inductors, transformers, and other devices you never thought could be produced in such minute form. There is no limit to the ingenuity of engineers. Eventually standard components will be taken over completely and although this may take a number of years, it will certainly occur. We have already seen the demise of the valve, the one-watt resistor and many other components. It's only when I see them in a museum that I marvel at the leaps we have made in technology.

If you think this won't happen to conventional componentry, you are kidding yourself. These changes are as certain as progress itself. They are driven by economics, and economics runs the world.

Surface mount has arrived and is here to stay. Manufacturers can see the savings in this area and are setting the pace. And the pace is mind blowing. Apart from miniaturisation brought about by surface mount, we have large scale integration and multi-layer PC boards. These have combined to shrink devices from desktop size to palm size — with 10 times the features and 100 times the power!

Manufacturers of VCR's, TV's, automotive instruments, cameras, com-

'Phone ringing' sound simulator

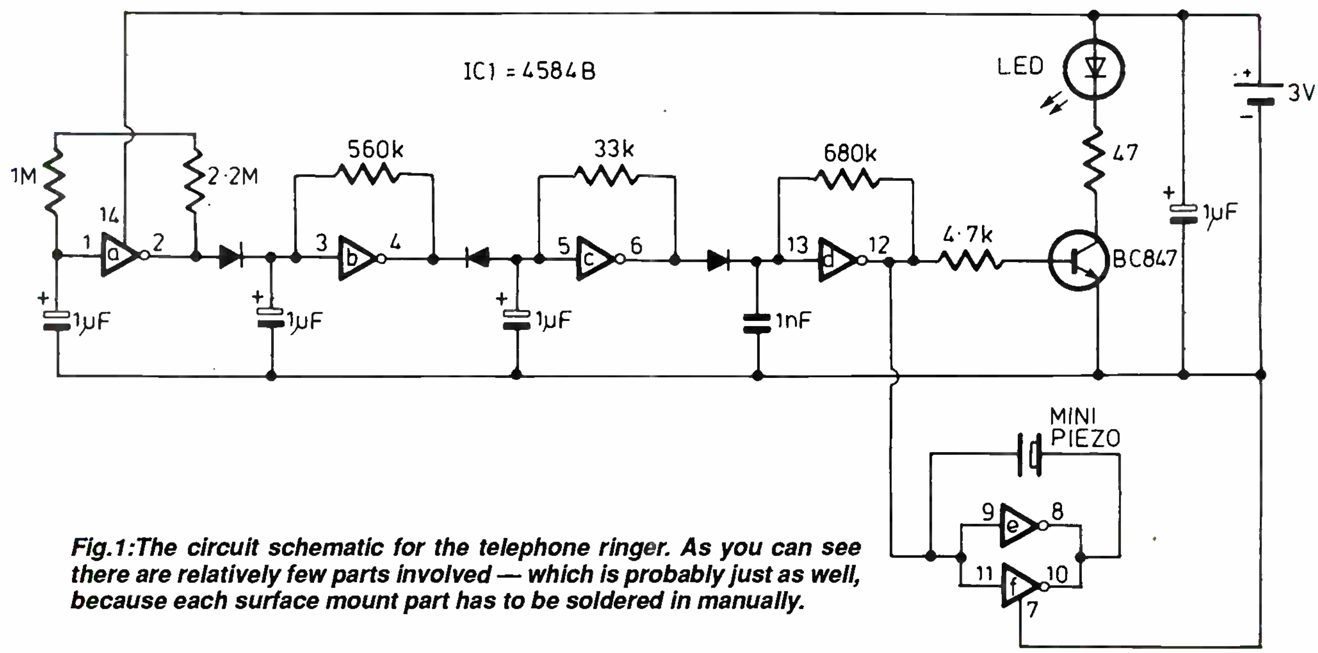


Fig.1: The circuit schematic for the telephone ringer. As you can see there are relatively few parts involved — which is probably just as well, because each surface mount part has to be soldered in manually.

puters and toys have all opted for surface mount as their preferred form of construction.

Why have we included toys? Because toys represent one of the greatest driving forces in the electronics industry. Many of the recent advancements in electronics have taken place through the medium of toys. Talking dolls, whistling keychains, swearing keyrings, etc, have all introduced 'dob electronics'. If you have ever taken a whistling or talking keyring apart, you will find it contains a single chip mounted directly on the PC board, and covered with a dob of potting compound. Some of the earlier designs used discrete chips and a few resistors, but as the designs were tidied up, this was converted to the 'chip under a dob of potting compound'.

The reason why manufacturers use toys as the proving ground is quite simple. It provides a huge market that can be supplied and tested in a very short space of time. This means the designers get rapid feedback and the product can be updated and perfected very quickly.

Speech chips have followed this trend. Early chips cost more than $70 each, while the latest are surface mount and cost less than $10! You can buy 30 seconds worth of digitised speech on a keychain or in a credit card for less than $8! The main problems with early speech chips was understanding the robotised speech. It was difficult to work out what was being said. But the new chips are so clear that you think it's a tape recording.

Handling SMD's

You won't believe anything I say about the size of these components until you see them for yourself. The size is almost unbelievable, and it may take a while to build up enough courage to take them out of their carrier strips.

Normally these devices are not handled by humans and it was never intended for them to be touched at all. The fact that some components have values marked on them is merely a result of pressure from end-users. There is no real need to have any markings on them as they are handled from start to finish by computer-controlled insertion equipment. Even testing and alignment of the built-up board can be carried out by robot testers and so component marking is a bonus for us.

A very small percentage of surface mount devices are soldered by hand in short-run productions and in these cases the operator works under a low magnification lens or with the naked eye. To do this sort of work you need to have very good eyesight, nimble fingers and a calm temperament.

Once the initial shock of the size subsides, you can get down to organising your soldering equipment and see if you are going to be able to physically handle the task. You may need tweezers to pick up the parts and something to hold them in place while soldering.

To do this properly you really need three hands(!), but if this is not available, you will have to use some other means of holding the part while feeding the solder and using the iron.

If you have someone that can help you, now is the time to enlist their assistance.

I'm not going to discuss the need to be an expert at soldering, as the sheer size of the components will keep any absolute beginner away. However I am going to say that you can forget the cheap and rugged 40-watt soldering iron, the instant heat-iron and many of the other so-called electronic soldering irons such as the gas iron, soldering gun and even the 700°F soldering station. They are all far too hot and/or too cumbersome for this type of work.

What you will need is a soldering iron or station with a temperature of 320-350°C and a *very fine* tip. When I say 'fine', I mean a tip that will almost prick you if you touch it. This fineness is absolutely essential for soldering the pins of the IC, as the lead spacing is half that of conventional IC's. Some of the other components can be soldered with a medium tip, but certainly not the IC.

We will not be glueing the components to the board before soldering, as the glue is very expensive and has a life of only a few months. Instead we will be holding each item in place with a probe (such as a paper clip or fine screwdriver) while tacking it in place, prior to soldering.

This is where you can ask for assistance by getting someone to hold the component or add the solder, while you solder it in place.

Some components, such as ceramic capacitors, are not identified in any way — while those that are marked require a magnifying glass to read the numbers. We have placed the components in a carrier strip in the kit and enclosed a note to let you know how they are arranged.

Do not take any of them out of the strips before they are required as you will not be able to identify them if they are mixed up. The old motto 'look but don't touch' certainly applies.

As we said in the introduction, this project is a telephone ring simulator circuit, using a mini piezo buzzer as the output device and a CMOS Schmitt trigger as the oscillator and driver. One of the outputs of the chip also drives a LED via a transistor, and this has been done to add a transistor to the board.

Some constructors will say the CMOS chip is the hardest component to fit, while others will have enormous difficulty with the transistor. In fact, the project would be ideal as a soldering test for advanced students as it will not only test soldering skills but also neatness, placement of parts and identification.

I believe a similar project was passed around a group of 20 workers at a hi-tech plant, with the requirement to desolder all the components from the model and solder them back in place. I understand that all the components withstood 20 solder and desolder operations without a failure.

The fact is, surface mount components are extremely robust if soldered quickly at the correct temperature. They are designed to withstand a 10-second submersion in molten solder — but if you subject them to a higher temperature, you run the risk of premature and permanent damage.

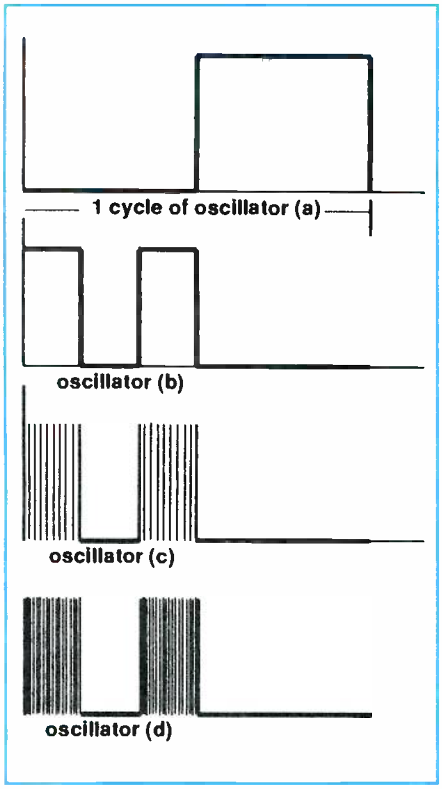


Fig.2: Overall on/off timing for the circuit is provided by oscillator (a), which gates oscillator (b). This in turn, gates oscillators (c) and (d).

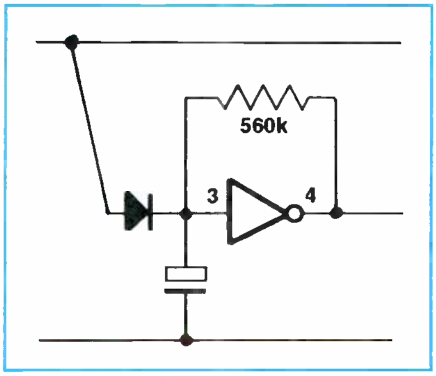


Fig.3: How the circuit uses a gating diode to 'jam' an oscillator by applying a logic high to the capacitor.

How it works

The circuit for the ring simulator consists of six 'building blocks', of which the first is the inverter between pins 1 and 2 of the 4584B CMOS chip (Fig.1). This inverter forms a low frequency oscillator, with a 1uF capacitor and the 1M and 2.2M resistors. These govern the overall timing of the simulator 'rings', by creating an ON and OFF time. When the output at pin 2 is LOW, the tone is emitted from the piezo. When the output is HIGH, the tone is inhibited and this produces the silence between the rings.

This oscillator has an equal mark-space ratio, to give the 'rings' the same length of time as the silences between them.

The second oscillator, using inverter 'b', operates at about twice the frequency of the first (this can be seen by the different value of the resistors, as both capacitors have the same value). The frequency has been adjusted so that it produces two highs during the interval when it is activated — see Fig.2. The second oscillator does not produce two full cycles, but only one and a half, as it is the HIGHs that are required.

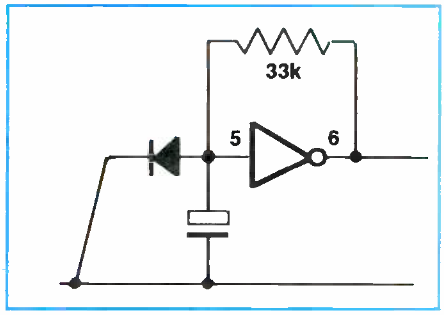


Fig.4: The alternative way of jamming oscillator operation, with a diode shunting the capacitor to logic low.

During each of these HIGHs, the third and fourth oscillators produce a warble that simulates the 33Hz ring of the 'bell'. The third oscillator (around inverter 'c') generates the 33Hz frequency and this gates the fourth oscillator to produce a 1kHz tone for the piezo.

The output of this oscillator drives the base of the buffer transistor and also one side of the piezo. The other side of the piezo is connected to the output of the two remaining buffers in parallel, and this provides good pull-down capability when the left side of the piezo is high.

The only fault in the design of this circuit is the drive to the left-hand side of the piezo. Ideally we should have included driving buffers to give it the maximum swing and thus produce the maximum output. But since we did not have any inverters left over, this is the best we could do.

When the piezo is driven from a pair of buffers on each side, it sees a voltage swing of nearly twice the rail voltage and this gives it the highest output.

The tone from inverter 'd' is also passed to a LED via a transistor, to give a visual indication of the operation of the circuit. A 47Ω resistor has been included in series with the LED to limit the current.

It is essential to include a resistor, as the LED drops a fixed voltage (called the characteristic voltage drop) when it is illuminated and the transistor drops a fixed voltage across the collector-emitter terminals when it is turned on. The voltage drops are 1.7V for the LED and 0.5V for the transistor. This adds up to 2.3V and thus we must include a resistor to drop the remaining 0.7V from the 3V supply rail. By making the resistor 47Ω we allow a maximum of 1.4mA to flow.

Without this resistor, the power rails would be pulled down to 2.3V every time the LED was turned on. This would cause (a) a very high current to flow through the LED, and (b) faulty operation of the circuit as the power rails fluctuate. The 1uF electrolytic across the power rails reduces the impedance of the battery and provides uniform rail impedance during the life of the battery.

A lithium battery has been used, as it produces 3V so that we only need a single cell to provide the minimum voltage for the chip.

The gating diodes

Between each of the oscillators is a diode called a gating diode, and these are to turn the oscillators on and off when required. To show how these work, we will use the second oscillator as an example, as shown in Fig.3.

When the output of the first oscillator (to the left of the diode) is HIGH, it is equivalent to connecting the anode end of the diode to the positive rail. This allows the diode to supply more current to

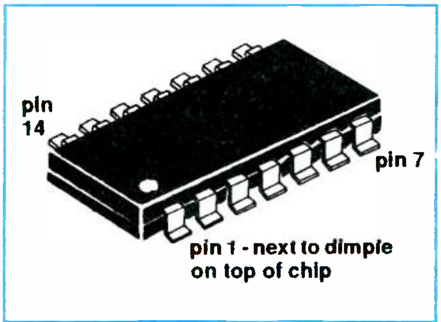


Fig.5: A close up view of the 4584B IC.

the electrolytic than can be bled away by the 560k resistor, and thus the capacitor remains charged. This means the inverter (between pins 3 and 4) will not change state and it is thus 'jammed'. But when the output of the first oscillator goes LOW, the diode is effectively connected to the negative rail and ceases to have any effect on the second oscillator.

By turning the diode around the other way, the oscillator will be blocked or jammed by a LOW from the previous oscillator, as the diode will bleed away any charging current so that the capacitor will not rise higher than about 0.6V. This is shown in Fig.4. This is a very handy way of gating or controlling an oscillator by the use of diodes.

Construction

The object of this project is not to rush things, but take it slowly and produce a neat result.

Start by creating a clear space on the workbench and get all the necessary tools and equipment ready. Make sure all the parts are in the kit by checking it against the parts list, and lay everything out neatly in readiness. Look at the carrier strips so that you know what's inside.

Clean the tip of the soldering iron on a wet sponge and open out the paper clip supplied in the kit to form a probe to hold the parts during soldering.

Take a little time to look at the legend on the board for the position of each part and also refer to the circuit diagram to see where everything goes. Make sure you know where each of the parts is to be placed before starting, as it will be very difficult to remove something once it is soldered in place.

Some of the parts are not identified, so don't remove anything from the carrier strips until they are needed.

There are two methods of construction. You can start at one end of the board and fit each part as you come to it, or take one component at a time from the carrier strips and solder it in place.

It does not matter which method you adopt, however I suggest you fit the IC first. We have not included a socket for the chip as it is more expensive than the chip itself and they are rarely used in any case — so you will have to be extremely careful, not to damage it.

Firstly position the chip on the board so that pin 1 aligns with the first PCB 'land' and make sure all the rest line up too. The dot or dimple on top of the chip indicates pin 1, as shown in Fig.5. Tack the two middle pins first, so that the chip does not move then solder the rest of the pins. Use very fine solder and take no more than one second to solder each pin. You should stop after a few connections, to allow the chip to cool down before continuing — we don't want to damage it.

Now we come to all the micro components. This is where the fun begins. Choose one of the methods suggested above, and remove one of the parts from a carrier strip. Drop it on the board with the identification numbers upwards, and use the paper clip to move it so that it is on top of the appropriate lands and aligned squarely. Keep it in place with the paper clip while you tack one end, and then the other.

The tacking process is done by first adding a little solder to the PCB pads before the component is placed in position. After the component has been positioned, this solder can be reheated to hold the part while the other end is tacked in place. After this, you can go over

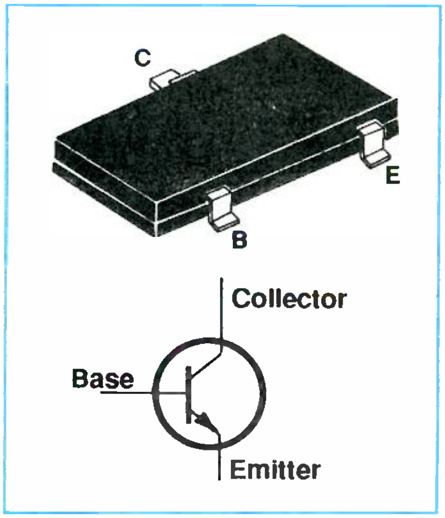


Fig.6: Connections for the BC847.

the joints again, adding a little more solder and making sure the connections are perfect. Don't press too hard with the clip or the iron, and don't move the component with the iron as this will make it stick to the tip and cause it to heat up too much.

When you have soldered one end, again wait a few seconds before soldering the other as this will allow the component to cool and prevent it getting too hot. This is important, as the temperature of the tip of the iron will be about the absolute maximum any of the components can tolerate and the only way to prevent damage is to limit the soldering time to one or two seconds.

The reason for this is the junctions of the semiconductors are very close to the point of soldering and any overheating will cause degeneration in performance

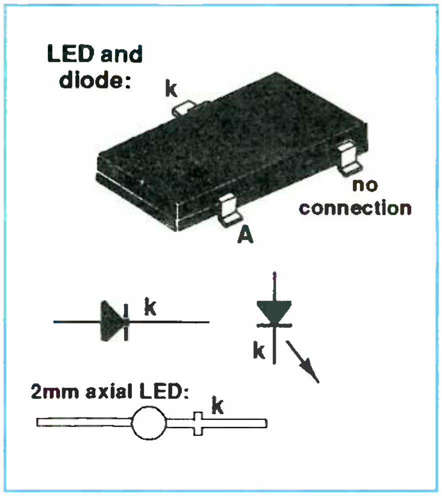


Fig.7: Connections for the diode and LED.

PARTS LIST

Note: All components are surface mount type

Resistors

1	47 ohms	(marked 470)
1	4.7k	(marked 472)
1	33k	(marked 333)
1	560k	(marked 564)
1	680k	(marked 684)
1	1M	(marked 105)
1	2.2M	(marked 225)

Capacitors

1	1nF ceramic	(102)
4	1uF electrolytic	

Semiconductors

3	BAS16 signal diodes (A6)
1	BC847 transistor (1K)
1	Red, orange or green LED
1	4584B hex Schmitt trigger

Miscellaneous

1	Phone Ring PC board
1	Mini piezo speaker
1	3V lithium cell type CR 2032

10cm length tinned copper wire, paper clip for holding parts while soldering

Kits

Kits for the Phone Ring project are available from:
Talking Electronics
35 Rosewarne Avenue,
Cheltenham, Vic 3192
Phone (03) 584 2386
Price for each kit, including parts and PC board, is $12.50 plus $2.50 for packing and postage.

and even premature failure. The LEDs are also very critical as the light-emitting crystal will lose its output at the slightest amount of overheating. The transistor will lose gain if overheated, while the signal diodes are slightly more tolerant; however they become leaky if subjected to too much heat. Even the electrolytics can suffer considerably by overheating, so take care.

While taking care with the temperature and soldering times, you must also remember the orientation of many of the components, as they will not work if placed around the wrong way. The placement of the transistor is fairly obvious, as it has three leads and you can see which way around it goes. The diodes come in the same package as the transistor and you must not confuse the two.

The collector of the transistor is in the centre of one side and the base and emitter terminals on the other side. Refer to Fig.6 to identify the terminals.

The cathode of the diode package is in the centre of one side, and the lead closest to the front in Fig.7 is the anode. The third lead is 'no connection'.

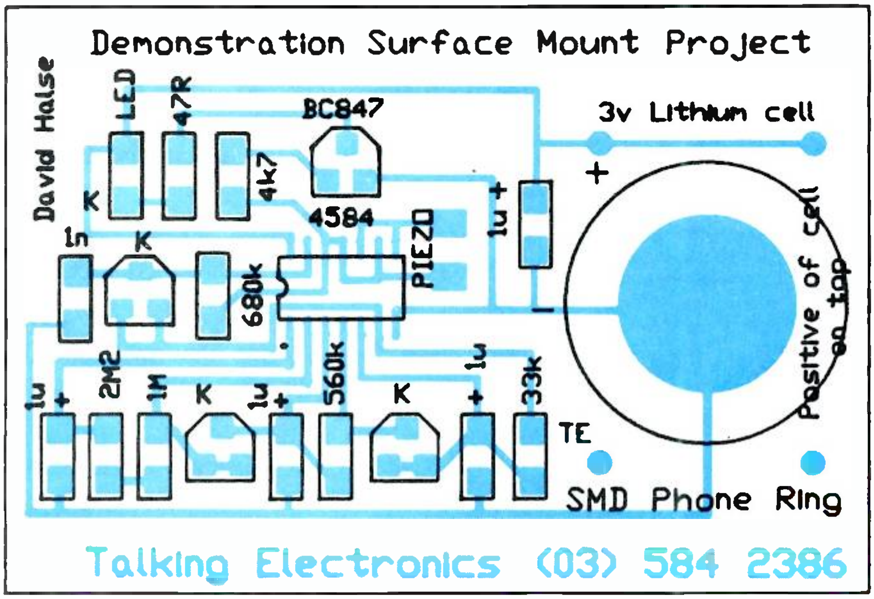
If the LED is a 2mm axial-lead type, the cathode lead is marked with a cross. Or if it is a true surface-mount LED, the pin in the middle of one side is the cathode. This lead must be placed over the letter 'k' on the board.

The piezo is fitted to the two lands marked 'Piezo' and the leads can be soldered either way around as the piezo operates on AC and is not polarised.

The single 3V lithium cell is fitted under two tinned copper wire straps at one end of the board to supply power to the circuit. These straps are made by placing the cell in position and bending the copper wire over it and through the holes. The ends are then soldered in position. The straps connect to the positive of the cell while the negative makes direct contact with the board. The straps should keep the cell tight so that it makes good contact with the board.

When the cell is fitted, the LED will begin to flash and the piezo will produce a sound similar to a phone ringing.

If it doesn't, you may have a fault and if this is the case, you can count yourself lucky — as you will be able to go over the project and diagnose the fault with the assistance of our following 'If it Doesn't work' section. This is where you will start to learn about electronics and the project will have great benefits.



Here is the wiring overlay diagram for the 'ringer' project, printed larger than life to make things easier. Use it in conjunction with the photograph to guide you in fitting everything in the correct position.

If it doesn't work

If the circuit doesn't produce a sound similar to a phone ringing, you will have to work out where the fault is coming from by reading the section on 'How it works'. There are possibly over 50 possible faults even with a circuit as simple as this, as any two components could be swapped, any of them could be faulty due to overheating or the board could have a short between the tracks. To locate the problem, here is the approach:

The first thing to do is measure the internal impedance of the battery. This is done by setting the multimeter to the 500mA range and placing the probes on the battery for 1/2 second. The needle should rise to about 200mA or more, to indicate the cell can supply driving current.

Next, measure the current actually being taken by the circuit, by placing a piece of plastic under the cell so that it doesn't make contact with the board (this plastic can be used as a switch to turn the project off when not required). Measure between the bottom of the cell and the PCB pad (either side of the plastic) with a multimeter set to 50mA — or 500mA to be on the safe side. The current should be about 1 to 2mA, and you can change the range to 5mA to get an accurate reading. If it is considerably more than 2mA, you have either damaged one of the components or created a short.

Make sure there are no solder bridges between tracks or under the chip by inspecting the board carefully. Next cut the negative track going to pin 7 of the chip, so that half the circuit is removed. Re-measure the current to see if the remaining parts contain the fault. Refer to the circuit diagram to identify which components are in this section and if the fault persists, make another cut in the trackwork and 'home-in' on the fault. This will save you removing any of the parts and testing them, as soldering and desoldering will create more problems than it solves. If this doesn't find the fault, you will have to read on.

In this type of project we start at the back-end and work to the front. This is because we have a LED and piezo to act as output devices to let us know what is happening and the extent of the fault.

We start with the LED and its driver transistor. If the LED does not light, the fault could lie in either of these components or the chip. To locate the problem, take a voltage reading at output pin 12 of the chip. The needle of the multimeter should flicker to correspond to the ringing of the circuit and if not, the fault will lie in the chip or one of the four oscillators.

If the needle does flicker, go to the collector of the transistor. Here, you should see the needle sit at slightly above 1V (due to the characteristic voltage drop across the LED plus a very small drop across the resistor) and fall to slightly less than 1V when the circuit produces ring pulses. If the LED does not produce a glow when this occurs, it has either been damaged or is around the wrong way. If the needle does not flicker at the collector, probably the transistor has been damaged. You can also measure the voltage at the base of the transistor. The reading you will get will only be about 100mV, as the needle will not have time to rise to 650mV during the ring. To get an accurate indication of the signal you must measure it with a CRO.

If the sound from the piezo is not similar to that of a phone ringing, the fault will almost certainly lie in one or more of the 4 oscillators.

Start at the first oscillator, between pins 1 and 2. Place the positive probe on pin 2 and set the multimeter to a low voltage. The needle should go high for about 1 second and low for the same duration. When the output is LOW, a tone is emitted from the piezo. If the output does not swing up and down, measure the voltage across the power rails (pins 7 and 14) of the chip.

If voltage is present, and the current consumption is about 2mA, the fault may lie in a damaged Schmitt inverter, a leaky or reversed 1uF capacitor, or an open 2.2M or 1M resistor.

You cannot measure across the 1uF while the circuit is operating as the resistance of your meter will prevent it charging to 2/3 of rail voltage and the oscillator will not change state. The only thing you can do is measure the output voltage. If it is HIGH, the input will be low (assuming the gate is working) and one of the feedback resistors may be open circuit. Set your multimeter to the 10V range (assuming a 20k/V meter) and place the probes firstly across the 2.2M resistor and then across the 1M. If you detect a very slight movement of the needle, the circuit is working and the resistance of the meter is taking the place of the resistor. Replacing the appropriate resistor will fix the fault.

If the circuit produces a ring-ring-ring-ring without a pause, the gating diode between pins 2 and 3 may be faulty or not making contact. If the output of the first oscillator is correct, the output of the second can also be detected on a multimeter by probing pin 4. This pin will give two high's during the ring tone and if a fault exists, you can diagnose it in a similar manner to the first gate.

The output of the third and fourth oscillators are more difficult to detect on a multimeter, as the frequency is too high for the needle to respond. The solution is to remove the piezo from its output terminals and place it between pin 6 and the negative rail. Here you should hear a series of clicks to correspond to the 33Hz oscillator, gated by oscillator (b).

Placing the piezo between pin 12 and the negative rail should produce the ring sound, except that the output will be lower than when connected to the output terminals.

If you find one of the inverters has been damaged, you can use the one between pins 9 and 8. You will have to do a little rewiring, but if the chip is not drawing excessive current due to it being damaged, the change can be made.

Conclusion

This just about covers everything and the project should be working perfectly by now — I hope so.

If you did not have any success despite following the troubleshooting procedure, the best solution is to buy another kit and start again. The main problem will probably have been your soldering. Next time you will learn from your mistakes and the project will work first go.

For those who have tasted the joys of success, wait for our next surface-mount project. It's a speech chip that gives tape-recorder quality and is ideal for a whole range of applications. Hold your breath, it's coming! ❖

SMT assembly and soldering in industry

There are three types of surface-mount assembly. The first is placement of surface mount components to one or both sides of the board. The second has both surface and through-hole components on one or both sides. The third type has through-hole components on the top side and surface mount components on the bottom. The different loading techniques for these boards call for different soldering methods and the most common methods are: Reflow and Wave soldering.

In the Reflow method, solder in paste form is screened onto the pads in a printing operation or individually added by means of a gun. The trackwork has been previously protected with a mask to prevent solder creating shorts and bridges. The components are then added and kept in place with solder paste or tiny dobs of non-conductive glue. The boards are then passed through an infra-red or convection oven that allows the solder to melt.

Another method of reflow is to immerse the board in a saturated vapour of a boiling Fluorinert liquid. The vapour, at the temperature of the boiling liquid, gives up its heat to the components, causing the solder to flow.

In the Wave soldering process, the board is dipped in flux and carried upside-down over a bath of molten solder. A wave of solder is created that rises up to touch the board and complete the soldering process.

These processes sound very simple, but in fact involve a high degree of technical skill. For instance, if a reasonably complex board has 100 faulty joints per million, the yield is zero and thus every board has a faulty connection!

With surface mount, the soldering process not only has to provide a good electrical bond but since the leads do not go though holes, it has to provide good mechanical bond as well.

The design of a surface-mount board becomes much more critical than a through-hole board due to the size of the components, the size of the lands, the placement of the components and the consideration given to heat stress both during and after soldering. This is an entire subject on its own, and technical centres can be contacted for more information for those who want to be involved in this area.

Along with the different soldering processes there are a range of soldering faults, where the components have either dropped off the board or begun to stand up due to a number of problems. The most common fault is called 'tombstoning', where capacitors, resistors and packages stand on end after soldering. This results from improper pad design, unequal solder mass, 'shadowing' of the component, misplacement of components, poor quality solder paste and wrong soldering temperature.

Fortunately, we don't have any of these problems in this project, as everything is soldered by hand. But as explained in the text, this calls for a great deal of care as surface-mount parts are extremely tiny and not really designed for manual soldering.

PROGRAMMABLE LOW COST CODEPAD

Although various 'combination lock' designs have been featured in *EA* over the years, this new codepad has many features which previous designs were unable to provide — thanks to the use of a microcontroller. How does four easily-changed user codes plus audible indication of a keypress sound, for starters? Read on and find out more...

by GREG CURRY and DAVID EVERETT

One of the problems many people have with codepads is that they have to remember a series of numbers. When it is a family situation, great arguments can arise as to what should be the number for the alarm system, etc. Dad wants his birth date, Mary her bank PIN number, and so on.

Well, with this new design the problem is solved. Everyone can have their own number, and it can be changed or deleted at anytime. As previously mentioned there are four user codes; each code consists of four digits, and numbers may be repeated in the code as often as you like — e.g., '1111'. Thus you are not restricted to using a number only once, as in wire programmed devices.

The codepad also has provision for a *master* code, which allows the changing or deleting of codes. When the master code is entered the codepad goes into a 'program mode', indicated by a LED.

In this mode as well as altering access codes, the timing of the momentary relay output may be adjusted from one second up to approximately 17 seconds.

In normal operation you are allowed 15 key presses to enter a valid code. If you fail to do so, the codepad will be locked out for two and a half minutes and the tamper output (T) will go low.

This output could be connected to a circuit in the alarm system to sound the sirens. By pressing any two outside keys on the codepad the tamper output will also go low, giving us a 'panic' feature.

The uses for programmable locks are many, but with our design a mini 'access control system' could be set up with several codepads controlling door strikes. By allocating a code to an employee and to specific codepads, unauthorised entry to certain areas can be controlled.

The microcontroller

For all the features available, the circuit for our codepad is amazingly simple due to the use of Motorola's MC68705P3S microcontroller. We do not intend in this article to go into a detailed explanation of this chip (that may come later if enough interest is shown); instead a rough outline of its features should be adequate for now.

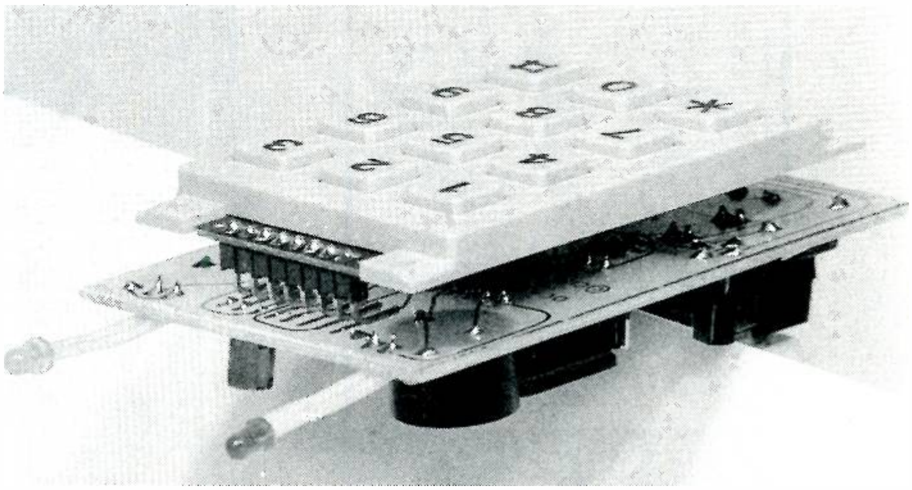
There are quite a few variations, or 'models' if you like, of the 68705 and we have chosen the 28-pin 'P3' version for a number of reasons.

The first and probably most important is cost. At around $15 it is not an expensive chip, particularly if you compare it with say the EEPROM version which is a 40-pin chip and sells for around $40. Chip size was also a consideration in using the P3. The P3 was designed to be a development model for other versions of the Motorola microcontroller range, but has proved to be very popular and is therefore readily available.

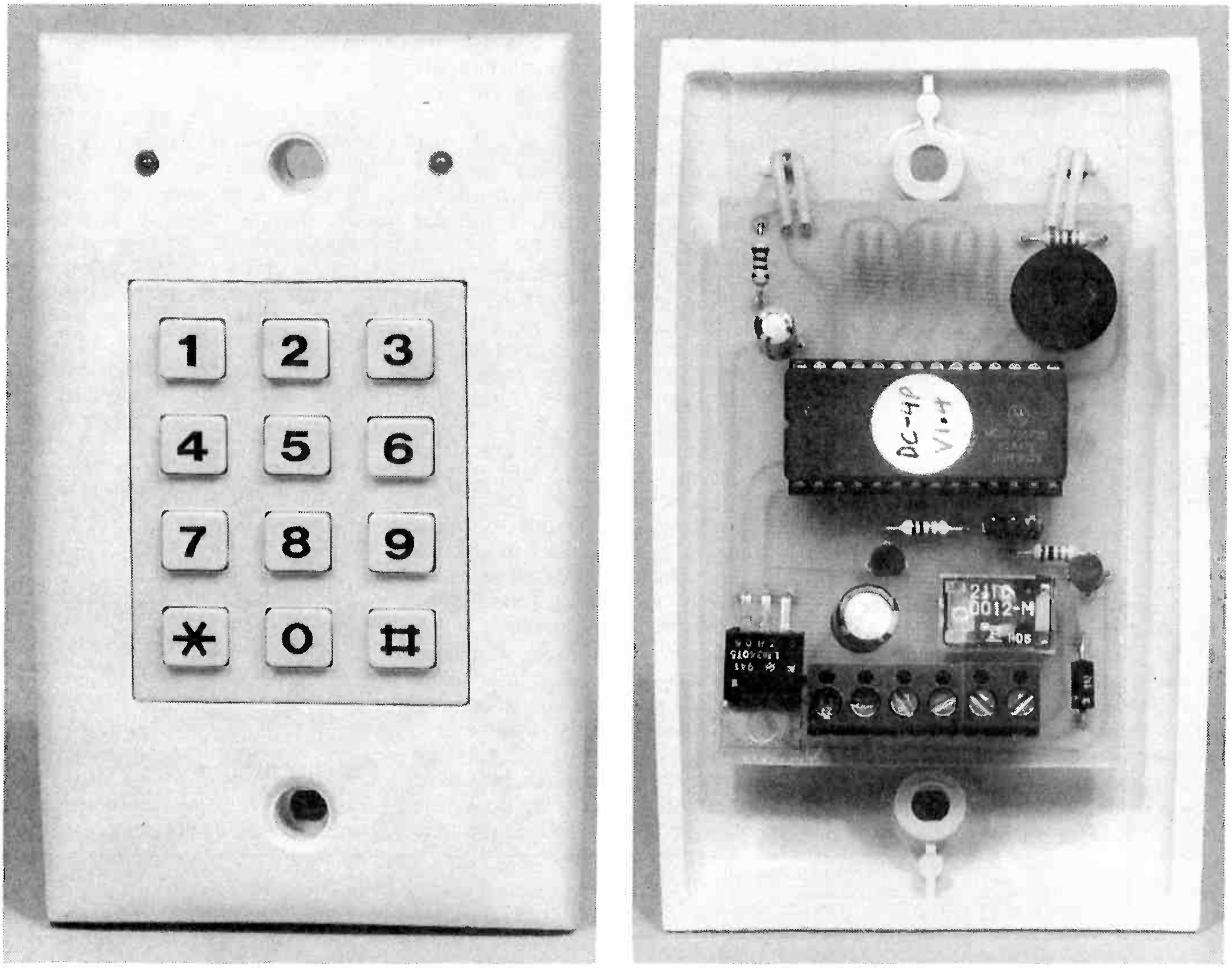
The 68705P3 does not require a crystal, for applications where timing is not important — as is the case with our codepad. This further simplifies the circuit and keeps cost down.

By connecting the XTAL and EXTAL pins together, the micro uses its own internal RC oscillator which is between 25 and 50% accurate.

The micro features 1804 bytes of internal EPROM, which is more than enough for most applications. It also has 112 bytes of static RAM and 20 I/O lines divided into three ports — one of which has the capacity to provide up to 10mA of



This shot of the naked codepad assembly shows how the keypad is mounted over the copper side of the PC board, with the connections made via an eight way 90° PCB pin assembly or 'launcher'.



Front and rear views of the codepad unit mounted in its wall mounting plate. Thanks to the use of a dedicated microcontroller chip, there are very few components required.

output current on each line. This allows us to directly drive LED's and transistors without the need for external current sources.

The chip has an 8-bit timer and can respond to external interrupt sources via the INT pin. Neither of these features are employed in this project.

One drawback to this micro is that it is NMOS technology and thus draws a little more current than we would like — approximately 100mA. We believe though that this shortcoming is far outweighed by the features and elegance of the overall design.

Circuit description

As can be seen in the schematic, most of the work is done by the micro-controller. Port A is set up to scan the codepad for key presses. While a logic low is placed sequentially on the codepad rows, port lines PA0-PA2 look for the low. If a low is detected the key pressed can be ascertained by crossing the two lines active at that time; e.g., if the PA4 output is low and this is detected by PA2, the key pressed must be the '6', and so on. Any key press can be detected by this method, while minimising the number of port lines required to do so.

When a keypress is detected the micro briefly outputs a low on pin 16 to produce a tone from the sonalert, thus giving audible indication that the keypress has been acknowledged.

Once the key has been released the software jumps to a routine which checks the keypress against the codes stored in RAM. If a match is found after checking all the digits that have been entered against the valid codes stored in RAM, the software then jumps to another routine to take appropriate action. Generally when a valid access code is detected, the micro enables the 'armed' LED and also the relay.

Actually two outputs from the micro are provided to activate the relay. One output toggles with successive valid code entries, while the other operates the relay on a momentary basis — the time of operation being controlled by the number programmed by the user. The selection of either of these modes is selected by a jumper J1.

The diode across the relay absorbs the power generated by the coil in the relay when it is switched off (nothing amazing here).

Capacitor C1 is provided to help prevent power supply surges from resetting the micro and therefore deleting your codes. The 1uF capacitor C2 is provided to ensure the micro starts up correctly, when power is first applied.

Codepad

Construction

A full kit of parts for this project is available by mail order from Circuit Level. Details are given in the parts list.

Construction of the project takes only an hour or so, and being so simple there is very little to go wrong. Start by inspecting the PCB for any shorted or broken tracks which may have occurred during manufacture, paying particular attention to ones running between the pads of the microcontroller. Next fit the one and only link, situated between the pad rows of the micro.

The 28-pin IC socket can be installed next. Do so with a fine-tipped iron, to prevent solder bridges occurring between pins and try not to apply heat for too long as the pads may come away from the board. The four resistors, two electrolytic capacitors and diode can now be soldered in, taking care as usual to orientate the polarised components correctly.

The jumper for selecting between latched and momentary operation is installed between R1 and R2. The position of the connecting header is not important at this stage. The sonalert mounts next to R4 and should again be checked for correct orientation.

Transistors Q1 and Q2 are both BC328 types should be installed as per the diagram as close as is practical to the PCB. The 7805 regulator should lie neatly adjacent to the terminal strip. No heatsinking is required.

Next fit the terminal strip and relay, pressing both down against the PCB before soldering. The excess length on the terminal strip pins should be trimmed after soldering.

An 8-way 90° PCB pin assembly or 'launcher' is used to connect the keypad to the main board, and also to support the PCB when the keypad is glued into the mounting plate. The longer ends of the launcher pins (with the 90° bend) are soldered to the PCB pads, but before this is done you should cut about 3mm from their free ends (after the bends) to allow them to be moved back and forth to find the correct launcher position — before soldering. This is necessary in order to make sure that the completed assembly will fit into the mounting plate without fouling the mounting screw pillars.

The easiest way to check alignment, after trimming the pins, is to 'tack' solder only the two outside pins of the launcher to the PCB and then sit the keypad on top, with the 'tops' of the pins passing through the eight centre keypad holes. Now mate the keypad loosely with the front plate and check the position of the PC board in relation to the plate fixing hole pillars. The PCB should sit so that its top and bottom edge do not interfere with these pillars. It may be necessary to unsolder the two outside pins, and move the launcher forward or backward along the PCB pads until this is achieved.

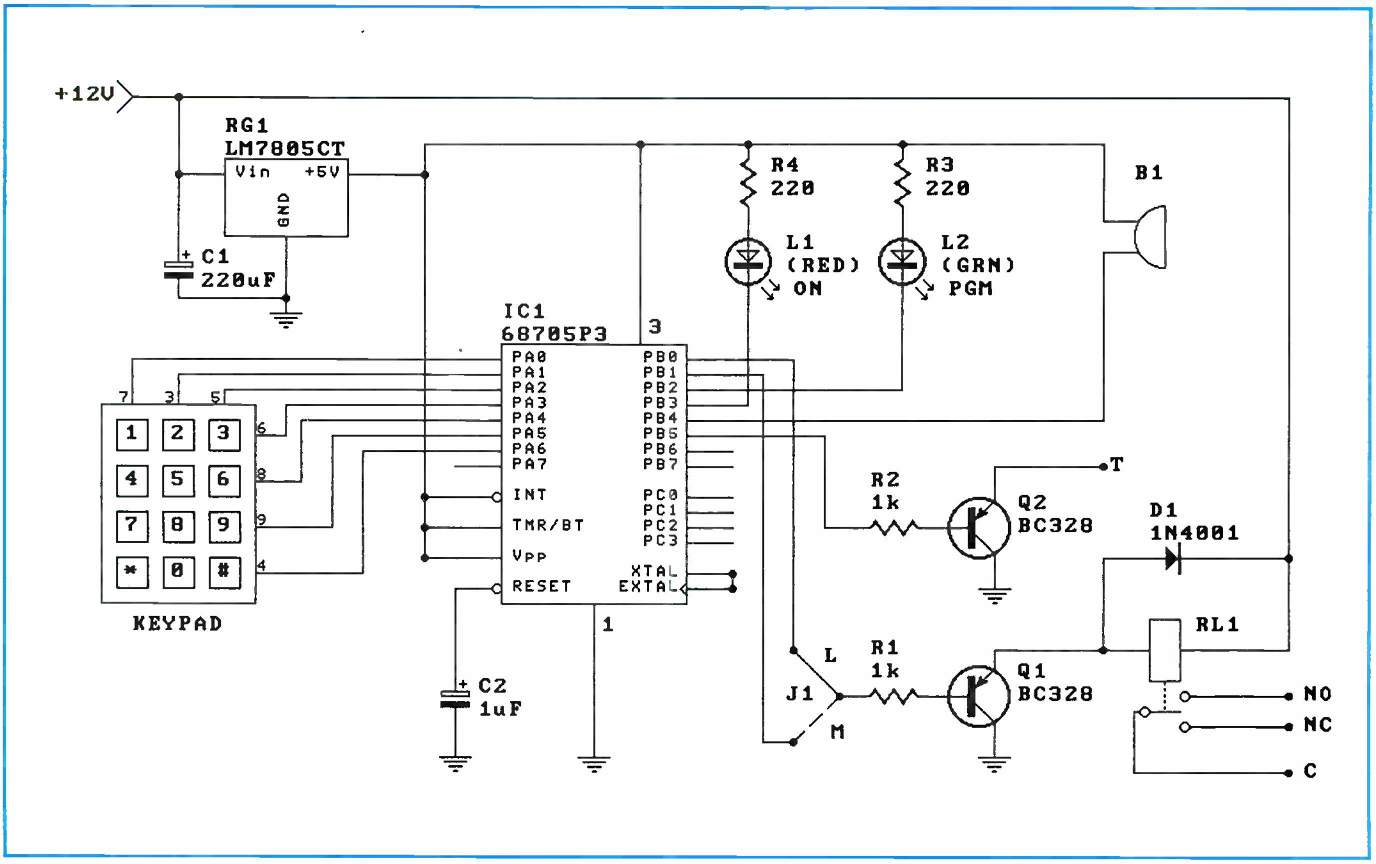
When you are happy with the alignment, solder all pins of the launcher permanently into place. Now solder the keypad to the launcher and cut any excess pin length off, as the protruding pins will interfere with the seating of the keypad in the front plate.

The only remaining components to be soldered are the two indicator LEDs. For the moment just solder them without trimming any excess length. The anode (a) pin is normally slightly longer, but even when you've cut them shorter the cathode (k) is easy to identify as the larger lead inside the LED when you look at it held up to a bright light.

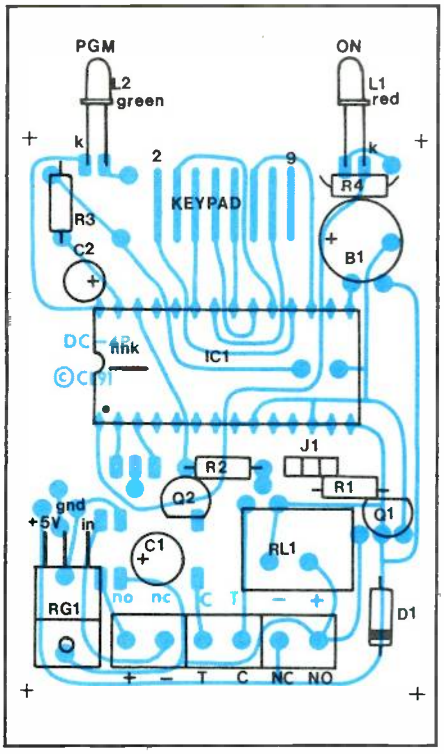
Before fitting the microcontroller chip to its socket, apply power to the board (9-15V DC) and check that there is 5-volts on pins 2, 3, 6 and 7 of the 68705 socket. If this checks out okay the chip can be installed and the codepad's operation tested.

Programming

Apply power to the unit. The green program LED should light and the codepad's



As you can see from the schematic, there's very little in the circuit apart from the 68705P3 microcontroller chip.



Here's the PCB wiring overlay, to guide you in wiring everything up.

sonalert should beep four times. You are now in program mode.

By pressing any of the following keys a different function can be programmed:

'0' - Programming access code
'1' - Access code 1
'2' - Access code 2
'3' - Access code 3
'4' - Access code 4
'5' - Momentary relay output timing
'#' - Exit program mode

When you enter the programming access mode by pressing '0', the codepad will beep once when you press the key, followed by two more beeps. The micro is now waiting for the input of a four-digit number which will be stored as the program access code.

So enter a number. After the fourth key is pressed two beeps will follow, to indicate the code is complete. If you wish, you can change this again by following the same procedure.

Whilst in program mode (green LED still on), pressing any of the keys 1-4 will indicate to the micro that you wish to enter an access code. The sequence of events is exactly the same as for the program access code.

Momentary Relay Output Timing: Pressing the '5' key will flash out, via the red LED, the default setting for this option. You should get five flashes. The higher the number the longer the delay before the relay resets. The numbers only roughly equate to seconds, but there is plenty of flexibilty for most applications such as electric door strikes.

Immediately after the micro has indicated the current setting you may enter a new setting, which will be flashed out followed by two beeps. The micro has now left this option; if you wish to change the setting again then you must press the '5' key again.

Exit Program Mode: When you have set up the program to your needs, pressing the '#' key will exit this mode. Again there will be two beeps. To gain access to the program mode again, you must enter the 4-digit code which was entered at option '0', or else power the codepad down again — in which case all stored data will be lost.

It should be noted that it is not necessary to program in a 'program access code' if it is unlikely that codes will need changing — but it sort of defeats the purpose of the unit if you don't use this feature.

Deleting Codes: If at any stage you wish to delete a code, then enter program mode and press the number of the code you wish to delete (1-4). After the two beeps, press the '*' key four times and the code is erased, without powering down.

Normal operation

After playing around with the programming functions it should be fairly obvious whether your codepad is operating correctly, but there are still a few more tests.

With the codepad in normal mode (not in program mode), try entering one of the codes you programmed in options 1-4. Upon completion of a valid code the unit should beep twice, then the red LED should come on and the relay activate. Depending on which position you have the jumper J1 in, the relay will either latch or close and then release, after a time governed by your setting in option '5'. Re-entering the code should extinguish the LED and activate the relay again, if you have J1 set to the latching/toggling position.

Now with a logic probe or multimeter connected to the tamper (T) output, try pressing any key in the 1/4/7/* column in conjunction with any key in the 3/6/9/# column; a negative voltage should appear at this terminal. This is the 'panic' feature, and could be used to trigger an alarm or whatever you like. To reset this output it is necessary to enter the code — once if the red LED is on, twice if the LED is off.

To test the keypad tamper feature, press a sequence of 15 keys without entering a valid code. After the 15th keypress, the beeper will start pulsing and the keypad will be locked out for a little over two minutes.

PARTS LIST

Resistors

All 5% 1/2W:
R1,2 1k
R3,4 220 ohms

Capacitors

C1 220uF electrolytic
C2 1uF electrolytic

Semiconductors

D1 1N4001 diode
L1 3mm red LED
L2 3mm green LED
Q1,2 BC328 PNP transistor
IC1 MC68705P3 microcontroller*
RG1 7805 5V regulator

Miscellaneous

B1 Sonalert
J1 3-pin jumper with header
RL1 12V SPDT miniature relay
Codepad PCB, code DC-4P;
12-key keypad assembl;
6-way terminal block;
28-pin IC socket; 8-pin 90° PCB launcher;
flush mounting faceplate
*With Codepad firmware in internal ROM

KIT AVAILABLE:

A kit of parts for this project, including all components, PCB and a pre-cut mounting plate, is available from:
Circuit Level,
112 Walpole Street,
Merrylands NSW 2160.
Phone (02) 637 2900.
Price of the kit is $64.95, plus $3.00 packing and postage if applicable. Fully built and tested units are also available for $89.95.

That completes the testing and operation of the codepad. If everything worked correctly, and there's every likelihood that it will, then the completed unit can be fitted to the front mounting plate. The keypad is a tight fit in the plate cutout, but should be permanently attached with a glue such as 'Araldite' or Selleys 'Multi Bond'. The LEDs will need to be bent to mate neatly with the holes in the plate, and secured with glue as well.

You may wish to put a piece of double-sided adhesive foam tape or fit a spacer to the unsupported end of the keypad for extra strength, but we have found this to be unnecessary.

In any serious application the power source for the codepad should include a backup battery to ensure no loss of codes in the event of a power failure. Circuit Level has a kit for a simple supply which is small in size and has provision for charging a lead-acid battery. This includes a plugpack transformer and is available for $27.95.

So there you have it — a codepad which is the equal of any commercially available unit. The elegance and simplicity truly display the beauty of 'computers on a chip' — it now only requires you to come up with suitable applications. ❖

Construction Project:

THE MULTIDIM

Our new Multidim is the ultimate light dimmer. It can control up to 2kW of incandescent lighting, either manually or with automatic fade up and fade down. It can also adjust the lighting in response to the ambient light level: when the sun goes down, up come your living room lights — automatically.

by JEFF MONEGAL

Several automatic light dimmer designs have been presented over the years in *EA*, but none with all the features of this unit.

Interestingly, a commercial unit of comparable features to the Multidim is also rather hard to find, the closest costing over $1800. This unit didn't have the 'dusk dimming' feature of the Multidim, and could only handle 1.5kW.

Automatic light dimmers have many uses, from fading the nursery lights so baby drops off to sleep, to giving cinema-style lighting effects. For a single bedroom light, the Multidim is probably overkill, as very few bedrooms have 2kW of lighting.

However this type of load is not uncommon in other domestic situations, such as large lounge or rumpus rooms. It doesn't take many 75W or 100W fittings to give over a kilowatt, requiring two or more 500W dimmers to handle the load. So while the Multidim can happily control a 40W light, it's nice to know it can also extend up to 2kW.

Another use is to control a radiant-bar type room heater. Most two-bar 'radiators' have no more than three settings, and this project could be used to give an infinite range of heat levels.

You could even use it as a timer for a heater by using the automatic fade-down mode. Great for heating a room initially at maximum output, with automatic fade down to a preset level!

The main feature of this project is its ability to automatically fade the lights, either up or down. The minimum or maximum levels can be set and the rate of change is fully adjustable.

Depending on the value of a timing capacitor, it can be set to take half an hour or more. Naturally the unit can be used manually, although the smoothness of the automatic mode is hard to beat.

An important feature of any automatic dimmer is the way the lights dim when their brightness is very low. Some designs cause the light output to 'jump' as the lights are faded, which becomes very apparent when the lights are nearly out. This unit gives a smooth change over the full range, regardless of the load.

The 'dusk' mode was included as it fitted in nicely without too many extra components. An LDR (light dependent resistor) is used as the sensor, and this sensor could be fitted externally. This way, you can come home at night to a welcoming light, or perhaps fool would-be intruders while you're on holidays.

By the way, this setting works great at parties. At several parties where the unit was being trialled, many guests didn't notice that the sun had set. And the party hadn't even started!

As the photos show, the front panel has three controls: the mode switch, the level control and the speed control.

When the selector switch is set to the OFF position all lamps are extinguished. Note that this setting doesn't isolate the mains power from the unit; it simply holds the triac off.

In the MAN (or manual) position, control of the lamps is achieved using the level control, in the same way as a conventional dimmer. The lights can be turned off with this setting as well.

When the AUTO mode is selected, the speed control is used to adjust the fade rate. For example, let's say you want the lights to dim down to a preset level from full brightness. This is best achieved by first setting the level to full brightness, perhaps with the selector switch at manual. When AUTO is selected, the lights will remain at full brightness until the level control is set to a new position.

The lights will then commence fading at a rate determined by the speed control. Then when the lights are dimmed, you can easily fade up by resetting the level control. The light output therefore 'tracks' the level control, at a rate determined by the speed control. This system is surprisingly simple to use and takes very little getting used to.

In the DUSK position the lamps will be extinguished if the LDR is exposed to normal daylight. As the sun goes down the resistance of the LDR increases due to the reduced ambient light, adjusting the lighting level to compensate. Naturally the LDR needs to be positioned so the light output of the lights being controlled is not sensed by the LDR.

The ON mode is fairly obvious, in that the lights are turned fully on when this position is selected. This setting simply turns the triac fully on, rather than bypassing the controller.

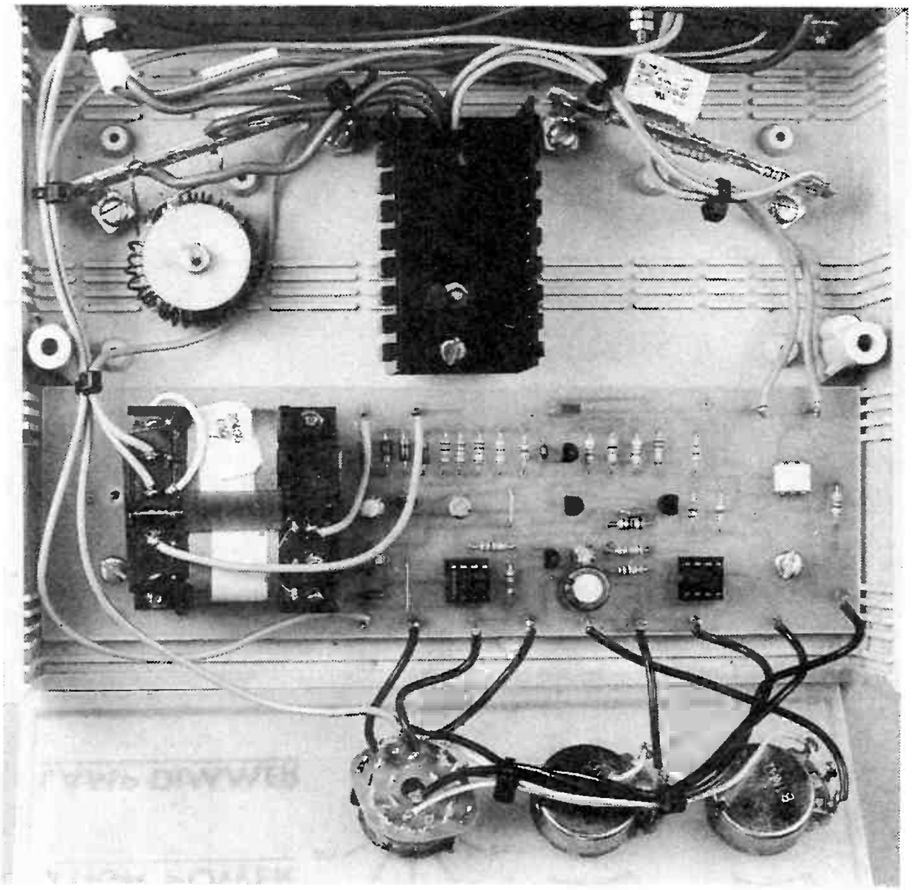
And, as stated earlier the unit will control up to 2000 watts of lighting, although as for any dimmer, it should not be used with fluorescent lamp fittings.

Another important feature is safety, and all the electronics for the controller are powered by a transformer rather than directly from the mains.

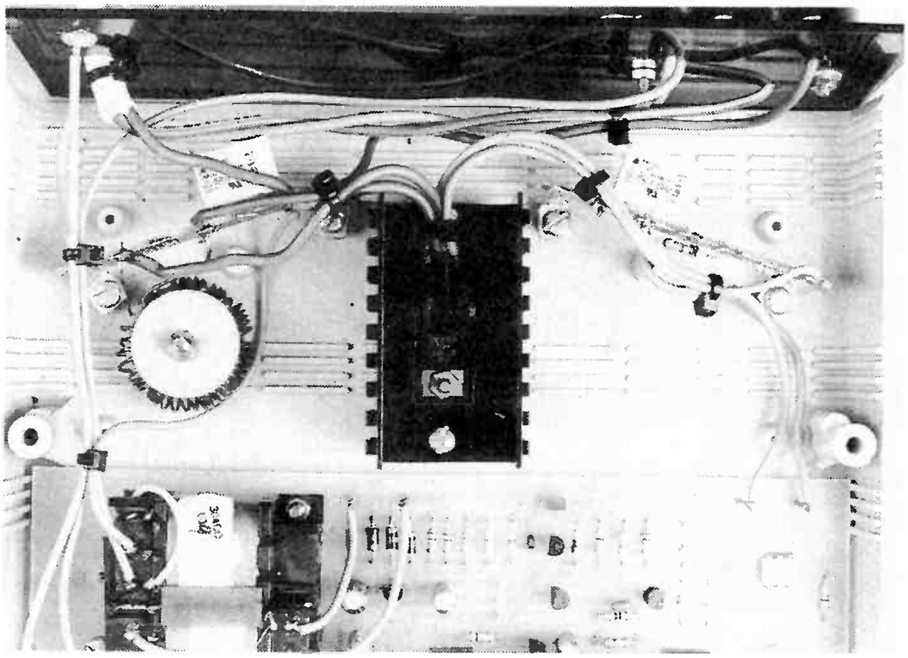
The triac and the RF filter components are at mains potential, but none of these components are on the printed circuit board, making the PCB relatively safe to work on.

How it works

Considering the number of things the project will do, it is surprisingly simple. Transformer T1 steps the 240V mains down to about 11V, which is then rectified by the bridge rectifier formed by diodes D1 to D4. This voltage is filtered by C1, then regulated by IC1, an 8V

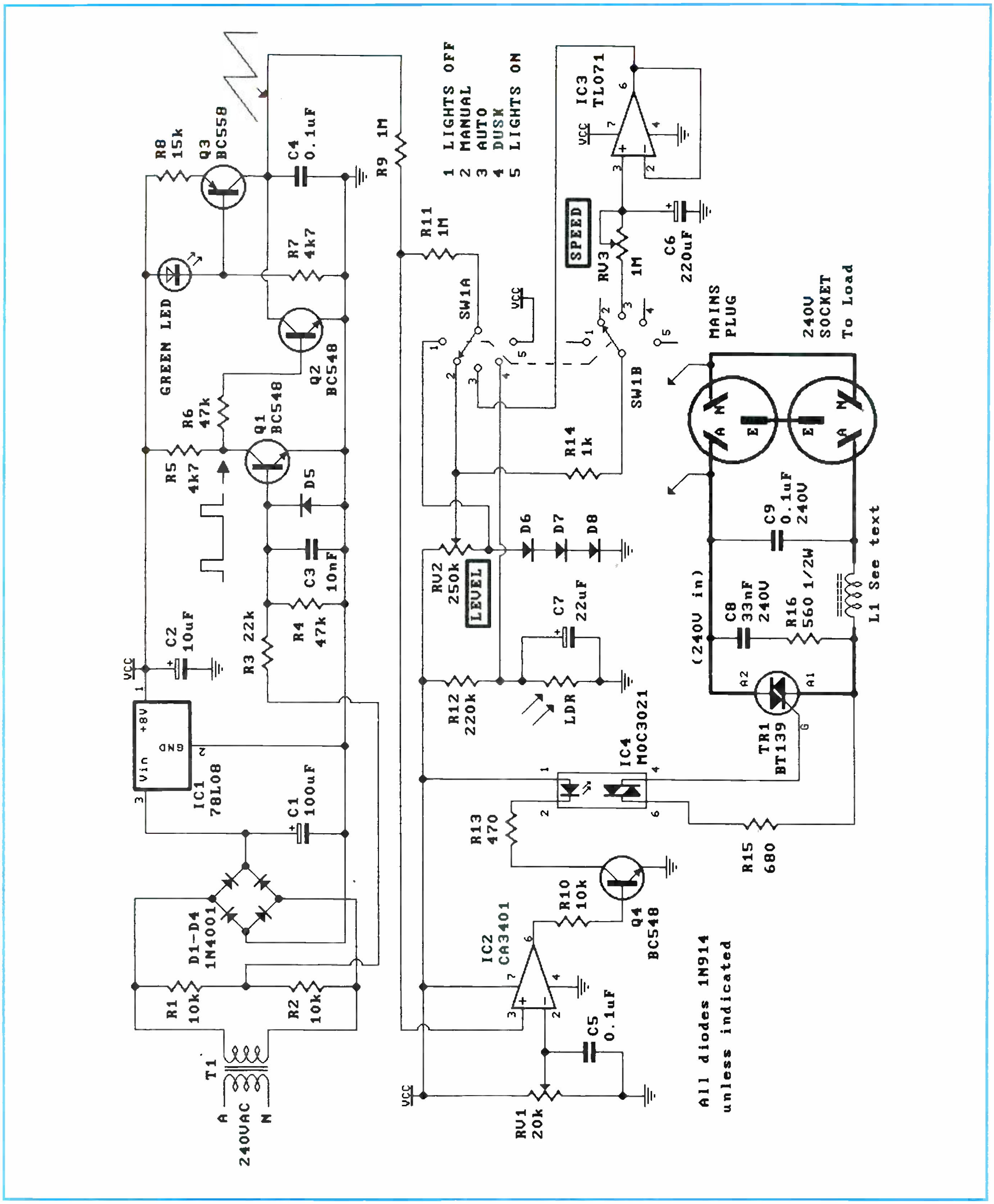


A closer view of the wiring to the front panel controls. The grey lead to the switch is a shielded lead from the LDR. The PCB is held in place with two self-tapping screws, and the transformer is held on the PCB by two nuts and bolts.



The mains wiring is shown here. The toroid is held in place with an insulated washer and a metal thread screw through the centre of the toroid and the bottom of the case. The LDR is silicon glued into a hole drilled in the rear of the case.

The Multidim



The circuit diagram. Synchronising pulses are derived from the mains by Q1, which locks the ramp developed across C4 to the mains frequency. The ramp and a control voltage selected by SW1a control the output of IC2, which then drives the triac via the opto-coupler.

three-terminal regulator which gives an 8V supply rail for the rest of the electronics.

In order to achieve a smooth control, the zero-crossing points of the AC mains waveform are used to synchronise a ramp generator to the mains frequency. This ramp is then combined with a control voltage to generate trigger pulses for the triac.

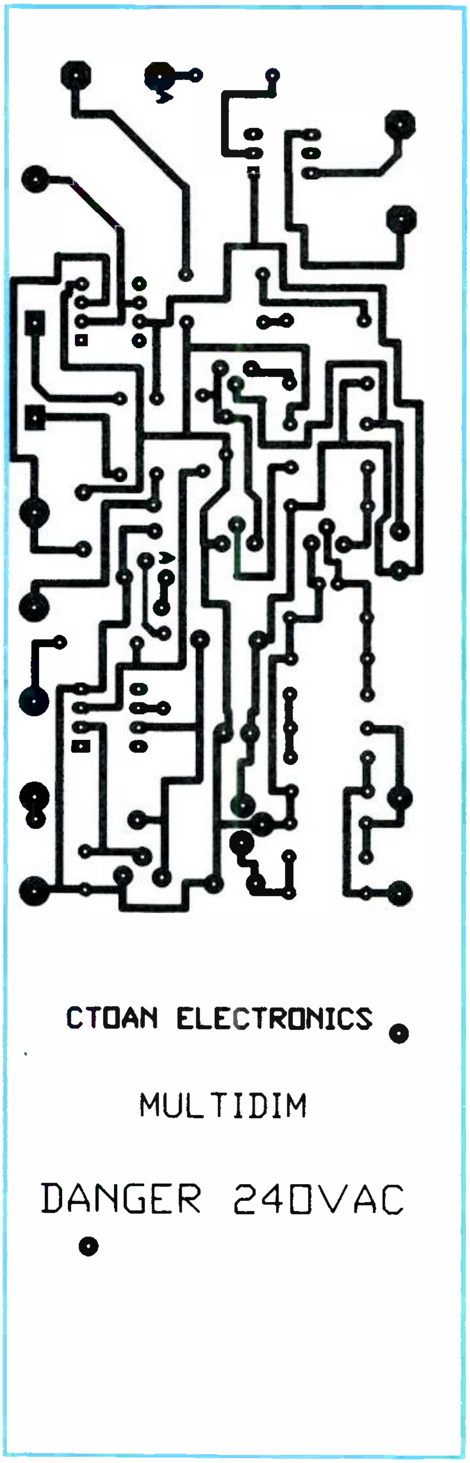
Resistors R1 and R2 tap off a portion of the AC supply and this voltage is then fed to Q1 via R3. The waveform applied to R3 is the same as the output of a full wave rectifier, due to the effect of D1-D4 in conjunction with R1 and R2. When this voltage is less than +2V or so, Q1 is turned off and R5 pulls the collector voltage high. Otherwise Q1 is on, giving a series of 1ms wide pulses, spaced by 9ms (the frequency is 100Hz) at the collector of Q1. When Q1 is off, Q2 is turned on and capacitor C4 is quickly discharged. This is the starting point of the ramp voltage used to control the rest of the circuit.

When Q1 turns on, Q2 turns off and C4 now charges linearly, via the constant current source made of Q3 and its associated components. The constant current source uses a LED to hold the base voltage of Q3 relatively constant at around 6V. This keeps the emitter voltage constant at about 5.3V and the current through Q3 is therefore constant. The emitter current of Q3 is used to charge the capacitor, giving a linear change in the voltage across C4 as it charges, rather than the usual exponential change. The peak to peak value of this waveform is around 6V.

The ramp voltage is connected to pin 3 of IC2 via R9, together with a second voltage selected by SW1a, via R11. The voltage present at the non-inverting input (pin 3) of IC2 is therefore the resultant of both the instantaneous value of the ramp voltage and the value of the voltage supplied via R11 from SW1a. For example, if the ramp voltage at a particular instance is 3V and the voltage via R11 is also 3V, their combination will give 3V at the input. When the ramp is zero, the input to IC2 will be 1.5V, as both R9 and R11 have the same value.

A reference voltage is applied to the inverting input of IC2 via the preset potentiometer RV1. This voltage sets the operating point of the comparator of IC2 and is the adjustment for ensuring that the lights turn fully off.

If the voltage at pin 3 exceeds the reference voltage at pin 2, the output of IC2 will be high. This will turn on transistor Q4, allowing the LED in the opto-coupler of IC4 to light. As a result, the triac turns on as gate current can flow via R15 and the light sensitive diac in IC4. Similarly, if the voltage at pin 3 of IC2 is less than the preset voltage at pin 2, the output of IC2 will be low. Thus Q4, the opto-coupler and the triac are off.



The PCB pattern is reproduced for individual constructors only. The pattern is copyright to CTOAN Electronics.

In summary, the triac is turned on at a particular point on the ramp voltage, depending on the value of the control voltage from SW1a. Because the ramp is synchronised with the mains, the triac is effectively phase controlled by the circuit. The triac turns off after each half cycle when the load current falls to zero.

Now to the various control voltages selected by SW1a. When this switch is in the 'off' position, the voltage developed across the series-connected diodes D6, 7 and 8 is applied to R11. This voltage is around 2V and was chosen by experiment. If 0V is applied, the op amp output swings high — quite the opposite of what it should do. Strange, but probably due to limitations of the op amp, caused by the single rail power supply.

When 'manual' is selected, the control voltage is determined by the setting of RV2. This voltage can be varied over the range of 8V to 2V and is used to control the brilliance of the lamps by manual operation of RV2.

When SW1 is set to 'auto' mode (position 3), the output of RV2 is connected via SW1b to RV3. Timing capacitor C6 will then charge at a rate determined by the setting of both RV2 and RV3, although RV3 will have the greatest effect.

The voltage across C6 is buffered by IC3 and the output of IC3 is then connected to R11 via SW1a. If RV2 is set to give a maximum output voltage of 8V, and if C6 is initially discharged, then C6 will charge towards 8V at a rate determined by the setting of RV3. This rising voltage is applied to R11 and the output of IC2 will switch high at progressively shorter intervals after the start of the ramp. Thus the lights will gradually brighten. If C6 is initially charged, then adjusting RV2 to give a lower brightness will cause C6 to slowly discharge, making the lights become progressively dimmer. The value of C6 can be changed to give maximum delays to suit your needs.

When the 'dusk' position is selected, the control voltage is determined by the resistance value of the LDR — due to the potential divider formed by R12 and the LDR. As the ambient light increases, the LDR resistance drops, giving a lower value of control voltage. The lights being controlled therefore reduce in brilliance, turning off when the ambient light is high enough. In position 5, the supply voltage of 8V is applied to R11, which effectively turns the triac on for virtually the full cycle. Toroid L1 and filter capacitor C9 help suppress any RFI generated by the triac and C8 and R16 are a snubber network to minimise false switching of the triac due to mainsspikes.

Construction

As usual, start by inspecting the PCB for any manufacturing faults. There are three links required, two on the component side of the board and one on the track side. This link connects between the points identified as 'A' and should be run with insulated wire. Load and solder the low profile components first, such as the resistors and diodes.

Be careful with the orientation of the diodes and the three electrolyticcapacitors. IC sockets were used in the prototype for IC2 and IC3, but these are optional. Next fit the transistors, the voltage regulator, the LED and the preset pot. The transformer attaches to the PCB with two mounting screws in diagonally opposite corners.

However, don't connect the transformer secondary to the PCB until the unit has been tested.

When the board is assembled, the wiring for the front panel controls can be completed. The various wires should be kept as short as possible and run with insulated, multistranded hook-up wire. Follow the layout diagram for details. All connections to the controls come from the front of the PCB. The LDR was connected with shielded cable in the prototype and mounted on the rear of the case. However, as suggested already, you might want to fit the LDR separately from the case.

The rest of the components are mounted on tag strips. Again follow the layout diagram and the photos to see the arrangement used in the prototype. The layout is not critical and can be varied to suit the case. The inductor (L1) is wound on an iron powder toroid using a 1.5m length (or so) of 0.8 to 1mm diameter winding wire.

Wind about 40 turns on the toroid core, keeping the turns evenly spaced and tightly wound. The triac is mounted on a heatsink, and because the metal tab of the triac is at mains potential, we recommend using a mica or mylar insulating washer.

This will prevent the heatsink also being at mains potential and make the unit somewhat safer to work on. It's a good idea to check with an ohmmeter that the triac is successfully insulated from the heatsink. All connections to the triac should be insulated with sleeving to prevent possible short circuits between the triac terminals or to the heatsink.

The final task is to complete the mains wiring. If you intend using the unit with a 2kW load, use 10A rated three-core flex for the mains lead. The load is connected to a 240V socket that can be either fitted to the rear of the case or connected as an extension socket.

It's important to use mains-rated cable for all 240V connections. These cables could carry up to 10A or so, at 240V. Double check all connections in the plug and socket and all soldered joints.

Testing

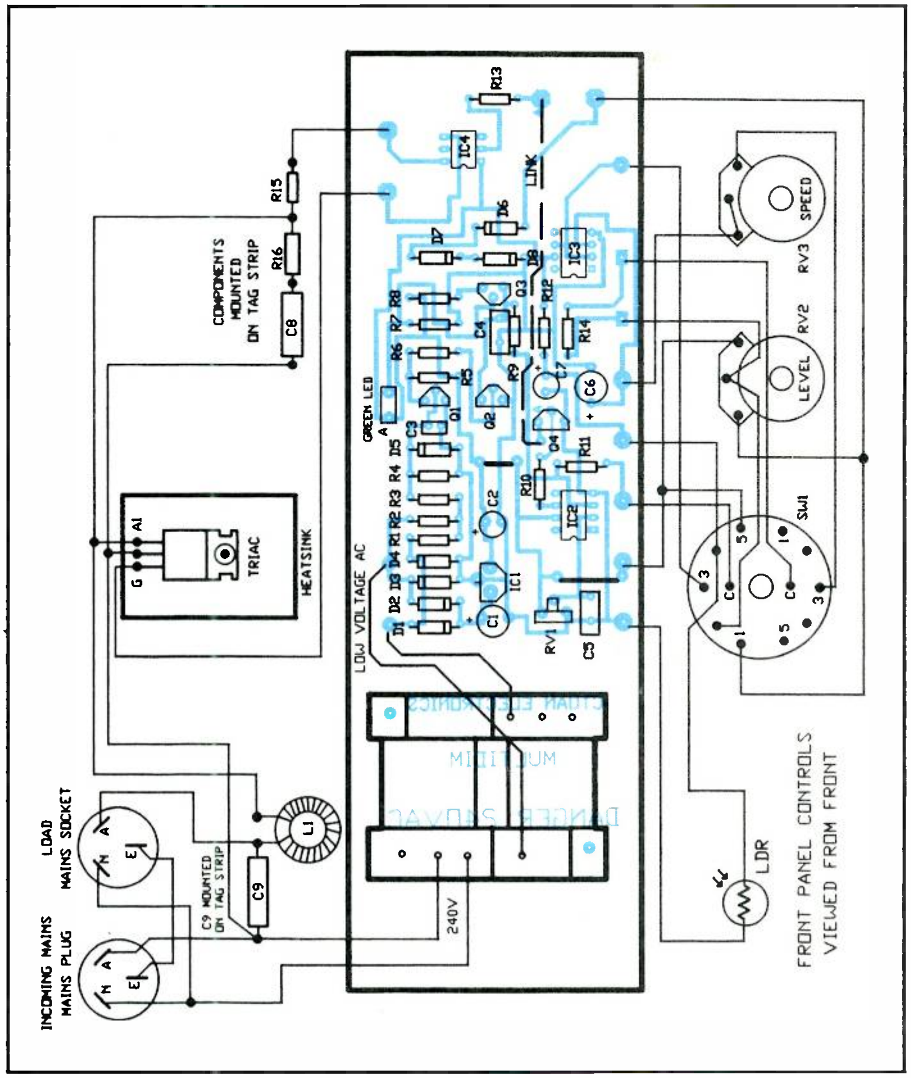
It's important not to apply mains voltage until the unit has been tested as described! At this stage the transformer secondary should not be connected to the PCB, as an external 1A rated AC supply of around 12V to 15V will be used in its place.

Connect the PCB to the external AC supply and also connect the 240V plug to the same supply. Switch on the low voltage AC supply and check that the DC voltage from the regulator is 8V.

The LED in the constant current source should light, indicating that this part of the circuit is operating.

If all is well, connect a 12V, 5W (or so) lamp to the load socket. This can be done with clip leads by connecting to a suitable point on a tag strip and the neutral wire. When the low voltage AC supply is applied, you should be able to confirm that the unit performs all its functions. Check that the lamp brightness can be adjusted over the full range when the unit is set to the manual mode. Also confirm that the automatic dimming function operates properly and that the light is fully on when the 'on' position is selected.

When the 'off' position is selected, the



Most of the components are mounted on the PCB, with those connected to the mains soldered to two tag strips. Note the link on the track side of the PCB, connecting between the points marked 'A' on the PCB.

PARTS LIST

Resistors

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

R1,2,10	10k
R3	22k
R4,6	47k
R5,7	4.7k
R8	15k
R9,11	1M
R12	220k
R13	470 ohm
R14	1k
R15	680 ohm
R16	560 ohm, 1/2W

Potentiometers

RV1	20k 5mm vertical trimpot
RV2	250k linear, panel mount
RV3	1M log, panel mount

Capacitors

C1	100uF, 16V electrolytic
C2	10uF, 16V electrolytic
C3	10nF disk ceramic
C4,5	0.1uF monolithic
C6	220uF 16V electrolytic
C7	22uF 16V electrolytic
C8	33nF, 240V AC polyester
C9	0.1uF, 240V AC polyester

Semiconductors

D1-4	1N4001 1A diode
D5-8	1N914 signal diode
Q1,2,4	BC548 NPN transistor
Q3	BC558 PNP transistor
TR1	BT139-600 16A triac
IC1	78L08 8V regulator
IC2	CA3401 CMOS op amp
IC3	TL071 op amp
IC4	MOC3021 opto-coupler
LED	Green LED
LDR	ORP12 LDR (or equivalent)

Miscellaneous

PCB 57mm x 190mm coded MULTIDIM; 2-pole, 5-position wafer switch; 15mm OD, 8mm ID toroid (iron powder core); low profile 240:11V transformer; knobs to suit controls; plastic case to suit; 2 x tag strips; heatsink for triac, TO-220 insulator, 10A rated mains lead; 240V plug; 240V socket; mains rated hook-up wire; low voltage hook-up wire; 1.5m length of 0.8-1mm enamel coated winding wire.

A kit of parts for this project is available from CTOAN Electronics. The kit is available in two versions: a short form kit that contains all PCB components, low profile transformer, PCB, triac and front panel controls, cost $39.95 plus $4.00 P&P. Certified postage $7.00 (within Australia only).

The other version is a complete kit which contains everything, including a case and printed front panel. Cost is $78.95 plus $6.00 P&P. Certified P&P is $10.00 (within Australia only).

CTOAN Electronics also offers a full backup and repair service for the kit. Cost for repair is $30, which includes return postage. Only kits built as described in this article can be accepted for repair. To order, write or phone:
CTOAN Electronics
PO Box 33,
Condell Park, NSW 2200
Phone (02) 708 3763

lamp should be completely off. If not, adjust RV1. As well, if you've fitted the LDR, test the 'dusk' mode by confirming that the lamp is fully on when the LDR is covered. Similarly, when the LDR is exposed to daylight, the lamp should be off.

A useful test to perform at this stage is the time delay available in the automatic mode. If the delay is too long, change C6 to a lower value. If too short, increase the value of C6. In short, fully test the unit before connecting it to the mains. If the unit is working properly, it remains to complete the wiring by connecting the transformer to the PCB.

As well, the assembly needs to be mounted in a suitable case. We used a plastic instrument case, although the choice is yours. However, use a plastic case of some sort for safety. Make sure that the mains lead is properly anchored. It's also a good idea to bind the various wires with plastic straps to form them into a loom.

Once the unit is complete, it can be connected to the mains. Apart from the transformer primary, there is nothing in the circuit between the active and neutral when a load is not connected.

In other words, the unit is unlikely to blow a fuse unless the transformer suddenly develops a major fault. If the triac or other mains components become short-circuited, the lights connected to the load socket will turn on at full brilliance.

Run the unit through the tests already described, this time using a 240V lamp and with the unit connected to the mains. It should perform as before, although check again that the lights are completely off when the 'off' position is selected.

If not, adjust RV1. Hopefully everything has worked, but if all else fails, CTOAN Electronics will fix it for you provided the mains wiring and the circuit board has been constructed as described. ❖

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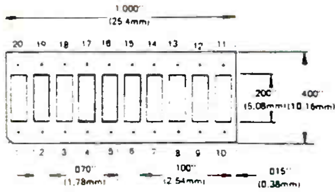

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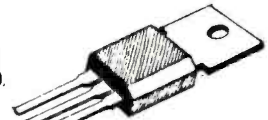
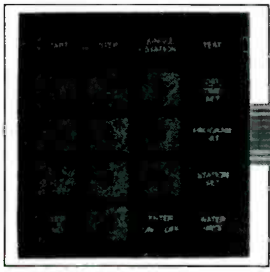




Membrain Touch Keypad

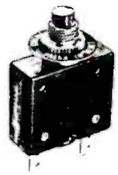
Worth well over $10 each. Has 20 separate keys, 1 to 0 and 10 others. Supplied with peel off adhesive back. Size 91(W) x 96(H)mm.
Cat SK-0755
$2

High Voltage Electrolytic

100uF 450V RT. Small quantity and very rare in this high voltage.
Cat RE-5888
$3.95 ea

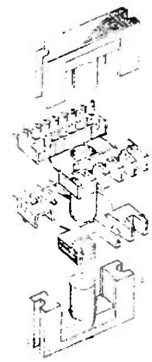
Circuit Breaker

125V 20 Amp.
Well below normal price.
Cat SF-2280
1-9 $1.50
10+ $1



Round 240 Volt Clipsal Socket

Well below normal price. A 240V socket which is self switching when a plug is inserted. White in colour.
Cat PS-4014
A bargain at $2 ea



Siemens E Cone Sets

Siemens E Cones use high quality N27 siferrit material, featuring an extremely high flux density and a frequency range of 0-0.1MHz. Ideal for compact power transformers, DC-DC converters, Chokes, Transducers, Interference suppressors. Coil former is glass fibre reinforced thermoplastic flame retardant polyester. Bobbin and cone pair supplied.
Cat LF-1270
BARGAIN AT **$3.95**

IDC Lead Bargain

This lead has a 16 way IDC DIL plug on each end, with ribbon cable connecting them. Length is 180mm. The plugs can easily be re-used. Cat PI-6552
$1 ea

Relay

12 Volt 5 Amp SPST. PC mount Cat SY-4057 **Only $2.95**

.47 Farad 5.5V Supercap

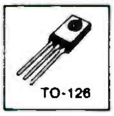
Cat RU-6702 **$5.50**

Pushbutton Thumbwheel Type Interlocking Counter Switch

These normally sell for $13-$15 each. Save a fortune..
Cat SP-0785
Only $3.95 ea

2N5192 Transistor Bargain

NPN, VCB 80V, IC 4A, HFE 20-80, 40W. Flat pack TO-126 device. Normally about $1 each.
Cat ZT-2100
Pkt 50 for $10



PC Mount Pushbutton Switch

High quality push on SPST. Grey/black.
Cat SP-0725 **$1 ea**

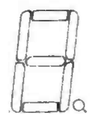
28 Way Pin Header

Cat HM-3211
$1.80

LED Display Bargain

7 segment red LED display, same as those in our catalogue - No ZD-1803. Common cathode. Connection details available on request. Normally $3.50 ea.
Cat ZD-1803

1-9 $1.75 ea 1/2 price **25-99 $1.00 ea**
10-25 $1.20 ea **100+ .70¢ ea**



UNIQUE DIGITAL TECHNOLOGY SCRAMBLER PHONE

. . . IS YOUR PHONE BUGGED? WHO CARES, IF YOU HAVE TWO OF THESE!

WERE $299

Cat YT-7000
NOW ONLY $39.95 ea

Jaycar has made a scoop purchase of Telecom approved telephones that scramble your message so that it can be deciphered only on a similar unit. The phone (faun in colour) is housed in a standard Telecom set. There are no dial out facilities. You use by simply connecting in parallel to another telephone. Dial out on the standard phone and once the line is connected, pick up the scrambler. (The party on the other line must have a scrambler phone as well.)

You can talk with relative security (we can't guarantee that ASIO or the CIA would not be able to decode the conversation).

These units once sold for $299. Another famous Jaycar scoop buy - far far below manufacturers cost - enables you to own a sophisticated scrambler phone at an unheard of price. You can own a scrambler phone for the ridiculously low price of $39.95 each! Remember, you will need at least two though. The stock is brand new, in cartons and has a 3 month warranty. Unit requires 9V DC to operate.

PLUGPACK MP-3007 $15.95

JUNE SPECIALS PRICES CURRENT TO JUNE 30TH

Professional Horn and Driver ROSS / Motorola 1155/6

This speaker incorporales a CD horn (constant directivity) which is made by the American Sound Company - ROSS. This horn is extremely well known and sells throughout the world in speakers that sell for over $1,700 pair. The driver is a Motorola Powerline Piezo which simply screws into the horn. The speaker offers smooth wide angle coverage with optimum driver loading.

Frequency response	1.8kHz-20kHz
Power handling	400W rms
Warranty	3 years

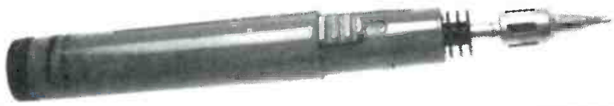
Cat CT-1920 **$89.95**

MOTOROLA 400 WATT CMPRESSION DRIVER REPLACEMENT - KSN 1142

A direct burnout proof driver for all standard 1" 18 UNEF thread horns. As used in the above horn driver combinatin. Stop paying for all those expensive diaphragm replacements. THis one is guaranteed to last 3 years.
Power handling 400 watts rms.
Cat CT-1922 **$45**

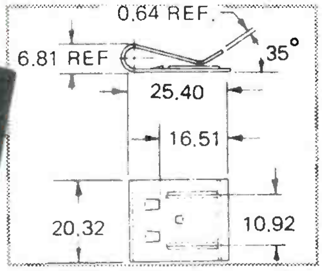
Portasol Portable Gas Soldering Iron

New generation soldering iron. Why bother with rechargeable batteries or chargers any more. THe Portasol needs no cords or gas batteries. All you need is a can of Ronson type Butane cigarette lighter gas. A full tank will last about an hour, and it refills in seconds.
Cat TS-1420 **$39.95**



TO-220 Clip On Heatsink

We're overstocked, so don't miss this bargain.
Cat HH-8503
Normally $1.20 each
This month 10 for $5.95



Bargain Bags Back Again!!

We haven't had these available for some months now, as we've been accumulating the 'JUNK' to go in them. Each bag contains approximately 3kg of assorted electronic goodies. This run also includes its own bag of semiconductors.

Unfortunately, due to massive weight, P & P is normal rates plus $5

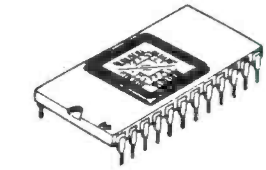
Cat XB-9000 **$14.95**

TURN YOUR SURPLUS STOCK INTO CASH!

Jaycar will purchase your surplus stocks of components and equipment. We are continually on the lookout for sources ofprime quality merchandise.
Call Mark Harris or Bruce Routley now
(02) 743 5222

USED EPROMS!

These turned up in a recent surplus stock buy. save a fortune over new prices. Most are not erased. We will guarantee these to be able to be programmed, and any returned faulty will be replaced, but only up to 2 weeks after purchase - keep your sales docket.



27256 Cat ZZ-8500	**$2.95** (new price $9.95)	**2708** Cat ZZ-8503	**$1.00**
27512 Cat ZZ-8501	**$4.50** (new price $14.95)	**62C64 RAM** Cat ZZ-8504	**$1.50** (new price $15)
2716 Cat ZZ-8502	**$2.95** (new price $9.95)		

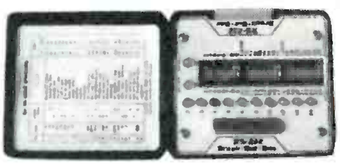
PUSHBUTTON SWITCH BARGAIN

Our suppliers sent us the incorrect switch recently, so we need to clear them out and it's your gain. Stock up now. It's a push on momentary, black body, red actuator, 125V 1A rating.
Cat SP-0705
Normal price about $1.75
Bargain price .50¢ ea
10+ .45¢ / 100+ .30¢

Jaycar will not be undersold on goods of the same quality

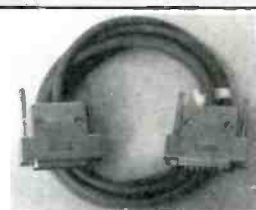
RS232 Break out box

A simple way of checking and monitoring 25 pin D series (RS232) inputs, outputs and connecting cables. Connects in line between computer and peripheral and has 12 signal powered LEDs to indicate which lines are in use, as well as 24 switches and jumper leads to allow you to break out circuits or reconfigure and patch out of all 24 active lines. Other suppliers sell these for up to $99.95. You won't pay anything like that from Jaycar.
Cat XC-5085
Only $69.95



HIGH QUALITY IBM COMPUTER LEADS

We've made a scoop purchase of IBM brand computer leads. These are high quality leads. The D25M to D25M has chrome plated backshells and thumbscrews and high quality Hitachi soft, flexible cable. The D25 to Centronics has a chrome plated backshell for the D25 and an Amphenol Centronics plug, again with high quality Hitachi flexible, soft cable.



D25M to D25M

9 Pins connected (that's all you require). Length 2.8 mt
Cat PL-0875 **$23.95**

D25M to Centronics

24 Pins connected. Length 1.4 mt
Cat PL-0879 **$23.95**

4Ah D Size NiCad

Brand new addition to our range of batteries. Compare our price with other suppliers
Cat SB-2462
$12.95 ea

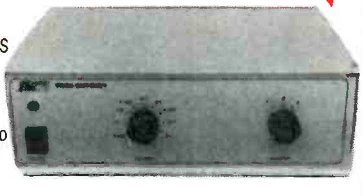
SCOPE PROGRAMMABLE HOUSE ALARM BOARD

See catalogue for full details. (No box supplied)
Sells for $199.50 with box.
• 6 sectors plus 6 x 24 hour sectors • No programming required for normal operation.
Includes PC board with keypad attached.
Cat LA-5182
Catalogue price $129.50
May special $79.50
Save $50

REMOTE KEYPAD TO SUIT

Intelligent remote keypad to arm/disarm and program the system. 7 segment readout, use of use up to 3 per alarm.
Cat LA-5183
Special price
$49.95 each

VIDEO SWITCHER KIT FOR CAMCORDERS & VCRS



Ref SC May 92
Do you need to copy old Beta video tapes to VHS or simply edit Video 8 to your VCR? Perhaps you simply wish to dub between two or three VCRs? This project eliminates the current patch-cord swapping ritual and provides stereo audio switching as well. The kit provides a monitor and RF output and features CMOS switching with RCA sockets for quick hook up to your VCRs. Jaycar kit comes complete with case, front panel label, video modulator and all specified components. Plugpack power supply not included.
Cat KC-5116 **$129.95**

Passive Infrared Detector Bargain

Our economy best selling PIR that works extremely well and is ultra reliable. It's so reliable that we have increased the warranty period to 1 year. This unit sold for $100 in 1988. Thousands have been sold and are still working reliably all over Australia. Features and specifications: • Dual element pyroelectric sensor • 24 Dual element detection zones in three layers • Wide angle 90° multi layer coverage • 12 Meter range • Operation voltage 7.5-16V DC • Tamper protected • LED indication • Size 65(H) x 84(W) x 46(D) • Colour beige • Relay output.
Cat LA-5017 **1992 catalogue price $49.95**
ONLY $39.95 STOCK UP NOW

NEW PENRITH STORE
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FACSIMILE **(047) 21 8935**
OPEN 7 DAYS A WEEK
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60 WATT SOLDERING IRON

If your 20 or 25 watt iron doesn't have enough heat for those LARGE soldering jobs, this is the iron for you. It's 240V operated and is Electricity Authority approved. It comes supplied with two tips, one bent to 45° and one straight, both with chisel 3mm points.
Cat TS-1470 **$29.95**

NEW BOOKS NEW BOOKS NEW BOOKS NEW BOOKS

CIRCUIT BOOKS

Four fabulous new books published by Micro Tech for Elektor Electronics. Each book has 300 circuits aimed at the electronic enthusiast, professional or amateur. They offer a comprehensive collection of practical ideas, concepts and developments, many of which have been in annual Elektor magazines. You will find circuits for audio and video, car, cycle and motorcycle, home and garden, receivers and aerials, hobbies and games, measuring and testing, oscillators and generators, current sources and power supplies, microcomputer and music electronics and more.

300 Circuits Cat BM-2470 **$19.95**
301 Circuits Cat BM-2471 **$19.95**
302 Circuits Cat BM-2472 **$19.95**
303 Circuits Cat BM-2473 **$19.95**

To give you an example of these circuits - the 303 circuit book includes 32 audio and Hi Fi projects, 14 circuits for cars and bicycles, 43 computer and microprocessor circuits, 11 electronics projects, 24 HF and VHF circuits, 16 circuits for a number of hobbies and pastimes, 54 projects for home and garden, 29 power supply circuits, 29 circuits for test and measurement equipment, 9 TV and video project, as well as 42 design ideas

BRAND NEW 1992 EDITIONS

UP TO DATE WORLD'S TRANSISTORS, DIODES, THYRISTORS & ICS, COMPARISON TABLES. TWO VOLUMES.

Vol 1 - A-Z

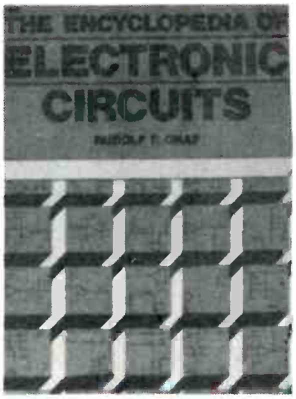
Comparison tables of transistors, diodes, thyristors and IC's. Nearly 28,00 types with brief data, pin assignment. Over 80,000 comparison and equivalents. Excellent reference book, 967 pages, 110 x 150 x 43 (thick)mm. Cat BM-4580 **$19.95**

Vol 2 - IN-60,000-μ

Comparison tables and brief data and pin assignments of another 28,000 types of transistors, diode and ICs of daily use. Over 80,000 comparisons and equivalents given. 950 pages, 110 x 150 x 42 (thick) mm. Cat BM-4582 **$19.95**

Teach Yourself DOS 3.3 & 4.0

By Al Stevens.
Teach yourself to set up fixed and floppy disk systems with easy-to-understand instructions contained in this book. Arm yourself with real time saving techniques including file maintenance and file protection. Improve your computer's efficiency and effectiveness. Learn how to back up and archive files for safe storage. Master easy ways to handle tricky file directories. Improve your disk formatting and copying techniques. Maximised learning - overview of DOS for the new DOS user - DOS commands - Paths, filters, pipes and input/output redirection batch files - EDLIN. 267 pages, 153 x 224mm.
Cat BM-2475
$19.95

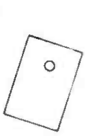


The Encyclopedia of Electronic Circuits

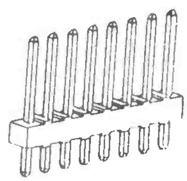
By Rudolf F Graf. This book has a circuit schematic for just about everything you could think of to build, nearly 1,300 in all. They are listed alphabetically and divided into 98 basic circuit categories. For example the sections starting with the letter A are: Alarms, Amateur radio, Amplifiers, A to D converters, Attenuators, Audio mixers, Audio oscillators, Audio power amps, Audio signal amps, Automotive. This is the hobbyists and technicians dream treasury of both analog and digital circuits. From amateur radio and crossover networks to fibreoptics, test circuits, motor control, video circuits, times, etc, with special emphasis on state-of-the-art IC circuit technology. Also included is a huge index to specific circuits. A massive 760 pages, size 175 x 230mm.
WAS SELLING FOR $69.95
Cat BM-2476
$34.95

TP220 RUBBER WASHERS

Silicone impregnated and don't require silicon grease. Pkt 100.
Cat HP-1155
Normally $8.95
June Special
$5.95
Save $3



LOWER PRICES ON LAUNCHERS



Description	Cat No	Old price	New price
6 Way launcher - vertical	HM-3208	$1.20	.50¢
8 Way launcher - vertical	HM-3210	$1.50	.60¢
3 Way launcher - right angle	HM-3213	.75¢	.30¢
4 Way launcher - right angle	HM-3214	.95¢	.40¢
8 Way launcher - right angle	HM-3215	$1.85	.90¢
5 Way launcher - right angle	HM-3216	$1.10	.60¢
4 Way Socket - crimp	HM-3218	$1.20¢	.90¢
6 Way Socket - crimp	HM-3219	$1.50¢	$1.20
8 Way Socket - crimp	HM-3219	$1.75¢	$1.40

WATERPROOF 'BOPLA' WALL MOUNTING BOXES

Available in three sizes. These are TOP quality boxes. They are ideal for housing timers, controllers, alarms, etc, outdoors. They are made from high impact glass reinforced polycarbonate with a hinged transparent door. They are divided into two separate sections, thereby providing a suitable means of interfacing electronic equipment with external wiring. The upper section has integral PCB slots moulded into 4 slides, also fitted to the back are tapped inserted (M3) to allow the mounting of a panel or board, which may be extended downwards into the lower section for interfacing purposes. The lower section has knockouts for conduits or cable in the rear and bottom faces. Both the opening door and the removable bottom front panel have a rubber gasket to ensure a waterproof seal. Colour is light grey. Operating temperature range -40°C to +80°C. Another Jaycar surplus deal which we can offer you these high quality boxes at well below 1/2 what other suppliers are asking. Three sizes available. Dimensions (mm):

	Width	Total height	Door height	Depth at door	Depth under door
Small size	162	154	96	115	47
Medium size	210	179	116	98	46
Large size	255	212	146	129	55

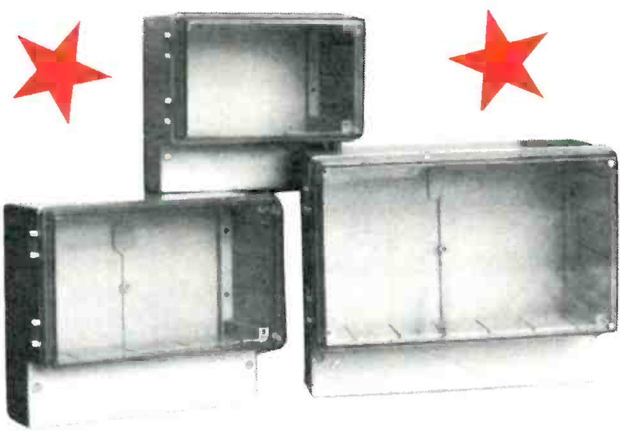
LESS THAN 1/2 PRICE

J A Y C A R P R I C E S

Small size	$34.95	1-9 pcs	Cat HB-6040
Medium size	$44.95	1-9 pcs	Cat HB-6041
Large size	$59.95	1-9 pcs	Cat HB-6042

Quantity buyers • 10+ less 10% off above prices • 20+ less 20% off above prices

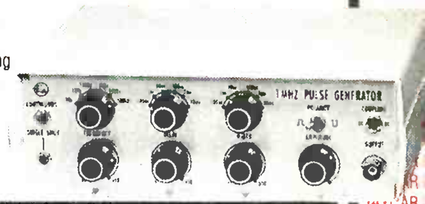
Our opposition (the ones with the really thick catalogue) sell the small size for $72.68 and the large size for $149.08 plus 20% Sales Tax!!!!



Low Cost 1MHz Pulse Generator Kit

This project is an updated and improved design that has many features found on expensive commercial generators, but at a fraction of their cost. It can be used for fast evaluation of wideband amplifiers and filters, adjusting the frequency compensation of scope probes and other attenuators. IT is a must for troubleshooting and developing digital circuits. The project provides BNC o/puts for CROs with single-shot and continuous pulses. THe Jaycar kit comes complete with case, front panel label, PCB and components.

Cat KA-1743 **$89.50**



BUY 10 LESS 10%

'GREENAIR' AIR PURIFIER & IONISER

PRICE BREAKTHROUGH

We have sold thousands of negative ion generators over the years. These work by building up a very high negative voltage, generating a stream of negative ion electrons which are emitted into the air. These ions then attach to particles in the air such as dust which are then attracted to the ground or other solid objects (just as metal filings cling to a magnet), thus purifying the air. The manufacturer claims the following benefits:

• 'Greenair' removes airborne bacteria, dust, unpleasant odour, allergen and tobacco smoke etc.
• Helps sufferers from allergy, asthma, bronchial problems, fatigue, hayfever, headache, insomnia and sneezing • Neutralise positive charges pollutants and ions repelled by highly charged TV, CCTV and computer video display terminals • 'Greenair' makes the environment around you a much healthier place to live in.

SPECIFICATIONS
Dimensions 105W x 105D x 70H mm, Weight 200g
Range 14sq mt (150sq ft)
Power consumption 240V model 3.8 watts, 12V model 2 watts
When we first started selling negative ion generators they were $70. See our 1987 catalogue.
If you've ever wondered about negative ion generators grab one of these.

T W O M O D E L S A V A I L A B L E

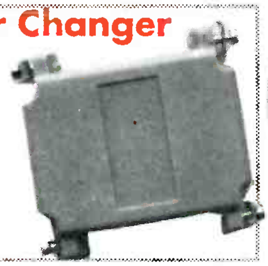
240V Mains Cat YX-2910 **$29.95**

12V DC With cigarette lighter plug Cat YX-2912 **$24.95**

D Connector Gender Changer Enclosure

If you have ever wanted to make up a special 25D adaptor, ie to have certain pins connecting between say two sockets, or 2 plugs, it was very difficult. Now with this new enclosure it's easy. You can now make up all these special adaptors/gender changer etc with a minimum of fuss.

Cat PM-0851 **$2.95**



Jaycar ELECTRONICS

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FAX (02) 743 2066

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$25 - $49.99	$4.50
$50 - $99.99	$6.50
OVER $100	$8.00

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ROAD FREIGHT ANYWHERE IN AUSTRALIA (up to 20kg) $13.50

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COBURG VIC	266 Sydney Rd (03) 384 1811 Mon-Fri 9 - 5.30 Fri 8.30 - Sat 9 - 4
MELBOURNE CITY	Shop 2, 45 A'Beckett St City (03) 663 2030 Mon-Fri 9 - 5.30 Fri 8.30 - Sat 9 - 2
SPRINGVALE VIC	887-889 Springvale Rd Mulgrave (03) 547 1022 Nr Cnr. Dandenong Rd Mon Fri 9-5.30 Fri 8.30 - Sat 9 - 2
SYDNEY - CITY	117 York St. (02) 267 1614 Mon-Fri 8.30 - 5.30 Thurs 8.30pm - Sat 9 - 4
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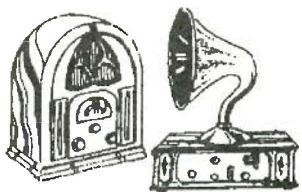
PARRAMATTA	355 Church St (Cnr. Victoria Rd) (02) 683 3377 Mon-Fri 9 - 5.30 Thurs 8.30pm - Sat 9 - 4pm Sunday 10am - 4pm
PENRITH	199 High St (047) 21 8337 Mon-Fri 9-5.30 Thurs 8.30 - Sat 9-4pm Sun 10-4pm
RHODES	6 Leeds St (02) 743 5222 Mon-Fri 9 - 5.30

Vintage Radio

by PETER LANKSHEAR



Australia's most popular mantel radio

Home construction was an important aspect of the valve era of radio, and a mainstay of *EA*'s predecessors *Wireless Weekly* and *Radio and Hobbies*. Often overlooked by collectors of historic radios, some of these projects produced classics that have an important place in radio history. Many influenced later commercial design.

Recently I was delving into one of my treasure chests (also known as junk boxes) and came across the 50-year-old remnants of a 'Little General' — the first mains powered receiver that I ever made. It had seen plenty of service before having most of its parts 'borrowed' for other projects. Looking it over I realised that here was a neglected classic, worthy of a place in any historic collection.

What *is* a classic receiver? The term 'classic' has been borrowed from art and literature, to imply a combination of such features as popularity, suitability for intended purpose, adequate performance, innovation and trend setting.

In April 1940, then *Radio & Hobbies* Editor John Moyle published an article about a small mantel receiver that was to become a classic. John's 'Little General', as he called his compact receiver, was just about the ultimate in simple superhets. It used only four valves including rectifier, and a handful of components.

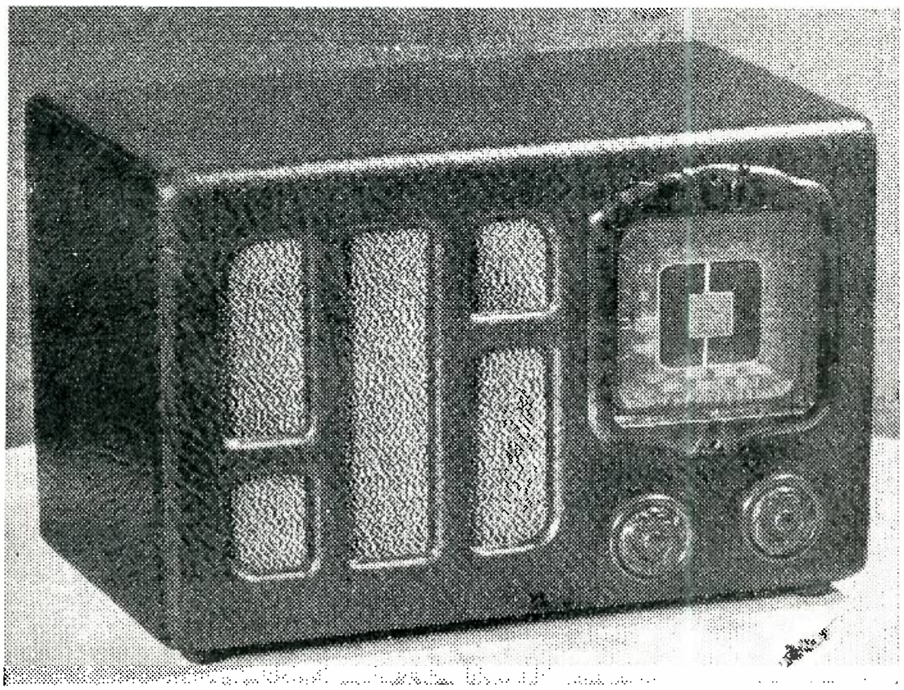
By 1940 the standard circuit for a small mantel receiver had become well established as having a converter, IF stage, diode detector, and an audio stage driving a power amplifier capable of several watts of audio. Indeed, the same chassis was often used for larger table receivers, and even consoles.

In the intended type of service, typically for bedside or kitchen listening to local stations at a modest volume level, much of the audio amplification and power of these receivers was wasted. At the same time, residual hum, noticeable at low listening levels and exacerbated by high audio gain, was often a problem.

As discussed in the July 1991 column, Australian manufacturers frequently resorted to reflexing as a way of reducing size and saving a valve, but the component count was high and performance was often compromised.

Some manufacturers, including Australia's Healing, Lekmek and National Radio had realised that eliminating the first audio stage was a practical way of producing a simple and docile receiver that was adequate for many applications.

European valve manufacturers had produced sensitive power pentodes including the PENA4, AL3 and EL3, EL3G, EL33, KT61 and 6AG6G which were suitable for these receivers. A similar valve, the EBL1 even included a pair of diodes with this type of service in mind. However, all these valves had heavy filament currents, were bigger than the standard 6F6G and 6V6G and by 1940 had become practically unprocurable.



John Moyle's original Little General, housed in a smart little leatherette-covered wooden cabinet. Many constructors made their own chassis and cabinet.

No frills

Why bother to compromise receiver performance for the sake of a valve and a few components? One reason was cost. It may surprise younger readers used to purchasing transistors for less than a dollar to learn that in 1940, a typical receiving valve cost more than a year's subscription to *Radio & Hobbies*! Another benefit from simplification was reliability. Anyone who has had much to do with repairing valve receivers will confirm that two very unreliable components eliminated by dispensing with the first audio stage were the anode resistor and its coupling capacitor.

Although the elimination of the first audio stage was a major step, John

Moyle contended that further simplification was worth striving for. Furthermore, he contended that the usual audio power capability of several watts was quite unnecessary for the intended type of service. He felt that a 'no frills' miniature superhet using the absolute minimum of parts and with the output valve restricted to a power of a watt or so would provide adequate performance, and that its simplicity and economy would appeal to many constructors who otherwise would be reluctant to tackle a mains powered receiver. Home constructors frequently started with small battery powered receivers and graduated to mains power only with caution.

One significant factor in reducing complexity and the number of small components was the elimination of automatic gain control (AGC), which is not essential for local station listening. Another was the use of a single resistor for screen and oscillator voltage supply. The final design was indeed simple, using only five fixed resistors, the customary two filter capacitors, and only seven paper and mica capacitors.

Apart from the use of a variable cathode bias resistor as a volume control, the first two stages of the Little General were conventional, with a 6K8G converter valve and 6G8G double diode remote cutoff pentode serving as IF amplifier and detector. The third valve was a ubiquitous 6V6G, biased sufficiently to reduce the anode current to about 25mA and limiting audio output to about a watt. HT rectification was by a trusty 80, with filtering provided by the field magnet winding of a 5" electromagnetic loudspeaker.

Immediate success

The immediate popularity of the Little General proved John Moyle's ideas to be correct, surpassing his most optimistic expectations as to its success. Although tens of thousands of kitsets were purchased by the more affluent home builders, many other Little Generals (like mine) were made from parts acquired, salvaged or scrounged from various sources.

As an indication of the Little General's continuing popularity, for the next decade variations on the theme were regularly featured in *R&H*. The first modification came a few months later in October 1940. To provide a bit more gain for difficult locations, the 6G8G was replaced by a 6F7 triode pentode operating as an IF amplifier and grid leak detector.

By now, loop aerials were standard for portable radios, and proving to be a practical proposition for mantel sets in good

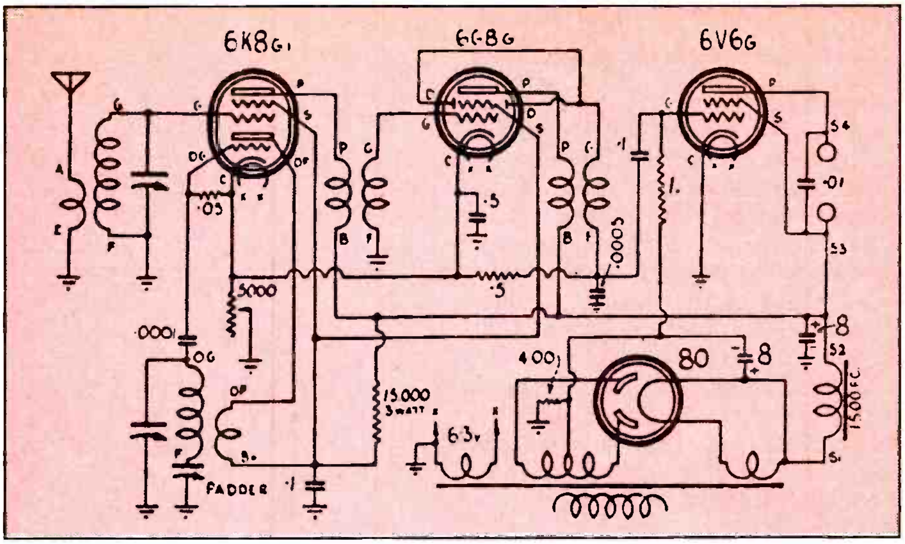


Fig.1: The circuit of John Moyle's original April 1940 Little General. It was just about the ultimate in superhet simplicity.

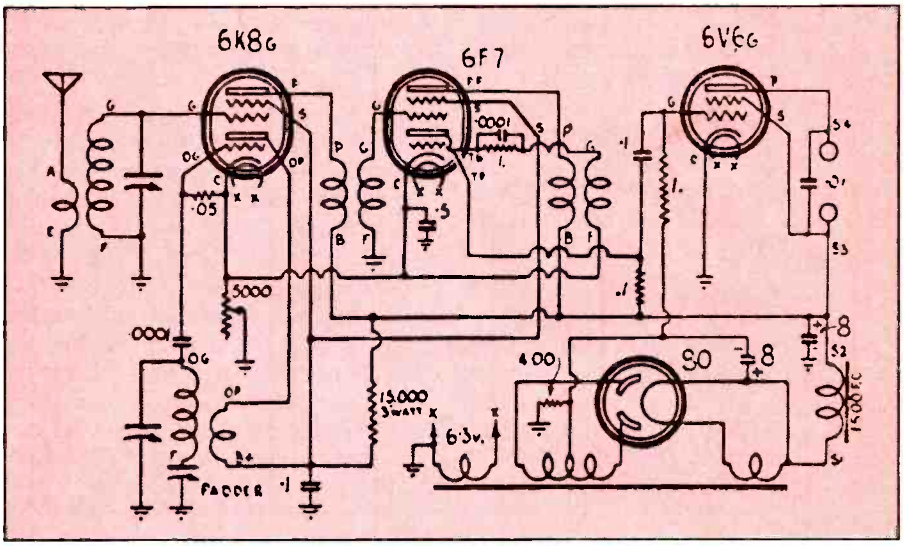


Fig.2: Despite the success of the original, there were requests for more gain. So in October 1940 John obliged with this version using a grid-leak triode detector.

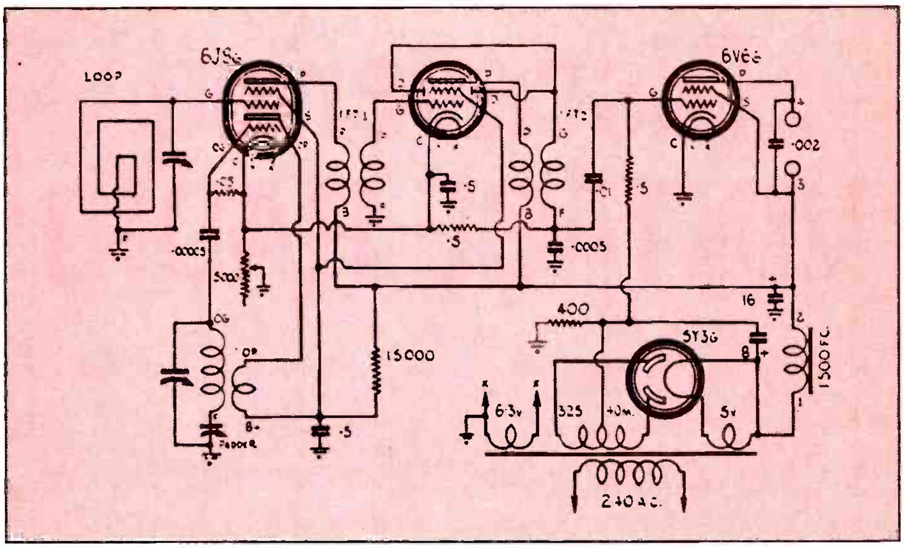


Fig.3: In the June 1941 issue, the original circuit was adapted to use a loop aerial. Minor changes included using a 6J8G converter and an octal 5Y3G rectifier.

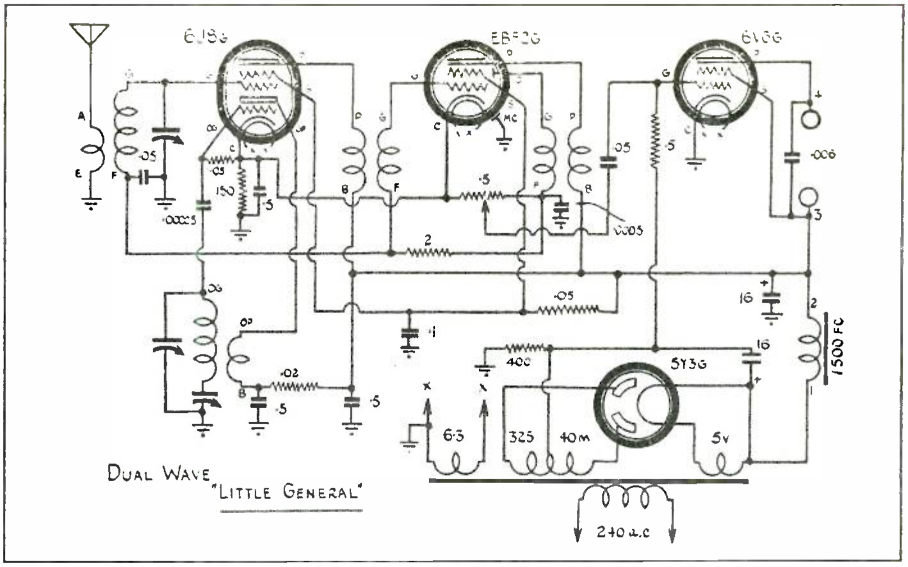


Fig.4: The basic circuit of the dual-wave version described in December 1941. Offering bandswitching and AGC, it was the most ambitious of the series. Although not actually shown in the circuit, a Crown or RCS bandswitching unit added shortwave coverage from 13.7 to 40 metres (22 - 7MHz).

signal strength areas. A further article in the June 1941 issue of *R&H* described the Little General fitted out with a loop aerial. At the same time, a 6J8G was recommended as a replacement for the 6K8G converter, which was in short supply and for best performance required a non-standard oscillator coil. A minor change was to replace the type 80 rectifier with its octal equivalent, the 5Y3G.

Six months later, in the December 1941 issue, instructions for making the most ambitious of all the Little Generals were published. This was the Dual Wave model, incorporating a miniature switched coil unit.

To cope with the weaker signals common in shortwave reception, a high gain Philips type EBF2G IF amplifier valve, and iron-cored IF transformers were specified. The most significant change, however, was the addition of automatic gain control, increasing the complexity of the circuit, and changing the position of the volume control to the diode load. It could be argued however, that the Dual Wave Little General had compromised the original idea of ultimate simplicity.

Back to basics

Further references appeared during the next few years, but with no significant changes. In an August 1947 article, called 'Australia's most Popular Mantel', John Moyle pointed out that the added features had moved the Little General away from the original concept of a basic little receiver using the absolute minimum of components. John now revived the original circuit, with small revisions to cater for the now readily available permanent magnet speakers, and the more efficient 6X5GT rectifier.

Resurrected regularly with minor changes until the final appearance in 1961 — no less than 21 years after John Moyle's first article, the Little General must hold some sort of a record for longevity as a popular project. There's no doubt that it was a classic.

Build your own?

Considering the large number of Little Generals built over the years, it would be surprising if there have not been many survivors — although bear in mind that non-kitset versions may not be immediately recognisable. In many cases rebuilding to working order should not be a problem.

However, there is another way of becoming the proud owner of one of these classics. Why not build one yourself, from scratch?

There is a growing interest in creating homebuilt radios and amateur equipment from old plans and components. Unlike copies of commercial models, which at best are only replicas, hobby designs using original parts can be considered as being authentic, and the Little General with its simplicity of construction is ideal for this type of project.

Although there were several firms supplying Little General kitsets, there were no 'official' components. Most collectors accumulate an assortment of 'junkers' — chassis that are beyond redemption. These can often provide all the essential major components, especially a dial mechanism, tuning capacitor, aerial and oscillator coils and IF transformers. Most small power transformers will be suitable, and chassis are readily made with the aid of a few hand tools. The only other major items of hardware are a 5" loudspeaker and output transformer.

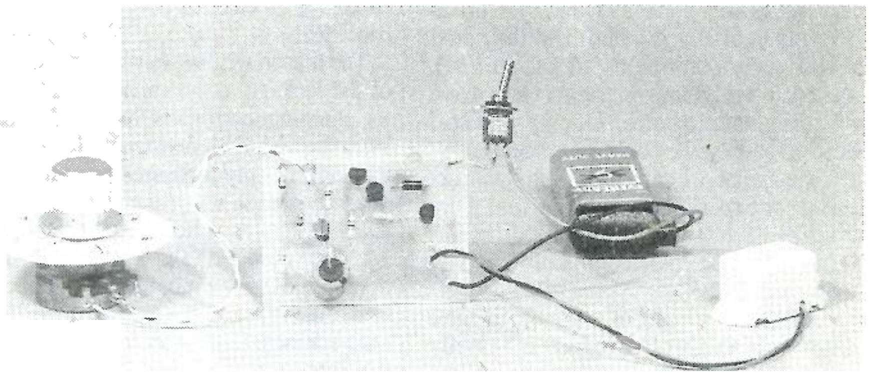
Next month we will provide detailed instructions for building your own genuine 1947 'Little General'. ❖

Experimenting with Electronics

by PETER MURTAGH

Noisy reminder

Do you need a simple timer to give you a penetrating reminder for times up to about 12 minutes? Then build this month's circuit. Simply set the desired time by varying a potentiometer, turn on the power, then wait for the piercing screech of the electronic buzzer — you will certainly know that the set time has elapsed!



There are many occasions around the home when you need a reminder that a certain number of minutes has passed. There's the traditional three-minute 'egg timer' for hard-boiling eggs, or perhaps a reminder to stop talking on the phone after 10 minutes, or five minutes to quickly feed the dog before your favourite TV program starts. The list is endless!

To provide for all such occasions, and of course, learn some more about electronics, we have designed this month's circuit. It uses only four transistors, and illustrates two new electronic ideas.

Transistor Q1 forms a constant current source — new idea No.1 — and transistors Q2 & Q3 form a programmable unijunction transistor (PUT) — new idea No.2. Transistor Q4 just turns on the buzzer.

So start building — then reflect on how it all works!

Construction

As usual, start your construction by soldering in the resistors, then the diodes and transistors. Be careful about polarity, since only the resistors can be soldered in either way round.

Note also that transistors Q1, Q2 and Q4 are all the PNP (BC558) variety; Q3 is the sole NPN (BC548) one. Even the small electronic buzzer which we've used for our alarm must be inserted the correct way round. (Its red lead goes to positive.) Refer to Fig.4 to identify which lead is which for all the polarised components.

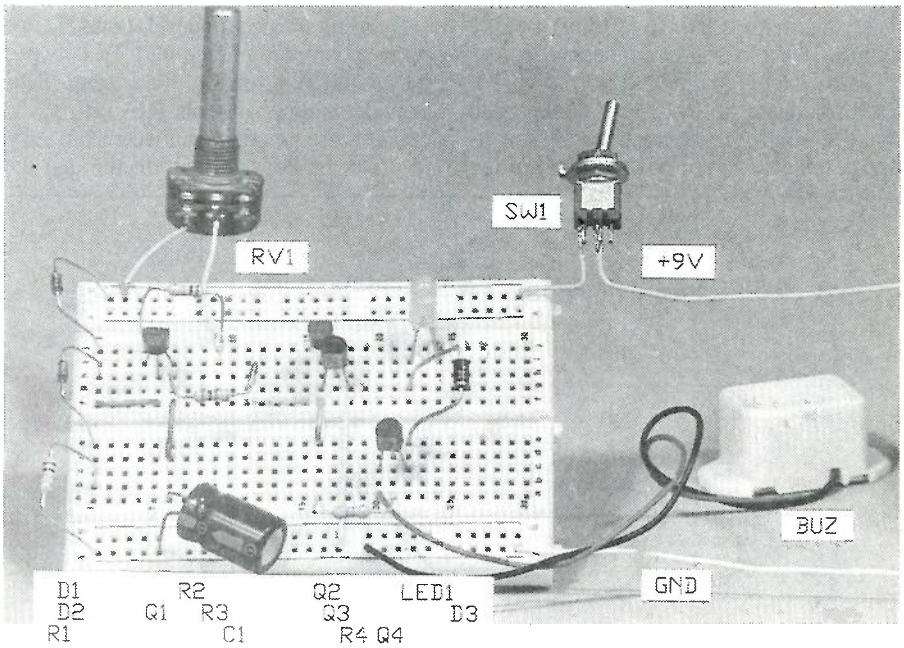
Next connect the pot to the PCB. Link wires from the centre and left lugs of the pot (viewed from the top) to the pads on the board — using these lugs means that turning the pot clockwise will increase the resistance and hence increases the time delay.

You will probably want to draw up a timing scale to place behind the knob on the pot. Refer to Fig.3 for the diagram of our scale, but realise that your maximum time, and hence your divisions, could easily be different.

There are two things to remember when designing your dial. Firstly, when the pot is turned fully anticlockwise, resistor R2 (10k) is still in the circuit, so the minimum time is not zero but about 1 minute.

Secondly, you need to measure the maximum time delay with the pot turned fully clockwise. Then you can work out how many divisions to put on your scale.

For example, our maximum time was 12 minutes. So the scale goes from 1-12



This photo shows the component layout for breadboard construction. Note there is a jumper lead (not visible) from the right pin of the LED to the +9V rail.

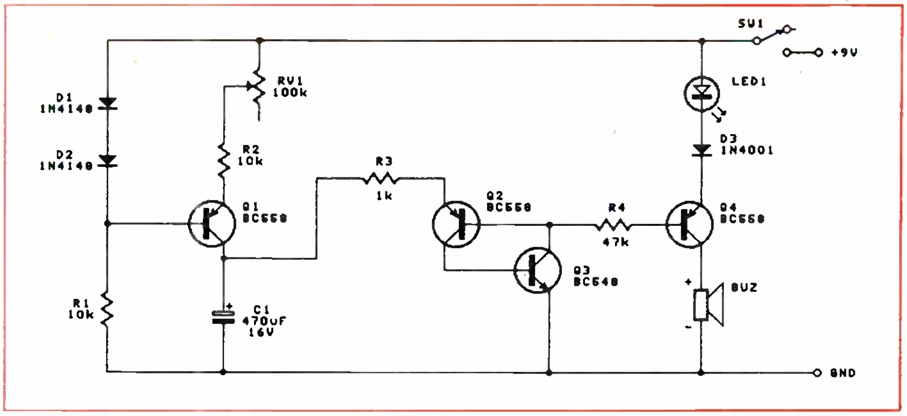
minutes, which is 11 intervals. Since the pot rotates through 300°, our divisions are 27.3° apart (300° divided by 11). Each interval is equally spaced, since the timing capacitor is charged up via a constant-current — this gives us a linear scale, which we wouldn't have if we simply charged the capacitor via a resistor.

About electros...

A few comments about the electrolytic capacitor (C1) which we have used. Electrolytics are quite cheap, and have large values of capacitance. However, they have severe limitations — they are not very accurate (some can even be up to 20% off their stated value) and they tend to leak (they don't block all DC current). So, each individual capacitor can have very different properties. Of course, if cost were no barrier, we could have used a low-leakage tantalum capacitor, but I suspect that most experimenters would find them too expensive (and, anyway, 100uF seems to be the largest value commonly listed by hobby suppliers).

This is all by way of warning. If your alarm fails to go off, or goes off briefly without latching, it's probably caused by a leaky cap. If this should happen, replace your capacitor with another of the same nominal value. If the buzzer still won't sound, you might have to settle for one of lower value, or use a less-leaky tantalum.

Interestingly, electrolytics store their charge better, and hence leak less, the more often they are used. If left for a long period on the shelf, they tend to be very leaky. So it's possible to improve a leaky 470uF, 16V electro by connecting it to a 15V DC supply and letting it 're-polarise' for an hour or so. But make doubly sure that the polarity is correct (positive voltage connected to the positive lead of the cap, etc.) — electros have been known to explode!



The schematic shows the constant current source built around Q1 at the left, the 'PUT' in the centre (Q2/Q3), and the switching circuit (Q4) to activate the buzzer.

The reason why we have to take account of the leakage in the capacitor is because its charging current is extremely small. With the full 110k resistance (R2 + RV1), this current only measures around 6uA. It doesn't take much leakage to drain this away as fast as it flows in. For example, when we used a 1000uF capacitor to try to double the delay time, it leaked too much to be able to set off the alarm for the higher time settings. (But, after we 're-polarised' the capacitor, the timer then worked for settings up to 22 minutes — for all but the highest 110k resistance setting!)

How it works

Transistor Q1 supplies a constant charging current to timing capacitor C1. It does this by making use of the fact that there is a constant voltage drop across a diode junction.

By using the two diodes, D1 and D2, we place a constant voltage of 1.2V between the transistor's emitter and base. This provides a drop of about 0.6V across the emitter-base junction, plus a constant 0.6V to drive the constant current through the resistors (R2 + RV1). Our minimum charging current is therefore 0.6V/110k = 5.5uA.

Over the whole variable resistance range, 10k-110k, this current is tiny — from 60-6uA. But, as mentioned before (if the resistance value is not altered), Q1 supplies a *constant* charging current, which makes it easy to calibrate our linear timing scale. This current flows into the capacitor, and gradually charges it up. The capacitor voltage eventually reaches a level which turns on transistors Q2 and Q3.

These two transistors form the functional equivalent of a Programmable Unijunction Transistor (PUT), also called a 'complementary' Silicon Controlled Rectifier (SCR). Unlike normal bipolar transistors which have three layers (e.g., NPN and PNP), PUTs and SCRs have *four* layers. If you look carefully at the schematic diagram, you can see that Q2 and Q3 form a PNPN device, with resistor R4 connected to the 'gate 1':

P	..	anode
N - N	..	gate 1
P - P	..	gate 2
N	..	cathode

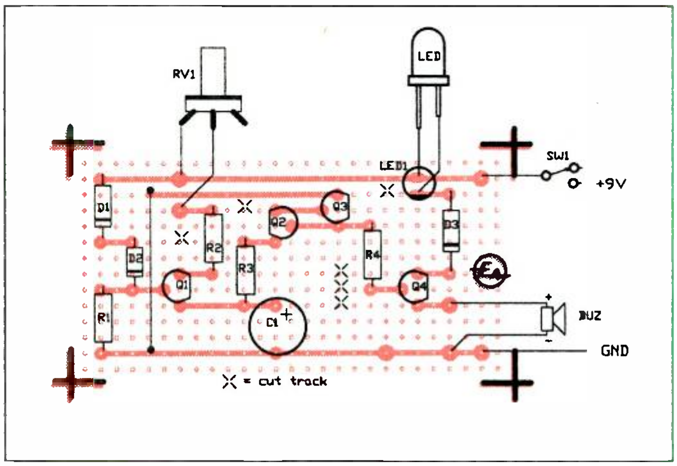


Fig.1: The component overlay for stripboard construction. RV1 alters the time which elapses before the buzzer sounds.

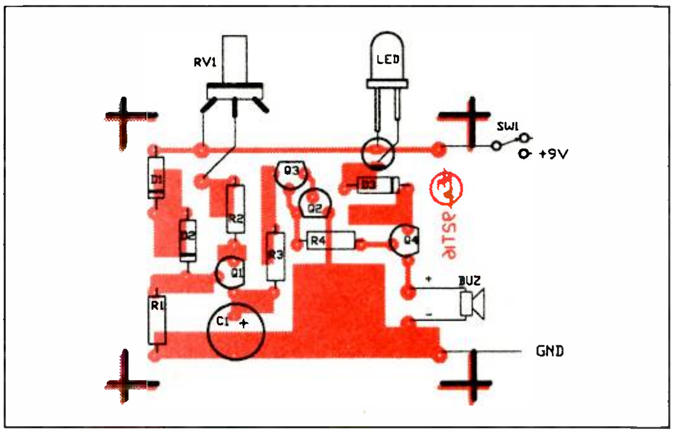


Fig.2: The PCB component overlay diagram. Note that the switch SW1 has been added so that you can turn off the buzzer quickly — its alarm is quite demanding.

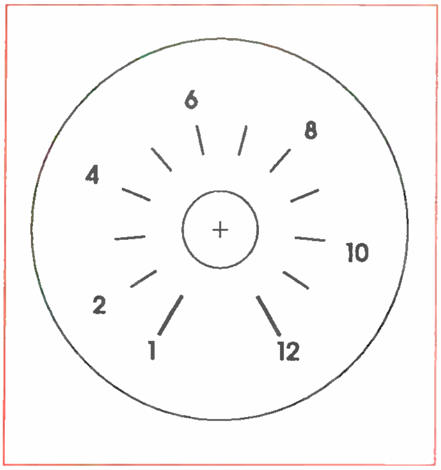


Fig.3: Here's a copy of our timing scale. The maximum time on your scale (and hence the number of divisions) could easily differ considerably from ours.

(Normal SCRs make use of gate 2, rather than gate 1.)

When enough base current flows through the emitter-base junction of Q2, this transistor will turn on. In doing so, Q2's collector current will provide the base current for Q3.

A tiny original base current is sufficient to cause conduction, and provided that this tiny current is maintained, the two transistor combination will latch on. This is characteristic of PUTs — they do not turn off unless the voltage at the emitter (of Q2), and hence the emitter current, drops to zero.

The reason why this combination is called 'programmable' is because the voltage at the gate sets a reference voltage. The emitter voltage of Q2 must rise a further 0.6V above this value before the PUT turns on. See how this works in our circuit.

The emitter of Q4 is connected to the +9V supply, via a yellow LED (LED1) and a diode (D3), to again provide a constant voltage drop. There is a larger voltage drop across a LED than across an ordinary diode (and a yellow LED drops more than a red or green), so this ensures that the reference voltage on the gate of the Q2/Q3 will always be lower than the maximum voltage to which the capacitor can be charged. We are making certain that our PUT *can* be turned on.

So, what happens is this. When switch SW1 is closed, capacitor C1 slowly charges up, until the voltage applied to Q2 is about 7V. Once this value is reached, the combination Q2/Q3 latches on, and the gate voltage drops. Because Q2/Q3 is now conducting, it will discharge capacitor C1, but not right down to ground. Q1 is still supplying its charging current and, though tiny, this is sufficient to keep Q2/Q3 latched on.

The low gate voltage is also transferred, via R4, to the base of Q4. This turns this transistor on, and its collector current activates the electronic buzzer. It also turns LED1 on. To turn off the alarm and LED, you must open switch SW1.

PARTS LIST

Miscellaneous

PCB 57x45mm, coded 92Ti6
9V battery
electronic buzzer
SPDT switch
hookup wire

Resistors

All 1/4W, 5%

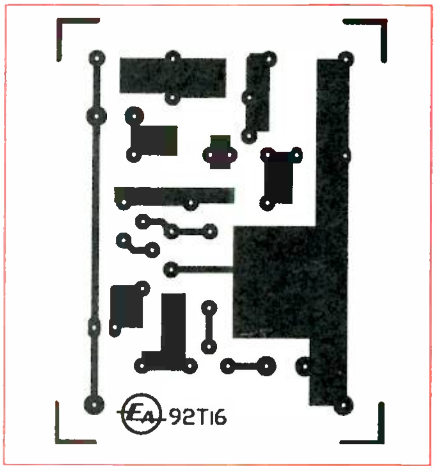
2	10k	R1,R2	brown-black-orange
1	1k	R3	brown-black-red
1	47k	R4	yellow-purple-orange
1	100k	RV1	rotary linear pot

Capacitors

1 470uF,16V C1 PC-mount electrolytic

Semiconductors

1 yellow LED
2 1N4148 signal diodes D1,D2
1 1N4001 power diode D3
3 BC558 PNP transistors Q1,Q2,Q4
1 BC548 NPN transistors Q3



The PCB pattern is produced here, full size, to let you etch your own board.

Because it can take a few seconds to discharge C1, do not re-use the timer immediately. If you do, the alarm will sound in less than its set time. Resistors R3 and R4 limit the currents into Q2 and Q4. R4 is made much larger in order to make certain that Q2/Q3 is triggered via R3.

Changes

Because the charging period is determined by R2+RV1 and C1, changing their values will alter that time. But it is not really practical to further increase the resistance setting, as the charging current becomes too small to offset capacitor leakage. But you might be lucky and find a less leaky, higher value capacitor (like a 1000uF) to achieve a much longer delay.

Another possible change is to replace the buzzer with a relay. The relay contacts can then be used to switch a variety of circuits, which can also be located some distance from the timing circuit. This opens up a whole lot of possibilities. So, it's over to you — use your imagination and ingenuity!

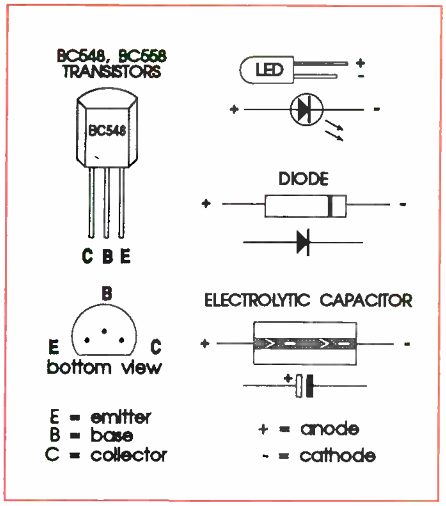


Fig.4: Identify the leads on the polarised components by referring to this chart.

Transparencies

A high contrast, actual size transparency (negative) for the PCB used in this circuit is available for only $2. This will allow you to etch your own printed circuit board. This special price applies for transparencies for all projects in this series only. Write to *EA*'s reader services division.

Happy experimenting — and please send us your comments on the circuits we have published as well as ideas for future projects. ❖

Electronics Australia

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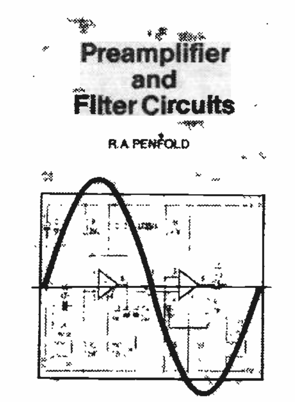
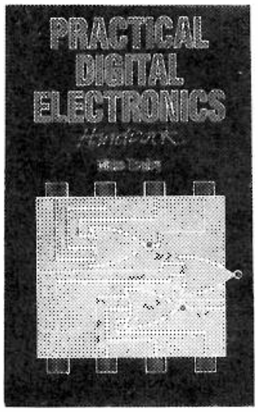
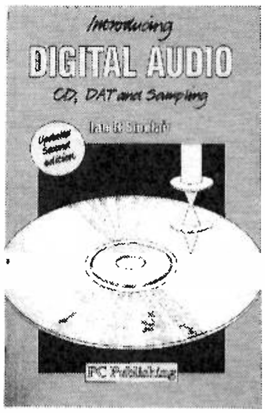


Preamplifier and Filter Circuits
This book provides circuits and background information for a range of preamplifiers, plus time controls, filters and mixers. The circuits described are simple and previous experience of electronic project construction is not needed.
CODE: BP 3090 PRICE: $11.00

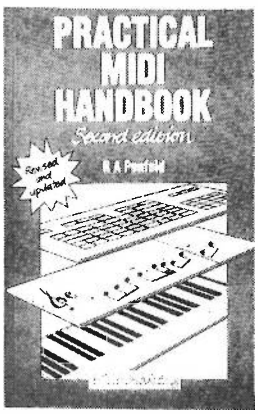


Practical Digitial Electronics Handbook
This book introduces digital circuits, logic gates, bistables and timers as well as microprocessers, memory and input/output devices. It will prove invaluable to anyone involved with the design, manufacture or servicing of digital circuitry.
CODE: PC 1004 PRICE: $21.95

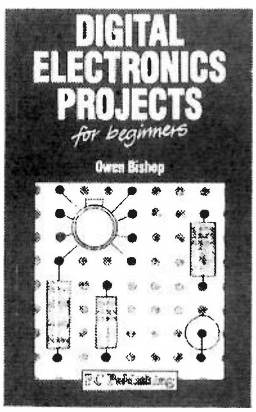


Introducing Digital Audio, CD, Dat and Sampling. - Second Edition:
This book bridges the gap for the technician and enthusiasts who have worked with audio circuits. It includes oversampling methods and bitstream techniques and technical terms.
CODE: PC 1007 PRICE: $19.95

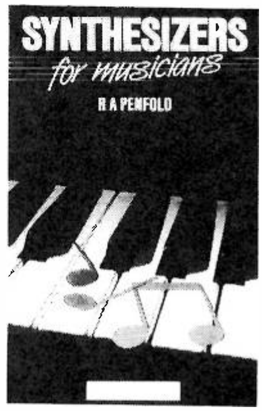
Computers and Music - An Introduction:
This book explains how to simply set up your own computer music studio. It covers the basics of computing, running applications programs, wiring up a MIDI system plus everything about hardware and the programs.
CODE: PC 1006 PRICE: $23.95



Practical MIDI Handbook
Refers to the powerful capabilities of MIDI and how to exploit it, with no knowledge of electronics or computing. It reviews the latest developments in MIDI covering keyboards, drum machines, sequences, mixers, guitars etc.
CODE: PC 1002 PRICE: $21.95



Digital Electronic Projects for beginners
This book provides simple, yet detailed instruction on practical projects. Covering instrumentation to home security plus circuit diagrams, this reference book also offers 'fun' projects for newcomers to electronic construction.
CODE: PC 1011 PRICE: $18.95



Synthesizers for Musicians
Written especially for musicians, this book explains how to get the best from your synthesizer or sampler. If you want to go beyond using the factory presets or the random poking of buttons, then this is the book for you.
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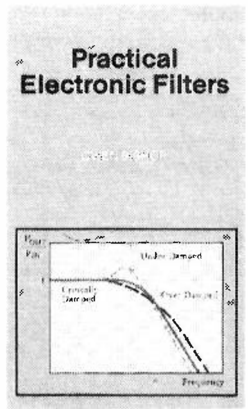
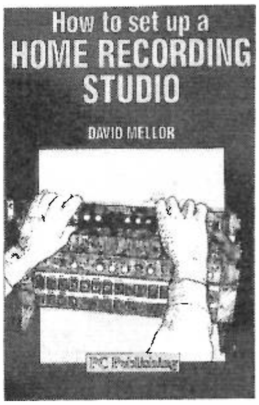
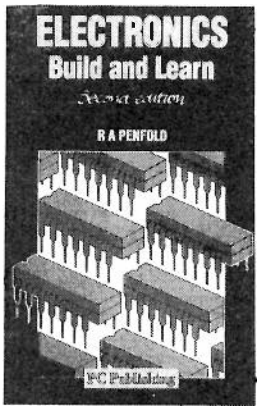


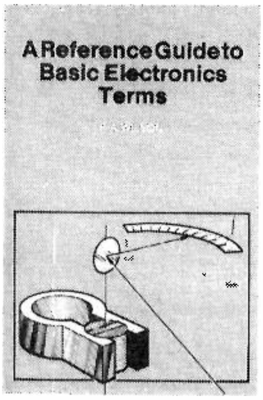
Practical Electronic Filters
Practical Electronic Filters explains in a simple form, the understanding of how to work a filter. It presents projects to apply in and around the home, including diagrams that are suited to the beginner and a more advanced constructor.
CODE: BP 2990 PRICE: $13.00



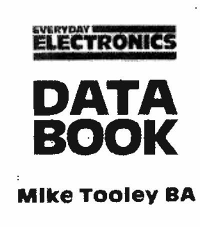
How to set up a home Recording Studio
If you have a studio at home or are about to set one up, this book is for you! It describes the setting up of an 8 to 16 track studio with an outline of the musical and recording gear needed.
CODE: PC 1009 PRICE: $21.95



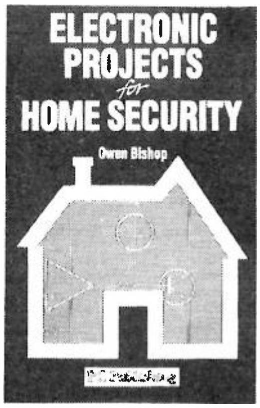
Electronics - Build and Learn
This book is the perfect balance of theory & practice. It introduces common electronic components and how they are built into useful circuits. An essential for the beginner, providing practical tests and experiments.
CODE: PC 1008 PRICE: $18.95



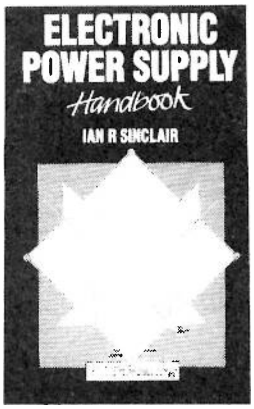
A Reference guide to Basic Electronic Terms
A comprehensive A to Z guide of electronic terms. This book chooses and explains some of the more important fundamental terms (over 700), making the explanations easy to understand and avoiding high level mathematics.
CODE: BP 2860 PRICE: $16.00



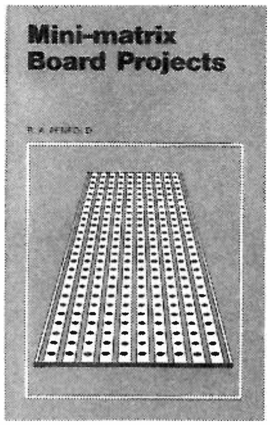
Everyday Electronics Data Book
This book is an invaluable source of information of everyday relevance in the world of electronics. A must for everyone involved on electronics who wants to put theory into practice.
CODE: PC 1012 PRICE: $26.95



Electronic Projects for Home Security
This book deals with the many aspects of home-security and how to construct your own security system. It covers the latest in technology, whilst remaining simple and reliable in its instruction.
CODE: PC 1010 PRICE: $21.95



Electronic Power Supply Handbook
This book covers the topic of electronic power supplies, including batteries, simple AC supplies, switch-mode supplies and inverters. Subjects dealt in detail are devices, their operating principles and typical circuits.
CODE: PC 1001 PRICE: $23.95



Mini Matrix Board Projects
This book provides you with 20 useful and interesting circuits, all of which can be used on a mini matrix board, which is just 24 holes by 10 copper strips.
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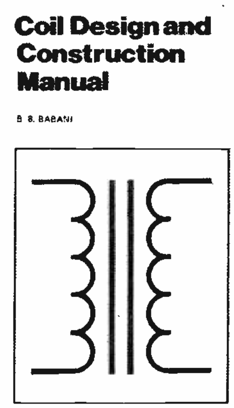

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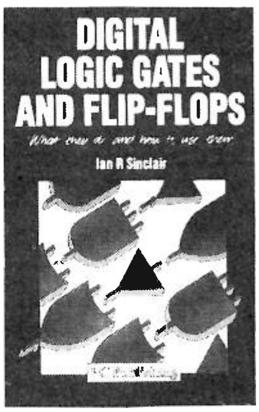

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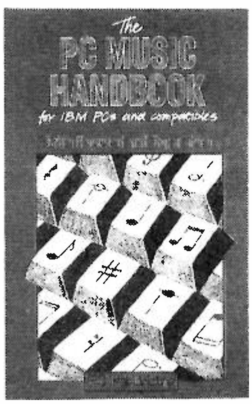

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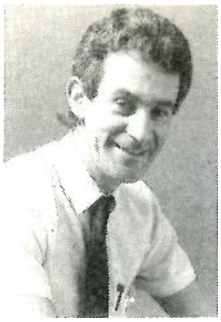
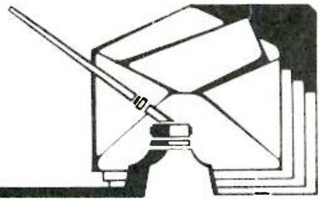


Information centre



Conducted by Peter Phillips

Power, rectifiers and all that

We stay mostly with power-related issues this month. Not people power, but power of the electrical kind. As ever, the answer to a What?? question (on power of course) is hotly contested. But I get my own back, with another What?? question — on a different aspect of power yet again...

The electronic circuit is one thing, but as the letters this month point out, its power source may be quite another. Many of us simply plug the appliance into the power point, switch on and enjoy.

But not everyone has mains power, particularly in country regions. And as you'll see, some quite elaborate alternatives are required if everyday things like washing machines, computers, sound systems, TV and all the items we 'city slickers' take for granted are to be a part of country life.

Of course, the power source is only part of the equation; let's not forget the humble power supply circuit. Like many things, the simpler the circuit, the blacker the art that surrounds it.

I've decided to concentrate on matters pertaining to power supplies and power sources, as this is always an interesting topic and one that knows no bounds. Featured this month also are reader experiences with inverters, in particular the 300W inverter described in the April 1988 edition.

We start at a fairly basic level, by revisiting the February What?? question — which it seems, has caused a few hackles to rise. Now that's unusual, isn't it?

VA ratings

It's the published answer to the February What?? question that has produced a few letters, contesting its reasoning. You might remember that the question asked why a centre-tapped transformer with a full-wave rectifier needs a higher VA rating than a similar transformer for a bridge rectifier. Our first letter argues against the use of the term 'VA rating':

Concerning February's What??, it seems you and presumably V.C. require some education about the use of VA ratings. My hackles rise when I see reference to VA ratings for the primary and each half of the secondary of the transformer, in the March answer.

What is the purpose of a VA rating? Mainly to determine the size of the transformer required for a task. In fact the venerable Radiotron Designer's Handbook says (in effect) that the optimum effective core area in square inches is given approximately by A = 0.179 x SQRT(W), where W is the volt-amperes output. These days, because of improved core materials, a lower constant can be used.

From the user's point of view, the second purpose of the VA rating is more important — exceed it and the transformer will cook! The interesting point is that the transformer dissipation is largely determined by the sum of I^2R in the various windings and that there is no logical basis for involving V in the calculation.

The voltage V might drive the current in the load, but the dissipation is not otherwise influenced by it. However, by setting a VA figure, the manufacturer can provide a good guide to the user in an easily understandable form.

For instance, it doesn't matter whether the A is drawn into a resistive or a reactive load. (It's important to note that since it is the heating effects we're concerned about, it's the RMS value of A that's important when non-sine waveforms are present, due to the diodes). However there are limitations. Don't expect a 240V to 240V transformer rated at 240VA (1A in the load) to be able to support a 120V, 2A load. The VA may still be 240, but twice the current in the winding means four times the heat dissipation.

By now, most readers should have caught on to the problems built into the March answer, particularly the absurdity of assigning VA figures to various windings in any meaningful and logically consistent way. Suppose we have another go at it, along the following lines.

Let's use the values quoted in the answer — 1:1 transformer, 10V RMS input, a 10 ohm load at the secondary and a transformer rating of 10VA.

The current in the load will consist of a sine wave with alternate half-cycles inverted by diode action. At each point in time, the magnitude of the load current will equal that in a 10 ohm load connected to a 10V AC source, although now rendered uni-directional by the diodes. Now comes the tricky part!

It's usual for the transformer designer to arrange for the full-load dissipations in the primary and secondary windings to be approximately equal.

Let's assume this is the case here. The designer would then assume that full load current for the transformer is 0.5A through the full 20V winding to provide the specified 10VA rating. The primary current would be 1A under the same conditions.

For the particular transformer size and make-up, the designer would have an allowable dissipation figure — say 5W in this instance. The consequent 2.5W allowance for the primary at 1A means that its resistance should be 2.5 ohms. The same allowance for the secondary at 0.5A means its resistance should be 10 ohms (i.e. 5 + 5).

When used in this application, the transformer has the 1A of secondary current flowing through one or other of the five ohm half-windings (on alternate half-cycles). Consequently the secon-

dary dissipation is 5W, twice the allowance, and not a safe condition.

On the other hand, if a full-wave bridge rectifier is used from a single winding, the space occupied by the two five ohm windings would be taken by a 2.5 ohm winding. This would provide 2.5W of dissipation for the 1A — just right!

The situation becomes worse when a filter capacitor is added, as the transformer becomes quite peaky, requiring a larger VA allowance. However, I've glossed over a few points to get my message across. For example, the proportion of over-dissipation by the two-diode circuit compared to the bridge varies with the design decisions regarding the allocation of available space between the primary and secondary windings. It could be more or less than the 5W:2.5W which emerged from the above example, but it could never be reduced to equality. (G.W., Florey ACT).

While you might consider using VA ratings an incorrect way to answer the problem G.W., at least we both agree on one thing: the transformer for the two-diode circuit needs to be larger. Certainly, as you point out, it is current that causes the heating, due to the I^2R losses in the windings.

By either reasoning a transformer with a larger VA rating is required implying that, for the same voltage, the secondary winding needs to be able to handle a higher current. Using your method, the resistance of the winding therefore needs to be less, requiring a thicker wire. Which is the same conclusion reached by the solution presented in March. Therefore, as we are interested in the VA rating anyway, why not use it in the solution?

I agree that the use of VA ratings is prone to misinterpretation, rather like the ampere-hour rating for a battery. A 40AH battery cannot necessarily produce 400 amps for one tenth of an hour, and may be able to give 4A for longer than 10 hours. But it's still a guide that gives a good idea of the capacity of the battery.

The next letter disagrees entirely with the answer, and argues that the VA rating of both transformers should be equal. Other letters I've received say the same thing, for slightly different reasons.

The answer to February's What?? doesn't sit squarely with me. Assuming that circuit losses are ignored, then certainly, if 10V RMS is applied to a 10 ohm resistor, a current of 1A RMS will flow, giving a rating of 10VA.

But in the explanation, for a peak current of 1.41A the RMS value is given as 0.71A, which is half the peak value. Perhaps my theory is failing me, but when I was taught and indeed when I teach about RMS values I state that the RMS value equals 0.71 of the peak value, which gives 1A RMS. This current is present for half the cycle (180°), and averages to 0.5A RMS over the full cycle. This gives a VA rating of 5VA for each half-winding, or 10VA for the full winding.

Am I missing something? It seems to make sense to me, as apart from introducing average values of current (0.637 of the peak value) over the half cycle (as we can't really talk about RMS values over anything less than 360°), the answer doesn't make sense. (R.E., Everton Park Qld).

Other letters say much the same thing, so perhaps it's appropriate to expand on the solution given in March. I didn't explain why the RMS value of a half-wave rectified voltage is 0.5 times the peak value, due to space limitations.

The diagram of Fig.1 shows the proof, in which the RMS value of any waveform equals the square root of the mean of the sum of the squares of the instantaneous values of the waveform.

The first equation in Fig.1 puts this mathematically. I've selected 12 instantaneous values at 30° intervals, which gives the rather long expression for I_{RMS}.

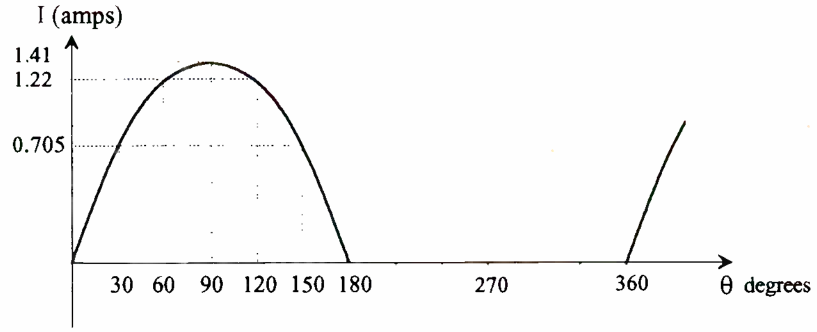
Check it yourself, but you'll find that it gives the answer shown. If in doubt, substitute a peak value of 1A and try it again. You'll end up with 0.5A, not 0.71A. Naturally, if there is another half cycle the same as the first, the RMS value will be 0.71 times the peak value, as for a conventional sine wave. The more instantaneous values you use, the closer the answer will be to 0.5 times the peak value. Given this, you can see that if a winding of 20V (the complete secondary of the centre-tapped transformer) has 0.71A RMS of current, its required rating is around 14VA. A transformer connected to a bridge rectifier has a 10V winding at 1A, giving 10VA.

So regardless of how it is proved, the transformer for a two-diode full wave rectifier needs to be larger (to give a higher VA rating) than that for a similar output bridge rectifier.

My thanks to Vic Ciscato for the question, and to the readers who prompted this discussion. As I've said before, power supplies are more complex than they first appear, and discussions like this help unearth the many issues that surround them. But now to the power source itself, which is not always from a coal-fired or hydro-electric power station:

Inverters

In January, a reader asked if a non-sinusoidal 12V to 240V AC inverter could be used to drive a range of appliances, including a computer, a hifi set and so on. The inverter in question was the 300W inverter published in *EA*'s April 1988 issue. I made a few com-



$$I_{RMS} = \sqrt{\frac{(i_1)^2 + (i_2)^2 + (i_3)^2 + \ldots}{n}}$$

where $i = I_{max} \sin\theta$

n = number of values

$$I_{RMS} = \sqrt{\frac{0^2 + 0.705^2 + 1.22^2 + 1.41^2 + 1.22^2 + 0.705^2 + 0^2 + 0^2 + 0^2 + 0^2 + 0^2 + 0^2}{12}}$$

$$I_{RMS} = \sqrt{0.497} = 0.705\text{A}$$

Fig.1

ments, with the disclaimer that I really didn't know.

Quite a few readers have since responded with actual experiences on driving different loads from this (and similar) inverters. As well, *EA* has now published a 1200W inverter by the same designer, making it even more appropriate to pass on some the experiences readers have had.

Because of the considerable amount of material sent to me, I am condensing it, hopefully leaving the details intact. Here's the first letter:

In the country we rely on power generated from a solar system, and I have built many EA inverters. We considered many commercial inverters, and have also repaired quite a few, and I must say your inverter is an excellent unit. However we have added a few modifications, and an EA 300W inverter has been in service now for three years with very few problems.

Some of the modifications we've incorporated are: reduce the hold-up time of the autostart, replace the fuse with a re-wirable type, vacuum dip the transformer in varnish, fit a snubber to the output and to the catch diode. As well, we found it necessary to add a delay to stop hiccup at start up, a ripple filter to the DC input and to replace the input cables with 15mm² cable. Other mods were to provide a manual start-up switch, to replace the output transistors with BUV18 types and the drivers with MTP3055 FETS. And probably more I've forgotten...

The inverter currently runs a Macintosh computer, jigsaw, sewing machine, 14" colour TV set, overlocker, kitchen knife, Beta VCR, a VHS VCR and compact fluorescent lights. Not all at once, of course. (G.B., Nimbin NSW).

Thanks G.B., although I think some of your modifications may apply to other inverters, as some of the parts you quote are not in the 300W design. Still it's good to know the design has proven to be reliable and that it operates so many different appliances. The next correspondent also uses the 300W inverter.

I have operated a Commodore 64 and an SX64 computer on power supplied by the EA 300W inverter for many hours on a number of occasions, with no problems. The inverter was being used as a UPS (un-interruptable power supply), being powered from a 12V battery charged by an unfiltered battery charger connected to the mains. Although it sounds crude, it works!

On a similar topic, all the hair driers I have taken apart use a diode switched in series with the motor to give the low speed facility. There must be a lot of DC on the mains! Thanks for a great magazine, I have been buying it since 1947. (B.W., Morphett Vale SA).

So obviously a computer can be driven by a non-sinusoidal inverter. Using the inverter as a UPS is an interesting idea B.W., and probably cheaper than buying a commercial unit. Your comment about the use of a diode as a speed control in hair driers is interesting, as it shows how popular this method is.

One wonders if the supply authorities are going to eventually say 'enough is enough'. Thanks for your letter and kind comments about 45 years of reading the magazine — not a bad record!

The next letter is from another country reader, again with considerable experience in the use of inverters.

Over the years I have designed and built various solar electricity supply systems, gaining quite a bit of experience with inverters in the process. Your remark about using two separate lines rather than a twin lead is quite correct. I have two 100 metre underground lines, one in twin and the other as two separate leads. The twin lead keeps the inverter running, while the separate leads allow the autostart feature to operate correctly 90% of the time.

Certainly inverters are devils when it comes to hum and buzzes. Not only do they produce mechanical noise in transformers, they force spikes through power supplies and amplifier stages. They also send murmurs through the air to any device receptive to it. As strange as it may seem, earthing the aerial of a radio takes most of the hum away on AM stations, although it reduces reception. I have not noticed any problems with the speed of my record player, although hum is induced in the pick-up.

Most hifi equipment keeps the inverter running when turned off, due to the mains filter in the amplifier. My computer runs perfectly on an inverter, although the transformer in the monitor buzzes loudly when turned off. It quietens down when turned on and works well otherwise.

Vacuum cleaners and washing machines all work well, as do all power tools. However, inverters play havoc with some types of equipment. I have burnt out three commercial NiCad battery chargers, in which both the charger and the battery become very hot, with eventual meltdown of the charger. I don't know why!

Incidentally, who invents those What?? quizzes, a mad professor, a sorcerer or Dr Faust? They seem to give some people hell...(B.P., Beaufort Vic).

Speaking as Dr Faust, thanks for your comments, although I hope the What?? questions aren't that bad!! Again it's obvious that a range of appliances can be driven by an inverter, with few ill effects. I can't see why a simple NiCad battery charger melts down, but perhaps it isn't an *EA* design!

The next letter is from yet another country reader, who also sent details of a 180A, 12V battery charger, which because of space limitations I've not included. Perhaps at a later date...

I have been living on my property for almost seven years without the benefits of mains power. I have an 800AH lead-acid battery bank and a 600AH wet type NiCad battery bank, both charged with a mixture of hydro-electric, solar and wind power — occasionally boosted with a 240V:12V, 180A battery charger.

I have tried a range of commercial inverters, which range from good to abysmal. The so called sine-wave types approach a sine-wave output, but at the expense of increased harmonic distortion. This causes clocks to run up to 10 times faster.

Some commercial units aren't even crystal locked, and operate at a frequency that depends on the temperature. My inverter is based on the EA 300VA design, with some extra output transistors to allow it drive a fridge and other similar items. The output transistors have actually burnt off the black anodising of the heatsinks!

Over the years I've found numerous items that operate well from an inverter, and some that don't. In general, any appliance that has a switch-mode power supply runs OK. This also includes computer monitors.

The spiky nature of the waveform has caused the demise of a few power transformers, such as the small types in clock radios, although the Australian made types seem to cope quite well. Failure is mostly due to a winding becoming open-circuit, not always insulation failure.

With some TV sets, there's a slight increase in noise level from the power supply, as well as a noticeable scanning line that moves slowly up and down the picture as the inverter beats against the vertical sync. My stereo unit runs very well, apart from a mechanical buzz from the power transformer. Some types of turntables require an additional load (such as a 25W lamp) to increase the output of the inverter to a suitable value. This is required in the EA 300VA design.

Some things that don't like an inverter are electronic controlled drills (except *on full speed), light dimmers (they become unstable at any level below full output) and the cheaper types of miniature fluorescent lamps. The Philips types are OK, but others have a very short life. I hope this information is useful.* (P.L., ALbion Park NSW).

It certainly is P.L., and thanks for writing. You obviously have quite a power supply system down there, and I hope to be able to describe your battery charger in a future issue.

So there it is folks, straight from the 'horse's mouth'. It seems most appliances will work with a non-sinusoidal inverter, and it also seems the EA designs (or actually those from Altronics, published by EA) perform well, even better than some commercial units.

And lastly, a vexing issue that many readers will have experienced:

12V car power

Many of us have struck electrical problems when coupling an unfamiliar car/trailer combination. Weird and wonderful things can happen, often due to bad earthing and sometimes combined with doubtful identification of wires.

These faults are difficult to track down with a multimeter, as some bulbs can earth via the filaments of others and all kinds of parallel paths can occur. Sometimes it's necessary to remove all the bulbs and start from scratch. Even identifying the earth connection can be difficult. Has any reader an easy way of sorting out such wiring? (R.V., St. Georges Basin NSW).

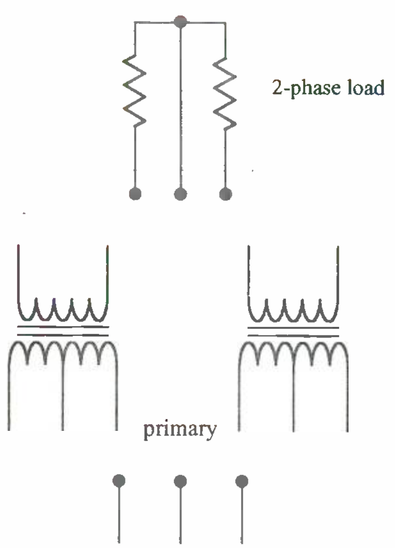


Fig.2

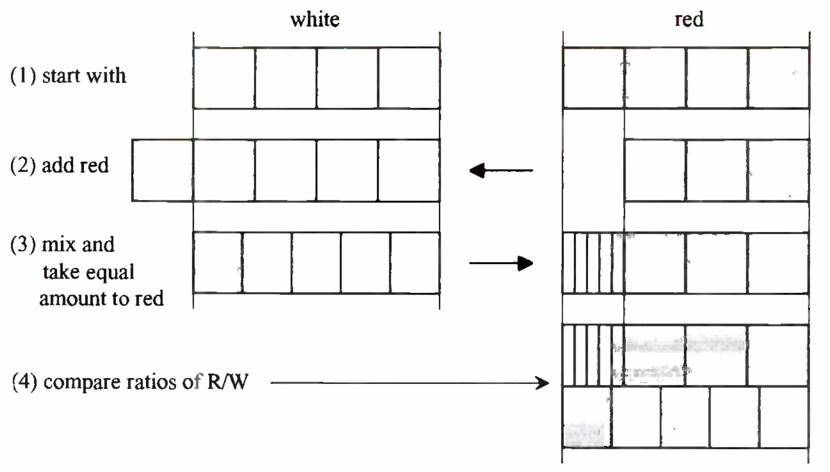


Fig.3

Now there's a Pandora's box. Space doesn't permit me to describe the sorts of problems I've experienced over the years, or the devious means I've used to find the problem. But I still remember the time my wife pointed out that the brake lights were coming on every time I turned to the left!

Perhaps readers might like to offer some experiences (and solutions) to automotive electrical problems, as they're in a class of their own.

What??

This question comes from Ken Christensen, of Blacktown NSW. Ken is an amateur radio operator with many years experience in the broadcasting field. However, at first glance you mightn't get the connection between this and his question, which has been re-phrased to make it more general. I'll show the relationship next month, but first the question.

The diagram of Fig.2 shows two similar transformers, each with a centre-tapped primary winding. How can these transformers be connected so a three-phase supply connected to the primaries provides a two-phase supply to operate a two-phase balanced load?

Answer to May's What??

Both tins of paint end up with the same adulteration. You might be inclined to think that because the initial paint transfer is pure and the other not, there would be more red in the white than white in the red. Not so! Here's a mathematical approach to prove it...

Add n amount of white to the red, then take n amount away from the mixture = R + (W/n) - [(1/n+1) x (R + W/n)]. This simplifies to R - (R/n+1) + (W/n+1).

For the white, if amount n is taken away, then amount n is returned from the mixed R and W, the result = W - W/n + [(1/n) x (R + W/n)]. Simplifying gives W - (W/n+1) + (R/n+1). The two simplified expressions show equal ratios, which can be proved by substituting a value for n.

In case you're not convinced, Fig.3 shows a graphical approach. In this diagram, a quarter of the red paint is initially mixed with the white as shown in (2). After mixing, the same amount (1/4 litre) is taken back to the white, leaving the same quantities in both tins. As you can see, the final result shows the ratio of the colours in both tins to be the same. ❖

SHORTWAVE LISTENING

by Arthur Cushen, MBE

Shortwave radio bands extended at WARC 92

The World Administrative Conference recently added some extra frequencies to the international shortwave radio bands. Most of the additional frequencies — an extra 790kHz — are already being used by broadcasters who have gone outside the recognised international bands. Other interesting news includes the fact that both Baghdad and Kuwait are back on the air.

The recent meeting of the World Administrative Radio Conference in Malaga, Spain, adopted a resolution to expand the international shortwave bands by some 790kHz.

It was obvious from the start of the conference that European countries were keen to find some additional frequencies in the lower frequency bands.

There was even discussion concerning high powered transmitters in the tropical band of 60 metres. While this was not agreed to, a small expansion of the 49m band was decided upon.

New Zealand and Mexico protested against any increase in allocation below 10MHz, as it would interfere with the utility services operating in their areas. It is worth noting that Radio Nederland recently announced that it could not serve its audience in Europe because of the congestion of the low frequency bands during falling sunspots — it would have to broadcast to Europe from its relay base in Bonaire.

The decision was made to add a further 200kHz to the lower frequency bands: the 49m band (at present 5950 - 6200) now goes down to 5900; 41m band (7100 - 7300) extends up to 7350; the 31m band (9500 - 9775) now extends down to 9410; and the bands above 10MHz are given a further 590kHz expansion.

The realisation that the broadcasting bands are over crowded was a unanimous view of those attending the WARC, and was adopted by the meeting.

It was also recognised that there are more than 60 administrations operating shortwave transmitters outside the recognised bands.

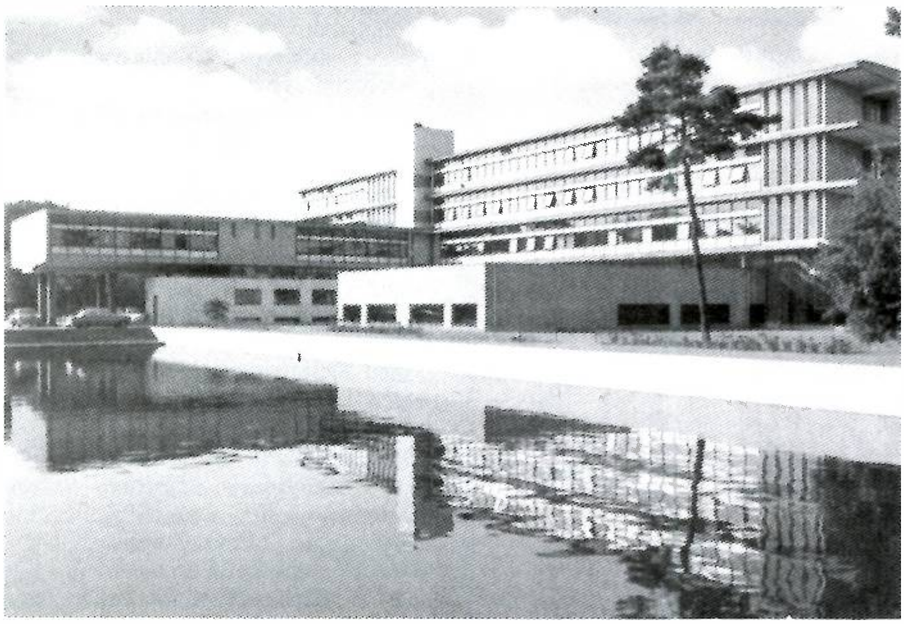
It was these unofficial areas being used by broadcasters, which the WARC looked at as being made a permanent area for broadcasting.

One of the proposals put forward by the European delegates was for an expansion of over 700kHz below 10MHz, and 800kHz above 10MHz. However, this was felt to be too liberal, so the allocations proposed were not agreed to. Only a small official extension on each band is expected to be made in the future.

Over 1000 delegates attended the conference, representing almost every country with an interest in communication. The conference not only covered broacasting and television, but satellite.

This latter topic took a major part of the time, as the broadcasters were looking for frequencies for new satellite transmissions, so that direct broadcasting by satellite could occur in the future.

Meanwhile, radio amateurs were keen to see their present band allocation maintained — in fact, proposals were made to increase the use of the 41 metre band, and to allocate 200kHz of that band solely for the use of amateur radio.



Studio buildings of Radio Nederland, Hilversum, Holland, where programmes originate, not only for transmission at a nearby transmitter site, but from Bonaire and Madagascar as well.

Voice of America looks to Asia

President Bush recently set up a Task Force to look at US Government International Broadcasting, and in particular, to increase broadcasting towards Asia. The Task Force, according to Radio Nederland, examined three aspects.

Firstly, if the US Government broadcasting organisations Voice of America, Radio Free Europe and Radio Liberty could be combined into one organisation.

Secondly, to look at new technical developments.

And thirdly, to find out if Government Broadcasting could cooperate with private enterprise.

Most of the findings concerned the first point, the re-structuring of US Government Broadcasting Services. The Task Force found that the three organisations should retain their own identities as they broadcast different types of services. It was also found that the VOA transmissions were weak in parts of Africa, Asia and Latin America; and it is to Asia that emphasis on better service is to be directed.

One idea is for a Radio Free China, or a Radio Free Asia. A Radio Free Asia would have a broader area of transmission not only broadcasting to China, but also to North Korea, Vietnam, Laos and Cambodia, depending on political developments.

The majority of the Committee of 11 voted in favour of Radio Free Asia, so this should be part of the expansion of the Voice of America. This expansion into Asia is an ongoing project, and a further committee is looking at putting the ideas into practice.

The Voice of America at present depends on its mediumwave transmitter in Thailand, which will soon be expanded with a shortwave facility, as well as its transmitters in Sri Lanka and the Philippines.

Tongan Radio returns

The devastating hurricane that hit the South Pacific last December caused damage to many broadcasters in the area. Shortwave listeners were aware that the broadcasts of the Tonga Broadcasting Commission on 5030kHz had disappeared.

Following a phone discussion with the Senior Technican, we now know that the building in which the 1000W shortwave rtransmitter was housed was severely damaged, but that the transmitter itself is intact. Also, the mediumwave outlet on 1017kHz was able to remain on air because it was located in another building.

During March, the shortwave transmitter was moved to this other building and came back on the air on 5030kHz, with 1000W, broadcasting 1750 - 1000 daily. To improve the signal the height of the tower used by the shortwave transmitter has been increased.

According to the spokesman at Nuku'alofa, there has also been a loss of staff, so no-one is available to verify reception reports, but he plans to do this work himself.

Kuwait again broadcasting

Kuwait is back in operation after the Gulf War, and is carrying broadcasts in Arabic and English. A 500kW transmitter is being used to broadcast the Arabic programming, and additional transmitters are being added for other services.

It was in August 1990 that the site was captured by the Iraqi Forces, and in February 1991 it commenced its programme called 'Mothers of Battle Radio'.

Once this occurred, the order was given by the American Airforce to take out the transmitting site. The transmitting hall was blown away completely, but the antennas were left standing.

Repairs have been underway and according to Media Network of Radio Nederland, the transmitting complex will gradually come back into full operation.

Radio Iraq International

Another country involved in the Middle East conflict is back operating with a shortwave service. With its new slogan 'Radio Iraq International', Baghdad has been heard with a broadcast in English.

The transmission is 0100 - 0200 on 15,150kHz, and opens with a five minute bulletin in English, followed by a short commentary. The balance of the programme is in Arabic, except for a short English announcement given when closing at 0200, asking for reception reports to be sent to Radio Iraq International, PO Box 8145, Baghdad, Iraq.

Baghdad has already been heard with Arabic transmissions, but this is the first reception of an English programme which is actually beamed for reception in North America. ❖

AROUND THE WORLD

ALGERIA: Radio Algiers broadcasts in English 1700-1800, and is heard on 17,745kHz. Following news and commentary when the station signs on, there is generally popular music. At 1730 each day there is a feature programme which on Mondays, covers the African sporting scene.

GREECE: Athens has a new interval signal which is heard before the commencement of broadcasting. It replaces the old 'cowbell' type theme, known to listeners over the past 40 years. The new interval signal is an orchestral version of the old theme but without the bells, and is based on the same background music. The original theme 'Once I Was a Shepherd Boy' — a folk song played on native flute and sheep bells — is still heard for a few seconds after the station signs on. Athens is heard in many transmissions and during our winter, the broadcast at 2100 on 9425kHz provides the best reception.

ITALY: One of the private stations operating in Italy is the Voice of Europe, which is now on 13,666kHz and its broadcasts have been heard around 1900. Programmes are of popular music, with a recorded English announcement every 20 minutes in which a woman gives the slogan and address. Reports should be sent to the Voice of Europe, PO Box 26, 1-33170, Pordenone, Italy.

LITHUANIA: Radiocentras Vilnius broadcasts on the last Saturday of each month at 0700 on 9710kHz in English, giving a full sign-on announcement including transmitter site and power (50kW). The hour long session includes popular music and answers to letters received from listeners all over the world.

NETHERLANDS: Radio Nederland has made some frequency changes for its service to the South Pacific. English is now broadcast 0730-0825 on 9630 and 11,895kHz; 0830-0925 on 11,895kHz; and 0930-1025 on 9720 and 11,895kHz. The popular Media Network programme is heard on Thursdays at 0750 and 0950 and these transmissions come from the studios in Hilversum, Holland.

NORWAY: The latest shedule from Oslo lists broadcasts in English to this area at 12200 and 1900 on 17,860 and 21,705kHz; and 2100 on 17,735 and 21,705kHz. Broadcasts are heard on Saturday and Sunday only.

RUSSIA: New commercial stations continue to appear and the latest is a station with the slogan 'New Wave Radio' which has been heard with short announcements in English at 0700 on 15230 and 15,560kHz. The broadcasts are at 0700-0800 on 17,00-2000 on Tuesday, Wednesday, Friday and Sunday.

Another new station is Radio Galaxy on 9880kHz, Broadcasting from Moscow at 2000-2300. According to Media Network on Radio Nederland, the station broadcasts business news.

USA: Broadcasting from Upton, Kentucky a new gospel station with the call WJCR is operating with four 50kW transmitters. The transmitters are used in parallel, one beamed to Europe and the other to Latin America.

The broadcasts are 24 hours a day and the frequencies allocated are 7485 and 15,660kHz. The station broadcasts around 20 hours of gospel music and four hours of Bible reading in its daily schedule. The call sign stands for 'Where Jesus Christ Reigns'.

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

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.

June 1942

Smashing the atom: From time to time throughout the last ten or fifteen years, reports have appeared in the newspapers of scientists who have progressed another step towards 'smashing the atom'.

Like most people you said to yourself, "Why bother about smashing an atom? Where does that get you?" and later you probably read that in the atom, just waiting to be released, were forces of power that dwarf the energy of our present power sources — coal, oil and gas — just as Mount Everest dwarfs an ant hill.

If and when atomic energy is successfully harnessed as a source of motive power, streamlined trains will thunder across vast continents, carrying no more fuel that the driver could conceal in the palm of his hand.

Automobiles might easily have a 'built- in' supply of fuel which would last for the lifetime of the car! Although apparently fantastic, even to modern minds, such possibilities have been opened up by modern science.

Death house drama: Remarkable action of the heart of a man executed in a gas chamber has been recorded by scientists. In three minutes the heart raced through the changes normally occurring in the last 20 years of the man's life.

It ceased pumping blood to the brain three minutes after the gas had been released, but twitched for about five minutes afterwards. The scientists recorded the heart action on a film, using a newly-developed device.

The victim cheerfully consented to having the elaborate recording paraphernalia strapped to his bare chest.

June 1967

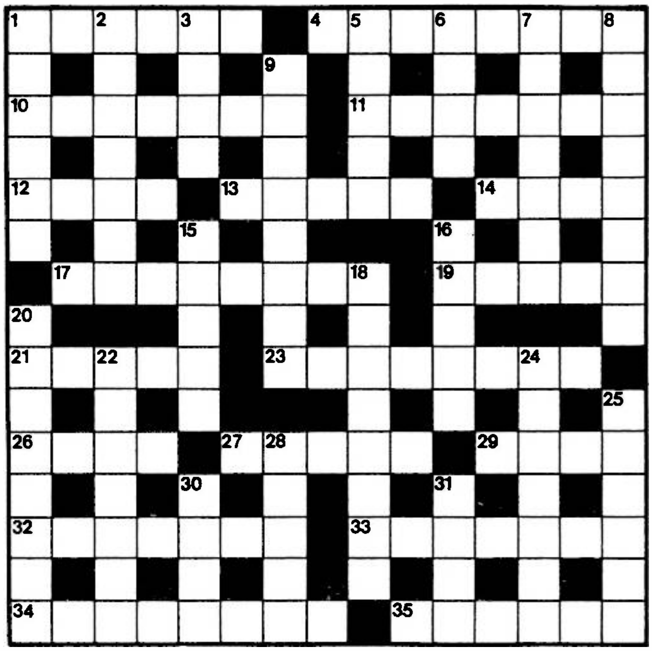
British colour TV: In about six months from now, Britain will begin regular transmission of colour television, bringing a rosy glow of relief from the dreary winter months, to those able to afford the extra expense of the colour televisions set. This initiation of Britain's colour service culminates the bitter and prolonged battle which has been going on in Europe over rival colour TV systems for several years.

There are, broadly, four possible systems of transmitting colour pictures, all closely related members of the same technological family, and each with its own merits. They are NTSC (developed by the Americans and also now in use in Japan), SECAM III (developed by the French), SECAM IV (a Russian adaptation of the French system), and PAL (developed by the Germans).

In Oslo, in July 1961, six countries chose NTSC on 525 lines, two NTSC on 625 lines, 33 SECAM or SECAM III, 16 PAL, and four SECAM IV. So much for unity!

It is to BBC's credit that, although its engineers slightly prefer NTSC, it fell in with PAL to conform with the majority of west European countries. ❖

EA CROSSWORD



ACROSS

1. Reserve data. (6)
4. Control on keyboard. (5,3)
10. Name of an absolute temperature scale. (7)
11. Opposite operation. (7)
12. Electrical appliance used flat out (or at scorching pace). (4)
13. Unit of frequency. (5)
14. Item absorbing electrical energy. (4)
17. Storage devices. (8)
19. Such is a chip-fabrication room. (5)
21. Energise. (5)
23. Process of repeatedly measuring a variable. (8)
26. Unit prefix with symbol T. (4)
27. Alert from a security system. (5)
29. Natural source of radio. (4)
32. What exhaust fans do. (7)
33. Said of an unvarying field. (7)
34. Device passing double signals. (8)
35. Electrical connector. (6)

DOWN

1. City associated with Planck's work. (6)
2. Control desk. (7)
3. A digit value. (4)
5. Increase potential energy. (5)
6. Value indicated by green band on resistor. (4)
7. Sing-along system. (7)
8. Giving up resistance. (8)
9. Servicemen find these for ailing equipment. (8)
15. Base for circuitry. (5)
16. Series of graduations. (5)
18. Useful rare-earth element. (8)
20. Electrically fuse together. (4-4)
22. Eavesdrop on telephone line. (4-3)
24. Group of interconnected systems. (7)
25. Helping message given to computer user. (6)
28. Machine that's electric with transverse spin. (5)
30. Attenuate. (4)
31. The 11-across of 26-across. (4)

SOLUTION FOR MAY

EA with ETI marketplace

ADVERTISING RATES FOR THIS PAGE

SMALL ADS: The minimum acceptable size of 2 centimetres x one column costs only $50. Other sizes up to a maximum of 10 centimetres are rated at $30 a centimetre. **CLASSIFIEDS:** $4 for 40 letters. Just count the letters divide by 40 and multiply by $4, ROUND UP TO THE NEAREST WHOLE NUMBER. **CLOSING DATE:** Ads may be accepted up to the tenth of the month two months prior to issue date. **PAYMENT:** Please enclose payment with your advertisement. Adress your letter to: **THE ADVERTISING PRODUCTION MANAGER, ELECTRONICS AUSTRALIA, P.O. BOX 199, ALEXANDRIA NSW 2015 FAX: (02) 693 9997**

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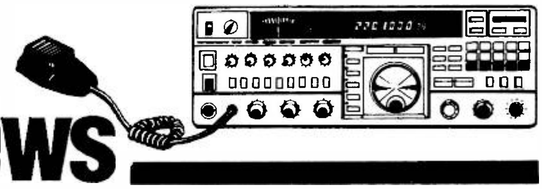
Amateur Radio News



DoTC and spread spectrum

With the growing interest in spread spectrum techniques among amateurs, the WIA apparently asked the Department of Transport and Communications recently for clarification regarding the application of document RIB 71, paragraph 39 to spread spectrum emissions by amateurs. And according to a somewhat puzzling report in the April issue of *Amateur Radio*, DoTC's response was rather disconcerting.

Dr Owen Lee Kidden VK1APR, who is described as a lecturer in Digital Signal Processing at ANU in Canberra, is reported as having advised the WIA that DoTC still requires amateur stations to listen on frequency and to identify, either by voice or Morse code, at the start and end of each transmission.

Such a requirement would obviously be impractical in the case of spread spectrum operation, as by their very nature SS signals are spread over a relatively wide band of frequencies at very low levels. If true, the DoTC requirement would also pose difficulties for people experimenting with 'frequency hopping' techniques.

'Dr Kidden' is quoted as commenting that "DoTC is completely missing the point of spread spectrum operation. When frequency hopping, the signal is only on a particular frequency for a few tens of milliseconds. If the operator must prefix each 'hop' with a QRL and station ID, the benefit of the mode is totally lost. When employing true spread spectrum, the situation is even more ludicrous, as at any particular frequency the signal level is near the noise floor, so nobody will hear the identification anyway."

"I blame the UK for this silliness", continued Dr Kidden. "They started it all, by requiring packet operators in the UK to identify in CW as well. It seems some British civil servants have migrated down here. Perhaps the military origins of spread spectrum are stirring up paranoia in Canberra."

The fact that the story was published in the April issue of *AR* may have some relevance regarding the name of 'Dr Kidden' and his callsign. We understand that the story actually came from Richard Murnane VK2SKY, whose tongue was perhaps planted firmly in his cheek.

But jokes aside, what *are* the DoTC requirements regarding SS and frequency-hopping? We suspect quite a few amateurs have been left rather confused...

6m records, callsign comment

Following publication of our March issue, we received a letter from John Martin VK3ZJC the chairman of the WIA's Federal Technical Advisory Committee (FTAC) — giving news of a new national record for 6m contacts, set by VK2QF. The contact was with CU3/N6AMG, and was over a distance of 19251.3km. Congratulations to VK2QF and CU3/N6AMG for this achievement, and thanks to VK3ZJC for his update.

Incidentally VK3ZJC suggests that anyone wishing to claim a VHF-UHF record can write to him, care of the WIA Federal Executive, at PO Box 300, Caulfield South 3162. QSLs or certified copies are required, plus the co-ordinates of both stations. Record holders receive a certificate from the WIA in recognition of their achievement, and all original cards are returned to the sender.

VK3ZJC also comments on the letter published in our February issue, stating that the callsign 6PM-FM was wrong and should have been 'PMFM'. He points out that in fact *all* radio callsigns in WA start with a '6', whether or not the licensees like it or not, and that the '-FM' is not in fact part of the callsign. He notes that the DoTC database lists the callsign of the station in question as 6PPM, and that maybe DoTC is the best authority on the callsigns of the stations they license!

SE Radio Group Annual Convention

The South East Radio Group has asked us to remind readers that its Annual Convention will only be days away when this issue is published — being planned for the weekend of June 6-7.

This year they have many interesting events planned, including the Australian Fox Hunting Championships and the Home Brew Competition — which this year will be split into a number of sections, to cater for everyone from Novice to Expert.

Strangely, the SERG doesn't provide a reminder about *where* the Convention is being held, or radio contact arrangements. However their mail address is SERG, PO Box 1103, Mt Gambier SA 5290.

MWRS 6m repeater

The latest newsletter to reach us from the Manly Warringah Radio Society advises that modifications to their 6-metre repeater had been completed by Steve VK2KFJ. Peter VK2KHZ had also completed construction of two new J-pole aerials for the repeater, which were ready for erection and testing. Apart from this and the addition of an aerial filter to the receiver, the Society was hoping to be able to carry out tests on 53.675MHz in the very near future.

Note to club PR officers

As we've advised on various occasions in this column, *EA* is happy to publicise the activities of radio clubs and societies. However some club publicity officers apparently aren't aware of the realities of magazine production, sending us information on upcoming events only a week or two ahead of the event itself. This means we can't help, because by the time we could publish anything the event will be history.

So club publicity officers please note: we need to receive material at least seven or eight weeks ahead of publication date, if it is to be in the running for publication in a particular issue. Ideally you should send us information even further ahead (say three months in advance), so your material has a chance of being considered for a couple of issues. ❖

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NEWS HIGHLIGHTS

OPTUS TO LAUNCH MOBILESAT IN 1993

Optus Communications is to introduce a mobile satellite communications service (Mobilesat) in the second half of 1993, using the new Optus B Series satellites. The service will become part of Optus' mobile communications product line, complementing the cellular mobile telephone services to be introduced in June and carried from 1993 via Optus' own digital GSM network.

Designed and developed by Aussat, Mobilesat will provide mobile and fixed voice, facsimile and data services anywhere in Australia via satellite.

The service will enable communication from both moving vehicles and fixed locations, directly to the satellite, and will be linked into the normal telephone network to allow calls to be made anywhere in Australia or internationally.

It will take advantage of the 150W L-band transponder in each of the B Series satellites. These allow subscriber uplinking at 1.65GHz and downlinking at 1.55GHz, using compact terrestrial antennas.

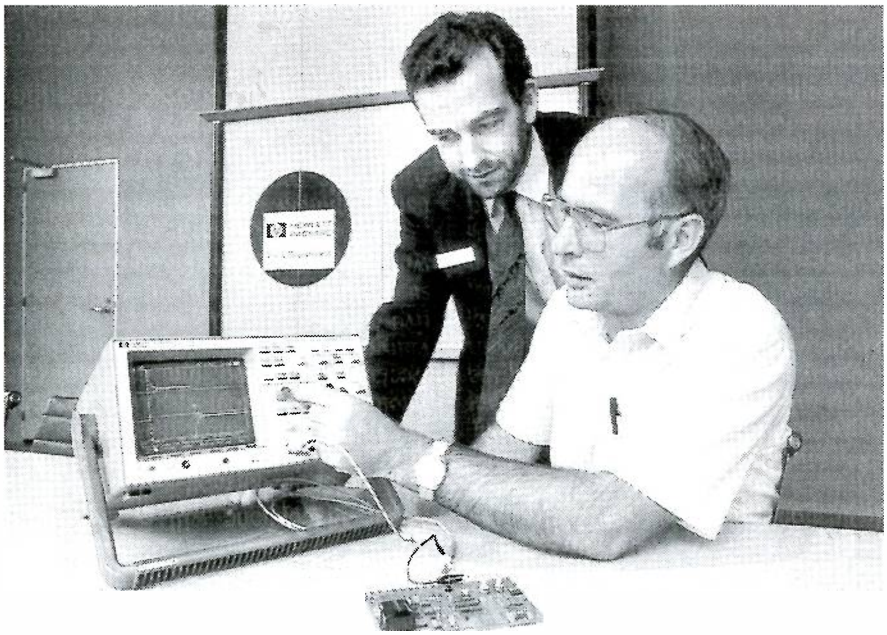
Network uplinking and downlinking will be via Ku-band transponders, at 14.5GHz and 12.5GHz respectively.

Optus has apparently also signed a four-nation Memorandum of Understanding, to develop common standards for mobile satellite terminal equipment. The other signatories to the MOU are the American Mobile Satellite Corporation (AMSC) of Washington, USA; Telesat Mobile Inc (TMI) of Ottawa, Canada; and Industries SA de CU (IUSA) of Mexico City, Mexico.

According to Mr Buddy Neel, Director of Optus' Mobile Division, the MOU will greatly help in the development of low cost dual-mode cellular/satellite mobile terminal equipment, and will greatly enhance the considerable development work already undertaken by Optus.

Optus has also revealed that the aborted launching of its B1 satellite in late March was due to low thrust from two of the booster rockets on the LM2E vehicle. This caused automatic shutdown by a control computer, protecting the satellite from damage.

A further launch attempt was anticipated for June or July.



LUCKY SUBS PROMOTION WINNERS

The following *Electronics Australia* subscribers were lucky winners of a Uniden Bearcat 70XLT eight-band VHF/UHF scanner, in our March 1992 promotion:

Mr D.I. Bayliss, of Karuah, NSW.
Dr B.R. Moore, of Balhannah, SA.
S.D. Killen, of Roseville, NSW.
Killarney Heights High School, NSW.
DEC Logistics Repair Centre, Lane Cove, NSW.
Mr Maher, Picton, NSW.
Mr A. Abbott, Longreach, Qld.
Mr T. Doyle, Alexandria, Vic.
Mr P. Webster, Seaford, Vic.
Mr B.J. Miller, Orbost, Vic.

We hope these readers get full enjoyment and use from their Bearcats. Our thanks to Dick Smith Electronics for its sponsorship of this promotion.

Shown in the picture is Mr Geoff Beutel of Mount Waverley in Victoria, lucky winner of a Hewlett-Packard HP 54600A two-channel DSO in our immediately preceding promotion. Mr Beutel is shown trying out his prize, watched by H-P's T&M sales manager Peter Shaw.

An electronics technician with the Air Force, Mr Beutel is involved in providing logistic support of new equipment, and says that his HP 54600A will be put to very good use in development of his own projects.

ALCATEL TO SUPPLY AOTC'S GSM NETWORK

The Australian and Overseas Telecommunications Corporation (AOTC) has selected Alcatel Australia as a supplier for its new DSM digital cellular mobile phone network, currently scheduled to begin commercial operation in April 1993. The value of the initial contracts is approximately $35 million.

Telecommunications regulatory body Austel selected the European GSM standard as the basis for the Australian network, following a study of systems around the world. The choice of Alcatel as supplier of the network was based on the company's long-standing committment to, and on-going development work with, GSM technology in Europe.

Alcatel will be supplying AOTC with a complete integrated 'turnkey' network comprising radio base stations, digital switching systems (based on Alcatel 1000 S12 technology), location timebases, operation and maintenance systems and a range of GSM terminals.

Alcatel Australia has been conducting extensive trials of the new GSM network in Sydney for AOTC, which were scheduled for completion by mid year. Full network deployment is planned during 1992. The company has had a team of engineers based in France and Belgium since 1989, working with Alcatel Radiotelephone and Alcatel Bell on the development of GSM.

For the mobile telephone user, GSM will mean significantly enhanced transmission quality, international compatibility, virtually total security on transmission and expanded mobile services such as data and text transmission. Several other Asia Pacific countries are expected to adopt the European GSM standard this year, as the basis for their digital cellular networks.

MELB. UNI STUDENTS WIN WORLD CONTEST

Three Melbourne University students have won the ACM Scholastic Programming Competition — one of the most prestigious international computing contests — against top teams from universities around the world.

During the five-hour Grand Finals of the competition, held in Kansas City, Andrew Conway, Craig Dillon and Stephen Simmons successfully answered six of the seven questions — putting them well ahead of runner-up teams from Michigan State and Stanford universities, which both finished five questions and finished second and third.

The competition is the largest computer programming contest in the world, and has been held each year since 1976 in conjunction with the Association of Computing Machinery (ACM) Computer Science Conference. This year no less than 606 universities from Europe, Asia, America and the Pacific competed in the regional finals leading up to the Grand Final.

In recent years Stanford, Caltech and UCLA have dominated the competition, so Melbourne University's win is a fine achievement.

AMSTRAD SHOWS VIDEOPHONE, PLANS FOR AUST PAY TV

Amstrad has unveiled a working preproduction model of the world's first mass market colour videophone, at the CEBIT exhibition in Hanover, Germany. Amstrad Australia has also announced plans for a major expansion into telecommunications, satellite technologies and consumer electronics — including possible production of Amstrad satellite receiving dishes for Pay TV in Australia.

This follows the purchase by its parent company, Amstrad plc, of 29.5% of the telecommunications company Betacom plc for UK£1.65 million on February 28.

The new Amstrad colour videophone, developed by Amstrad in conjunction with GEC Marconi, is scheduled for introduction throughout Europe by the end of 1992. It could be available in Australia as early as next year.

The videophone is designed for use with ordinary public telephone networks, including the Australian Telecom and Optus networks, and is therefore expected to have very wide appeal.

Only 205 x 243 x 110mm, it has a hinged 128 x 96 pixel, 3" liquid crystal display colour screen, and is fitted with a CCD video camera with a 50° field of view. The screen has a freeze frame facility and contrast and brightness controls. Australian availability and pricing of the videophone will be announced after its approval by Austel.

Amstrad Australia's Managing Director, Bordan Tkachuk, said Amstrad's satellite technologies, the 'Double Decker' VCR and the new Amstrad videophone were "typical of the innovative electronics products with high consumer and business appeal that Amstrad will launch in the months ahead."

Although best known in Australia for its computers, internationally half of Amstrad's revenue comes from consumer electronics. It claims to be Europe's leading supplier of satellite TV equipment, with over two million sets sold since 1989.

Amstrad's products overseas cater for both conventional PAL and D2MAC broadcasts.

WARC 92 ENDS

The World Administrative Radio Conference (WARC 92) ended in Torremolinos, Spain, after global agreements were reached on most issues — on the basis of compromises achieved after strenuous negotiations. No vote took place on any of the substantive issues. The conference was attended by more than 1400 delegates from 127 member countries of the ITU, and by observers from 31 international and regional organisations.

In the area of HF broadcasting, a total of 790kHz of additional spectrum was added — of which 200kHz was below 10MHz and 590kHz between 11 and 19MHz. The extended bands are allocated on a worldwide basis, subject to planning, are reserved for SSB emissions and will become available for broadcasting on 1 April 2007.

The decisions made in relation to mobile and mobile-satellite services will enable the implementation of systems such as those provided by low earth orbit (LEO) satellites or future public land mobile telecommunications systems (FPLMTS), as well as public correspondence for airline passengers.

For mobile-satellite services operating

above 1GHz (including big LEO), allocations were made in bands near 1.5, 1.6 and 2GHz. In the 1.5GHz band, a new worldwide primary allocation was made to the Maritime-Mobile Satellite Service at 1525 - 1530MHz. As primary world wide allocations already existed in the bands 1530 - 1544MHz, there now exists a primary worldwide allocation for MSS from 1525 to 1544MHz.

The Conference also agreed to make available, on a worldwide basis, a primary allocation for the Broadcasting Satellite Service (BSS) in the band 1452 - 1492MHz. However a significant number of countries indicated, through footnotes, alternative allocation in this band, providing BSS sound broadcasting in either the 2310 - 2360MHz or 2535 - 2655MHz bands.

No compromise was found on a worldwide unique frequency allocation for wideband HDTV. Region 1 (Europe/ Africa) and Region 3 (Asia/Australasia) opted for the 21.4 - 22GHz band to become available as from April 1, 2007, while Region 2 (Americas) also opted for the 17.3 - 17.8GHz band to be allocated from the same date. Prior to this time, HDTV may be implemented pro-viding existing services are protected.

As WARC 92 did not free any spectrum space in the 7MHz area, a further worldwide allocation in this band to the Amateur Service was not considered possible.

MAGELLAN MOVES CLOSER TO VENUS

The Magellan spacecraft's orbit around Venus will be lowered later this year to just above the planet's dense atmosphere, to conduct gravity studies of Venus.

Magellan continues to map a region near the Equator of Venus to provide three dimensional, high resolution views of the highlands of Aphrodite Terra. The stereo mapping phase, which began January 26 near Maxwell Montes, the highest mountain on Venus, will end in mid-September said Project Scientists Dr Stephen Saunders. The orbit at its closest point to the planet will be lowered later that month. Magellan is in its third mapping cycle around Venus.

The spacecraft's closest approach to Venus will be moved downward from 186 miles to 111 miles above the surface, for maximum sensitivity to variations in the gravity field, he said.

Gravity is mapped by analysing slight variations in Magellan's radio signal sent back to Earth. Gravity mapping is planned for a complete 243 day cycle, or one Venus rotation, during the fourth cycle around Venus.

S-A DEVELOPING VIDEOCRYPT DECODER

Scientific-Atlanta Inc, in conjunction with Thomson Electronics and News Datacom, have announced their participation in the development of a new set-top terminal for international cable television and terrestrial markets. The terminal will incorporate the VideoCrypt signal security and scrambling system.

The new set-top terminal will include Scientific-Atlanta's new model 8600 'set-top' which eliminates a user's manual and confusing message symbols. Possible features for the new set-top are onscreen displays, individual and group message capabilities, and easy ordering and onscreen confirmation of pay-per-view purchases.

The new terminal will also include the VideoCrypt system, with features such as smart card security, conditional access and scrambling technology.

General Manager of Scientific-Atlanta Australia Mr Steven Dean, said, "This will allow Scientific-Atlanta to address certain cable television and terrestrial Pay TV markets with an alternative option for security and picture scrambling."

UNSW SELLS $1M SOLAR CELLS TO JAPAN

NSW's Centre for Photovoltaic Devices and Systems has delivered its first consignment of the highest efficiency silicon solar cells commercially available anywhere in the world.

The purchaser, a Japanese corporation which wishes to remain anonymous at this stage, paid just over $1 million for the 2000 Green Cells made on the Centre's pilot production line in the School of Electrical Engineering. Professor Martin Green, Director of the Centre, presented the cells to Mr David Hogg, Technology Transfer Manager of Unisearch Ltd., who will pass them on to the customer.

Professor Green said the profits from the sale would be ploughed back into the Centre's research activities.

"These cells have been made using our patented laser-grooved process, in which the elements carrying away the electric current are buried in the surface of the cell," he said.

"We are naturally pleased with this sale. It demonstrates that there is a market for premium quality cells at a premium price and it helps speed up research at the Centre."

"By accelerating our work at the Centre, we expect to bring closer the time when photovoltaic cells will be seen to be truly competitive with other energy sources," Professor Green said.

INMARSAT FILES FOR MSS FREQUENCIES

Inmarsat has filed for frequencies just allocated to mobile satellite services (MSS) at the recently concluded WARC (World Administrative Radio Conference), to enable it to provide global handheld telephone services by the end of the decade.

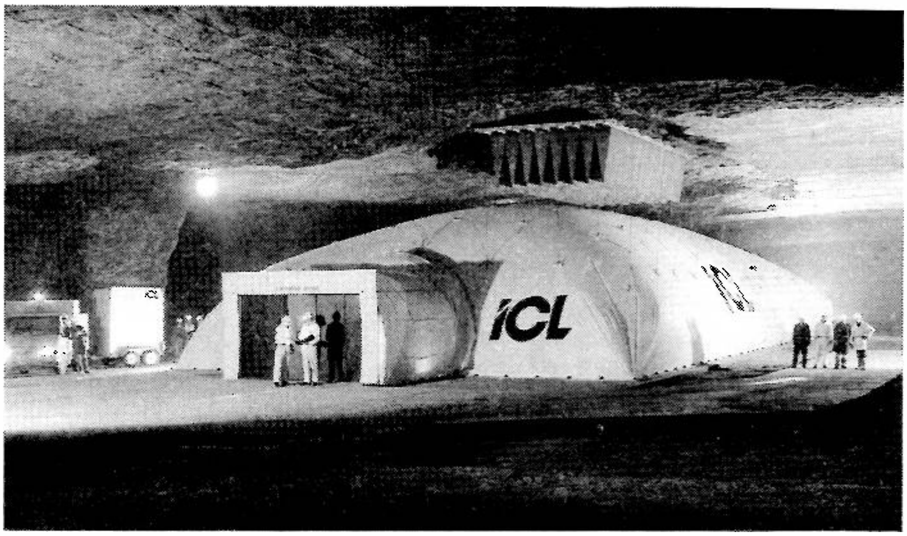
The filings were submitted to the International Frequency Registration Board (IFRB) which coordinates the use of fre-

Telecom Industries has designed and built prototypes of two wooden wall-mounted reproduction telephones, for use by period home restorers. If sufficient demand exists, the company will manufacture small batches.

quencies worldwide. They apply for frequencies set aside by WARC for mobile satellite services (1616 - 1626.5MHz and 2483.5 - 2500MHz; and 2170 - 2200MHz and 1980 - 2010MHz), and include plans for both geostationary and low earth orbiting satellites.

There was a general recognition at the WARC that these MSS frequencies will have to be shared with existing and future satellite and terrestrial users, necessitating extensive coordination to preclude problems of interference. Inmarsat is now developing alternative system designs for its global handheld mobile telephone system, taking full account of the decisions taken at WARC by minimising the potential for interference.

"Inmarsat is confident that it can coordinate with existing users and other future providers of MSS and will ensure the technology under consideration for its handheld telephone system makes that possible," said Olof Lundberg, director general of Inmarsat.



The increasing levels of electronic noise in our atmosphere have made accurate testing of EMI emissions and sensitivities of equipment increasingly more difficult. British computer company ICL has tackled the problem by going underground — it now tests equipment deep down in a salt mine in Cheshire.

TOSHIBA DEVELOPS DIGITAL VCR FOR HDTV

Toshiba Corporation has developed a prototype digital VCR using 3/4" cassette tape. The new compact and lightweight device offers the same high quality picture and sound as current 1" open reel HDTV digital video tape recorders.

The new equipment can record up to 64 minutes of high definition digital video and audio signals on a 3/4" tape, at twice the recording density of open reel HDTV digital VTRs.

It is designed to meet the 1125-line HDTV studio standard (SMPTE 240M), and is expected to be widely used by broadcasters, video production houses and studios. Toshiba plans to introduce a commercial product to Japan in 1993.

Realising a digital cassette recorder for high definition programs has been a high priority for the industry, as a VCR offers size and weight advantages over open reel VTRs and reduces total HDTV system size. However, there are several issues to be resolved; among them, stable contact between the rotating drum and the video tape is the most important, as digital cassette recording requires faster drum rotation.

In order to improve stability, Toshiba researchers optimised the drum structure and widened the grooves on its surface. The grooves absorb the air between the tape and drum and stabilise the head/-tape contact.

Toshiba also developed smaller and wideband dedicated amplifier ICs for both recording and playing back high speed data, which can be mounted on the rotating drum due to their low power consumption.

The new digital VCR uses 16 amplifier ICs for recording and playing back, respectively, to realise a 1.2Gbps data transfer rate — five times faster than for the current NTSC system.

AUSTEL TARGETS ADVERTISERS

Advertisers who fail to disclose that a phone does not have an AUSTEL permit risk criminal proceedings.

"The risk is real," said Dr Bob Horton, Executive General Manager of AUSTEL's Technical Division. "The competitor is the best policeman and there are a lot of competitors read to blow the whistle on opposition advertisements which do not meet the requirements of the Telecommunications Act."

Anyone supplying or offering to supply equipment such as telephones, facsimile machines or modems which do not have an AUSTEL permit will notify the purchaser in writing about the consequences of connecting it to a telecommunications network.

A precise form of words has been declared under the Telecommunications Act. Advertising material is required to contain a notice substantially in the following form -

This customer equipment has no AUSTEL permit and may be dangerous or damage a telecommunications network. Connection to a telecommunications network is an offence under section 253 of the Telecommunications Act 1991 and may attract a maximum fine of $12,000.

The onus is clearly on suppliers, including any advertiser, to inform consumers that the equipment offered for sale does not carry an AUSTEL permit.

NEWS BRIEFS

- Siemens has appointed ***Advanced Component Distributors*** (ACD) as Australian distributor for its range of semiconductors and passive components.
- ***Integrated Networks*** has appointed Mr Martin Klador as General Manager, replacing Mr Andy Larson who has been promoted to head a new division in the parent company.
- ***Standards Australia*** has released the AS 3508 standard for printed board assembles, Part 4: Acceptability of printed boards and soldered joints. Comments are requested for several drafts on converters, power supplies and telecommunications cables (DR 92044-92056).
- ***Fairlight ESP*** has appointed John Lancken, formerly of Amber Technology, as International Sales Manager.
- ***Auto-ID Asia '92***, an automatic identification technology exhibition, will be held at the World Trade Centre, Singapore, Sept.1-4, 1992. For more information, contact the organiser, Business & Industrial Trade Fairs, Singapore (65) 278 3900.
- ***Yamaha Australia*** has announced the formation of the 'Pro Digital Group', to provide direct access to its digital audio technology for the professional audio and broadcast markets. ❖

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Low noise microwave amps

Miteq has introduced a new family of low noise figure microwave amplifiers, with a frequency range from 1 - 20GHz, a noise figure down to 0.8dB max, and gain up to 32dB min.

For further information circle 275 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999.

80MHz op amp

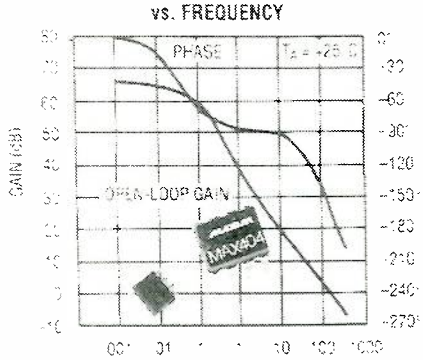
The new Maxim MAX404 is a high speed operational amplifier, optimised for AC performance, output drive and stability, while operating from +/-5V supplies. Ideal for video and other high speed applications, this op amp features a 500V/us slew rate, an 80MHz gain bandwidth, and 0.01/0.05% differential phase/gain.

Unlike current feedback amplifiers, it is not limited to low gain, non inverting applications. The MAX404 can be used in virtually all high speed op amp applications because it has a fully symmetrical differential input, 70dB common mode rejection ratio (CMRR), and 66dB open loop gain.

The MAX404 also remains stable while driving unlimited capacitive loads. As a result, flash analog-to-digital converter inputs, long distance coaxial cables, and other large or varying capacitive loads can be driven without output oscillations.

As a 75 ohm back terminated video coaxial cable driver (AVCL = 2, VOUT = 2Vpp), the power bandwidth is greater than 64MHz, which ensures the NTSC, PAL or SECAM video signal is well within the op amp's slew rate capability.

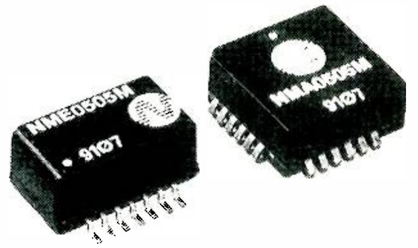
OPEN-LOOP GAIN & PHASE vs. FREQUENCY



And with a guaranteed 50mA continuous output current, as many as three 150 ohm loads can be driven to +/-2.5V for video distribution applications.

For further information circle 274 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

Surface mount DC/DC converters



Newport Components has launched its NME and NMA series of surface mount DC/DC converters.

The two series feature single and dual outputs respectively, and both the 1W NME05XXM and 750mW NMA05-XXM/12XXM have 100kHz switching; +/-10% load and 1/1.2% line voltage regulation with +/-5% output voltage accuracy. The NME 05 offers 5, 9, 12 or 15V from 5V, while the NMA 05/12 provides +/-5, +/-9, +/-12 or +/-15V from 5 and 12V respectively.

For further information circle 276 on the reader service coupon or contact Alpha Kilo Services, PO Box 180, Lane Cove 2066; phone (02) 428 3122.

Fast codec/filter for digital phones

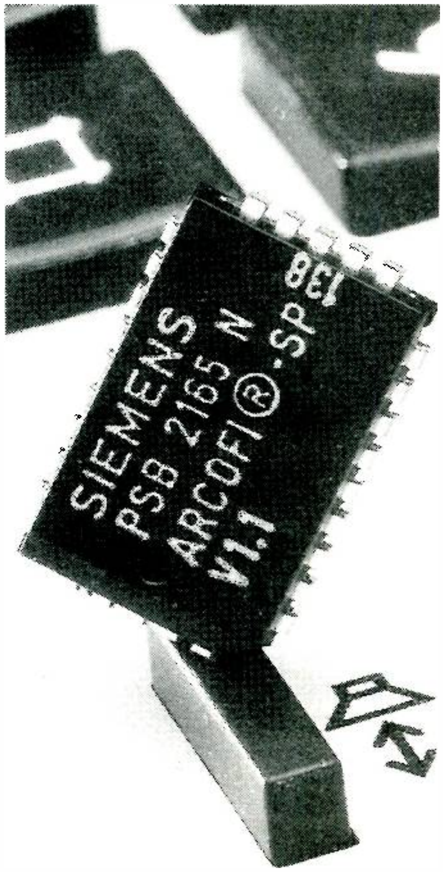
Siemens has introduced a codec filter for digital telephones that includes speakerphone switching capability claimed to be more than 100 times faster than any speakerphone switching capability on the market.

The highly integrated codec, called the PSB 2165 'Audio Ringing Codec Filter featuring Speakerphone Function' (ARCOFI-SP), replaces 20-40 components required for typical hands free speakerphone designs. This approach makes design and implementation easier, increases reliability, requires less energy and reduces the space needed inside the phoneset by 40-50%.

The ARCOFI-SP will be used in digital telephones, voice/data terminals, voice-featured PC cards, video terminals, multimedia workstations and cellular telephones.

A digital signal processor (DSP) performs all codec functions — which means that a design can be customised through software, wiring is reduced and layout testing is simplified. The ARCOFI-SP offers traditional codec functions including filtering and flexible tone, ringing and DTMF generation in one chip. It also provides full digital speakerphone support without microprocessor support during operation, and without external components.

For further information circle 272 on the reader service coupon or contact Siemens Components, 544 Church Street, Richmond 3121; phone (03) 420 7111.



High temperature op amps

National Semiconductor's LMC660 and LMC662 are now offered in the extended temperature range (-40°C to +125°C), demanded by automotive and industrial control applications.

The new devices were developed in response to the higher-temperature requirements of underhood engine-control units, where the ambient temperature can easily rise above +85°C. While this feature makes the devices especially well-suited for automotive applications, both op amps can be used for industrial control and other extended-temperature-range applications.

The new op amps have an extremely low input bias current of 40fA. This feature is especially important for low leakage sample-and-holds in process monitoring applications. Both devices operate at a supply current of 376uA/amplifier (typ). The ability to dissipate less power means long operating life times and a more effective use of valuable board space. Specified for operation from +5V to +15V, the LMC660 and LMC662 have an input common-mode range that includes ground. In addition, the devices are fully specified to drive 600 ohm loads. This enables them to process audio in telecom and cellular radio applications.

For further information circle 277 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766.

HF signal processor

Burr-Brown's OPA660 is a new IC designed to simplify and lower costs for complex, high frequency signal processing. Its wide bandwidth, fast slew rate and low differential gain/phase error make the OPA660 a valuable 'building block' for HDTV cameras, network analysers, and various types of communications equipment. Within such applications, the advanced circuit topology of the OPA660 allows designers to achieve excellent dynamic performance, using less power and board space than standard transistor-only solutions.

The monolithic device combines a voltage-controlled current source and a separate voltage buffer in a compact 8-pin plastic DIP or surface mount package. The operational transconductance amplifier, or OTA, acts as an 'ideal' transistor but is also self biased and bipolar. By programming the quiescent current using a single external resistor, users can optimise bandwidth and gain tradeoffs quickly and easily.

The complementary emitter-follower type buffer section provides wide bandwidth and fast slewing. The OTA and buffer sections can be interconnected to create a current feedback amplifier. Key specifications for the buffer section are the 700MHz bandwidth, 3000V/us slew rate, 0.06% differential gain error, and 0.02% differential phase error. Transconductance for the OTA section is 125mA/V.

For further information circle 278 on the reader service coupon or contact Kenelec, 48 Henderson Road, Clayton 3168; phone (03) 560 1011.

Small outline SMT package

TI has released a new 'thin scaled small outline package' (TSSOP), to meet customer requests for space restricted systems. These requests include handheld cellular telephones that have a 2.0mm height restriction; 2-1/2" hard disk drives for which existing surface mount packages will be too large — IC packages will need to be no more than 1.40mm in height; and new systems designed for multiple boards to be stacked vertically, to conserve space. TSSOP has the following dimensions for the 20-pin version:

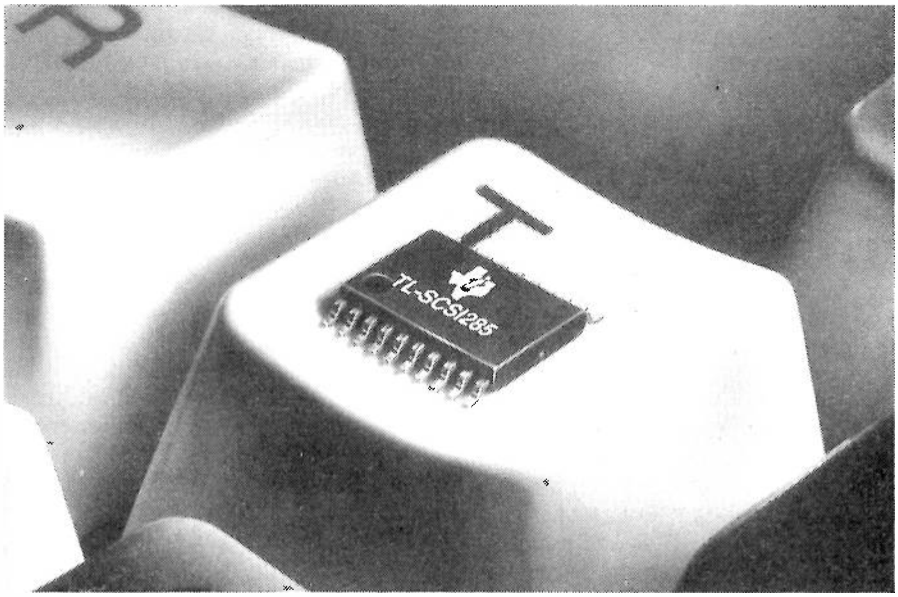
height	1.10mm	maximum
lead pitch	0.65mm	typical
width	4.40mm	
length	6.50mm	
lead-to-lead width	6.40mm	

The TSSOP will also be available in 8, 14, 16 and 24-pin options. For all options, the TSSOP height, width and lead pitch remain the same — only the length changes.

The first TI linear devices to be made available in the new TSSOP package are the TL-SC1285 and the TL2217-285 fixed voltage regulators for active SCSI termination.

The package will be available for new and existing standard linear devices, including op amps, comparators, special functions, voltage, regulators, voltage references, building blocks and supervisors.

For further information circle 271 on the reader service coupon or contact Texas Instruments, 6 Talavera Road, North Ryde 2113; phone (02) 878 9000.



3.3V microprocessor

Motorola has announced an addition to its 68300 family of 32-bit integrated microprocessors: a low voltage version of the 68340 integrated processor with DMA (direct memory access). The new device is suitable for powering handheld and battery powered equipment, such as computers, instruments, data entry and communications terminals, games, weapons guidance systems, CD-ROM and CD-I systems.

The 3.3V 68340V is identical to the original 5V 68340, except for the electrical specifications. Both devices are fabricated using the same masks. The new 68340V dissipates just 140 milliwatts (mW) from a power supply of 3.3 volts, when clocked at 8.3MHz.

By contrast the 5V 68340 dissipates 650mW when clocked at 16.78MHz. At the heart of the 68340V is a CPU32 processor core, which is based on the 68020 and provides three times the performance of the original 68000. The CPU32 connects to the internal peripheral circuits via an intermodule bus which is common to all 68300 family members.

For further information circle 279 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711. ❖

Software emulates basic CPU operation

Nowadays, the CPU in most computers is a single chip — a miniature sealed 'black box'. Which poses a problem for teachers and students of computer science: how do you demonstrate how a CPU works, when you can't get inside one? The author has developed an interesting software package for PC's, which solves this problem.

by FRED STRATFORD

This article is the first of two, about computers. It is not just a review of yet another super-fast appliance computer, but addresses the 'nitty gritty' questions about how a computer actually works. It looks inside the CPU (Central Processor Unit) and how it interacts with the memory and I/O devices, as well as how instructions execute using the circuits inside the CPU. As such, it is part of a long tradition in this magazine of trying the broaden the knowledge of its readers.

While this tradition was long established before 1974, there was a milestone event in September of that year, when Editor Jim Rowe published the first of a series of articles describing a scaled-down minicomputer for home construction. This computer was called the EDUC-8 — for 'Educational Digital Micro(u) Computer' — and represented a scaled down version of the then very successful and popular Digital Equipment Corporation's PDP-8 minicomputer.

The design was inspired by the lack of details about computer circuits as found in textbooks and other information sources. A quote from Mr Rowe's first article illustrates a point which has as much validity today as it did then: *...there are few books if any from which one can get more than a superficial understanding of the nitty gritty of computers...* There are books which describe computer architecture, but these tend to be esoteric — using a complex descriptive language rather than actual circuits or block diagrams.

In this context the EDUC-8 was a great design. It used commonly available integrated circuits to implement a computer which was practical and could actually do something, yet was small enough that it could be built by an experienced — though possibly well heeled hobbyist. The estimated cost was around $300 in 1974 dollars. The actual design was quite modest however. It was built around an 8-bit word, with a limited instruction set and a total of 256 bytes of memory (yes, that's right: 256 *bytes*, NOT 256K bytes).

The project timing turned out to be unfortunate. The American magazine *Radio Electronics* turned out to have pipped *Electronics Australia* at the post, with an article describing a home construction computer based on the new Intel 8008 microprocessor. In terms of functionality this machine had a vastly greater instruction set and could address larger amounts of memory.

It was the thin end of the wedge, and while the cost of microprocessors was initially high, their increasing popularity and consequently increasing volume of production quickly drove prices down. In addition, competition saw increasing numbers of ever more powerful microprocessors on the market.

Few hobbyists could justify building two computers. The choice often came down to the EDUC-8 with its excellent educational potential, but limited expandability and software, or one of the 'evaluation kits' which were emerging from the microprocessor manufacturers. These kits contained just enough hardware to make a small computer which did something.

By and large these kits were meant for use by developers of industrial and commercial systems, and were often very limited in the way that they could be expanded. However despite their limitations they usually came with excellent documentation, which explained exactly how the system worked and how a computer for any purpose could be designed.

The documentation alone was worth a

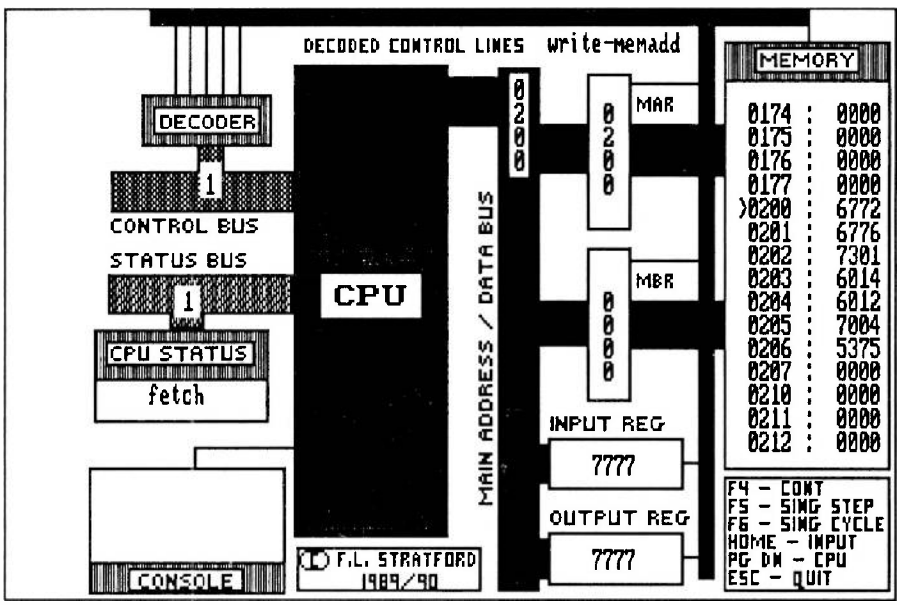


***Fig.1:** The main display graphic produced by the author's EMUL-8R emulator program looks like this, and shows the status of all main computer components along with the most relevant area in memory.*

mint, as it was general enough to be useful in forming concepts. In addition the evaluation kits seemed to offer a path to useful software such as assemblers, editors, and BASIC interpreters.

Many enthusiasts were waiting eagerly for an opportunity to own and use a computer that was 'theirs', and the opportunity that these small systems provided was too much of a temptation to ignore.

Combined with the documentation referred to above, the result was an explosion in the knowledge in the community at large, about what computers could and could not do and their potential in a vast number of areas.

In most ways the microprocessor solution did not provide as detailed an understanding of internal computer details as did the EDUC-8, but few individuals could justify building the EDUC-8 with its limited future potential as a useful computer. (Useful is defined as one which could run BASIC or a word processor).

Consequently an opportunity for the hobbyist and student to gain a depth of insight into the internal circuits of a computer was lost, except of course to those who bothered to read the EDUC-8 articles even if they did not actually build it.

There is an ironical twist here too. Most of the evaluation kits ended up in the 'junkbox' anyway, as the limitations placed on expandability by their design were so great that it was generally easier to start again than try to modify them. Most people might as well have built the EDUC-8 and gained a real insight. Following on from these systems were a large number of other more complex microcomputers, which were based on the same 8-bit technology but were more flexible and expandable in the way that they were designed. Many people moved on to these from the evaluation kit stage.

In a sense though, this was the 'beginning of the end' for those who wanted an understanding of the internals. Most of these new computers were more like 'appliances' and consequently lacked the collection of valuable technical information.

There developed a whole class of people now who simply 'used' computers for lots of very valuable things, but who had no idea about the operation inside, and even if they wanted to, were inhibited by the complexity of the systems.

It is interesting that this trend has also been followed closely by *Electronics Australia* over the years, and a typical article was the cover story in September 1979 entitled 'The Personal Computer Revolution'.

To complicate matters further, the technology has advanced very quickly — with the relatively simple double-sided printed circuits and 8-bit processors being supplanted with multi-layer boards, surface mounts and 16-bit or greater processors.

The days of building and understanding the technology and ending up with a useful computer at the end of the process are long gone.

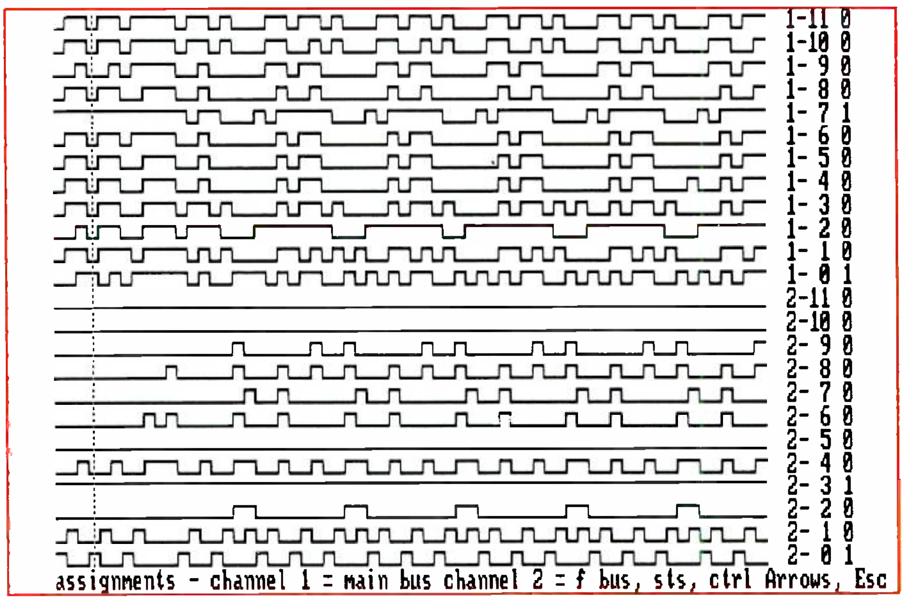


Fig.2: In addition to showing block diagrams for either the simulated computer as a whole or inside its CPU, the program also provides a 'logic analyser' display of the main data bus and control bus lines.

Seeking insight

Where does this leave the person who wants to learn how the computer sitting in front of them — with its multi-megabytes of memory, incredibly fast and complex processor, sophisticated peripherals like high resolution colour displays and vast hard disk drives — actually functions?

Well, these systems can be tackled first off, but the complexity of the processor instruction sets alone and the associated jargon can be very daunting. Also the equipment needed to look at the timing has grown way beyond the enthusiast's budget.

Once, a good logic probe or moderately fast oscilloscope would do to find faults and generally 'look around a circuit', but now a fast 'scope is the minimum. A logic analyser is really desirable, if not mandatory for the 'hard ones'.

One answer to this dilemma is *simulation*. That powerful and fast computer in front of you can be used to simulate a much less powerful and more straightforward computer which has a simple instruction set and limited peripherals, so that the principles can be grasped without unnecessary complexity. The advantage is that the very same principles learnt on the simulations apply exactly to the powerful and fast computer.

Further to this the simulation can be stopped or slowed down at any time and viewed, to see detail lost on even the early evaluation kits (and perhaps even the EDUC-8 itself, as it did not display every internal bus state).

Finally, the potential exists to simulate very expensive equipment — such as a logic analyser — so that experience can be gained on the use of this type of instrument without actually owning one.

Well, where are all these simulation packages? There are a number around, but the one presented here was inspired by that original EDUC-8 series and has the same aims: to inform the interested about the nitty gritty details of the operation of a computer.

It is very complete having a simple processor, 4K of memory, four peripheral devices, a integrated editor and assembler, a disassembler, and a logic analyser built in. This hardware and software would cost thousands of dollars if it had to be purchased and is well out of reach of the average hobbyist. It is designed to run on any IBM-compatible computer with at least 380K of memory, one or more floppy disk drives and a Colour Graphics Adaptor or

CPU operation

better. Thus it can be used in any environment where the fundamentals of computer operation are being learnt, without the expense of purchasing obsolete 8-bit equipment and/or tying up expensive logic analysers on beginning students.

Simulator program

The simulation package is called EMUL-8R (pronounced 'emulator' — an outrageous pun was required to follow up EDUC-8!), and is based on the same old but very respectable PDP-8 minicomputer. The original computer (PDP stands for Programmed Data Processor) was the first minicomputer released on the world market, and was known for its very simple and practical instruction set. EMUL-8R draws heavily from the PDP-8 instruction set, but has enhancements more in line with modern practice — such as program counter relative addressing and a stack. Because EMUL-8R sets out to teach the user hardware concepts as well as elementary assembler programming, it is required to show a very large amount of data which changes very rapidly. The position of the data is also important. Consequently it is a graphics-based program. These graphics represent block diagrams — the level above the schematics.

It is strongly felt that this level is very appropriate, as there are any number of ways of achieving the functionality of a block diagram, and that the block diagram gives an easily grasped understanding of the flow of information. Where required the contents of blocks can be filled out by discussion of the possible options.

EMUL-8R has two main graphics which show the operation of the computer. The first of these is shown in Fig.1, which is the main or computer graphic. This shows the main features at the system level. This consists of the CPU proper, which in line with modern practice is a 'black box' at the centre of the diagram. (However there is another diagram which shows the inside of the CPU.) This discussion will start with Fig.1.

Also shown on the main diagram is a sample of the memory. Since only a few locations can be shown at any one time, this display is co-ordinated with the memory address register. In order to explain the complete operation of the memory display system the function of the overall system must be explored first.

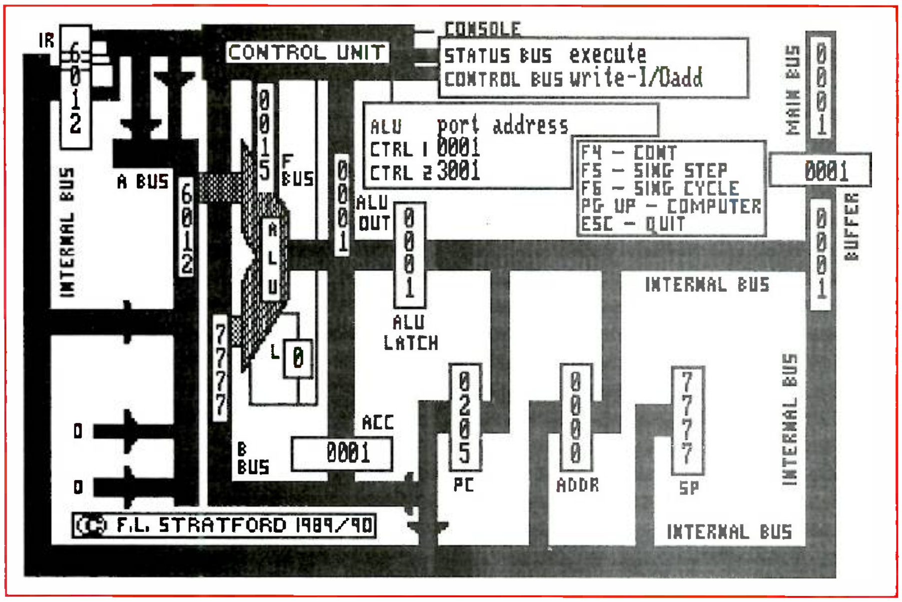


Fig.3: The other main graphic provided by the program shows the flow of data and instruction information within the simulated CPU chip itself.

EMUL-8R's CPU uses a main address and data bus which is 12 bits wide. This is a bidirectional bus on which the address and data information is multiplexed, and is known as the main bus. The current value on the bus is shown on the vertical section of the bus immediately to the right of the CPU. The type of data on the main bus is determined by the CPU and its current activity.

This information is provided to the 'outside world' on the control bus, which changes state to indicate the type of information on the main bus. The control bus emerges from the left hand side of the CPU and the value on it is shown immediately below the decoder. These numbers correspond to the various data types present on the main bus.

An example is perhaps best to clarify the operation. Take a memory read as a simple case. In order to do this the sequence is as follows. First the CPU places the address it wishes to read on the main bus. To indicate that this is an address, it also sets the value on the control bus to 1, which means memory address information. This is decoded by the decoder on the top left hand side of the diagram.

The decoder feeds a number of the devices on the page including the MAR (memory address register), MBR (memory buffer register), the memory itself and the input and output registers.

A control bus value of 1 triggers the MAR to store the information on the bus, as the function it has is to hold address information. The next step is for the control bus to change to 2, which indicates a memory data read. The main bus also changes direction, so that data can be passed to the CPU from the memory.

The decoder uses the control bus data to provide a signal to the memory, to read the data in the location specified by the MAR. The same signal also goes to the MBR. The MBR is present to 'buffer' signals from the memory array onto the main bus, and vice-versa. Consequently it is a bi-directional device. The control signals to the MBR are there to ensure that the direction is correct. The data will thus be read from the memory and appear in the MBR on its way to the main bus. In this way the data required has been read.

It is not necessary to remember the numbers corresponding to each of the control bus conditions. These are decoded into readable states and displayed just above the MAR for reference. Similar operations occur for memory writes and accesses to the input and output ports. This is typical of the operations which real microcomputers undertake, and such is the level of detail of the simulation.

Returning now to the memory, it should now be clear that the address of the memory location being accessed by the system is stored in the MAR.

In order to give a reasonable representation for the memory content the memory 'around' this MAR address value is displayed. For instructions this will show a few instructions before the current one and the next instructions to be executed. This is useful in appreciating the flow of a program.

EMUL-8R at a glance

General

EMUL-8R is a program simulating a simple computer for teaching purposes. It has about 30 instructions, broken down into four basic types.

It allows viewing of the operation of the computer and CPU at a detailed level. Interrupts are also available.

Support software

EMUL-8R is a completely self-supporting teaching aid. It contains an inbuilt text editor to allow students to create source programs and then assemble them with the assembler. Memory contents can be disassembled to mnemonics at any time using the disassembler. Debugging is facilitated by being able to single step and set breakpoints.

Hardware simulation

EMUL-8R provides a detailed level of simulation for teaching hardware concepts. The computer level shows the memory and the CPU as well as I/O. The CPU level is a detailed view inside the CPU. All buses can be selected and then examined via an internal software 'logic analyser'.

Requirements to run it

EMUL-8R will run on any IBM or closely compatible computer with the following capabilities: at least 380K of base memory, at least one 360K floppy drive (preferably two, or a hard drive) and a colour graphics display adaptor or better derivative (not Hercules). It requires DOS 2.00 or later.

How to get EMUL-8R

EMUL-8R is a totally Australian developed product. It normally sells for $99.00 for a single user, and $499.00 for a site licence for up to 15 users. However if you order EMUL-8R during the life of these articles (i.e., the next two months), you may purchase the single user package (with on-disk manual) for $49.00. Site licences can be negotiated.

Send your order with a cheque (including an additional $5.00 to cover postage and packaging) to Brycal Enterprises, PO Box 245, Kingaroy, Queensland 4610.

In addition to the ability to step through these events one at a time, EMUL-8R provides the capability to record the data and display it in a logic analyser like fashion. A typical display is shown in Fig.2. The data can be displayed both as a timing diagram or as a series of data points.

The timing diagram is modelled on that used by common logic analysers. The dotted line down the left hand side of Fig.2 is a cursor, which in use can be moved around the diagram to assist in alignment of the data. Currently the cursor is set to the point which corresponds to the operation which is occurring in Fig.1.

Inside the CPU

One of the disadvantages of even the early evaluation kits was that the inside of the CPU was a black box. The user had to rely on the descriptions of the internal operation provided in the manuals, and these were often grossly oversimplified. This problem can be readily addressed in a simulator, however, particularly when the CPU itself is relatively simple.

Such is certainly the case for EMUL-8R, where the inside of the CPU is simple enough to be represented in another busy but understandable graphic. This is shown in Fig.3.

It can be seen that all of the components normally hidden from the user are visible and available for inspection. These include the various registers which are common to most computers and which are essential to their operation, such as the accumulator and its extension, the link. (Note that the link is perhaps an old term for this item, as today it would be more likely termed the 'carry bit'. However the name has been preserved out of respect for the original PDP-8 concept). The program counter (PC) and the stack pointer (SP) are also visible, and actively simulated.

In addition to the items which manufacturers readily admit to, other details are shown. These are necessary to make the system work, but are seldom disclosed as knowledge of them is not required to actually use their product and such information could be useful to a rival manufacturer. All of these components do not act in isolation. They require links and timing to make them operate.

This is provided in the form of busses, components to perform the arithmetic actions and control signals. An important component in the diagram is the *arithmetic-logic* unit (ALU). This device has two input buses and one output bus, and provides all of the arithmetic and logic capability of the CPU. Despite this apparent complexity the functions provided by the ALU are relatively simple and can be readily appreciated. The function being performed by the ALU is determined by the F bus, which emerges from the control unit.

The control unit is the heart of the CPU, and while it is not simulated in great detail, its operation can be readily determined from the control signals which emerge from it. However this will not be discussed further at this point. Suffice it to say that the logic analyser can be used to record data inside the CPU as well, so that the level of understanding developed can be very high.

Instruction set

This article would not be complete without some discussion of the instruction set. It has been said that EMUL-8R was inspired by the PDP-8 series of minicomputers. While this was a successful computer, with a very cleverly designed instruction set, it is now somewhat dated in its approach and some changes were felt necessary to reflect more modern practice. However the same basic classes of instructions were preserved.

The first of these classes is the *memory reference instruction* (or MRI class). These instructions are the core of the instruction set and generally allow access between the accumulator and the memory. They include the TAD (add), AND (boolean and), ISZ (increment and skip if zero), and DCA (deposit and clear accumulator) instructions. Also in this set are the JMP (unconditional jump) and JMS (unconditional jump to subroutine) instructions. The latter two do not reference the accumulator, but do obey the same rules with respect to the addresses.

The MRI class of instruction can address the memory in a number of different ways. The first of these accesses the base page. The base page is the first 127 locations of memory and this part of memory is accessible from anywhere in memory. The other direct method of access is by an offset from the program counter (also called PC relative). If other places within the memory are required, then the *indirect* mode can be used. This accesses the contents of a location using the same rules as noted above, but the data found is used as an address to obtain the target data.

The second class of instructions is the *operate* class. These perform operations of two basic types, involving the accumulator and link. Examples of the first class include CLA (clear the accumulator), CLL (clear the link), RAR, RTR, RAL and RTL (rotate the accumulator right or left, and by either one or two bits). The second class includes the ability to test the accumulator and link and change the flow of the program based on these tests. Some examples here are SNA (skip on non-zero accumulator), SPA (skip on positive Accumulator), SNL (skip on non-zero link).

The third class of instructions are the *input/output* group. These allow data to be passed to and from the general register ports on the emulated computer. There are only two such instructions: WTP (write to port) and RDP (read from

Continued on page 141

Test Instruments Feature:

ComSonics 'WindowLite' handheld FSM for TV/FM

Antenna and MATV system installers should find the ComSonics 'WindowLite' of particular interest. It effectively combines the features of a VHF-UHF field strength meter and a spectrum analyser, in a compact and portable handheld case which should make it very suitable for field use.

It's a little hard to know exactly what to call the WindowLite, because it combines many of the features of a traditional field strength meter with those of a spectrum analyser. Perhaps the best way to describe it is a 'multi-purpose instrument for VHF-UHF antenna and distribution system testing'.

Physically it measures 270 x 102 x 78mm, and weighs 1.1kg. At the top is a liquid-crystal display panel 58mm square, with an active area of about 55 x 55mm. Below this is a moisture proof membrane-type keyboard with six software programmable function keys, a pair of arrow keys, and 15 further keys used for things like numerical entry, power on/off and control of a backlight for the LCD screen.

Below the keyboard again is a small speaker grille, to allow monitoring of sound carriers, while the RF input socket is on the right-hand side of the case at roughly the level of the function keys. The input socket can actually be changed by the user, between either a type 'F' (F-81) or standard BNC.

Power comes from a rechargeable 9.6V/1.2Ah nickel-cadmium battery pack, which slides inside the case. A sturdy safety ring at the top of the high-impact ABS plastic case allows the instrument to be attached to a belt hook or lanyard, for convenience and security against being dropped. At the rear of the case there's also an adjustable strap, to allow the unit to be held firmly in the user's hand.

As with many modern test instruments, the WindowLite is essentially a microcomputer system. In this case the computer is dedicated to the task of scanning the VHF-UHF frequency spectrum, and measuring the strength of any signals it finds. So along with the LCD screen and keyboard provided for the 'user interface', inside that compact case there's also quite a deal of computer controlled RF scanning, amplification and signal analysis circuitry. The fact that all of this circuitry can be fitted inside such a compact case, along with the battery, is surely a tribute both to the ComSonics designers and the benefits of modern SMT and multilayer PCB technology.

The quoted frequency range of the WindowLite is from 50MHz to 860MHz, so it could probably be used for mobile radio work as well as TV, FM and MATV applications (also for CATV if this comes to Australia). A version is also available

with a range extending down to 5MHz, for work at HF.

The input signal level range is quoted as extending from -45dBmV to +60dBmV (i.e., from about 6uV to 1V), which should allow it to provide useful readings in almost any practical situation. The input impedance is 75 ohms, and the maximum allowable RF input power is 1W.

The quoted measurement passband is 280kHz, while the displayed dynamic range is user selectable to cover a range of either 30dB or 10dB. The displayed amplitude units can be either absolute, in dBmV, or relative — in either percent or dB. Display resolution is 0.1dB or 0.1%. Signal level measurement accuracy is +/-1.0dB at 20°C, or within +/-2.0dB worst case over the full operating temperature range of from -18°C to +49°C. The corresponding figures for carrier/-noise measurement accuracy are +/-2.0dB at 20°C, and +/-4.0dB worst case.

The WindowLite LCD screen is effectively a dot-matrix display, with 128 x 128 pixels. It can be used in four selectable basic display modes, labelled SWEEP, TAGS, ZOOM and TUNE. Generally the central section of the display is used for the graphical output, while a strip along the top is used to present numerical information such as the display mode, vertical range, and measured parameters for the signal selected by the cursor (along with its channel number).

The section along the bottom of the display is used to present 'labels' for the six software-programmed function keys, immediately below. This can be seen in the close-up photo, along with the other parts of the display.

Note that when the shot was taken, the cursor had been aligned with the 'peak' for the main SBS-TV signal in Sydney, on 527.25MHz (channel 28). As a result the reading at the top shows this signal's frequency and amplitude — here -1.0dBmV.

The graph normally shows each signal as a solid vertical line, with its height prop-ortional to the measured strength; however the cursor is also shown as a similar line, of full height, and when it is aligned with a signal line, the latter is turned into a white line.

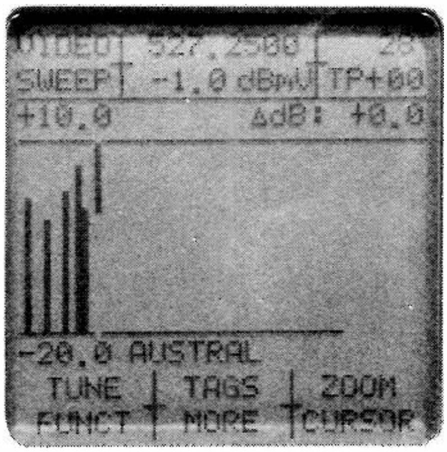
Hence the appearance of the right-most line in the photo, as 'suspended' above the baseline — the dark upper section is essentially the cursor, while the white lower section still indicates the height of the channel 28 signal.

Included in the many measurements that can be made using the WindowLite are the carrier amplitude of any desired signal, differential level measurements between signals, carrier to noise ratio (C/N), peak-to-valley measurements for either video or audio signals, video-audio differential for a particular channel, and low frequency disturbance (hum).

Custom 'personality'

An important feature of the WindowLite is its ability to be customised, to suit the user's specific needs. Thanks to the inbuilt micro, it's possible to store in the internal memory (presumably an EEPROM) not only the frequency details of TV and FM transmitters in the user's area, but also their channel numbers and so on. Data on specific signals of interest can also be saved in groups, and the WindowLite instructed to search for them as a group when desired.

Actually the instrument comes with quite a lot of information pre-stored in its memory, including the TV channel fre-



A close up of one of the displays that can be produced on WindowLite's LCD screen (see text).

quencies for many different countries — including Australia. This means that the instrument can not only be set up quickly to suit the basic situation in the user's country, but can also be provided fairly easily with its own 'personality' to suit the local area and the kind of work performed by the user. Once this is done, most testing can be performed with a surprisingly small number of keystrokes.

I use the words 'fairly easily' in the foregoing paragraph, because with its relatively small keyboard the WindowLite has to use a fairly complex hierarchic menu system for its programming functions.

The designers seem to have recognised that this menu system may present users with a few hassles, because the manual for the instrument includes a special 'Menu Navigator' diagram which looks a bit like a programming flow chart. This certainly helps in visualising the menu structure, and I suspect it will become an essential reference for many users — especially on occasions when they have to change rarely-altered stored information.

Trying it out

ComSonics' local representatives MMT Australia very kindly loaned us an advance sample WindowLite for a few days, to get a feel for its capabilities and ease of use.

At first we found ourselves a little daunted by the unit, as it came with only an incomplete draft copy of the user manual — with a number of major sections still to be written. However in practice the WindowLite turned out to be rather easier to use than we expected.

The sample unit had already been configured for Australia, and had also been set up to look for the main TV signals present in Sydney: ABN2 in the low VHF band (band I), ATN7/TCN9/TEN10 in the high VHF band (band III), and SBS28 in the lower UHF band (band IV).

As a result it proved very easy to carry out many of our test measurements, on TV signal strengths produced by a number of antennas and at various outlets in a typical domestic distribution setup. In most cases this involved little more than connecting the input cable, obtaining a display of the signals, and then simply manipulating the cursor to obtain readings of their individual magnitudes.

The calibration tables stored in the sample unit were 'generic', and a note supplied with the unit stressed that as a result its absolute magnitude accuracy would not meet specification — a shortcoming that obviously wouldn't apply for later production units. However the readings obtained were quite sensible, and in line with figures obtained with other instruments.

In short, we found ourselves quite impressed with the WindowLite. Despite its compact form it is a very powerful instrument, and one that should prove invaluable for anyone involved in installing and/or testing VHF-UHF antennas, cable distribution and MATV systems.

Quoted price for the ComSonics WindowLite model 1 (50-860MHz) is $2211, plus 20% sales tax where applicable. The model 2 (5-860MHz) is $2673, again plus tax. Both prices are for the instrument together with battery pack and charger. A matching carry case is available for an additional $90.

For further information contact MMT Australia, 7 Amsted Road, Bayswater 3153; phone (03) 720 8000. (J.R.) ❖

The Latest Test Instruments

Digital sound level meter

The TES-1350 Digital Sound Level Meter is designed to meet the sound survey needs of safety engineers, health and quality control management personnel. It can be used to measure sound and noise levels, and also to check the acoustics of studios, auditoriums and domestic listening environments.

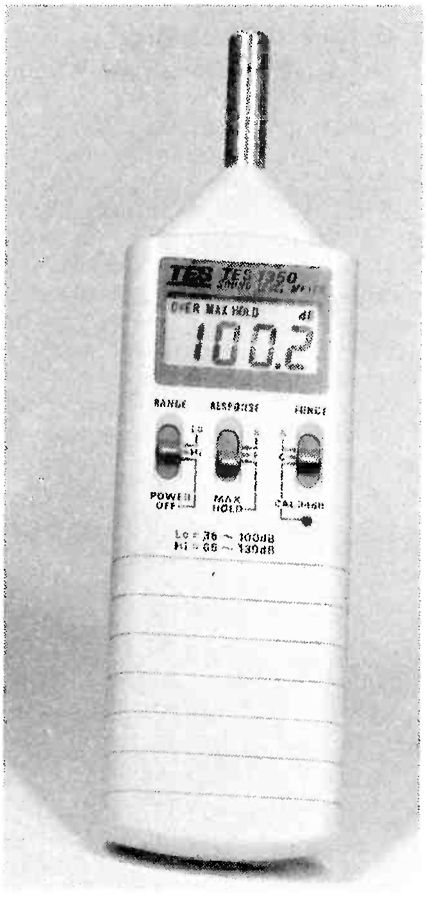
The unit has a highly readable 3-1/2 digit LCD display and conforms to IEC standard 651 Type 2. It has a frequency range of 30Hz - 12kHz, a resolution of 0.1dB and a rated accuracy of +/- 2dB at 94dB sound level (1kHz sinewave).

Features of the unit include A and C weightings, slow and fast time weighting, over and under range indication and a 'maximum level hold' function (decay <1dB over 3 minutes).

It also provides both conditioned AC (0 - 650mV on each range) and logarithmic DC (10mV/dB) outputs, available via a 3.5mm stereo jack for connection to other instrumentation.

Dynamic range is 65dB, with four measurement ranges provided: A LO (35 - 100dB), A HI (65 - 130dB), C LO (35 - 100dB) and C HI (65 - 100dB). An internal calibration oscillator is provided.

The TES-1350 is very compact, measuring 240 x 68 x 25mm overall including the 1/2" electret microphone. It weighs only 215g. Power is from a 216-type 9V battery, and the unit comes with instruction booklet, battery, carrying case and adjustment screwdriver.



The TES-350 Digital Sound Level Meter is available from all Jaycar Electronics outlets. It carries the catalog number QM-1580 and is priced at $239.50.

Arbitrary waveform generator

The Or-X model 610 generates any complex waveform or function with a 120bit by 32K points resolution. The waveform is defined either by point entry of individual X-Y data points, by segment interpolation between points (Autoline) or by downloading from an external device.

The Model 610 offers the versatility of 10V p-p into 50 ohm, while very low amplitude signals can be generated with high offsets of up to +/-5V and low harmonic and spurious distortions. An internal clock covering 0.01Hz to 20MHz, or an external clock may be used. Two or more units can be connected in parallel for multiple waveforms with adjustable phase relationships.

In addition to menu-operation, a software package provided with the model 610 converts an IBM AT, or compatible PC, into a powerful tool for operation and programming. Control of the 610 can be either from the computer or the instrument front panel.

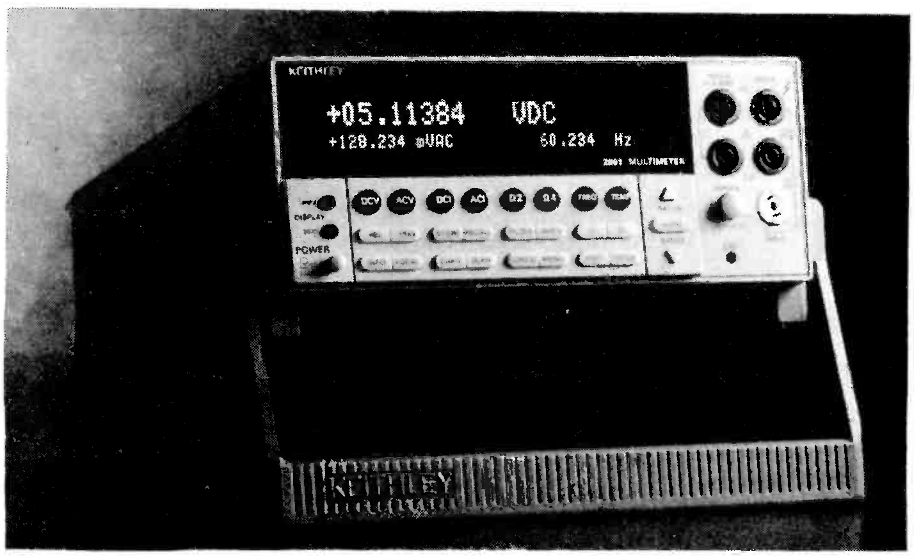
For further information circle 201 on the reader service coupon or contact Elmeasco Instruments, PO Box 30, Concord 2137; phone (02) 736 2888.

Multi-function DMM

Keithley Instruments' new model 2001 digital multimeter is a half rack unit with the high resolution, accuracy and sensitivity usually found only in 8-1/2 digit DMMs.

The range of resolution of the model 2001 is 4-1/2 digits to 7-1/2 digits. Unlike many units that must average multiple 6-1/2 digit, 22-bit readings to extend their resolution to 7-1/2 digits, the model 2001 has true 7-1/2 digit, 28-bit resolution, so it can provide wider dynamic range, and ensure high DC and AC measurement integrity over a broad measurement range.

Its basic accuracy is: DC voltage, 18ppm (90 days), with 7ppm for 24 hours; and AC voltage, 0.05%. Frequency measurments are accurate up to 2MHz and down to 1Hz, with a sensitivity accurate to 1% of range. The Model 2001 DMM is capable of reading rates of up to 2000 readings/sec (at 4-1/2 digit resolution) for fast throughput in production test applications and for capturing fast moving signals. At 6-1/2 digit resolution, at full accuracy, the model 2001 can take up to 45 readings/sec continously.



For further information circle 202 on the reader service card or contact Scientific Devices, 2 Jacks Road, South Oakleigh 3167; phone (03) 579 3622.

Analysing recorder

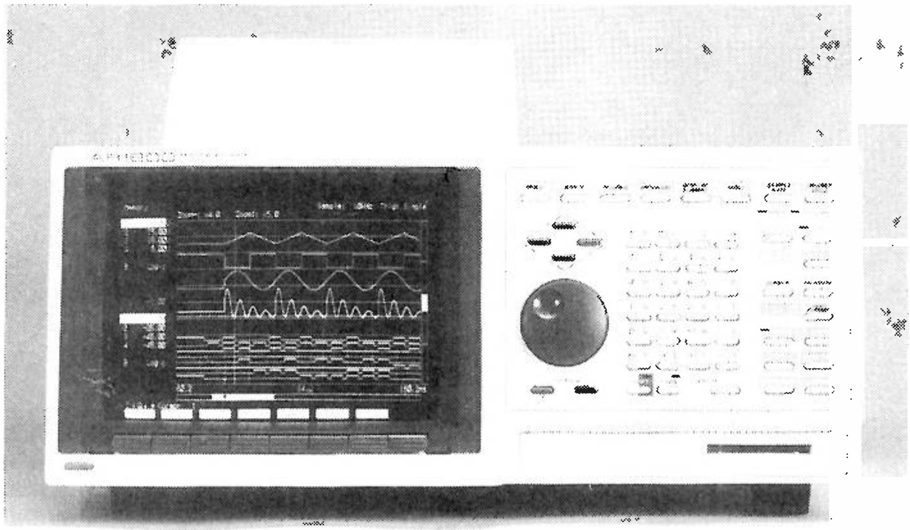
A new analysing recorder designed for industrial and scientific use has been released by Yokogawa. Known as the AR1600, the recorder is portable, self contained, and includes a 22cm amber display and 21cm thermal printer. 12V DC operation is also available.

The recorder has been designed to aid in applications such as maintenance of heavy electrical machinery, electricity supply maintenance, electrical testing and vibration analysis.

Available configurations offer up to 16 analog channels with 14-bit resolution and memory length of 256K, or 12 analog channels with 16 logic channels.

Three recording modes are selectable.'Memory mode' allows capture of high speed events, for subsequent printout and analysis; 'recorder mode' allows real-time continuous chart logging of up to eight channels; and 'FFT mode' allows frequency analysis such as linear and power spectrum from DC to 20kHz to be performed. Waveform data storage, in either binary or ASCII format, can be extended by fitting an optional 3.5" DOS format floppy drive.

For further information circle 203 on the reader service card or contact Yokogawa Australia, 25-27 Paul Street North, North Ryde 2113; phone (02) 805 0699.



Four function portable

Leader Electronics claims to offer the first T&M package that includes four separate measurement facilitities.

The Model 300, which is just 240 x 165 x 44mm in size, is not only a two channel digital storage scope and a full featured digital multimeter with large display, but also a DMM with a data logging facility for unattended operation.

In addition, it is an eight channel logic scope, making the whole package very suitable for servicing applications. Now the design or service engineer can have virtually all his measurement requirements at his fingertips, in the one box.

The instrument's dual channel DSO has a sample rate of 30MS/s and a bandwidth of 10MHz. Continuous signals of up to 10MHz and one shot events up to 3MHz can be observed, with AUTO SETUP choosing the optimum parameters for signal display. The bandwidth is adequate for video signals.

The Model 300's digital multimeter offers manual and autoranging on its seven measuring functions.

The DMM measurements and units can be displayed simultaneously with the waveform on the instrument's screen, since the DSO and DMM are electrically isolated.

In situations where the instrument is unmanned, or is taking periodic readings over some time, such as in powerline monitoring, the model 300 becomes a data logger. Readings can be output directly to a printer, or stored on a memory card for later printout.

The large display is a high contrast STN liquid crystal screen with a wide viewing angle. It is large enough to accommodate all setting data and axis markers as well as waveform and DMM data. The unit operates for 2.5 hours from four internal type AA alkaline batteries, but an AC power adaptor is also available.

For further information circle 204 on the reader service coupon or contact AWA Distribution, 112-118 Talavera Road, North Ryde 2113; phone (02) 888 9000.

Portable DSO

LeCroy has released its 9300 family — portable digital oscilloscopes that offer record lengths of up to one million points per channel.

Available in both two and four channel versions, with prices starting at under $5000, each version also comes with three memory configurations: basic 'M' (medium), and 'L' (long).

The basic units have 10K record lengths per channel; the 'M' units have 50K per channel, and the 'L' units have 1M per channel. The entire 9300 family features 300MHz analog bandwidth and independent 100MS/sec digitisers on all inputs. Special features include: fast autostep for repetitive signals, and SEQUENCE mode which allows storage of multiple events in segmented acquisition memories; automatic PASS/FAIL Testing; FAST GLITCH, DROPOUT and WINDOW Triggers; and Signal Processing and FFT Analysis.

For further information circle 205 on the reader service coupon or contact Scientific Devices, 2 Jacks Road, South Oakleigh 3167; phone (03) 579 3622.

Data time generator

Tektronix Australia has released a Data Time Generator which provides complete logic stimulus-data and timing on every pin. The new HFS9000 Stimulus System combines the capabilities of a complete data generator, pulse generator and switch matrix in a single instrument. A new addition to the HFS9000 Series, the system can provide up to 640 channels or more of recision, phase-locked stimulus.

The Data Time Generator is one system for all logic stimulus, broadening the scope of practical tests an engineer is able to do during design verification, characterisation and at-speed test of digital integrated circuits (ICs). The system allows the user to test earlier in the development cycle, thereby reducing IC turns. Users are able to specify data and timing simultaneously on every pin with extremely flexible formatting.

The system has been designed with a proprietary digital architecture that enables it to generate any combination of signals needed to characterise a digital IC, provide precision timing relationships, and offer multiple channels synthesised off the same timebase. It can generate signals at rates up to 630Mbps, including data buses, clocks, strobes, gated clocks, logic level sources and pseudorandom bits with 64K memory depth. The system also offers 5ps resolution, highly accurate placement of rising and falling edges, and replication of most logic signals.

For further information circle 208 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066.

STM/Sonet analyser

Anritsu Corporation has released a new instrument designed to evaluate the performance of synchronous multiplexers and demultiplexers.

The MP1560A STM/Sonet analyser can access the Network Node Interface (NNI) of 52, 100 and 156Mbps systems, thereby meeting all of the multiplexing structures of CCITT, SONET (ANSI) and the JAPANese system.

The unit, consisting of only one housing, comprises a transmit and receive section and a range of plug in optical interfaces, allowing selection of either an electrical or optical interface.

The instrument can perform single and multiple error addition and detection. SOH, TOH or POH overheads can be set, 1.5 and 2Mbps signals can be dropped or inserted as well as 64k, 192 or 576kbps. An internal floppy disk drive is provided for storage of measurement setups and measured results.

For further information circle 206 on the reader service coupon or contact Alcatel Australia, 58 Queensbridge Street, South Melbourne 3205; phone (03) 615 6666.

Wideband level meter

Level meter URV35 combines the features of an RF volt and power meter in one instrument, with both analog and digital displays. The moving coil meter has the measured value superimposed via an LCD display, greatly facilitating tuning, peaking and nulling adjustments.

All voltage measuring heads and power sensors of the URV5 have inbuilt temperature, diode transfer constant and frequency response calibration factors stored in inbuilt EPROM.

URV35 may be ordered for use with AC mains or battery power. Common torch type dry cells or NiCad rechargeable equivalents are used. With the appropriate probes and sensors it can measure from DC to 26.5GHz, and over a wide voltage and power range. An RS232 interface allows for operation with a laptop computer and for external calibration.

For further information circle 210 on the reader service coupon or contact Rohde & Schwarz, 63 Parramatta Road, Silverwater 2141; phone (02) 748 0155.

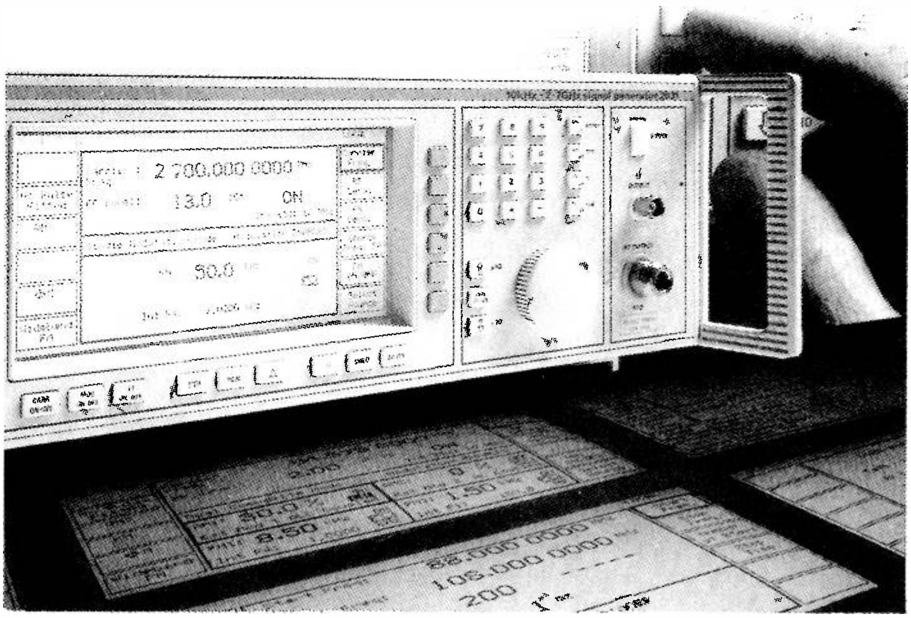
Signal generators have GSM option

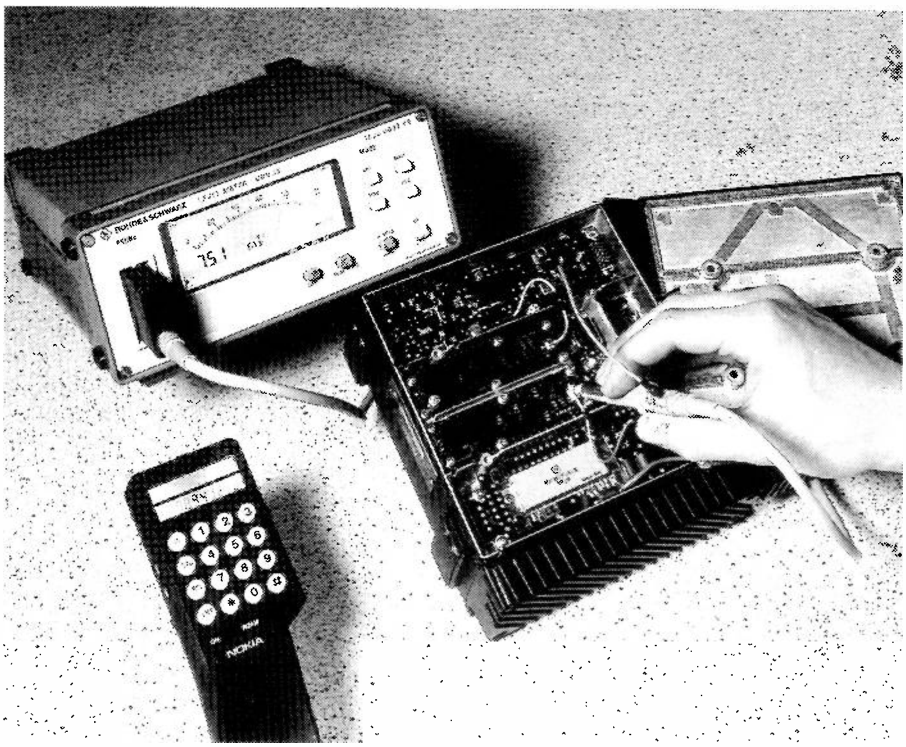
Marconi Instruments has released a new option for its 2030 series of signal generators. The option generates the complex GMSK modulation, defined for use in the new digital cellular system, GSM.

The 2030 series of RF Signal Generators feature a large, bright liquid crystal display, which makes the use of the generators simple, even in complex applications such as GSM. There are well over 30 models in the 2030 family, covering from 10kHz to 1.35GHz, 2.7GHz and 5.4GHz.

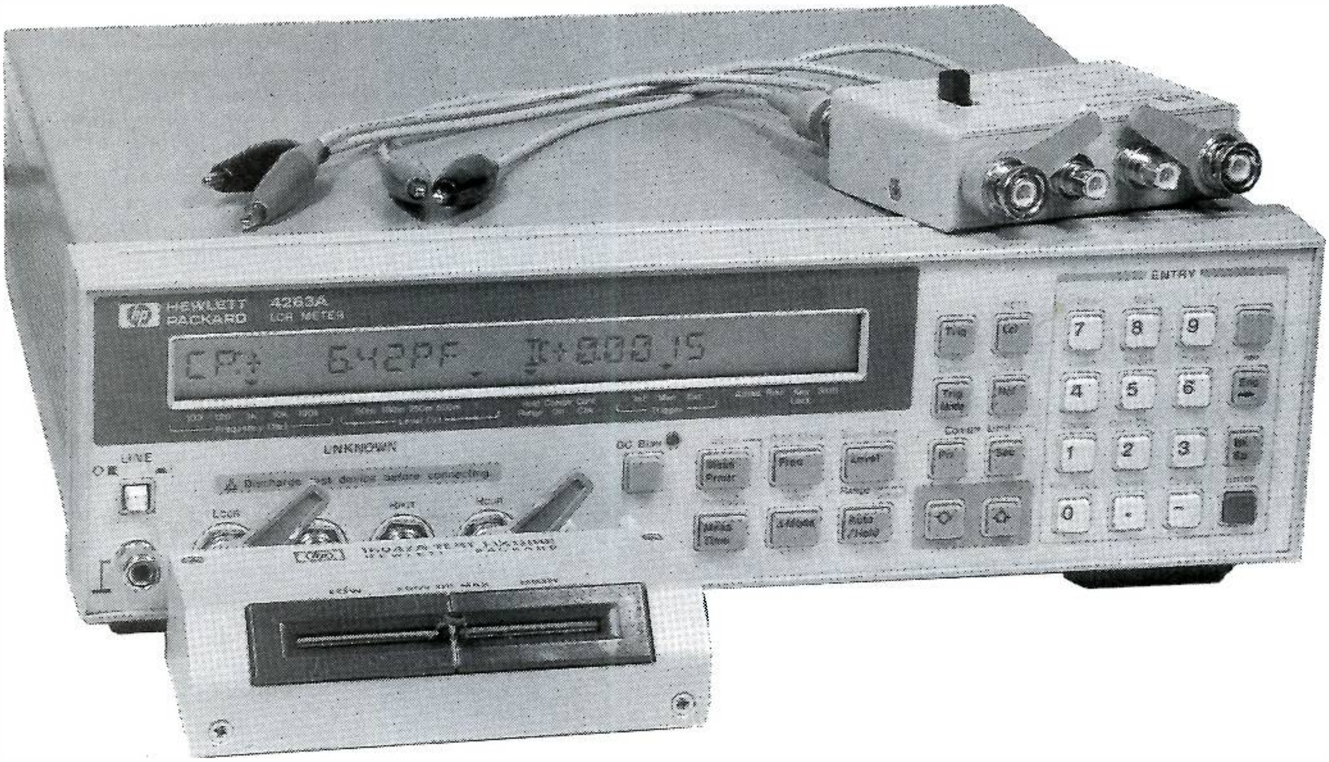
Extremely low noise models are also available, with other options available such as high output power, pulse modulation, a VOR/ILS capability and the use of two identical 0.1Hz to 500kHz modulation oscillators. In addition to being able to generate GMSK signals from external data, this new 2030 version includes an internal data generator and data editing facilities which will greatly simplify testing GSM products.

For further information circle 209 on the reader service coupon or contact Marconi Instruments, PO Box 1390, Lane Cove 2066; phone (02) 418 6044. ❖





FLEXIBLE NEW LCR METER FROM H-P



The new HP 4263A LCR Meter is the latest addition to Hewlett-Packard's steadily expanding range of 'affordable' mid-range test instruments (albeit at the top of this range). It offers the ability to make accurate measurements on virtually any kind of passive component, at frequencies up to 100kHz.

by JIM ROWE

The last couple of years have seen Hewlett-Packard release a number of new test instruments, in which the emphasis has been on 'affordability' rather than 'performance at whatever cost'.

We first noted this trend with the appearance of the HP 54600 series of digital sampling scopes, reviewed in our May 1991 issue.

Since then the company has followed up with the E3610/11 bench power supplies, and then more recently with the 34401A 6.5-digit bench DMM. These were reviewed in the November 1991 and January 1992 issues respectively.

The trend seems to be continuing, with the recent release of a new instrument: the HP 4263A LCR Meter. Actually this appears to be part of a new 'family' of closely related instruments, all made in Japan by Yokogawa-Hewlett Packard.

The other instruments in the family are the HP 4338A Milliohmmeter, the HP 4339A High Resistance Meter and the HP 4349A Four-Channel High Resistance Meter.

As the name itself suggests, the LCR Meter is a 'general purpose' instrument, with broader application than its siblings. In many ways this kind of instrument is the modern replacement for the well known 'R-L-C bridge' of yesteryear, which played a key role in many labs for the measurement and evaluation of passive components.

H-P has had quite elaborate digital LCR meters available for a few years now, but their complexity and price have tended to restrict them to only the most well-heeled of R&D and standards labs. The HP 4263A appears to be a 'scaled down' version of these larger instruments, designed to bring it within the reach of a broader group of users.

But despite this 'economy' image and compact size, the new instrument still goes somewhat further than did its familiar 'bridge' predecessors. Basically it will measure impedance, resistance and reactance in the range from 1mΩ to 100MΩ; admittance, conductance and susceptance between 10nS and 1000S (Siemens, formerly known as 'mhos'); capacitance, between 1pF and 1F; inductance, between 10nH and 100kH; and also quality parameters such as dissipation factor D (0.0001 - 9.999), quality factor Q (0.1 - 9999.9), phase angle θ and ESR (equivalent series resistance). With an option fitted it can also measure the turns ratio, mutual inductance and individual winding inductances and resistances for transformers.

The basic accuracy of the HP 4263A is 0.1%, and it provides five-digit resolution. Measurements can be made at any of five accurate frequencies: 100Hz, 120Hz, 1kHz, 10kHz or 100kHz. The AC test signal amplitude can also be set to five different levels — 50mV, 100mV, 250mV, 500mV and 1V RMS — and the DC bias also selected between 0V, 1.5V, 2.0V or derived from an external 0-2.5V supply.

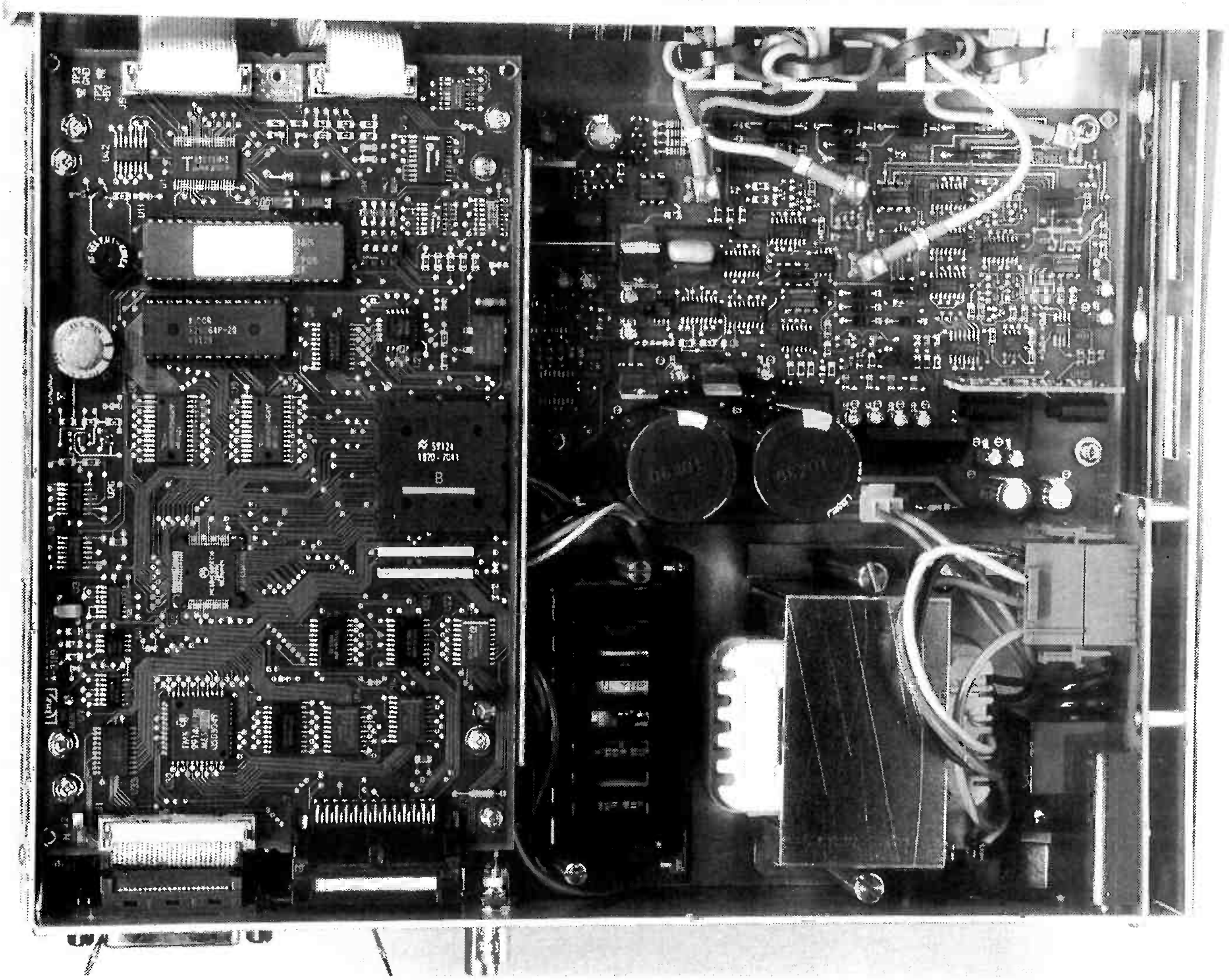
An important feature of the HP 4263A is its measurement speed. Measurement of any component can be carried out in 25ms, and this together with the instrument's HPIB/GPIB/IEEE 488 remote programability makes it well suited for automated testing applications.

Other features include the ability to perform comparator testing, built-in calibration functions, the ability to compensate for different test leads and fixtures, and also the ability to check the reliability of contact between the test leads and the component under test.

How it works

Basically what the HP 4263A does is measure the voltage across the component or 'device under test' (DUT), and the current it draws, at the test frequency. And by measuring both the magnitude and relative phase of these quantities, it therefore has all of the information necessary to work out the DUT's equivalent complex impedance.

The diagram of Fig.1, taken from H-P's service manual, shows the basic idea. An AC signal source drives a current through the DUT, and a differential amplifier (V) responds to its voltage drop. The current through the DUT is also monitored by a further pair of amplifiers, in conjunction



Inside the HP 4263A, most of the circuitry mounts on two horizontal PC boards — with the microcomputer circuitry on the smaller rectangular board on the left. The analog transducer circuitry is on the lower board in front of the power supply components (upper right). The instrument makes extensive use of surface mount technology.

with a shunt or 'range resistor', to produce a second voltage proportional to the DUT current (I). A vector ratio detector then measures both voltages and their relative phase difference and digitises this information via an A-D converter.

The rest is largely a matter of number-crunching and interpretation by the instrument's internal microcomputer, as directed by the user. Here a series of menu options allow you to get the HP 4263A to interpret and display the DUT's impedance in any of the following ways:

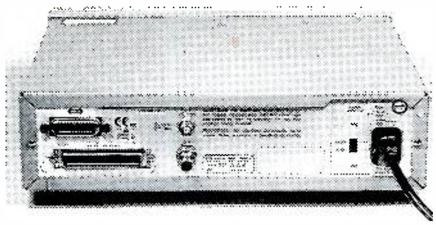
- Absolute impedance and phase angle (|Z| and θ);
- Real (resistance) and imaginary (reactance) components of impedance (R +/-jX);
- Absolute admittance and phase angle (|Y| and θ);
- Real (conductance) and imaginary (susceptance) components of admittance (G +/-jB);
- Parallel capacitance (Cp) and dissipation factor (D);
- Parallel capacitance (Cp) and quality factor (Q);
- Parallel capacitance (Cp) and equivalent parallel conductance (G);
- Series capacitance (Cs) and D;
- Series capacitance (Cs) and Q;
- Series capacitance (Cs) and equivalent series resistance (Rs, = ESR);
- Parallel inductance (Lp) and D;
- Parallel inductance (Lp) and Q;
- Parallel inductance (Lp) and G;
- Series inductance (Ls) and D;
- Series inductance (Ls) and Q;
- Series inductance (Ls) and Rs.

If the '001' transformer measurement option is fitted, five further options are added:

- Series primary inductance (Ls) and direct current resistance (DCR);
- Parallel primary inductance (Lp) and DCR;
- Secondary inductance (L2) and turns ratio (N);
- Secondary inductance L2 and mutual inductance (M);
- Secondary inductance L2 and secondary DC resistance (R2).

As you can see, the instrument is very flexible in terms of parameter measurement options. It's equally flexible with regard to physical measurement configurations, with a choice of various test fixtures and leads of different lengths.

How has this been achieved, you may ask, bearing in mind that the HP 4263A can measure accurately down to a milliohm, a picofarad and a nanohenry? Well, look again at Fig.1, and you'll hopefully see that it actually uses a four-



The rear of the LCR Meter, showing the HPIB and other interface connectors.

terminal 'Kelvin' measurement system. The test current is driven through the DUT via one pair of terminals, while the voltage across it is measured via a second pair of terminals.

On the instrument itself, the current terminals are marked 'Hcur' (for the signal current source) and 'Lcur' (for the 'low' or current measurement terminal) respectively, while the voltage measurement terminals are marked 'Hpot' and 'Lpot' respectively.

As with other kinds of measurement using this four-terminal system, the end result is that if care is taken, all four terminals can be extended via leads and measurement jigs or fixtures. The main requirement is that the voltage measurement connections are made as close as possible to the DUT as possible, to negate lead impedances, and that the leads are shielded or 'guarded' to minimise the effects of stray capacitance.

Needless to say this can all be done with the HP 4263A; all four terminals are guarded, and matching shielded test leads and fixtures are available. The internal micro can also be calibrated fairly easily to compensate for the residual effects of measurement fixtures and test leads of different lengths, as noted earlier.

Compact package

Despite its impressive flexibility, the HP 4263A is quite compact — measuring only 320 x 300 x 100mm and weighing a not-too-heavy 4.5kg.

As the measurements are made automatically, there are no conventional adjustment knobs on the front panel at all. Instead, as with most modern microcomputer-based instruments, there's basically just a customised keyboard-and-display 'user interface' — apart from the four measurement terminals, which are standard BNC connectors.

In this case the display is an LCD panel with a single row of 24 alphanumeric character positions, used not only to display measurement values but also things like menu options, error messages and so on. The characters are about 6mm high. A row of small 'arrow head' symbols along the bottom of the display are also used to indicate the current settings for controlled variables such as test signal frequency and voltage, and also various other aspects of instrument status.

The keyboard has a total of 31 keys, most of which have dual functions — with a blue 'shift' key used to activate the second function. Fifteen of the keys are used mainly for numerical entry (for things like setting a comparison value), while the rest are used for things like selection of measurement display format, selection of test signal frequency and voltage, selection of DC bias level, manual range selection, trigger mode selection and so on. The only other controls on the front panel are the usual power switch and an earth terminal for connection to test fixtures.

At the rear of the case there's the now fairly standard IEC mains input connector, together with a protective fuse and mains voltage selector. This is marked '115V/230V', but the HP 4263A will operate on any voltage within the ranges 100 - 120V and 220 - 240V, with a frequency between 47Hz and 66Hz.

Also on the rear panel are BNC connectors, for provision of external DC bias for the test component and external triggering of measurements, and a 24-way '57N' series connector for remote control of the HP 4263A via the HPIB/GPIB/IEEE 488 instrumentation bus. There's also a large 50-way 57N series connector marked 'Handler interface', used to allow the instrument to interact with automated and

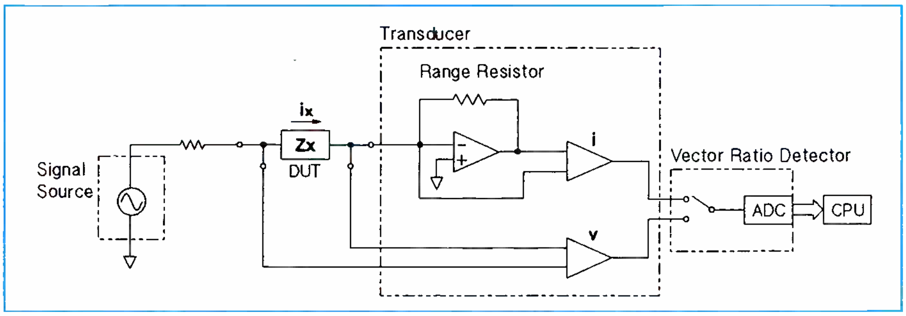


Fig.1: The basic measurement configuration used by the HP 4263A. As you can see, it measures the current flowing through the device under test (DUT), and the voltage drop produced across it. A four-terminal measurement system is used.

semi-automated component feeder/handler units.

Inside the instrument, almost everything is neatly mounted on two horizontal PC boards — an L-shaped main board which seems to cater for all of the analog circuitry, and a smaller rectangular board for the microcomputer. The LCD and keyboard assemblies fit vertically behind the front panel, while a power supply module fits in the rear left-hand corner of the case.

The HP 4263A comes complete with a comprehensive User Manual, in an A4-sized ring binder. A smaller Service Manual in A4 comb-bound format is also available. Accessories available include a test fixture for conventional axial and radial-leaded components (HP 16047A), another for SMD's (HP 16034E), a transformer testing fixture (HP 16060A), a variety of matching test lead sets and Kelvin clip leads.

Trying it out

Hewlett-Packard Australia very kindly loaned us an early sample of the HP 4263A, to allow us to evaluate its operation at first hand. The sample was fitted with the '001' transformer testing option, and also came with the leaded components test fixture and the transformer testing fixture (see photo). We used it to carry out a wide range of measurements, on many different kinds of passive components, and this gave a good impression of both its capabilities and ease of use.

Broadly speaking we found it a very impressive instrument indeed. It allows measurements to be made on most components very rapidly, and in general with high resolution and accuracy — although we don't have access to a standards lab, to fully verify the latter.

We were also very impressed with the degree of control it offers, both over measurement conditions (like test signal amplitude and frequency, and DC bias) and over the way in which the measurement results can be displayed. It's a pleasure to be able to set the instrument to display the results in virtually any desired form — no more time-wasting calculations to convert the instrument readings into the form you *really* wanted!

Of course the more flexibility an instrument provides, the more we users tend to want. For example, after using the HP 4263A for a while we found ourselves wishing that it provided a few more test frequencies (say 300Hz, 3kHz and 30kHz at least) — so that one could examine the behaviour of many frequency-dependent components (like electrolytic capacitors) in more detail over the range covered by the instrument.

Similarly we also found ourselves wishing that it allowed a wider selection of DC bias voltages — ideally, up to say 25V — again for more comprehensive testing of electrolytics. And while we're talking about wish fulfillment, it would be nice too, if it had provision for adjusting a DC bias current through inductors, as well...

But there's really no end to this kind of wish list, and I guess it boils down to a question of how many facilities can be provided for the price. As it is, H-P/-Yokogawa seems to have done rather well with the HP 4263A, so these gripes are rather unreasonable.

There are only two real criticisms we can make of the instrument, and neither is of a major nature. One is that we found the LCD readout a little hard to decipher at times, due to the rather strange shapes used for some of the characters. The 'S' and 'V' are a little mis-shaped, while the lower-case 'n' (as used in nF and nH) seems to have two top 'humps' rather than one, and can all too easily be mistaken for an 'm' (as in mH, or mΩ).

The other criticism is regarding some of the English expression in the User Manual. On the whole, the manual is very comprehensive, and displays a great deal of effort in seeking to provide the user with all information they might need to use the HP 4263A to its full potential. We were particularly impressed with the section headed 'Measurement Basics', for example, which gives a good introduction to the concepts of accurate component measurement using the four-terminal technique.

But to be honest, some of the other areas of the manual are quite difficult to follow — mainly because of the fractured 'Japanese English' expression. This is unfortunate in an otherwise excellent product, and suggests that the Japanese manual writers may not have sent copies to H-P in the States, for proof reading and constructive criticism. Either that, or the person they sent it to for this function was too busy to read it carefully...

Hopefully this weakness can be remedied in fairly short order, to allow the manual to serve its full intended purpose in support of the instrument. On the whole, though, the HP 4263A seems to us a well-designed and very flexible instrument which should prove of great value in many development labs. It makes an excellent addition to H-P's growing range of 'affordable' instruments.

Quoted price for the HP 4263A is $5585 plus sales tax where applicable. For further information contact H-P Australia's Customer Information Centre on (008) 033 821. ❖

CPU operation

Continued from page 131

port). It should be noted that these instructions allow the specification of a port address, although the external hardware does not decode that information. (That is, all reads and writes address the same port irrespective of the port address). This allows the concept of 'sparse' addressing to be confronted.

EMUL-8R also allows the transmission of ASCII data from the PC keyboard, via the console area of the computer graphic. The origin of some of these instruction mnemonics is less clear and the following are supported to send characters to the console area: TCF (teletype clear flag), TSF (teletype skip on flag) and TLS (teletype send character to console).

The keyboard can be read also, using the following instructions: KCF (keyboard clear flag), KSF (keyboard skip on flag) and finally KRB (keyboard read buffer). Using these instructions programs that read from the keyboard and display on the console area can easily be written.

The last area that can be controlled by this group is that of *interrupts*. In EMUL-8R interrupts can only be taken from the keyboard and console device. The ports cannot interrupt. This illustrates the point well enough, however. In order to implement interrupts the minimum instruction set is provided. This includes ION (interrupt on), IOF (interrupt off), SKN (skip if interrupt on) and SKF (skip if interrupt off).

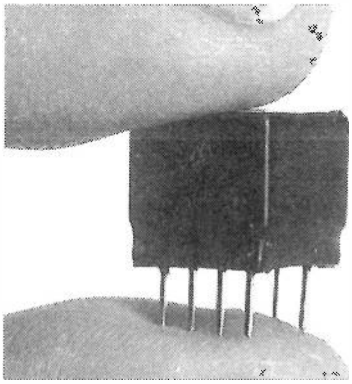
The fourth and final class of instruction provided is that of *stack manipulation*. These are very simple, in that they only allow the pushing and popping of data from the accumulator or the control of return addresses from the program counter. However they are sufficient to allow the principles of stack operation to be established. They include PSH (push the accumulator onto the stack); POP (pop the value on the stack into the accumulator); RET (perform a subroutine return, by taking the value on the stack and placing it in the PC); and finally RTI (return from interrupt). The RTI instruction is similar to RET except that it turns the interrupt back on.

That completes this first article on the story behind, and some of the features and capabilities of EMUL-8R. The next article will look in detail at some of the instructions, and then describe a simple program and its execution on the EMUL-8R.

(To be continued) ❖

NEW PRODUCTS

Mini line transformers



Australian manufacturer Selectronic Components has received Austel Approval for its 600 ohm/600 ohm line isolation transformers.

While the PT720 is a very small isolation transformer (12 x 11 x 11mm), it achieves a return loss greater than 20dB, and meets Austel's Technical Standards TS001 and TS008.

It can be used in the isolation of mains operated equipment, on private and leased telephone lines.

For further information circle 243 on the reader service coupon or contact Selectronic Components, 25 Holloway Drive, Bayswater 3153; phone (03) 762 4822.

High voltage filter capacitors

Aerovox has designed a new line of high voltage DC filter capacitors, using the most recent developments in capacitor technology. This line of capacitors employs a paper/polypropylene dielectric, impregnated in a non-PCB fluid, trademarked 'Environol'.

These high voltage DC filter capacitors are specifically designed for high voltage filtering in power supplies, X-ray equipment, hard tube modulators, transmitters, high energy particle accelerators, and other applications where high voltage bypass or blocking is required. The low dissipation factor of polypropylene will allow a high AC ripple voltage without any temperature increase.

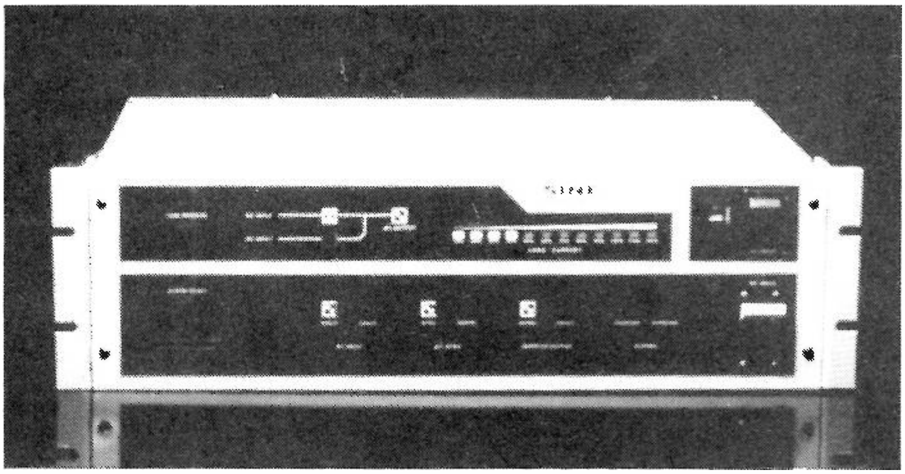
Life expectancy for this range of capacitors is greater than 20,000 hours, voltage range is 7.5kV, and capacitance range is 0.25uF to 150uF.

For further information circle 242 on the reader service coupon or contact Crusader Electronic Components, 73-81 Princes Highway, St Peters 2044; phone (02) 516 3855.

Compact 150W power supply

Power General's FLU4-150 is a new series of quad output, 150W, open-frame switching power supply, in a compact 100 x 200 x 50mm format. Five models provide primary outputs of +5.0V DC and combinations of +5, +12, +15 and +24V DC, with zero minimum load requirements. All outputs are fully isolated; primary outputs are +/-5% adjustable.

High performance features of the FLU-150 series include autoranging inputs, with an input range of 90V AC to 265V AC (or 100V DC to 370V DC). An on-board input line filter exceeds the requirements of VDE/FCC Class B by an average margin of 10dB, virtually eliminating noise due to conducted emissions and, in many cases, eliminating the need for an external line filter. The series offers in-



1200VA/1kW sine wave inverter

The Sinetec HPI-1200 is a high performance 48V DC to 240V AC, 50Hz sine wave inverter. It is designed to power 240V AC, 50Hz equipment, using a nominal 48V DC supply as the power source. The design employs the latest high frequency switchmode power conversion techniques to achieve 1kW of output power (1200VA @ 0.8 power factor) in a compact 3RU high, 483mm rack mounted unit, weighing 16kg.

The unit is capable of supplying loads of any power factor, and in particular has been designed to supply the high crest factor currents drawn by computing and other electronic equipment. Under any load conditions an output voltage sine wave with very low distortion is maintained.

The operating input DC voltage for the unit is 40.8V DC (1.70 volts per cell) to 57.6V DC (2.40 volts per cell) and within this range the inverter will supply its rated output continuously.

A feature of the design is the low psophometric noise current drawn from the input DC supply. In addition, the inverter has the capability to handle short term overloads for equipment start-up, inrush currents, etc.

A supervisory microcontroller is used to monitor the operation of the unit and display the status and any alarm conditions via a mimic diagram, and illuminated symbols on the front panel.

Various voltage free alarm contacts are available via rear panel screw terminals to facilitate the connection of remote alarm. In addition, a Remote Emergency Power Off input is provided, to enable the unit to be turned off from a remote location.

For further information circle 241 on the reader service coupon or contact Critec, GPO Box 536, Hobart 7001; phone (002) 73 0066.

definite short-circuit protection, soft start, over voltage protection and a 32-millisecond hold up time with 115V AC input. Other features include optional, TTL-compatible power fail circuitry, an onboard input line fuse and 5300V DC input/output isolation.

Efficiency for the series is 70%. Line regulation is 0.3% for the primary (+5.0V DC) output and 0.5% for auxiliary inputs. Primary load regulation is specified at 1%, ripple and noise also at 1% maximum.

For further information circle 247 on the reader service coupon or contact Priority Electronics, 1/23 Melrose Street, Sandringham 3191; phone (03) 521 0266.

Soldering station

Australian manufacturer Royel International has now introduced soldering/desoldering stations which are fully compatible with modern electronic components, and includes equipment suitable for removing surface mount devices.

These stations are available for either 240V or 120V operation, and with either analog or digital temperature selection. They are provided with static dissipative handles, auxiliary ground connectors and DC elements, to avoid absolutely any possibility of electrical leakage to damage semiconductor devices.

Features include fast heating, accurate temperature control, positive vacuum from a vane-type pump and simple cleaning of the desoldering tool. There is also a patented device to eliminate the need for removal of soldering tips, so that you can maintain positive grounding.

For further information circle 246 on the reader service coupon or contact Royel International, 27 Normanby Road, Notting Hill 3168; phone (03) 543 5122.

Sealed carbon trimmer pots

The PT Series of carbon trimmer potentiometers from NACESA (formerly Piher) are now available in 6, 10 and 15mm diameter variants. Standard values range from 100 ohms to 5M and are available in linear, logarithmic or anti-log variations.

These enclosed and dust sealed trimmers have a nominal power and voltage (@ 40°C) of 0.1W/100V (PT6, 0.15W/200V (PT10) and 0.25/250V (PT15) in the linear version (with slightly lower power in the non-linear).

The potentiometers are available for either vertical or horizontal mounting, and can be controlled by screwdriver, thumbwheel or spindle.

For further information circle 245 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999.

SMD transformers

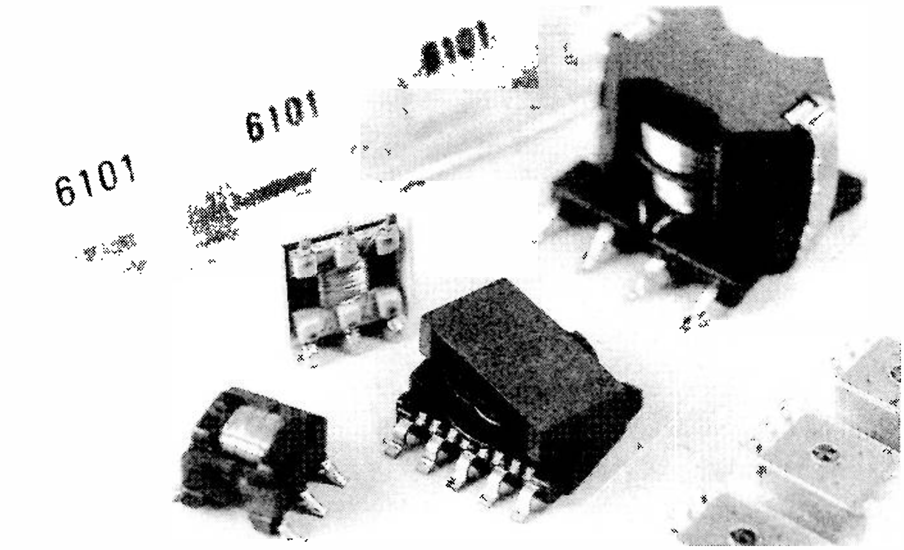
Following the trend towards miniaturisation, Siemens now offers complete transformers in the form of surface mounted components. Typical applications are in digital communications technology, for power supplies and for triggering power semiconductors.

The SMD transformer range from Siemens currently includes versions with core types P4.5, E6.3, ER11, RM4 low profile and RM5.

Using these particularly compact core types allows the size of the complete transformer to be kept to a minimum. Sizes range from 8.0 x 5.0 x 3.0mm^3 for the P4.5 version to 19.0 x 16.5 x 10.6mm^3 where the RM5 core is used.

There is a wide variety of possible applications. For motor controls, the new SMD transformers are suitable for isolated triggering of power semiconductors; and in DC/DC converters, they are available as power transformers and also as control transformers. In digital communications technology, noteworthy applications are ISDN interfaces (for the ER11 and RM5 transformers) and also mobile telephones (for P4.5 types).

For more information circle 244 on the reader service coupon or contact Siemens Components, 544 Church Street, Richmon 3121; phone (03) 420 7716.



PCB-mount XLR connectors

Neutrik has introduced two new series of XLR style connectors: the K-Series and R-Series, which are precise, Swiss-made connectors, designed for printed circuit board mounting in OEM aplications.

The K-Series connectors are available in vertical or horizontal PCB mounting configurations, are machine insertable for automated assembly lines and feature an integral metal bracket which secures the PCB to the connector and chassis. The connector body is fabricated from HD-Zytel PA6 30% GR material, with gold plated contacts on the female version and silver plated contacts on the male.

The R-Series are extremely compact and low cost connectors designed for horizontal PCB mounting. Composed of the same materials used in the K-Series, the female version of the R-Series also features gold plated contacts, is available with a retention spring instead of a latch, and can be supplied without a ground contact.

For further information circle 248 on the reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975 1211.

Ultra thin chip capacitor

ROHM has released an ultra thin, high reliability chip capacitor.

The outside electrode layer of conventional laminate ceramic capacitors is folded around all five sides of the capacitor body. However this newly developed MCS (thin film electrode) series has the outside electrode layer on only one side. This results in a more compact construction, with high heat resistance and improved solderability.

Features include higher package density; less thermal cracking during soldering; physically smaller; and high durability with regard to stresses and strains related to board bending.

For further information circle 249 on the reader service coupon or contact Fairmont Marketing, 57 St. Hellier Street, Heidelberg Heights 3081; phone (03) 457 7300.

NEW PRODUCTS

Answering machine has dual messages

Panasonic has designed its new telephone answering machine, the KX-T1476BA to offer maximum convenience. For example, the day/time voice stamp indicates exactly when someone called, while the LCD readout indicates how many people have called.

Also, a two message outgoing tape allows the user to switch from one outgoing message to another.

This is seen as particularly useful for businesses which wish to leave, perhaps, a short message during the regular trading hours and a longer announcement for out of hours operation. In the case of domestic use, it may be that the two outgoing messages vary from weekday to weekend, or morning to evening.

Unlike most answering machines on the market, this model employs a standard compact cassette to allow for longer outgoing message.

It carries a recommended retail price of $309.

For further information circle 251 on the reader service coupon or contact Panasonic Australia, 95 Epping Road, North Ryde 2113; phone (02) 886 0202.

Compact multi-testers

Tandy Electronics has added three new multitesters to its range. At the top end is the Micronta Auto-Range Voice Meter.

This multitester has a built-in voice synthesiser which clearly speaks the reading on the display. It is perfect for people with impaired vision.

It has full autoranging and autopolarity, diode check function for checking semiconductor junctions, overload and transient protection on all ranges. It is priced at $179.95.

Next on the list is the Micronta LCD Auto Range Digital Multimeter, a portable 3-1/2 digit, compact multitester. Full autopolarity operation protects the meter and gives valid measurements when leads are connected in reverse polarity. Overload and transient protected, it costs $89.95.

And last we have the Pocket Autoranging Multimeter, with manual override. This compact pocket meter accurately measures AC and DC voltages and resistance, to one ohm and one millivolt sensitivity. Its range includes 10 megohm resistance and 400 volts AC/DC and is priced at $44.95.

For further information circle 252 on the reader service coupon or contact Tandy Electronics, PO Box 254, Mt Druitt, 2770; phone (02) 675.1222.

Compact faxes

Ricoh has launched two stylish new compact business facsimile machines, the FAX 500 and the FAX 550. The Ricoh range now incorporates 10 different thermal fax models and four plain paper models, with a machine to suit every need and budget.

The new models boast several new features, some of which have previously only been offered on much larger, more expensive machines. The FAX 550 is the more advanced of the two new models. Like the FAX 500, it has been designed for maximum flexibility, and incorporates a telephone handset which allows it to operate as both a fax and a phone using a single line. Both models include memory as a standard feature, but the FAX 550's memory is twice the size of the FAX 500's and can be further expanded to 1.25MB or 2.256MB.

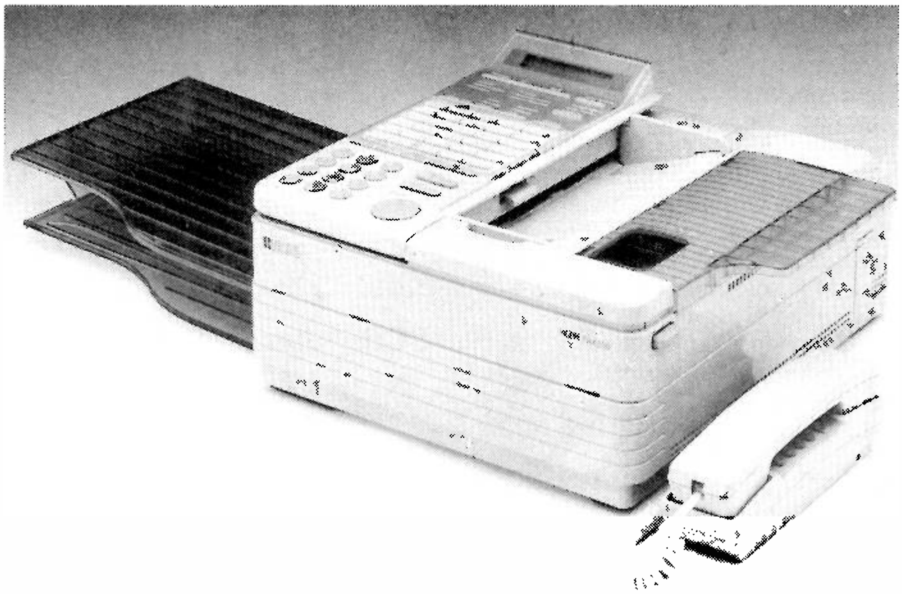
While the FAX 500 offers some of the conveniences of memory such as Memory Transmission, Serial Broadcasting and Substitute Reception, the FAX 550's powerful expanded memory provides access to a host of sophisticated features.

Batch Transmission function can store two or more fax messages for the same location, to be sent in a single transmission, thus reducing protocol time.

Auto Document uses the FAX 550's memory to permanently storage image data such as company logos, which can be transmitted as header sheets at the touch of the Quick Dial Key. The Confidential Reception function stores data received in your absence, and prints it out only when a personal ID code is entered.

Scanning data into memory is remarkably quick at only 4.5 seconds per standard A4 page, and both machines use a new improved half tone mode, with 64 levels of grey. This allows the machine to separate text from graphics and photographs and treat each differently for the clearest reproduction possible.

For further information circle 250 on the reader service coupon or contact DBE Australia, 12 Barcoo Street, East Roseville 2069; phone (02) 415 9444.



Pulse capacitors

Aerovox has released a new series of metallised electrode energy-discharge pulse capacitors.

These provide a highly reliable, cost effective source of energy storage for a variety of applications such as airport tower and runway lights, flash lamps for copiers, and numerous high intensity flashing industrial lights.

The new MetEDC pulse capacitor designs are small in size and weight yet they safely store up to 5J of energy per cubic inch. Ratings are available up to 1600uF, in voltages from 500 to 5000V DC. Special designs are also available up to 10,000V DC.

The capacitors are constructed of wound metallised electrode sections, enclosed in a case of terneplate steel, which is more resistant to dents than aluminium. The solid dielectric material is impregnated with a specifically designed, non-PCB fluid. Steel covers are roll seamed to the cases, using a sealant to ensure leakproof enclosures.

For further information circle 253 on the reader service coupon or contact Crusader Electronic Components, 73-81 Princes Highway, St Peters 2044; phone (02) 516 3855. ❖

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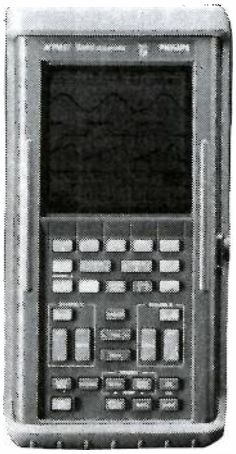

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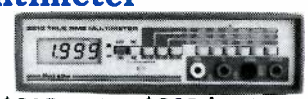

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Silicon Valley NEWSLETTER

Mountain View workstation manufacturer Sun Microsystems has just celebrated ten years of successful operation, an achievement of which the company's chairman, president and CEO Scott McNealy is justly proud. McNealy's fiercely competitive company has just pulled off an impressive coup: hiring the former Soviet Union's complete supercomputer design team. (See story at left)

Sun hires top Russian designers

The computer scientist considered to be the Russian counterpart of supercomputer legend Seymour Cray has been hired by Sun Microsystems to help redesign and improve the performance of the company's SPARC line of microprocessors.

Boris Babayan has been the former Soviet Union's chief computer scientist, responsible for the development of the 'Elbrus' supercomputers which the Soviets used to design their nuclear and other advanced weapon systems.

Under the terms of the deal, Babayan and his team of some 50 software and hardware scientists will work full time for Sun from their research laboratory in Moscow. The group will be part of Sun Labs, the Sun subsidiary responsible for the company's advanced product development.

While Sun will supply Babayan's lab with all the Sun and other computers it needs, the group will not be able to get Sun's most advanced workstations and servers, which are still restricted from export to the former Soviet Union.

To be sure, Sun is getting the deal of the century on the high level design team. Babayan will be paid on US$100 per month. Other engineers will receive even less. In the US engineers with Babayan's credentials can draw starting salaries of more than US$100,000.

Although negligible by Western standards, the wages still amount to upper class income in Russia. In fact, Sun said Babayan didn't want a Western-size income, which he said would create bitter feelings among the members of his team and within the Russian computer science community.

Industry and political analysts said the Babayan move will be only the first of many, as Soviet scientists are increasingly eager to seek a safe haven by working directly for Western organisations. In military circles, these deals are welcomed as there have been fears that some of the top former Soviet scientists may be lured by countries with adversarial relationships with the West.

The deal between Babayan and Sun came to a large degree by the efforts of T.J. Rodgers, of San Jose chip maker Cypress Semiconductor. Babayan has tried to persuade Cypress to produce his five million transistor microprocessor which would have outperformed any similar chip on the market in the West. The Soviets lack the equipment and expertise to make such a chip.

Cypress also declined, as it lacked the resources to take on such a project. But Rodgers then introduced Babayan to Sun's chief technologist Bill Joy, initiating a meeting that resulted in Babayan and his team signing up with Sun.

90,000 electronics jobs lost in 1991

The American Electronics Association has announced what tens of thousands of electronics workers in the US already know: 1991 was a terrible year for the industry. In all, 90,000 high-tech jobs were lost in the recession, bringing the total of vanished jobs in the last three years to a whopping 210,000.

In one of its sharpest criticisms of US policies, the AEA directly blamed the failed trade policies of the Bush Administration and the Congress for the job decline in the industry.

The 1990 drop in employment was the biggest one year decline in US electronics instry history. At 2.39 million workers, the industry now employs fewer workers than it did back in 1986. A significant portion of the lost jobs resulted from the dramatic cut-backs in the defence industry, following the end of the Cold War.

Also hard hit was the computer industry, where fierce competition forced even the traditionally strongest firms, including Hewlett-Packard, IBM, DEC and Apple Computer to reduce their payrolls in order to remain profitable. Other companies were forced to export manufacturing jobs to lower-cost areas off shore.

AEA president Richard Iverson said the large drop in employment "should signal an alarm for the nation. Although we are still fueling job growth, total employment is no longer expanding." Iverson said few, if any of the lost jobs will return unless the government finally takes some long overdue steps to improve the business climate for US high-tech companies.

Most of all, the government needs to find a way to encourage capital investment, he said, typically by a sharp reduction in capital gains taxes. Although proposed almost every year, the issue has been a steady victim of partisan politicking in the Congress, where the Democratic party has depicted such measures simply as a tax break for the rich.

Bush to hold Japan to chip deal

A high-level US chip industry delegation on a lobbying visit to washington DC has reportedly found some new willingness in the Bush Administration to consider punitive action against Japan if the US share of the Japanese market does not improve and the US-Japanese chip trade agreement fails.

US Trade Representative Carla Hills, who has often expressed her dislike of the agreement, reportedly told the chip delegation her office will consider taking steps if the US share continues to remain stalled at the 14% level.

"The Administration intends for the terms of the agreement to be met. A 'NO' answer will be unacceptable," Hills was quoted as having told the chip executives, according to Texas Instruments semiconductor division president William Spencer who participated in the meetings.

While Hills and the Administration appear to support the SIA's efforts to get Japan to live up to the terms of the agreement, Hills would not specify what sort of action the Administration may take if the trade agreement fails.

In the last six months, the US share of the US$21 billion Japanese market has declined from 14.7% to around 14% in the fourth quarter. The Japanese have blamed their sagging economy for the problem, and Japanese industry and government officials have recently conceded that it will be very difficult to achieve the 20% marketshare level by the end of this year as the agreement calls for.

A full review of the chip trade agreement is due in December, one month before the agreement expires.

H-P enters consumer market with TV gadget

In a major departure from its traditional technical markets strategy, Hewlett-Packard is entering the consumer electronics field with 'TV Answer,' a box that will allow TV viewers to participate in live television broadcasts such as games, educational programs and consumer surveys.

The systems consists of a VCR size control box that hooks into the television set, plus a remote control device with which the viewer selects various options when participating in a program.

TV Answer will retail in the US for around US$400-500 and uses low power radio signals to transmit signals to a local base station which can serve up to 2800 homes. The signal is then relayed per satellite. Responses back to the viewer are processed in the same, but opposite direction.

H-P president John Young said he hopes the device will reach the market in the fourth quarter of this year. The company expects to sell as many as 1.5 million units in the first year alone. They will be marketed through traditional consumer electronics outlets.

The TV Answer system, which essentially provides a personal computer with radio capabilities, was actually developed by TV Answer Inc. in Reston, Virginia. This firm granted H-P an exclusive licence to make and sell the systems. Children can use the gun-like remote controller to answer maths questions during the broadcast of an education program. Individual results, as well as comparison results can then be displayed on the viewer's television screen. Also, news organisations will be able to conduct polls on major political and other issues, among thousands, if not millions of viewers.

Future political elections may be even more dramatically influenced by the TV Answer system than they are already today by small telephone-based polls. Other viewers may be able to participate in TV game shows and weven win prizes.

'Revolutionary DRAM breakthrough'

In what is already being hailed as the most important development in DRAM technology since the invention of this type of memory chip 22 years ago, a small Silicon Valley start-up has announced the invention of a new DRAM design that will boost the speed with which these chips operate by a factor of 5-10.

Three of Japan's top five DRAM producers — NED, Toshiba and Fujitsu — announced they have licensed a revolutionary memory chip design technology invented by Mountain View start-up Rambus, and will use the technology to build a new generation of so-called 'RDRAM' memory chips which will vastly boost overall system performance.

The first RDRAMs may become available before the end of this year.

The Rambus invention eliminates one of the biggest and longest nagging bottlenecks in computer system design. In recent years, microprocessor speeds have increased at a much faster rate than the speed at which DRAMs process information. The slow speed of DRAMs have provided a huge boost to faster, but far more expansive SRAMs.

The Rambus technology increases the speed of DRAMs by a factor of 10 or more, allowing them to catch up to the computing capabilities of the microprocessor and allowing personal and other computers to achieve their full operating potential.

The Rambus design consists of a special interface chip that sits between the microprocessor and the DRAM, which features a redesigned channel bus to communicate with the processor. From the outset, Rambus had planned to license its technology to chip makers rather than trying to make DRAMs itself, a nearly impossible venture for any start-up.

Rambus was formed in 1989 by Mark Horowitz, an electrical engineering professor at Stanford University, and Mike Farmwald, a Stanford graduate student in computer science. The company was started with US$1.8 million in venture capital, from three ventual capital companies and one major — unnamed — chip maker.

Their patented technology is based on a DRAM interface that is radically different from the current industry standard. Their design is both simpler and faster than the existing standard.

One major side benefit of the new design is that computer makers will be able to design computer products with a single memory chip. Until now, it usually requires eight similar DRAM chips. With the Rambus design a computer with a single 16Mb RDRAM chip would still be able to have about two megabytes of storage capacity.

IBM chip doubles data transfer record

IBM researchers have announced the development of an experimental electronic switching circuit capable of processing up to 80 billion bits of data per second.

The chip is divided into 16 different data channels, each processing data at the rate of five billions bits per second — twice the current world speed record. At this speed, the chip would be able to process in one second an amount of data equivalent to 16,000 average size novels, or just about the total volume of books stored in a community library.

IBM stressed the chip is experimental and the technology may not appear in commercial form for several years. ❖

Computer software/hardware review:

LMS turns your PC into a speaker testing system

Developed to run on IBM-compatible PC's, LMS uses its own calibrated microphone and a sophisticated hardware card to carry out a host of detailed acoustic measurements. It can then store the results on the machine's hard disk, process or convert the data to suit your needs, and send a high quality printout to a range of output devices — plus much more...

by ROB EVANS

Those involved in developing and testing loudspeaker systems will be well aware of the need for some kind of acoustic measurement system, to help you determine how a speaker is *really* behaving. In many ways it's analogous to using an oscilloscope in electronics, where the displayed results are used to evaluate the action of a circuit, and this information is then used to (say) modify and improve its characteristics.

Of course, this analogy falls down a little when you consider that you can't normally 'see' into a circuit without a scope, but you *can* hear a loudspeaker without an acoustic measuring system. The problem is however, that your ears are a long way from being an objective test instrument, since they are under the control of some rather unpredictable software (or 'squishyware', you might say)...

For many years the answer to this problem has been the ubiquitous acoustic chart recorder, which simply plots a microphone's output level against frequency, in the time domain. In its basic form, the unit has an internal ramp generator which controls both the frequency of a sine-wave oscillator and the movement of the chart paper, so as it's output test signal (which ultimately drives the loudspeaker) sweeps between say 20Hz to 20kHz, the chart paper will move a matching set of graduations past the recording pen, which in turn responds to the mic signal level.

The end result is the familiar frequency response plot where frequency is shown in a logarithmic scale across the X-axis, and generally sound pressure level (SPL) is represented in the Y-axis. As you would expect, this type of chart recorder can be used for a whole range of other audio-related jobs; such as plotting a loudspeaker's impedance against frequency, recording the residual noise spectrum of an industrial environment, and so on.

In all, this traditional style of acoustic test instrument has served the industry well. However, while it's been progressively refined over the years by a handful of (mainly) European audio specialist companies, there are some areas where the setup is quite restricted by nature — and above all, it *has* become a rather expensive beast to both purchase and run.

So in line with the trend amongst an increasing number of other test instruments, the traditional audio test set is now being challenged by PC-based alternatives, which tend to offer both an exciting new range of capabilities and a lower overall purchase price — even when you take into account the cost of a suitable computer, in some cases.

It's with these thoughts in mind that we were particularly keen to try out the new LMS system, from US-based Audio Teknology Incorporated (formerly CSN Electronics) — which by the way, are also responsible for the excellent PC-based LEAP (Loudspeaker Enclosure Analysis Program) as reviewed in the May 1989 issue of *EA*.

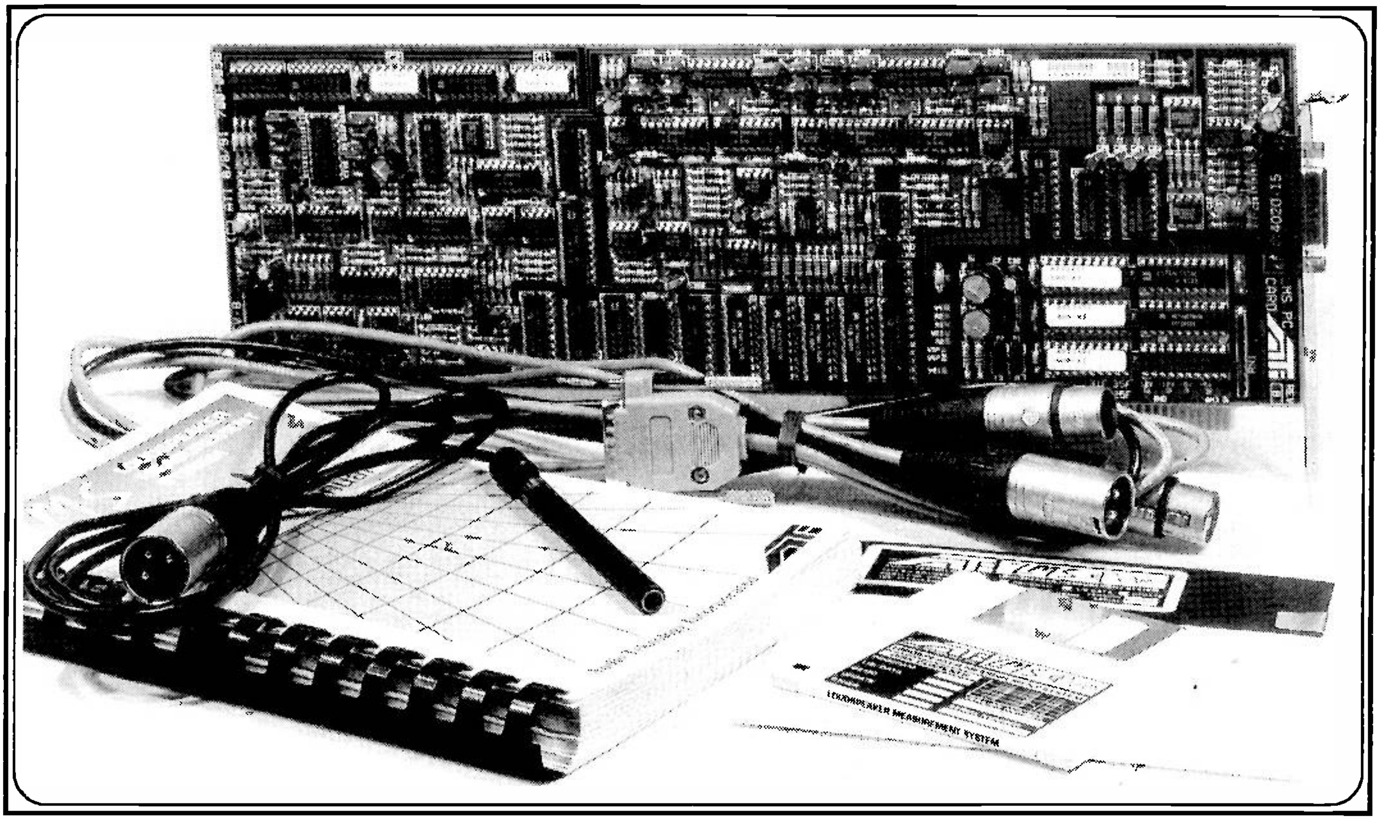
The LMS approach

The LMS package includes a full-length hardware card designed to fit into the 8-bit expansion connector of an IBM-compatible PC; the LMS software itself, on both 3.5" and 5.25" diskettes; a substantial spiral-bound user's manual; a small high-quality condenser microphone, and a special cable assembly terminated in three XLR-type connectors for the microphone and line inputs, plus line level output.

In computer terms, LMS is quite suitable for virtually any level of PC, from modest 8088-based systems right up to the latest '486 screamers, and can use any of the common types of display systems (Hercules to VGA). While a maths co-processor is not strictly required, LMS will make use of one if fitted to the machine. You *do* need a hard disk however, since when installed LMS will need around 4MB of free space for its various sub-directories with executable, overlay, and library files.

Fortunately, the installation procedure for both the hardware and software sections of the system is really quite straightforward. Hardware wise, you just insert the LMS card into a spare slot in the PC's expansion bus, and then connect the cable assembly via its 15 pin D-type plug to the matching socket on the card's end plate. After that, the LMS program can be transferred onto the machine's hard disk by simply invoking the 'install' program on the original LMS floppy.

The LMS card is rather an interesting device in itself, and features a gated low distortion oscillator, dual tracking filters, average and gated peak detection circuits, and an input stage for the phantom-powered reference microphone. The real power of the card rests in the fact that all of these sections are *fully* programmable, which allows the LMS software to totally and dynamically con-



trol all of the system's audio characteristics. As you would expect, this is exactly what's needed for an effective PC-based audio analyser.

In raw performance terms, ATI claims the oscillator to have a distortion figure of 0.015% (THD) between 20Hz and 20kHz, a maximum frequency range of 10Hz to 100kHz, and a frequency response which is flat within +/-0.25dB. The two programmable filters can be configured as low-pass, high-pass, band-pass or band-reject (notch) filter stages, which ultimately allows LMS to perform a wide range of useful functions.

Features

As already mentioned, the programmable nature of the LMS card allows its matching software to reconfigure the system for a number of alternate testing routines. Frequency can be plotted against absolute SPL in dB, relative voltage in dBm, gain change in dB, normal voltage readings in VRMS, impedance in ohms, and reverb decay time in seconds. Also, this already impressive list is expanded by the option of performing all voltage and SPL tests in a 'gated' mode, which greatly reduces the corrupting effects of a room's standing wave patterns.

When the gated mode is selected, LMS directs the oscillator to produce a number of bursts of complete sinewave cycles at each test frequency, rather than supplying a simple continuous tone which steps in pitch (as in the 'normal' mode). Each of these gated bursts lasts for a predetermined time duration, and is synchronised with the action of the data recording input or 'meter'. The trick is that the meter is then enabled for a *shorter* period during the middle of the oscillator's burst period, while it captures the incoming signal from the microphone and measures its level.

In this way, the meter will not read any leading edge transient products (that is, transient distortion) produced by the loudspeaker, nor hopefully pick up any reflected energy from nearby boundary walls. The logic goes that by the time the energy has travelled from the speaker to a nearby wall and back to the microphone, the meter capture period will have ended — presto, the room's boundary effects are ignored. Apparently, LMS only needs to 'grab' one full cycle of the incoming waveform to make an accurate measurement.

There are limits to the effectiveness of this system however, since the minimum frequency which can be accurately measured will ultimately depend upon the size of the room — or in practice, the distance to the nearest wall.

This is because as the test frequency goes down and its wavelength increases, the meter must be activated for a proportionally longer period so as to sample and measure a full cycle. This longer sampling period means that the acoustic reflection from the wall may now arrive *before* the metering gate is closed, resulting in an inaccurate reading.

For example, if the nearest wall is say 2.5 metres from the test setup, then the tone burst from the speaker will travel to the wall and back in around 15ms (since the speed of sound is 345m/s). If we are using a 5ms delay before the meter gate opens (to allow the speaker time to 'settle'), the gate can only be open for 10ms if we are to avoid capturing any *reflected* energy in the measurement.

Now, the lowest frequency which can be captured as a full cycle in a 10ms duration is 100Hz — below that frequency, the meter is receiving less than a complete cycle, and cannot make an accurate measurement.

While you might imagine that these complications make LMS rather difficult to operate in the gated testing mode, it's really very easy thanks to the elegant nature of the software itself. As you would expect, the tone burst time, meter pre-delay and sampling time can all be programmed by the user, but as a bonus however, they are displayed in both time (in ms) *and* distance (in feet or meters).

This means that if you judge that the nearest wall is say 1.7m away, the meter delay plus sampling 'distance' must be less than 3.4m (to the wall and back) if we are to avoid reflections. In this case you might simply dial up 1m for the pre-

Speaker testing system

delay (2.9ms) and 2.4m for the sampling time (6.9ms), which is a very straightforward procedure.

You don't even have to worry about the possibility of inaccurate data below the cut-off frequency, since LMS notes the sampling period (in this case, 6.9ms) and automatically ignores the readings taken with frequencies which have a longer cycle time — here, measurements taken below 143Hz.

In all, this is a very effective and quite accurate way of removing the effects of room aberrations, particularly if you have quite a large testing room.

It's interesting to note that many chart recording test sets offer a 'warble' tone option, where the test tone is continuously and quickly varied over a third- or full-octave range (typically) in an effort to reduce the build-up of standing waves. While this helps to some degree, it's by no means a cure, or nearly as effective as the LMS gating system.

Although the LMS gated testing routines are one of its more interesting features, it's certainly not short of other practical and powerful facilities.

For example, you can print out the resulting curves to dot-matrix printers, laser printers, plotters, or as an encapsulated PostScript (EPS) file for desktop publishing and drawing programs. Also, the printer data can be sent to parallel or serial ports, or written directly to disk, and arranged in a portrait, landscape or customised configuration.

The curve data generated by a test is stored in an LMS library, and can also be displayed on the PC's screen as a high-resolution graphics image, or even exported to a single file for loading into other packages such as ATI's own LEAP program (release 4.0).

This is of particular interest, since LEAP can derive most of the parameters needed for its speaker 'model' from two different impedance curves: one representing the driver's free air response, and the other showing its characteristics in a sealed enclosure of a known volume (Delta Compliance method) or with a known mass attached to the cone (Delta Mass testing).

If you are lucky enough to have access to both LMS *and* LEAP, a driver can be tested with LMS, then have its parameters derived by LEAP, which will then help you design a suitable enclosure. After the enclosure has be constructed, the final speaker system can be tested with LMS to check and fine-tune the results.

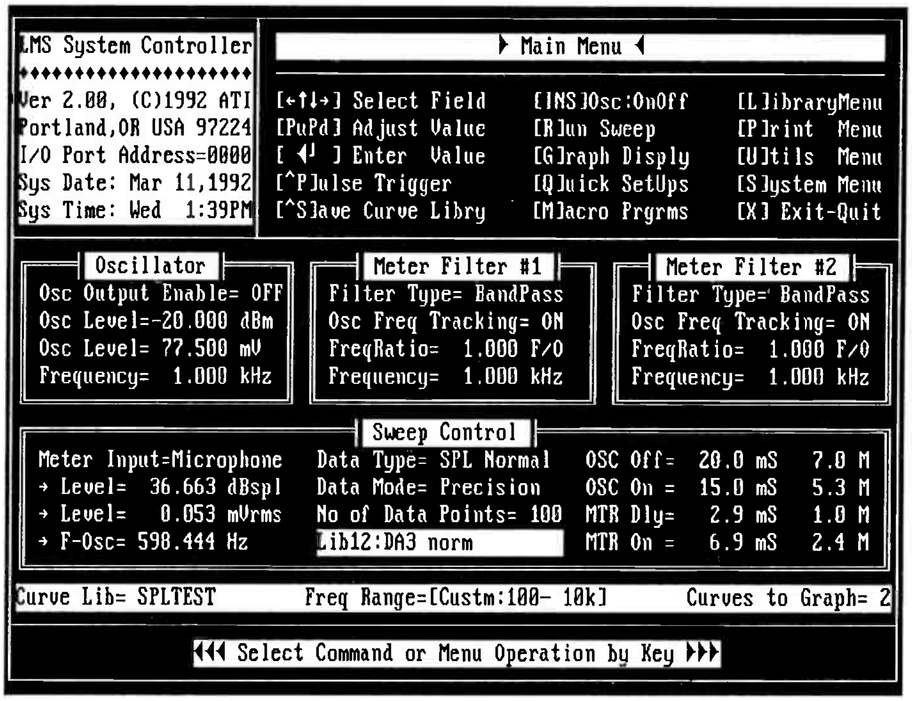
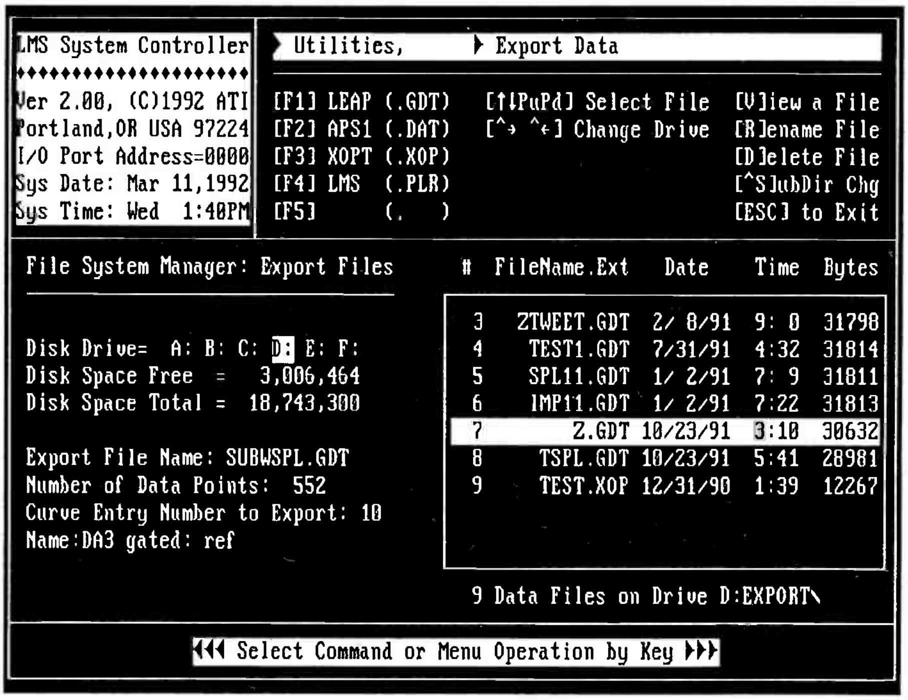


Fig.1: The main menu screen from LMS. The gating times for the oscillator 9OSC) and level sensing meter (MTR) stages are shown in the lower right-hand corner of the display — note how the equivalent distance that sound will travel during these periods is also shown (in M for metres).

Note that in the above scenario, computer-aided design has been used from start to finish, and in this case, appears to live up to CAD's promise of speed, convenience and accuracy.

We can in fact testify to the effectiveness of this system, since we've been using the most recent version of LEAP in conjunction with LMS for some time in the *EA* lab — stay tuned for a full review of this new and upgraded revision of LEAP.

By the way, for LEAP to successfully develop a set of speaker parameters



LMS can export (and import) data in a number of different formats to suit other audio CAD packages. Here, the export utility screen is shown with its associated file manager read to transfer a file.

from imported LMS data, the *phase* as well as impedance figures must be available. Since LMS is a single channel instrument however, it cannot directly measure the phase response during a test run, and this data must be calculated after the event.

According to the manual, LMS uses a 'Hilbert-Bode' transformation to generate a phase curve from the existing magnitude data (in this case, impedance).

The post-processing capabilities of LMS extend much further however. Within the program's 'utility operations' you can generate further plots showing a curve's group delay, the *ratio* between two existing curves, or the *difference* between two curves. This latter option can be particularly handy for subtracting the effects of the test cable's resistance from a speaker's impedance plot.

The list of utility functions goes on. Curves can be scaled up or down for comparison purposes, levelled to remove small spikes, compared to a reference curve for quality control (QC) testing, and have the vertical scales converted between log (dB) and linear (volts) units — or visa versa. Also, the data from a number of separate curves can be averaged to derive a 'typical' curve for QC purposes, or when the curves contain the data for a speaker's response taken at 30° rotations around the enclosure, combined to form a polar plot.

So with all of these capabilities, it's clear that LMS really does go way beyond the features offered by a traditional acoustic chart recorder for example. As with other PC-based test instruments however, it's the software's 'user interface' that often ends up defining the system's practical value...

Using LMS

After working with LMS for a short time, it was apparent that ATI have done a fine job with the software. We were able to perform all of the common types of speaker tests, then store, display and print the results after only a casual glance through the supplied user manual — which by the way, is clearly written and arranged with a generous sampling of diagrams and sample screen shots.

The main text-based menu screen — as opposed to the graphics screens showing data curves — displays the major LMS functions and their associated command keys in the top section, and the various settings for the oscillator, two tracking meter filters, and test tone sweep configuration in the lower area (as shown in Fig.1).

To change settings, you simply move the highlighted cursor to the desired 'control', and either type in a new value or increment/decrement/toggle the setting with the PC's PgUp and PgDn keys.

To save you the trouble of having to re-configure these parameters each time a different style of test is performed, LMS has a 'quick setups' option where the control panel settings may be saved to disk (as a 'snapshot'), and the resulting file recalled at will. This is particularly handy where a number of different, but standard tests are run on a regular basis — in fact, the way in which LMS would mostly be used.

Taking the idea even further, LMS also offers a macro programming facility, where the user can 'execute' a simple text file containing a series of dedicated LMS commands, which then instruct the software to perform a range of tasks. In practice, this file can be generated by any standard text editor (or word processor), and would contain instructions to say, load the desired library and quick setup files, then perform a test sweep and store the resulting data in a particular library location.

The actual programming language is surprisingly powerful, and not unlike BASIC in its expressions and capabilities — for example, it offers 'if/then' and 'goto' statements, and is executed in a conventional line number sequence. To actually run the LMS macro program you simply load the file from the macro file manager menu, and the listing will then take control of LMS until the tasks are completed. As you can imagine, this facility would be ideal for repetitive tests performed in a manufacturing environment.

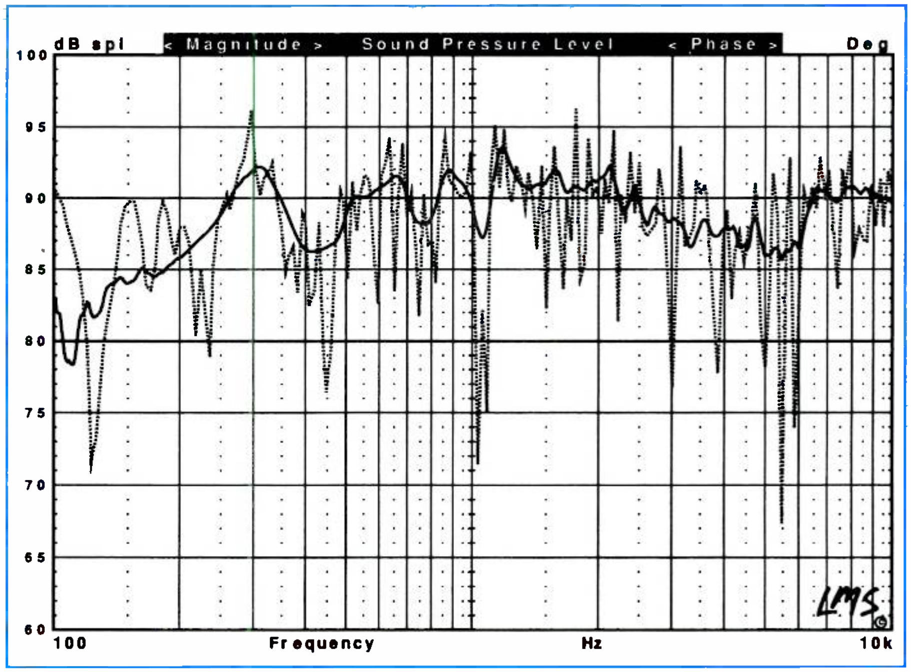
The other operational aspects of LMS are also well thought out, with the commands mostly functioning in a logical and intuitive manner. The only annoying aspect that we found was the way in which the file manager system selected a different disk drive.

This reasonably minor grumble is caused by an arrangement where LMS can only *cycle* through the available drives (with the left and right arrow keys), rather than being able to select a drive directly (say, by typing A:).

The problem with this system is that if you are normally operating on say the D-drive and wish to import a file from a floppy disk in the A-drive for example, then you *must* pass through (and automatically select) the B-drive which is probably not holding a disk.

Not surprisingly, DOS then tries to access a non-existent disk in drive B, and finally times-out and reports an error to LMS — meanwhile everything stops as both DOS and LMS seem to discuss the problem then try the drive a couple of more times, just to be sure...

Unfortunately the situation is repeated in many areas of LMS, since most of the program's major functions (Quick setups, Macro programs, Library, and so



This printout from LMS shows a speaker's SPL in a medium sized room, where the jagged curve (dots) shows the effects of reflections from the boundary walls. The smoother curve (solid line) was the same test, but run with LMS in its gated mode.

on) use this same imbedded file manager. We circumvented the problem on our test machine by leaving a floppy disk in both the A and B drives while we were using LMS.

The main test computer by the way, was a relatively modest (nowadays) 10MHz AT fitted with a maths co-processor and a standard VGA monitor. LMS ran without any problems on this machine, indicating that you don't really need to spend large sums of money on a high-end CAD orientated PC to satisfy the program's demands. As it turned out, we also used LMS on a rather elderly 8MHz XT-clone (fitted with a Hercules monochrome display) in our sound lab to record the response plots of various speakers, then transferred the files to the main AT machine for viewing and processing.

You could in fact use a low-performance and inexpensive machine as the main platform for LMS, as long as you are prepared to wait while the program does its initial configuration routines, and during any post processing number-crunching such as phase generation and curve levelling — there's more than enough time to have a cuppa while you're waiting...

On the other side of the coin, our AT machine fitted with a co-processor zipped through the post processing routines in a few seconds, indicating that while it's not strictly necessary, LMS does indeed use the maths chip during these floating-point calculations.

What you *do* need however is around 540K of free memory to run LMS. This means that a machine with at least 640K of main memory is required, and it must be configured with the least possible number of terminate-and-stay-resident (TSR) programs and device drivers.

Since LMS doesn't respond to mouse commands for example, you could increase the amount of free memory by not installing your mouse driver.

Nevertheless, LMS places surprisingly few demands on the host PC when you consider the inherent power of this CAD program. What you mainly need as it happens, is enough physical space inside your computer to fit the full-length LMS hardware card, which may rule out the majority of portable/laptop machines. This is a little unfortunate, since LMS could form the basis of a highly effective, portable acoustic test instrument.

Conclusions

All in all, we're very enthusiastic about the capabilities of LMS. It performs all of its testing routines in an elegant manner regardless of the machine's configuration, and above all, is very easy to operate — full points to ATI in this regard. When combined with the latest version of LEAP (in particular), it becomes an extremely powerful loudspeaker system development tool that would be ideal for private or industrial use.

The quoted price for the full LMS package (including the high- quality reference microphone) is $1490, plus sales tax if applicable.

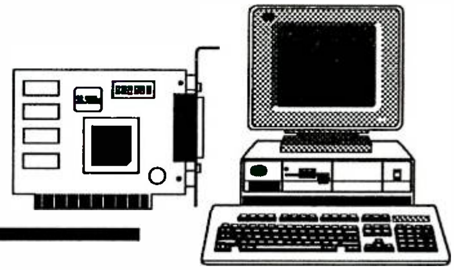
In our opinion, this constitutes an excellent deal when you consider the complex nature of the LMS hardware card, and for that matter, the current price of a high-quality condenser microphone. When compared to the price, running costs and capabilities of a traditional audio test set using a chart recorder, LMS comes out way ahead.

For more information on both LMS *and* LEAP, contact the Australian distributors of ATI products, ME Technologies at PO Box 50, Dyers Crossing, NSW 2429, or phone (065) 50 2254. ❖

READER INFO NO. 37

READER INFO NO. 38

Computer News and New Products



32-bit PCB CAD package

The new PADS-2000 circuit board CAD package from CAD Software of the US is a true 32-bit CAD system for PCB design, which runs on a PC.

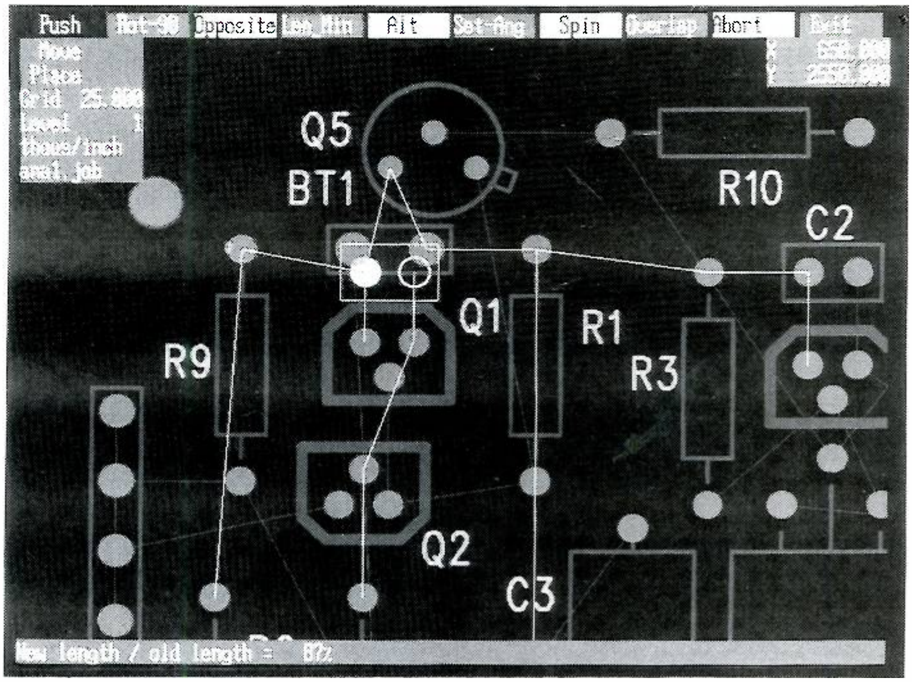
Designed to run on 80386 and 80486 machines, it runs under virtual memory to overcome the memory limits of the MS-DOS operating system.

Virtual memory is a significant advantage, because it allows PADS-2000 to offer a far higher level of functionality and performance. It is capable of designing layouts as large as 4000 integrated circuits without difficulty, and also provides a very high resolution — allowing users to define features with an accuracy of 0.001mm (0.0001").

PADS-2000 is suitable for the design of all layout technologies, including complex analog and SMT (surface mount technology) circuits.

For analog design, it has important design features such as 1/20th degree component rotation, user definable curved traces, and a copper fill function with automatic DRC.

For SMT design, PADS-2000 supports top and bottom layer component placement, blind and buried vias and the ability to create predefined via fanouts.



For further information circle 161 on the reader service coupon or contact Emona Instruments, PO Box K720, Haymarket 2000; phone (02) 519 3933.

10A relay board for PCs

Procon Technology has released an externally mounted, high current relay output board (PC-10-DK2). Designed and manufactured in Australia, this board provides 16 relay outputs capable of switching 10A at 250V AC or 30V DC. Up to seven of the boards may be daisy-chained to provide 120 outputs when using the bi-directional parallel port card (PC-BD-IO).

A new feature of the board is its ability to turn off all outputs if new data is not received within one to 10 seconds (user selectable). This function may be disabled, allowing the outputs to remain in their last state indefintely. The PC-10-DK2 is compatible with other input and output boards produced by Procon Technology, and with the PC-10-XX software available for control from most high level languages (e.g., Basic, C, Pascal).

The board is also compatible with the PLC (Programmable Logic Control) software, capable of controlling up to 128 inputs and 120 outputs in a relay ladder logic programming environment.

Applications include home or business automation systems, environment control, factory automation and robot control.

Ex tax and including the PC-10-XX software the board is priced at $450.

For further information circle 163 on the reader service coupon or contact Procon Technology, PO Box 655, Mt Waverley 3149; phone (03) 807 5660.

Low cost integrated multiplexer

Australian datacom manufacturer Datacraft, has released a low cost, integrated voice, data fax and LAN multiplexer that can be easily expanded to cater for large network traffic needs.

Called the Marathon 1K Data/Voice Network Server, the new product not only incorporates all the data handling facilities of a much more expensive stat mux, but it can also transport data, voice, fax and LAN traffic over the same low speed (9600 - 64kbps) lines to remote offices.

The Marathon 1K compresses data by a factor of 4 to 1, freeing up bandwidth for additional data, bridged LAN, voice and facsimile traffic.

It retains high quality voice transmission while compressing the standard speech signal of 64,000bps down to as little as 4800bps and allows fax to travel over the network at 9600bps instead of the standard 64,000bps.

For further information circle 165 on the reader service coupon or contact Datacraft, 266 Maroondah Highway, Croydon 3136; phone (03) 727 9111.

Integrated sound package for Macs

Firmware Design has released SoundEdit Pro, which is designed specifically for recording, editing and integrating sound, using Macintosh CPUs with 68020 or faster processors.

These include the SE/30, LC, IIsi, IIfx, Classic II, PowerBook 140 and 170 and Quadra 700 and 900.

This new software builds on the capabilities of SoundEdit 20.5 which is recommended for use with the MacPlus, SE, Classic and PowerBook 100.

Some of SoundEdit Pro's new features are the ability to record, edit and play sounds from disk (eliminating RAM constraints); input sound from any hardware device whose driver is compatible with the Macintosh Sound Input Manager; open and save sounds at eight or 16-bit sample sizes; sample sounds at any rate up to and including 48kHz and the ability to use System 7.0 disk-based sound resources and virtual memory.

The recommended retail price for the MacRecorder Sound System Pro is A$575; for the SoundEdit Pro (software only) A$449; or for an upgrade from earlier versions, $119.

For further information circle 171 on the reader service coupon or contact Firmware Design, 28 Coombes Drive, Penrith 2750; or phone (047) 21 7211.

Industrial fibre optic modems

Optical Systems Design, a Sydney-based fibre optics designer and manufacturer, has released a new range of fibre optic modems.

The OSD120 series is a range of fibre optic modems which interface with major programmable logic controllers (PLCs) including Modicon, Square-D, General Electric, Allan Bradley and Texas Instruments. Diagnostic indicators on the modem assist in system fault location.

The modems are packaged in a rugged steel case, suitable for stand alone or cabinet storage.

Powered from 240V AC, 115V AC, or 24V DC, they work with all common fibre core sizes, enabling easy integration with existing fibre optic cabling.

For further information circle 172 on the reader service card or contact Optical Systems Design, 2-5 Vuko Place, Warriewood 2102; phone (02) 913 8540.

UPS for larger PC's

The Upsonic PC-Might 55 has a rated output of 550VA/33W, sufficient for larger personal computer configurations. In the event of mains supply failure, the unit transfers over to the inbuilt battery derived supply in 4ms — so there is no disturbance to computer operation.

The PC-Might 55 contains two rechargeable batteries, providing a total capacity of 7Ah at 12V. This allows it to maintain backup power for 6-8 minutes at full rated loading, or 15-20 minutes at half loading.

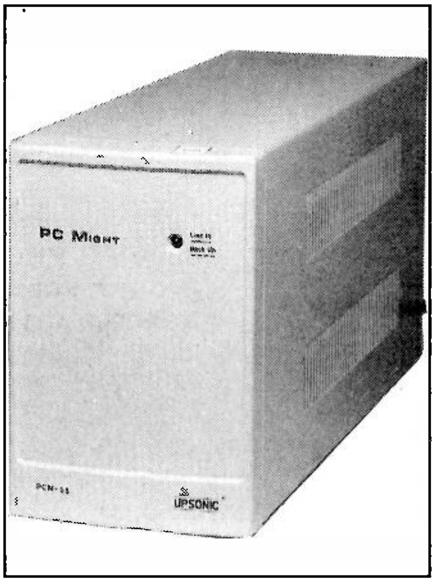
These times are more than sufficient to allow saving and backup of essential data, and will often allow uninterrupted operation through short power failures. Transfer from AC line power occurs at 219V AC +/-2V. Noise level at 1m is 55dB for normal AC line operation, and 60dB in backup mode.

A further feature of the PC-Might 55 is inbuilt surge, transient and overload protection during AC line operation. Rate attenuation is 20dB between 100kHz and 100MHz, while power of up to 7.5MW can be dissipated for periods of 20us or less.

Standard warranty cover is 12 months from date of purchase, and includes labour and all parts except the battery. Optional extended warranty cover of 36 months is available.

The PC-Might 55 measures 365 x 170 x 115mm, and weighs 13.5kg.

For more information circle 175 on the reader service card or contact Lumen International Electronics (Aust.), 18 Amberley Crescent, Dandenong 3175; phone (03) 706 9090.



Double speed Intel 486 CPU

The Intel486 DX2 microprocessor is a new high-speed member of the Intel486 microprocessor family.

The new chip provides 50 and 66MHz execution speed, in a way that makes it easier for system manufacturers to deliver cost effective, high performance desktop systems.

It is functionally identical to, and 100% binary compatible with the Intel486 DX CPU, incorporating the same RISC technology central processing unit, a floating point unit (FPU), an 8KB cache and a memory management unit.

In addition, however, the Intel 486

DX2 processor also incorporates the new Intel 'speed doubler' technology. With this technology, the microprocessor runs at 50MHz, while it interfaces to a low cost 25MHz system.

This helps to combine the high performance of the 50MHz core with low cost, mature 25MHz system technology. The 50MHz Intel486 DX2 microprocessor is available now; a 66MHz version will be available in the second half of 1992.

The DX2 microprocessor also adds a new feature to facilitate high volume manufacturing: JTAG boundary scan. The CPU provides test ports using pins defined in earlier 486 CPU's as 'No Connects'.

Consequently, system designers can leverage existing designs to get to market faster with a high performance system. It's important to note, however, that the higher core speed of the Intel-486 DX2 microprocessor may conflict with existing system designs.

Because of its internal frequency, the Intel486 DX2 CPU consumes about 40% more power than a 33MHz Intel486 CPU in an existing design.

Consequently, the DX2 CPU may require cooling above that of existing 25 and 33MHz 486 DX designs.

Furthermore the DX2 microprocessor's higher core speed may cause problems in older software that uses instruction loops for timing.

Some BIOS code, for example, uses such timing loops to provide sufficient time for critical peripheral operations.

For further information circle 174 on the reader service coupon or contact Intel Australia, PO Box 1486, Dee Why 2099; phone (02) 975 3300.

Two-section mains filter

Dick Smith Electronics has released a new Australian-made mains filter and transient suppressor unit, designed to provide increased protection for computer systems.

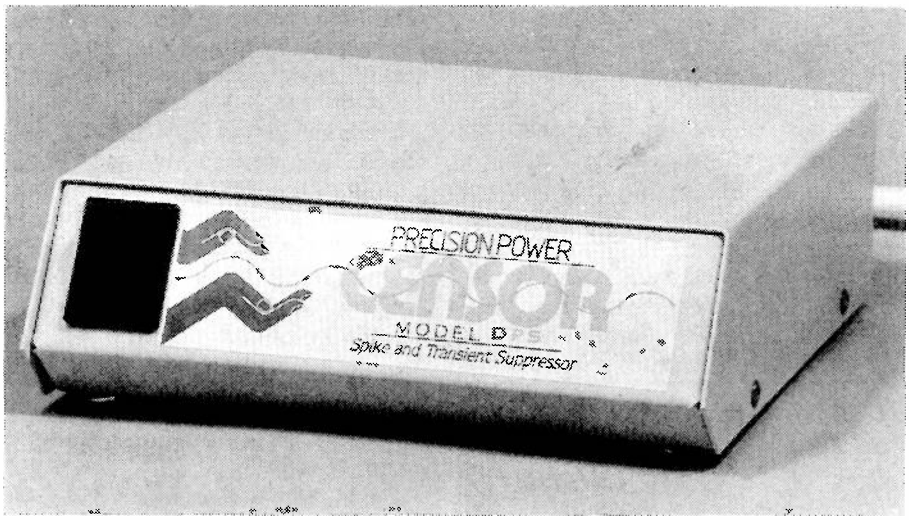
The Censor DPS Passive Filter unit has two cascaded 'pi' configuration L-C filters, providing normal-mode attenuation of 40dB over the range from 100kHz to 4MHz. This is considerably greater than that provided by most single-section filters.

Common-mode attenuation over the same range is 30dB. The unit is also fitted with surge suppressor devices, able to absorb transient currents of up to 4500A for 20us. The Censor DPS is rated for continuous loads of up to 10A at 250V, and can withstand overloads of up to 10 times this rating for periods of 1 second or less.

It is fitted with a convenient front-panel mains switch and two rear outlets, plus a captive 2m power cable. The case is solidly made from steel, finished in white, and measures 170 x 165 x 55mm. Weight is 1.5kg, and the internal circuitry is encapsulated in epoxy to prevent damage from moisture ingress.

The unit carries approval from both NATA and QEC for connection to the mains supply.

Available in Australia exclusively from Dick Smith Electronics, the Censor DPS Filter carries the catalog number M 7185 and is priced at $199 (RRP).



Laptop range

All Data Australia, manufacturers of the Arrow range of computers, has been appointed Australian distributor for the Bondwell computer range.

Initially, two lightweight laptop units are available. The 286 version, Model B310V, gives a rapid fire 21MHz Landmark, 80MB hard disk, mono VGA and 1MG or RAM. The 386 version, Model B310SX, provides a 40MB hard disk and 2MB of RAM.

Each unit has a 1.44MB floppy drive, and weighs only 3.7kg. Additionally, both models have an inbuilt PC Alarm security feature to discourage theft.

A 386-Notebook computer, with a 60MB hard disk, 2MB or RAM and a built-in modem is due to be released soon.

For further information circle 166 on the reader service coupon or contact All Data Australia, 27 Rhur Street, Dandenong 3175; phone (03) 794 5799.

Video overlay

ADDA Technologies of Taiwan has released the VGA AVer card, an 8-bit, AT bus card which will convert anything on the VGA monitor to a composite video signal (either PAL or NTSC) in real time, without disabling the computer monitor. Its advanced genlocking technology makes it easy to overlay live video with computer generated titles, animated graphics, logos and subtitles.

The VGA AVer works with any eight or 16-bit VGA card via the features connector, supporting all standard VGA modes up to 640 x 480 in 256 colours.

Its TSR 'pop-up' menu system, which only comes up on the VGA monitor, allows the user to change overlay settings during operations without interfering with the video. Ex tax, its price is $1500.

For further information circle 162 on the reader service coupon or contact Lako Vision, 1/45 Wellington Street, Windsor 3181; phone (03) 525 2788.

COMPUTER PRODUCTS

PC coax emulator card

The new Memorex Telex 1472 PC Card is an IBM 3472 compatible coax emulator card which uses the latest 3270 technology. One of a series of emulation products to be introduced, the 1472/PC Coax Emulator also provides an easy transition to coax functions for all IBM-compatible PCs. It is claimed that the emulator package gives the most modern 3270 emulation available.

Available in both ISA and Micro Channel versions, the emulator provides fixed function users a familiar look and feel, while affording all the advanced functions of a PC, both in MS DOS and Windows. The special introductory price for the 1472 PC/Coax Emulator is $695. This price includes both hardware and software.

For further information circle 177 on the reader service coupon or contact Memorex Telex, 3 Thomas Holt Drive, North Ryde 2113; phone (02) 805 5932.

PC-driven PROM programmer

The B&C Proteus programmer is a very flexible PC-driven programmer at a modest price. It can be updated when the number of pins on the target device is greater than the capacity of the hardware. This is achieved by purchasing additional pin devices which can be incorporated into the Proteus unit, enabling the unit to be expanded from an initial 40-pin device to up to 296 pins. The device connects to the parallel printer port of any MS-DOS computer.

Self test diagnostics are inbuilt. These comprise a 10-bit A/D connector which allows 100% automatic calibration and testing of each pin driver, voltage sources and internal circuits at power on. No external instruments, such as multimeters or oscilloscopes are required.

Proteus is also protected against damage from inadvertently inserting devices the wrong way around, or inserting devices with shorts.

Whilst the programmer is supplied with menu-driven software tc program standard EPROMS, MICROS, EPLDs, PALs, etc., there will always be new or special devices that will not be supported by any programmer. To overcome this difficulty Proteus is supplied with an algorithm development package which is similar to 'C'.

For further information circle 179 on the reader service coupon, or contact PP Component Sales, PO Box 580, Bayswater 3153; phone (03) 764 5199.

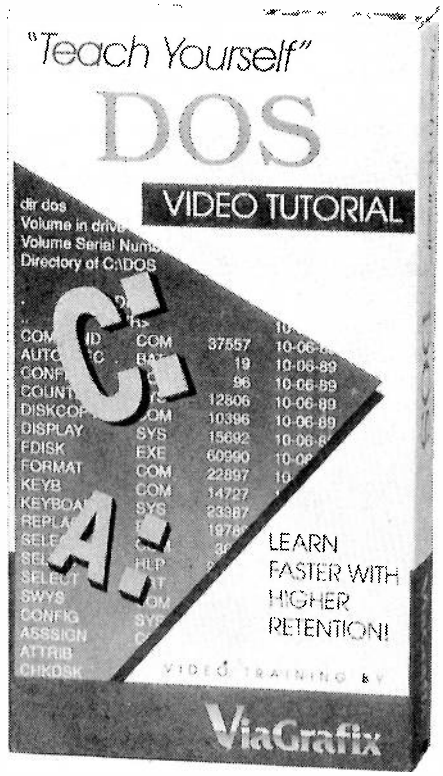
Software training videotapes

A new range of videotapes makes it possible to learn any of the major software packages in an easier and more convenient manner than using conventional manuals.

Produced by ViaGrafix in the USA and endorsed by MicroSoft, the tapes allow novices and experienced users alike to learn about a new package at their own pace. The tapes can also be used by other individuals, making them suitable for schools, colleges and other training institutions.

There are two series of videotapes currently available, the 'Introduction to...' series (all priced at $30 each) and the more advanced 'Professional' series with the price range from $75 to $90 each. Packages supported include DOS, Windows, PC Tools, Harvard Graphics, Norton Utilities, dBase IV, Lotus 1-2-3, DesignCAD, BASIC, C and Pascal. Many of the Professional Series tapes come complete with a learning diskette. Being original training material, the tapes qualify for the Training Levy. Mail order purchase is available.

Further information is available by circling 173 on the reader service card or by



contacting Companion Computers, 26 Fulton Street, Oakleigh South 3167; phone (03) 562 9900.

Low cost radio modems

GES Electronics has announced two new low cost radio modems. Designed to fit applications in the areas of industrial data acquisition and control, as well as telemetry, the units are suited for interfacing with a widely used range of programmable logic controllers. The RM-1201 and RM-1202 both provide a 1200 baud, eight bit transparent asynchronous interface between either an RS-232 (RM-1201) or RS-422 (RM-1202) port and a simplex or full duplex VHF/UHF radio system.

Both models provide DTE handshaking and radio PTT (Push to Talk) control via their RTS and CTS data lines. If required, error correction can be implemented by using an external protocol, such as one of those commonly used by most PLC's. Transmitter settling times from 20 to 400ms are user selectable on both models, and CSMA (Carrier Sense Multiaccess) anti-collision control is incorporated. The model RM-1201 is 12V DC powered, with an operating current of approximately 70mA, while the RM-1202 can be operated from either 12V or 5V DC and draws 110mA or 100mA respectively.

For further information circle 167 on the reader service card or contact GFS Electronics, 17 McKeon Road, Mitchum 3132; phone (03) 873 3777.

Multi video system

The Multi Video System 9MVS) from Vine Micros of Kent, England, is a AT-bus, eight bit card which will allow you to combine live or pre-recorded video with text, graphics and animation, and record to final presentation, on video tape. It can also be used to convert the computer's VGA signal to a video signal for protection on large screen TV sets or projection systems.

Unlike other video output or genlock cards, the MVS is designed around scan conversion circuitry, which converts high resolution non-interlaced computer images to interlaced video images, without serious deterioration of the picture quality.

The card can also be configured with a digitiser (or frame grabber) and genlock modules. The digitiser will capture single frames of the incoming video in 1/60th of a second and save them to disk as PCX files.

The genlock module will superimpose or overlay any computer generated image onto either live or pre-recorded video, and re-record the output back to tape, making it an ideal for video titling, animations, sub-titles, sports scores, etc.

For further information circle 168 on the reader service coupon or contact Lako Vision, 1/45 Wellington Street, Windsor 3181; phone (03) 525 2788. ❖

EA DIRECTORY OF SUPPLIERS

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PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications. Members of our technical staff are not available to discuss technical problems by telephone.

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Mr Keating, Mr Hewson:

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In the bush even a trip to the library can be a big problem. And you don't just drop down to the deli when you run out of milk.

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