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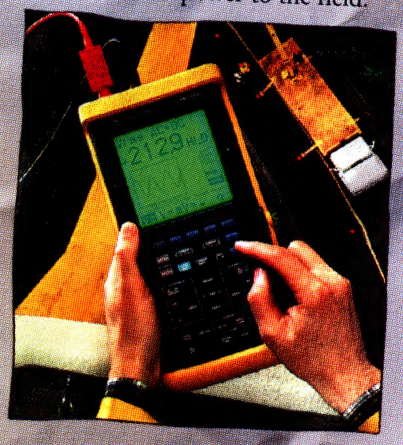
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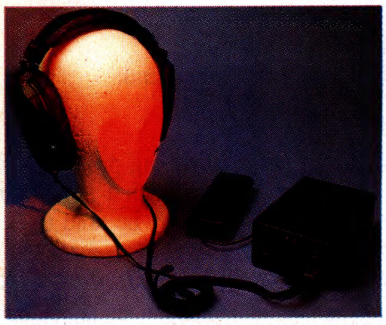
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Electronics AUSTRALIA WITH ETI

Volume 55, No.12
December 1993

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Sound that can amaze you...



This month Louis Challis has been testing two of the high-end electrostatic stereo headphones: the Koss ESP/950 and the Stax SR-Lambda Pro. As you'll learn from his review starting on page 12, he found them both very impressive indeed...

Video editing: camcorders & correctors



In his second article discussing video editing using the latest generation of consumer video gear, Colin Dawson looks at the most suitable camcorders, timebase correctors, titling gear and other components you'll need. It begins on page 8.

On the cover

This month, NASA plans to send up a team of astronauts who have been trained to carry out in-orbit repairs on the faulty-when-launched Hubble Space Telescope. Kate Doolan gives the background to this crucial mission in her story starting on page 26. (Picture courtesy Ball Corporation)

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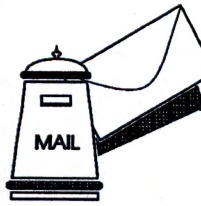
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LETTERS TO THE EDITOR



Technical nightmare

I suppose its one way of celebrating Hiroshima Day — an article about the excitement of the Los Alamos project (*EA* August 1993). For me though, Hiroshima brings to mind very different images — of instant death for tens of thousands and prolonged suffering and death for hundreds of thousands, all by remote control. A symbol, it seems, of the nightmare that technology means for many people caught in conflicts the world over.

Don't get me wrong. I am not about to launch into a diatribe about the evils of technology. I'm as fascinated by the stuff as Tom is. Nor do I want to polarise the situation into two camps of evil, amoral scientists and politically correct commentators. Neither do I expect *EA* to turn into an ethics journal.

But surely we can spare some space to grapple with the problems technology brings right here in 'our' magazine, rather than ignore them completely as Tom's article does. Los Alamos marked a major crisis in the history of science, as the participants subsquently struggled with the morality of their involvement. Many, including Oppenheimer and Oliphant, became strong opponents of the bomb. Some like Oppenheimer, were savagely victimised for these beliefs.

The separation of our thinking into watertight compartments is an ingrained characteristic of western science. Many analysts of science, including some practising scientists, consider it is a major obstacle to problem solving. This is especially recognised in ecological science, but increasingly in other fields.

Maybe it is also a major limitation to stopping the needless suffering of people in wars. In a century that began with a war to end all wars we are not finishing it well. *EA* readers will be among many in the community distressed by the suffering of ordinary people in Bosnia or the carnage in the Gulf war. Obviously technologists cannot end war alone, but we do have a unique contribution to make. We understand what can and cannot be done, and how it is done. And we have the ultimate sanction — the bombs cannot drop without our contribution.

I am hopeful that those of us working with technology can help make the world a safer and happier place. I believe we need to do this at the coalface, where w are working, by thinking, discussing, a guing, and researching the problems c technology, not ignoring them. Its not th Tom's article doesn't have its place, b that the priority is wrong. After all, we a people first, and technologists second.

Rhodes Hart,
Physics Department,
University of Queensland.

Delinquent PC

I have a very frustrating problem wit my home computer which I am hopin one of your readers may be able to hel me solve.

My computer is a fairly commo 386DX 40MHz IBM clone, with a SVGA 0.28 dot pitch monitor. My prob lem relates to a pulsating screen, occurin at irregular times of the day and night an more pronounced when I am in a Win dows application.

Both the monitor and the PC (includin the SVGA card) have been checked b their respective suppliers and found t be faultless. In fact, when the computer and the monitor were run together at eac of their outlets, there was no pulsating. have even borrowed and tried differen combinations of monitor and PC, but th problem still occurs seemingly only whe the computer is at home.

I recently employed an electronic tech nician, who diagnosed electro-magnetic interference, however he could not locate the source. I have removed all pos sible causes from the vicinity of the com puter and at one stage, even disconnected all electrical appliances ex cept the computer, but the problem con tinued. I have also moved the computer around the house. In most rooms, there is no pulsating, but it tends to increase the closer I get to the room where the com puter is housed.

The intensity of the pulsating varies, with no discernible pattern as to when it will be better or worse. The least pattern which I can establish is that it seems to increase around dusk, at about the time that people are beginning to switch on electrical heaters and cook their evening meals. It then tends to lessen from about 10.00pm onwards. I have taken note of the appliances being used in my own home at that time, but cannot re-

late any effect on the computer to their switching on or off.

The mains power inlet to the house is approximately four metres from where the computer is situated and the earth peg is approximately six metres away (in the opposite direction). The mains supply must run above the room to reach the power board, which is also some six metres from the computer.

The technician was unable to solve my problem and I have also tried a power filter, but to no avail. I have no idea what to do next to locate the source of my problem. I realise that a Faraday Shield may be useful, but I would rather trace and (if possible) remove the source of the problem.

I use my computer frequently for home work and for study. With a pulsating screen, it is difficult to fully enjoy its benefits. I am also concerned at the possible (yet unproven) effects which an uncontrollable electro-magnetic field may have on my health.

I would be pleased to hear from any of your readers who may have experienced a similar problem and can suggest a solution.

Mark Clemow,
Kambah, ACT.

Reader with a problem

I am a regular reader of more than 20 years and I need your help.

I own an uninterruptable power supply (UPS) for my computer which I bought a few years ago. This unit became faulty and to repair it I need the service manual or at least the circuit diagram. The PC board is a double sided one (Jaymac 3-5 Side A/B), and accommodates 10 ICs, two opto-couplers and a few more transistors.

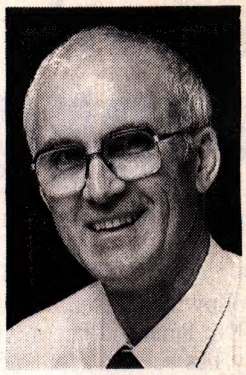
I understand the manufacturers went out of business and all my efforts to get hold of a copy of the service manual failed. The only option left to me now, is to ask if you could help. Perhaps someone out there has got the answer.

The UPS brand is Jaymac, model FS250, serial number 251 333. Built in Victoria by Jaymac Pty Ltd and named Mini Mains Guard. The FS300 model which replaced the FS250 is not the same. The PC boards are completely different.

Mr A Ripoll,
10 Ursa Street,
Richlands, Qld. 4077

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

EDITORIAL VIEWPOINT



Plenty of good reading for the holiday season!

I think you'll find quite a lot of worthwhile reading in this issue, regardless of your areas of electronic interest. One story I myself found particularly interesting is Kate Doolan's feature on NASA's mission, planned for this month, to carry out in-orbit repairs to the Hubble Space Telescope. The HST has had a fault in its optical system ever since it was launched, you may recall, and the world's astronomers are hoping that the repair mission will be a success so the full potential of the telescope can finally be achieved. NASA must also be pinning a lot on the mission too, because it hasn't had too many other wins lately.

As Kate Doolan explains, the repair mission is not only very important, but a difficult and involved one as well — especially for team of astronauts doing the job. So I imagine there will be a lot of very nervous people over at NASA, about the time you're reading this and our feature...

Another story I trust you'll also find interesting is the one by Colin MacKinnon, written to commemorate this month's 70th anniversary of radio broadcasting in Australia. From where we are now, in the era of satellite TV broadcasting and personal computers, it's hard for most of us to imagine what it must have been like back in December 1923 — when the first primitive AM stations were just struggling onto the air in Sydney. Colin's story (together with its sequel, which we'll try to fit in next month) takes us back to the era of crystal sets and enormous outdoor aerials, and explains how the industry almost scuttled public acceptance of broadcasting by attempting to force listeners into buying 'sealed' receivers.

For the audio enthusiast, we have a very informative report by Louis Challis on two of the main models of up-market electrostatic stereo headphones. As their prices suggest, these are in a totally different category from the common electrodynamic 'cheapie' phones — and the difference in performance can be almost mind-blowing as well, according to Louis!

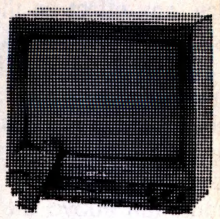
Quite apart from these features, we also have a particularly good batch of construction projects for you this month. There's a brand-new and improved 40V/3A lab power supply design by Rob Evans, for example, incorporating just about all of the desirable features of earlier supplies but at the same time setting a new standard for cost-effectiveness and ease of construction. Jeff Monegal also describes a new digital photo timer based on a dedicated 68705P3 microcomputer, while Peter Murtagh describes a very low cost utility amplifier for beginners, capable of delivering a couple of watts. I even get into the act myself, with a short article explaining how to fit Bob Parker's great little ACS decoder into a low-cost Tandy portable radio.

This is only a sampling of what's in the issue, of course; there's a lot more besides, to keep you occupied over the holiday season. But I've run out of space — there's only room left to wish you all the very best for Christmas and the New Year, from everyone here on the *Electronics Australia* team.

Jim Rowe

What's New in VIDEO and AUDIO





New A-V amps from Sony



Following the success of Sony's STR-D1090, launched late in 1992, the company has released four new reasonably priced audio/visual receivers to attract the mass market.

The new Sony STR-D311, the entry level model, features Direct Access Tuning. This allows the user to choose any desired station by simply inputting the frequency — i.e., 104.9. It also features an output of 60W RMS per channel, 30 random FM/AM tuner presets, six inputs including tape monitor, loudness control, A-B speaker switching and audio and visual remote commander. The STR-D311 has a recommended retail price of $499.

The Sony STR-D511, STR-D611 and STR-D911 all feature Dolby Pro-Logic Surround Sound and Digital Signal Processing (DSP). DSP enables digitally constructed acoustic environments to be recreated and the preset modes are programmed to recreate environments.

Dolby Pro-Logic is the basis of home theatre. Speakers are placed strategically around the room — usually two at the front, one in the centre and two at the rear, emphasising the sound capacity.

The Sony STR-D511 features two-mode DPS, allowing hall and Dolby acoustic environments to be recreated. It also features 50W per channel for the front speakers, 10W for the centre and 10W x 2 for the rear speakers. It also features 30 random FM/AM tuner presets, direct access tuning, six inputs including two video sources and video switching, five Dolby modes, rear centre level control, speakers A and B and A/V remote commander. It has a recommended retail price of $699.

The STR-D611 features all of the above named functions, as well as three mode surround DSP which includes hall, simulated and Dolby; 70W RMS x 2 for the front speakers, 20W for the centre, 20W x 2 for the rear speakers and Dolby delay time control. It has a recommended retail price of $799.

Finally, the STR-D911 features most of the functions found on the premium model STR-D1090, at a reduced price. The Dolby Pro-Logic integrated into the system is specially designed to work in conjunction with video software encoded with the Dolby surround system. Backed up with 100W RMS x 2 (stereo), 65W x 3 Dolby and 25W x 2 for the rear speakers, it generates real cinema sound.

It features seven mode DSP surround, including hall, live, dance, theatre acoustic, simulated and Dolby; as well as electronic tone controls, 30 random

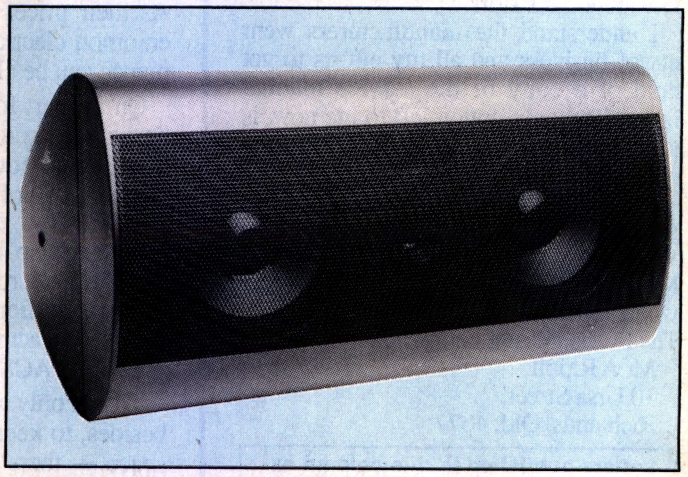
Centre channel speakers from Jamo

Well known Danish speaker manufacturer Jamo has released the Centre-50, a new centre channel speaker designed along the same lines as the larger Centre-100 speaker. Centre-50 features two high quality 100mm bass/midrange drivers, flanked either side of a 25mm ferro-fluid cooled tweeter.

Each of the three drivers is magnetically shielded to allow close placement to a television set without affecting picture quality.

Visual design is in keeping with Jamo's designer range of speakers: an attractive black mesh front panel with matt black cabinet. The relatively small dimensions — 160 x 320 x 120mm (HxWxD) of Centre-50 allow the speaker to be placed either above or below a television set quite unobtrusively. Retail price of the Jamo Centre-50 is $299 each.

Available for some months now, the larger Jamo Centre-100 has quickly established itself as one of the finest centre channel speakers available today. Centre-100 also uses two 100mm bass/mid- range drivers and one 25mm dome tweeter. Magnetically shielded, this unit can be placed close to a television set without causing disturbance of the picture. The visual



design, with the rounded and sloping front panel, allows the speaker to integrate well with modern interior decors. The gold plated terminals accept a variety of different cables up to 4mm square.

The Jamo Centre-100 retails for $399 each.

FM/AM tuner presets, direct access tuning, nine inputs including three video and tape monitors, and a 'total effect' control which allows the user to adjust the presets to suit home environments and personal tastes.

The Sony STR-D911 (pictured) has a recommended retail price of $999.

New 'normal' position cassettes from TDK

TDK has introduced a new Normal Position (Type I) audio cassette tape line-up. Formulation improvements have been incorporated to reproduce as faithfully as possible the most demanding musical peaks encountered from today's digital sources. The line-up consists of D (dynamic), AD (acoustic dynamic) and AR (acoustic response), and all are available in various playing times. Cassette mechanisms have also been improved to within micro tolerances to improve stereo imaging.

The D formulation, long considered the basic tape, meets the same stringent standard as the higher grades. Employing TDK's latest and most refined 'Pure Grained Ferric Particle' formulation, it has improved MOL (maximum output level) — up by 3.5dB — and a lower bias noise (-55dB) than previous D formulations. This contributes to a wider dynamic range and is the reason this formulation is claimed to be suitable for recording from digital sources.

The AD formulation employs a highly refined TDK proprietary 'Pure Linear Ferric' magnetic particle which achieves higher particle orientation and packing density. This translates into improved MOL (+5.5dB) in the low frequency range (315Hz) and -4.5dB in the higher frequencies (10kHz). Sensitivity which relates to frequency response has been improved by 0.1dB in the low range and between .02 to .05dB in the upper range. The end result is extended frequency response in both crucial areas in terms of digital sound. Bias noise has also been improved, into a class normally reserved for High Position tapes and this is claimed to make AD a natural choice for those wanting uncompromising musical fidelity.

For the new AR formulation, TDK's world famous non-porous Avilyn magnetic particles are specially aligned and packed using a newly developed binder system which overcomes the difficulties of particle dispersion arising from size reduction. As a result the new AR's MOL is a remarkable +6.5dB (ref 315Hz), putting it on par with metal tapes. Similarly at high frequencies MOL has been boosted by 0.5dB in comparison to the previous formulation, which leads to AR having the widest dynamic range of all TDK Normal Position tapes.

Mini stereo system from Akai

Designed for smaller living areas and to meet a specific price point of below $600, the MX65 mini is highly featured and includes functions usually the domain of more expensive systems. Measuring only 365mm high and 270mm wide, the MX65 is as much at home on the bookshelf as it is on the sideboard. In stylish contoured lines and matt charcoal finish, the MX65 is capable of a beefy 25W RMS/channel and offers a 25 preset digital FM/AM stereo tuner, double cassette deck, 21 random play CD deck and two two-way ported bass-reflect speakers.

The amplifier section uses a quality motor-driven volume control in preference to cheaper but noisier electronic types. The ever popular 'karaoke' mixing and level control is also included. The single-bit CD player section takes both the standard 13cm and the single play 8cm CDs, and up to 21 sections can be programmed to play in any order or at random. Selections can also be repeated and shuffled.

The double cassette deck offers high speed dubbing and sequential play. An auto tape selector automatically sets for either Normal Position or High Position tapes and a CD synchro feature automatically synchronises with the cassette deck tape 'record' mode.

The MX65 is covered by a 12 months parts and labour warranty and is available at selected Akai dealers and department stores. It has an RRP of $599.



New VHS camcorder is easier to use

Those who have found existing camcorders intimidating should welcome Panasonic's introduction of the NV-CS1A 'Snap' video camera. A simple record-only VHS camcorder, the CS1 is not unlike the 'instamatics' of the still camera world in concept.

A new concept in camcorders, the CS1 is designed with key user-friendly features like its ability to run on 'AA' alkaline batteries. When rechargeable battery power runs out the user can simply attach the alkaline battery case to the camcorder to obtain an extra 60 minutes of video taping. This means the user need never run out of batteries, being able to buy the alkaline batteries almost anywhere.

A combination of rechargeable and alkaline batteries can give you up to 135 minutes of recording time. Recording with the CS1 is simple. All you need do is press one button to start, and release it to stop. This ensures you won't continue shooting by accident. The CS1 also features a super wide angle lens and telephoto setting. Wider than on previous models, the 28mm wide angle lens allows you to easily shoot wide scenes, especially indoors, without the need to pan or tilt the camera.

For dramatic close-ups, you switch to a 3x (84mm) telephoto lens. The new self-timer function means the person filming can also get in the picture. When the self-timer is on, the CS1 pauses for 10 seconds and then shoots for 10 seconds. Other features available on the CS1 include an LCD screen that shows battery and tape life as well as an auto date recorder, an optical direct finder plus an anti-scratch body.

With its lightweight, compact design, the CS1 is suitable for everyday use, and as an alternative to a still camera on business trips and when travelling. ❖

VIDEO EDITING WITH CONSUMER EQUIPMENT - 2

In this second article discussing the ways in which the latest generation of reasonably-priced consumer level equipment can be used for video editing, the author explains about the types of time code that are available in this type of gear. He then looks at the most suitable camcorders, timebase correctors and some of the other accessories that are worth having if your budget allows, and finally lists where to go for further information.

by COLIN DAWSON

It is possible to get very accurate editing with consumer VCRs, but you have to use a *time code*. Although there are plenty of variations on the theme, time codes fall into two categories: video and audio. The most universal type of video time code is called VITC (vertical interval time code) and is recorded in an otherwise unused part of the video signal. Audio codes are collectively called LTC (linear time code), with European Broadcasting Union (EBU) being the variant of interest for PAL users.

Sony has not one, but two proprietary time codes for Hi-8 equipment, referred to as professional and consumer time codes. Although they are both video time codes, they are not compatible. The consumer variety is called RCTC (rewriteable consumer time-code). Unlike VITC, RCTC is not recorded in the vertical interval and can be added to a tape at any time.

There are plenty of time-code controllers available that work with a personal computer, but a limited choice in stand-alone systems that work with consumer VCRs. Two German companies specialise in this niche: Alpermann+ Velte and GSE. This give an idea of the popularity of consumer video editing in Europe.

As well as having Panasonic 5-pin serial connectors, both of these firms have models that work with Sony's Control-L interface (covering all of their consumer Hi-8 equipment), JVC's wire remote control (covering most of their S-VHS equipment), and other IR-controlled equipment by means of a code learning facility.

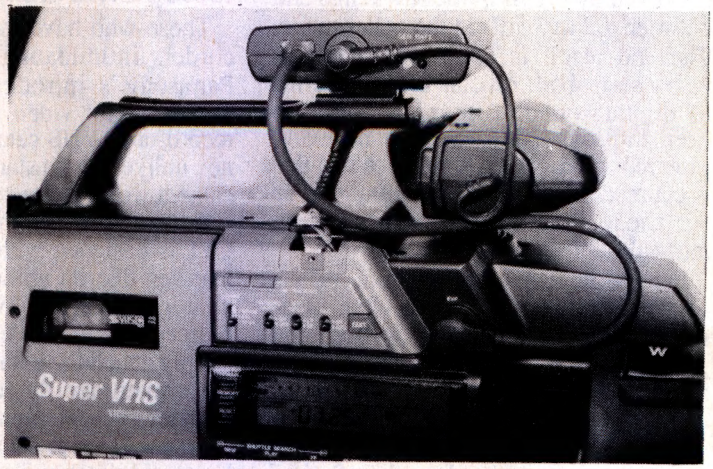
The Alpermann+Velte ME-50 edit controller uses either RCTC or EBU time-codes and the more up-market TE-701 uses VITC or RCTC. GSE's MPE-200SX supports VITC, RCTC and Rapid Time Code. This is an interesting system which, unlike VITC, allows tapes to be time-coded after recording. Although popular in Europe, the only compatible VCR available in Australia is the Blaupunkt RTV-950PC. Both Alpermann+Velte controllers and the MPE-200SX also work without any time-code, but naturally with lower accuracy.

Video time-codes are superior to audio because they work in any VCR mode, whereas audio time codes only work properly in play mode — or if the speed is not too high, in shuttle mode. This makes editing a much slower process. The big advantage of audio time codes is that they can be easily added to an already recorded tape using a standard video recorder.

In competition to GSE's Rapid Time Code, Alpermann+Velte offer a system that inserts an audio time code on the source tape but still allows you to edit with VITC. Basically, you make a copy of your source tapes and insert VITC codes in the process. You use these tapes to compile the edit decision list, and then apply the list to your EBU-coded master tape. It may take a long time for the edits to complete, but once the edit decision list is compiled you can leave the system on 'auto pilot'. This system works with any VCR.

Just in case there have not been enough options for you yet, GSE have another method of dealing with tapes that have no time code. In order to use this method, you have to shoot 20 seconds of black at the beginning of the tape. This is used as a reference point in





The price of the Alpermann+Velte TCI-40J VITC adaptor (left) varies according to the camcorder. At right this adaptor is shown fitted to a JVC GRS-707 compact S-VHS camcorder. The microphone has been removed to allow a better view.



Panasonic's S-VHS MS4 is VITC equipped and priced at $3499.

future edits from that master tape. Whenever the tape has to be rewound (even for a few seconds) it actually rewinds right back to this reference point and then goes into play mode.

If you have a lot of non-sequential shots, the editing process could clearly take a very long time. However, you can still compile the edit decision list on a VITC copy and then apply it to the master tape and, once again, leave it on auto-pilot.

Both the TE-701 and MPE-200SX allow you to store the edit decision list externally on a video tape. It can then be retrieved at any time to duplicate the production. This beats the usual method of duplicating from your master tape, because you save one generation.

One other point in passing about time codes: if you get serious about the audio content of your productions and decide to use a synchronised multi-track recorder, they can only be controlled by *audio* time codes.

The sophisticated corporate video makers often use a combination of video and audio codes to get around this problem. If you plan to follow in their footsteps, choose an edit controller that supports both types.

Camcorders

Unless you have pre-recorded tapes to work with, you will need a camcorder. Suitable Hi-8 and S-VHS machines can be hired for about $70 per day. Professional quality three-chip cameras can be hired for about $150 per day.

Hi-8 VCRs may be a bit thin on the ground, but camcorders offer plenty of choice. They range from under $1500 to $5999 for the full-featured Sony V6000 with RCTC and built-in timebase corrector. The TR805E traveller at $3199 records RCTC but can't read it; the V6000 can read and write RCTC.

Recording the time code during shooting is the best option if you can afford it. Aside from the two Hi-8 offerings just mentioned, there is Blaupunkt's CCR650S camcorder which has VITC right out of the box. Alternatively, Alpermann+Velte have nifty plug-in adaptors that work with a range of camcorders and allow them to record with VITC.

As far as cost goes, the Blaupunkt CCR650S is the cheapest at $2465. Panasonic has the full-size S-VHS MS4 at $3499 which is also VITC-equipped. The Alpermann+Velte VITC adaptors vary in price, depending on the particular camcorder you have. The TCI-40J for JVC's compact GRS-707 is $575.

Whatever you do, use a camcorder which has stereo hifi sound, if you choose S-VHS. This is worth it for the improved sound alone, which rivals compact disc quality. But there is an even more important reason: as well as the stereo hifi, you get a lo-fi (linear) track which can be used for dubbing or to insert an audio time code later.

Watch out for the automatic time and date that camcorder manufacturers love to inflict on us. Except in unusual circumstances, this will ruin any 'serious' shots that you take.

On my GRS-707, I can set the time/date display off, but when the camcorder has been turned off for 20 minutes or so, it resets. The Sony V6000 records this information invisibly, so that you can choose to display it or not at the time of playback.

The next best arrangement would be a toggle switch that permanently sets the time and date display off until you actually want it.

Titling, audio

Chances are, you will also want to add some titles to your masterpiece. Some camcorders have built-in titling and that may all you need. If you want better control over the titles and an individual appearance, a dedicated titling machine or a suitably equipped personal computer will cost anywhere from $500 to around $5000.

The titles built-in to camcorders or edit controllers/effects units do not compare to a good PC package in terms of quality. Expect to get 'jaggy' text, in a limited range of sizes and styles, along with varying amounts of bleed (where the text colour puts streaks across the background image).

Sound facilities are much the same: you can spend as little as a $200 for a small mixer and microphone. At the other extreme, you can get Tascam TSR8 1/4" eight-track recorder for $6153. It can be synchronised with your VCRs, but you also need to spend a further $1540 for the external EBU con-



Sony's camcorders range in price from $1500 to $5999 for the full featured Sony V6000E with RCTC and built-in timebase corrector.

Video Editing with consumer equipment- 2

troller unit. The same controller also works with the 238 eight-track cassette recorder at $2700.

Don't forget that a multi-track recorder is not much use without a suitable mixer.

There are plenty to choose from, but the starting price is about $1500. Also, the time-code in any non-digital audio recording system will occupy one track. For this reason, four-track systems become effectively three-track, and would be a bit marginal for most people.

You have probably seen some video processing units for about $1000 to $2000. These units have a fairly limited application. The ability to fade an incoming video signal to black is the most attractive feature that they offer. This can make an interesting change from repetitive cut edits.

Some units also offer colour correction. This is handy when you did not set the white balance properly on the camcorder, or where the lighting colour was outside of the camcorder's white balance range.

JVC has the JX-SV77 processor at $1299 which has colour corrector, fader, wipes and titles. Note that the wipes are between video and background colour, not between two video signals. Sony has a more comprehensive colour-corrector, also with wipes and fades, in the XV-C900 at $1699. The companion XV-T550 titler is a further $1599.

The MPE-200SX edit controller comes complete with titler (but the keyboard is an optional extra if you don't have one already), three-input sound mixer, video fader and colour corrector.

The colour corrector is particularly good in that it can be controlled by the edit decision list. This allows you to dial in automatic colour correction for each scene. Maybe one scene was shot under strong sunlight and is bluish; another was shot under fluorescent lighting and is greenish. This presents no problems — you set up the required corrections and store them as part of the edit information.

The MPE-200SX also has a Sync Impulse Reconstruction feature, which is claimed to restore the stability of tapes that have poor quality sync pulses, or even missing sync pulses. This can easily happen with tapes recorded on a consumer camcorder. Sync Impulse Reconstruction may help in some circumstances, but you really can't go past a timebase corrector for cleaning up ratty video tapes.

Timebase correctors

Whenever you want to perform video effects that involve two sources, the two signals have to be perfectly synch- ronised.

This is the task of the timebase corrector (TBC). It digitises the signal, stores it in video memory and then plays it back in sync with a reference signal.

Further information

Here are the firms to contact for further information on any of the equipment mentioned in these articles:

Sony
Consumer: Chatswood Sony Centre, 505 Victoria Ave, Chatswood, NSW 2067; phone (02) 411 7948.
Professional: BRE Communications, Unit 4/14 Rosebery St, Balgowlah NSW 2093; phone (02) 949 2133.

Panasonic
Consumer: Nobody, really. GEC know more about Panasonic consumer editing than anyone else, but I had to figure out a lot of the information.
Professional: GEC Panasonic, 2 Giffnock Ave, North Ryde, NSW 2113; phone (02) 887 6222.

Alpermann+Velte, Blaupunkt, GML
ACE Edit, PO Box 323, Bondi Junction, NSW 2022; phone (02) 398 9039.

JVC
Hagemeyer Australasia, 13 Garema Circuit, Kingsgrove, NSW 2208; phone (02) 759 5511.

Digital Processing Systems TBC
Colour Computer Systems, 288 Alexander Drive, Dianella, WA 6062; phone (09) 375 3018.

GSE
R. Gunz (Photographic), PO Box 690, Darlinghurst, NSW 2010; phone (02) 211 3155.

Tascam
AV Designers/Tascam Sales, 51 Ramsey Street, Haberfield, NSW 2045; phone (02) 716 0211.

Videonics
Joe Newhouse, Shop T276 Bankstown Shopping Square, Bankstown NSW 2200; phone (02) 796 1558.

In the process, it strips out the original sync pulse and generates a new one. The sync reference can be supplied by a dedicated timebase device, a camcorder or is sometimes built into the TBC.

With two VCRs, you need two timebase correctors. The two signals will then be in perfect sync and you can then perform wipes and dissolves between the two images.

This capability is called A/B roll, meaning two simultaneous source VCRs. It sounds simple, but is actually costly to achieve.

Even if you don't want A/B rolls, TBCs sometimes offer drop-out correction. If you watch your camcorder tapes closely, drops-outs appear as flashes and glitches — they are failures in recording. Not all TBCs can correct for drop outs.

If it's just video effects that you want, rather than drop-out correction, the cheapest option is the Blaupunkt DVM-200SX0 (a clone of the Panasonic WJ-AVE5, but cheaper). This retails for $3300. It can also be fitted with an auto-take option for a further $200, which allows the wipes and fades to be initiated by an edit controller.

Panasonic has a more up-market model in the MX12, at close to $5000. It offers colour correction and an easier to use 'T-bar' type video fader, along with a four-input video switcher. Both perform their effects on two unsynchronised S-video inputs.

Professional VCRs often have a TBC built in. Except for the Blaupunkt RTV-950PC, consumer VCRs don't. You can buy the Digital Processing ES 3200 stand-alone TBC for around $4000, or $2330 for an equivalent personal computer card.

The GML PC-SYNC plug-in TBC goes for $2250. Both of these models are controlled by a personal computer, which you have to supply. You also have to add the cost of the video mixer or effects unit if that is what you want, but there aren't any that qualify as consumer.

Building a 'suite'

You can see that there are plenty of ways to skin a cat when it comes to consumer video editing.

The most important decision to make is how smooth and accurate you want the editing of your productions to be, and how far you want to take your home studio. If you plan to go 'all the way', start off with equipment that fits in with those plans.

The only caution here is that by the time you build up the suite with the capability that you wanted in the first place, it may have been cheaper to have gone by another path.

A lot of the functionality of TBCs, edit controllers and titling can be incorporated in the up-market personal computer packages. But that is another story. ❖

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HIGH END KOSS & STAX ELECTROSTATIC 'PHONES

This month, as a change from amplifiers and loudspeaker systems, Louis Challis decided to look at the hifi component area which is often neglected: high end electrostatic stereo headphones. These are in a totally different league from the sub-$100 cheapies, and well worth consideration by the serious audiophile as an alternative to speakers. In this report Louis examines the Koss ESP/950 and Stax SR-Lambda Pro electrostatics.

With recent developments in loudspeakers tending to take centre stage in most hifi magazines, and headphones tending to be relegated to joggers, travellers in aeroplanes, and people who many of us would classify as being 'anti-social', few of us have paid much attention to the serious developments which have progressively been made in high quality headphones over the last decade or so.

The most exciting development in this respect is the recent release of 'active noise quieting' headsets, which ANVT has developed in conjunction with Koss, and which were released in August in the USA with a US$189 retail price tag. At that price I imagine many US Christmas stockings will be stuffed with Active Noise headsets, as this price constitutes fantastic value.

The ANVT Model NQ100 headset is designed to provide welcome relief for the most insidious low frequency noises which plague jet and propeller aircraft, factories, subways, as well as homes adjacent to freeways and busy roads. I

foresee crowds of frequent fliers purchasing these exciting headphones, as they will provide 18dB of low frequency noise cancellation (in the 30Hz - 1.4kHz bandwidth) whilst still providing an audio frequency play-through bandwidth of 30Hz to well beyond 10kHz. The brochure which I recently received from the manufacturers cutely refers to the included accessory plug — designed to suit Qantas jet aircraft, amongst those listed.

The last time I reviewed a pair of really high quality headphones was way back in the late 1970's or early 80's, when I reviewed a set of Stax electrostatic phones. Their superlative sound reproduction left me with a very powerful impression of audio excellence, which other reviewed headphones have until now not bettered.

Now really *good* electrostatic headphones aren't cheap. When their price tags range between $1000 and $18,000, then you have to be really serious about your music. Alternatively, I suppose you have to have a real fetish in terms of 'insisting on your musical privacy' — as well as the money to support it!

I am not absolutely certain what prompted this review, but I suspect that it came as a result of my casting about in the industry for headphones suitable for the profoundly deaf. After having decided to review the latest generation of electrostatic headphones, I initially thought I would test three sets. However when the third set arrived, I was confronted with a most unusual situation. On careful examination of the delivery slip, my secretary noted that a signature was required, and that we were being asked to accept financial responsibility for any form of damage, even of the packaging.

In effect, by opening the carton, and in the event that it was marked or disfigured, we would ultimately have incurred a responsibility to purchase the headphone system. With a suggested retail price of $17,900, there was little by way of prospective joy in that situation. I therefore regretfully declined to review those exciting headphones, although I have no doubt I would have been enthralled with them if I had.

After that initial let down, I wasn't too concerned, as the other two sets of headphones are each less than 1/10th the price of the third. To the vast majority of prospective purchasers, to whom $1200, let alone $1800 seems a fortune, an $18,000 figure seems like a 'king's ransom'. Bearing in mind the latter figure, I fear that with these 'phones included the review may well have become 'elitist', and that is not the position which either *EA* or myself ever wish to take.



The Stax SR-Lambda Pro electrostatics look rather more 'rectangular' than the Koss ESP/950's shown opposite, and have a rather different type of headband. But both are quite light in weight, and surprisingly comfortable when you're wearing them. In any case, the sound quality soon makes you forget them...

Major advantage

Now electrostatic headphones have one major and most decisive advantage over conventional electrodynamic headphones. The really good ones have the ability to cover an unbelievably wide frequency range. That is normally coupled with a standard of fidelity which very few loudspeakers can ever hope to match.

Back in the late 1960's, Martin Lange at Koss pioneered the application of self-energised electrostatic transducers in stereophones. In 1971, he was awarded a US patent for what ultimately became the Koss Model ESP/6 headphones. He developed what I suspect became the first headphone drivers which were capable of smoothly covering a full 10 octaves — i.e., from 20Hz to 20kHz.

Whilst conventional electrodynamic headphone transducers, with paper or polypropylene cones, generally exhibit some insidious problems in terms of their relatively low resonant frequencies, they also frequently have other problems in reproducing high frequencies in the 8 - 20kHz region. Most of them also exhibit some rather basic problems in terms of their ability to reproduce low frequency sounds. The net result is that we generally end up with a set of dynamic headphones which have a fairly limited and uneven frequency reproduction.

Electrostatic transducers work on a radically different principle, in which a very thin diaphragm, which generally uses a metallised polyester (or metallised Tedlar) material, is inserted between two carefully contrived stator plates. The stator plates are maintained at a high DC potential relative to the central diaphragm, and a superimposed AC signal causes the central diaphragm to vibrate and produce the acoustical output. This phenomenon is actually the reverse process by which a capacitor microphone operates, and as it happens, most conventional capacitor microphones can be used in this way to produce an acoustical signal.

Electrostatic headphones are normally configured so that the diaphragm operates like a true piston, with linear piston motion. The resulting sound wave normally exhibits remarkably low distortion characteristics, especially when compared with any other dynamic transducer with which you may wish to compare it.

Koss ESP/950's

The Koss ESP/950 headphones (which I will now refer to hereafter as the Koss headphones), owe their development to Koss' need to monitor live recordings of

the Milwaukee Symphony Orchestra, for the first of Koss' own private label CDs. They decided that they wanted a completely self-contained transportable electrostatic system, which would have its own amplifier, battery pack, AC/DC converter and of course, the headphones.

Koss were rather brave (some of their staff would suggest foolhardy), as they set an electrical specification for the E/90 energiser unit (which is an integral part of the system), to have a frequency response from 1.6Hz to 50kHz. They also sought to achieve distortion figures of a fraction of a percent, under all working conditions. Last but not least, they decided that the headphones should aim to achieve a true 100dB dynamic range, for that is effectively what the best CDs are capable of providing.

The construction of the Koss headphones was based on a new ultra-low mass polyester film, which is electron-beam coated with a proprietary semiconductive material, only 250 angstroms thick. With the degree of coupling provided to the average wearer's ears, this is capable of providing a flat response to way below the normal infrasonic threshold of hearing.

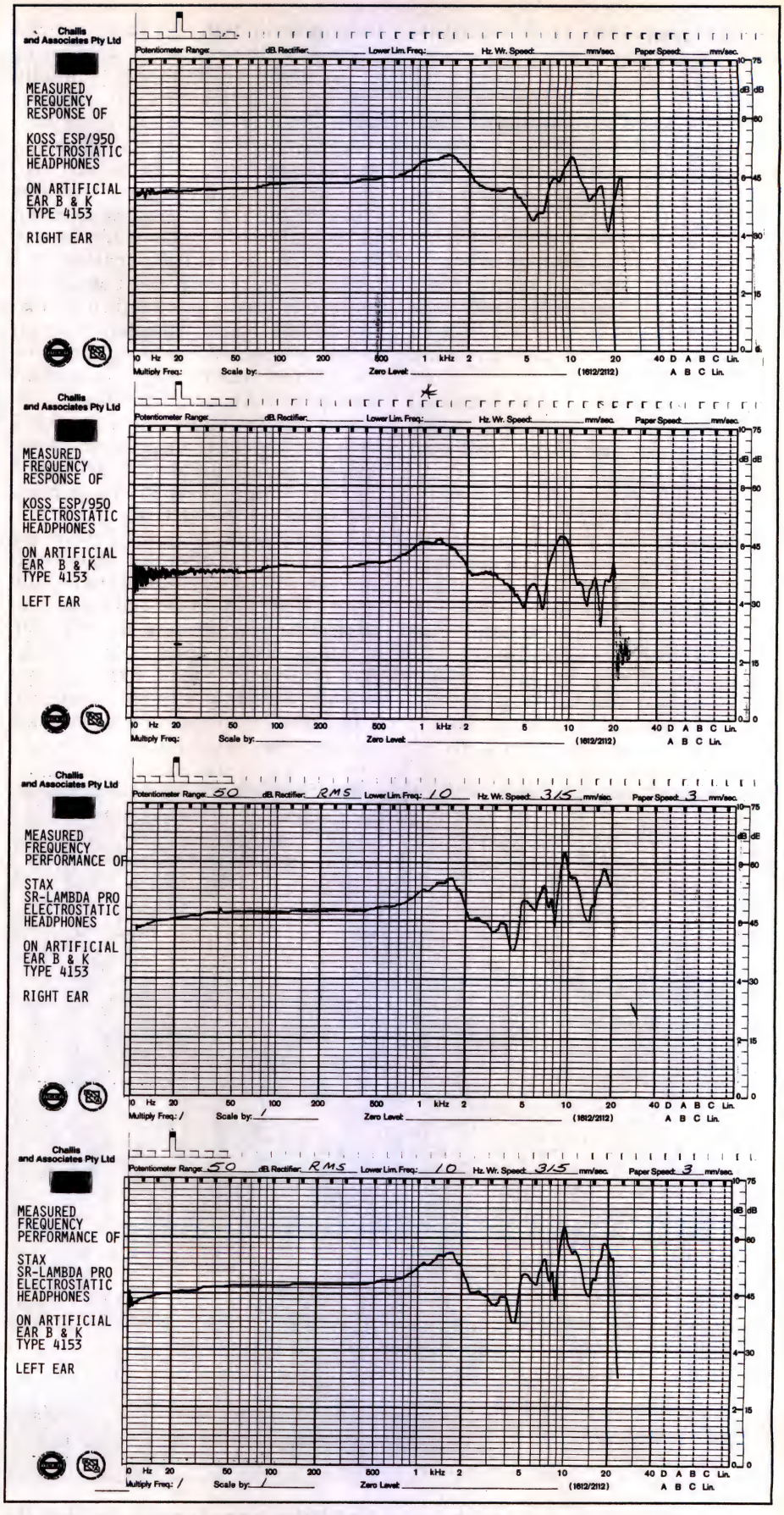
The amplifier and related circuitry were designed to be transformerless, and certainly capable of producing an output level of 118dB, with a level of distortion which Koss now claims is 6dB better than their closest competitor. Now that's quite a claim, but my subsequent investigations and measurements tend to support it.

The Koss headphones come beautifully packaged in a neat and well conceived zippered carrying pack, with all attendant cables, power packs — and most critically of all, with a side pocket for your miniature battery-operated CD player, MD player, DCC player or DAT player.

All in all, this is a beautifully packaged kit, and of course at $1800 it ought to be. The packaging also claims that the unit comes with a 'lifetime warranty'.

Stax SR-Lambda's

The Stax SR-Lambda Pro Classic electrostatic headphones (which I will hereafter refer to as the Stax headphones) claim performance characteristics which are generally similar to those of the Koss phones in respect to frequency response, but Stax tend to be a little vague in some of the other areas. The limited literature which they provide certainly lists and displays a frequency response, which is equally wide to that offered by the Koss headphones. The literature refers to the use of 'push-pull electrostatic/open back rectangular enclosures', which as you will see from the photos are larger and



Here are the frequency response plots for the Koss (top) and Stax (above) electrostatics, all measured using the Bruel & Kjaer type 4153 artificial ear — which does introduce some unavoidable perturbations of its own.

Measured performance of Koss ESP/950 electrostatic stereophones
Serial No. 54106

	Output	90dB	100dB	110dB	120dB
Harmonic distortion at 100Hz	2nd	-38.2	-48.8	-59.2	-57.3
	3rd	-45.3	-55.3	-62.0	-63.0
	4th	-52.6	-64.0	-67.7	-71.4
	5th	-48.3	-58.9	-68.0	-72.7
	THD	1.4%	0.41%	0.15%	0.16%
Harmonic distortion at 1kHz	2nd	-66.0	-59.8	-55.5	-52.8
	3rd	-66.0	-67.6	-67.6	-64.3
	4th	-65.1	-72.2	-71.7	-73.5
	5TH	-66.5	-74.4	-74.9	-70.8
	THD	0.1%	0.11%	0.18%	0.24%
Harmonic distortion at 6.3kHz	2nd	-	-52.6	-59.7	-54.6
	3rd	-	-51.1	-54.7	-23.0
	4th	-	-53.3	-56.9	-
	5th	-	-	-	-
	THD	-	0.42%	0.25%	7.1%

have a somewhat more ungainly appearance than that of the Koss phones. Of the two shapes, I tend to lean towards that of the Koss, which I think look marginally more comfortable.

The Stax headphones are neither as beautifully boxed nor as well presented as are the Koss. The carton contains just the headphones with integral ribbon cable, the drive unit amplifier with level control, and a thin leaflet. There is no carry pack, no battery pack, no extension cables nor any of the other extras.

The Stax headphones, like the Koss, require an external DC power supply (12 volts DC as opposed to 9V for the Koss), and the Stax supply surprisingly uses a negative centre pin on the socket. This could prove to be tricky if you tried to use a conventional supply with positive centre pin, which is now generally the industry standard.

The Stax headphones are connected by a neat strip coded ribbon cable of six conductors, similar to the Koss. One of the most obvious visual differences between the two systems is the type of headphone support yoke and the shape of the earpieces. The Koss overhead yoke is neatly configured with a well conceived single padded assembly; this provides an adequate range of adjustment of the headphone positions. Stax uses a radically different yoke structure and design, to which Stax has added an adjustable flexible headband. The position of this flexible band determines the position of the ear pieces relative to the wearer's ears.

Objective testing

For the objective assessment of the two sets of headphones I used a standard Bruel & Kjaer Type 4153 artificial ear. This is designed to incorporate a 12mm pressure response capacitor microphone. I used a Bruel & Kjaer type 4134S quartz-coated microphone, which has an extremely flat frequency response over the 10Hz to 20kHz range.

Now it is important to point out that the Bruel & Kjaer Type 4153 artificial ear does not automatically produce a frequency response which is absolutely flat when driven by a perfect earmuff. Although it is still regarded as one of the best artificial ears for objectively evaluating wide-range headphones of this type, it nonetheless introduces some fairly significant frequency perturbations in its output response. These may have little to do with the headphones being tested, and are primarily a characteristic of the artificial ear itself.

The major advantage of the 4153 artificial ear is its ability to measure stable acoustical signals, and in particular to measure the distortion of those signals at sound pressure levels as high as 160dB.

The first series of measurements which I conducted were to assess the frequency response of the two headphones. As you will see from the graphs which are presented, the frequency response of both electrostatic headphones are remarkably flat from 10Hz to 500Hz, with the Koss being marginally flatter than the Stax.

Both headphones then exhibit a comparable nominal 5dB rise in their output response between 1kHz and 2kHz, and which I attribute to the artificial ear. Both then exhibit somewhat similar drooping responses between 1kHz and 5kHz, and this is again attributable to the artificial ear. On the other hand both also exhibit a rising response between 6kHz and 12kHz, but this is primarily a function of the individual electrostatic headphone characteristics, rather than the artificial ear. If we initially ignore the position of the respective peaks and bumps, it is interesting to note that both headphones are reasonably flat over the full frequency range. The measured frequency response of the Koss headphones lies within a +6dB range from 10Hz to 13kHz, and within a +7.5dB range from 10Hz to 20kHz. The frequency response of the Stax phones is within a +6dB range from 10Hz to 9.5kHz, and within a +8.5dB range from 10Hz to 20kHz.

Although the frequency responses displayed by both sets of phones are by no means 'ruler flat', when appropriate allowance is made for the non-linear characteristics of the artificial ear they are nonetheless as close as I could reasonably desire, in terms of their 'relative flatness'.

Whilst frequency response is an important factor, harmonic distortion and intermodulation distortion are clearly of comparable significance. One of the most compelling claims made for electrostatic headphones, in much the same way that similar claims were made for electrostatic loudspeakers in the past, is their relatively low harmonic distortion, even when operating at close to

Measured performance of Stax SR-Lambda Pro electrostatic stereophones
Serial No. 34681

	Output	90dB	100dB	105dB
Harmonic distortion at 100Hz	2nd	-50.5	-60.0	-64.4
	3rd	-56.1	-60.6	-67.6
	4th	-65.4	-69.2	-69.0
	5th	-65.2	-64.7	-72.3
	THD	0.35%	0.15%	0.085%
Harmonic distortion at 1kHz	2nd	-64.6	-63.1	-60.2
	3rd	-59.1	-64.6	-64.9
	4th	-70.3	-79.4	-75.0
	5th	-63.5	-76.6	-75.3
	THD	0.14%	0.09%	0.12%
Harmonic distortion at 6.3kHz	2rd	-58.9	-46.0	-31.7
	3rd	-53.3	-39.5	-23.7
	4th	-57.6	-	-
	5th	-	-	-
	THD	0.28%	1.17%	7.0%

their maximum permissible level for diaphragm excursions.

I initially thought I would have relatively few problems in evaluating the electrostatic headphones. In point of fact, I almost made a cardinal error, by using the battery pack to test the Koss phones. Whilst the frequency responses came out well, the distortion figures did not conform to what I would have anticipated. It was only relatively late in the piece that I realised a crucial point: once the battery voltage drops below about 8V, the distortion starts to rapidly rise, and the dynamic range is truncated.

When I reconnected the Koss headphones up to a fresh nine-volt supply, the peak output turned out to be 121.5dB SPL. At this point they reach the 'very sharp knee of the curve' — following which, to use a colloquialism, 'they really drop their bundle'.

What I found surprising, indeed almost mystifying with the Koss headphones, was that with a sound pressure level output approaching 120dB, there was no significant rise in the level of harmonic distortion at either 100Hz or 1kHz. By contrast at 6.3kHz, the total harmonic distortion level had risen to a very appreciable (and audible) level of 7%.

When I repeated my distortion measurements and evaluated the Stax headphones, I found these were limited to a somewhat lower peak sound pressure level output. Whilst they would quite happily produce a sound pressure level of 105dB, on raising the output sound pressure level to 110dB they voiced their dissatisfaction quite audibly, and I feared for their safety. Unlike the boldly labelled Koss carton, there is no reference to a 'lifetime guarantee'.

Listening session

I took the two sets of headphones home for a subjective evaluation, which I must acknowledge from the outset was one of the most memorable listening sessions I've had. It was also unquestionably one of the most exciting.

I used three new outstanding CDs, the first of which was Midori in 'Encore', in which she plays a delightful and entrancing selection of violin solo pieces from Kreisler, Paganini, Faure, Tchaikovsky and Sarasate, among others (Sony Classical SK 52568). Both sets of headphones provided a quality and realism of sound which was absolutely astounding. The feeling of 'being there' was absolutely uncanny; at times, it almost bordered on the surreal.

The headphones, unlike loudspeakers, produce no room-mode effects, and all that you hear is the original sound. Midori for her part has developed a style and skill which is world class, and on this particular disc, is absolutely 'first class'. This is one disc that you can safely add to your selection of classical vignettes.

Using 'Encore', I simply could not readily pick the difference between the two headphones, unless I upped the level to what I would classify as 'ear-shattering peaks'. At this point Koss had the clear advantage.

The next disc I used was Mendelssohn's 'Overture & Incidental Music to A Midsummer Night's Dream', and his Symphony No.4 'The Italian', with Yoel Levi and the Atlanta Symphony Orchestra (Telarc CD 80318). This disc contains a superb rendition of these two delightful pieces, and they are both amongst the best that I have yet heard.

It was when listening to the strident peaks of the Wedding March that I *could* hear differences between the two headphones. One trouble was that because I was unable to organise an instant A-B, B-A comparison, I experienced considerable anguish in trying to identify precisely what I could hear by way of differences.

I repeated this exercise with greater care on the fourth track of the Italian Symphony, where I again convinced myself that I could hear the differences — and more significantly, that the differences I was detecting were primarily associated with the highest level transients, which the Koss headphones reproduced with less colouration than the Stax.

I progressed to a third and what may well be a more popular new disc — Chesky Records' 'The Collection'. This disc features 16 tracks of potpourri format with some of Chesky's most recent and best 'pop' and 'classical' music. As the label boldly states, 'Chesky Records/You Can Hear The Difference' — and begorrah, I *could* really hear the difference!

First of all, the music is exceptionally well recorded, using 20-bit technology, and the quality of the music provides an exciting basis for comparison.

The differences that I could detect were really subtle, I acknowledge, but there were differences. The wide range in music, which included the gentle plucking of Luis Bonfa's guitar in 'Samba De Orfeo' on track 13, through to Sara K's singing 'Wanna Spend More Time' on track 3, or even Herbie Mann's 'Caminho De Casa' on track 8, provided superlative program material with which to carry out the comparison and assess differences.

Summarising...

In the end, I have to admit that the Koss and Stax headphones were neck to neck in this competition to select a winner. The Koss headphones did display one clear advantage, though, in having the ability to provide higher peak outputs with significantly lower distortion.

The Koss also offer the advantage of a beautiful package, which incorporates some very useful extras designed to suit the traveller who wishes to carry a full hardware system (including the battery pack) with him or her, and have configured it right down to a 'T'. However at almost one-and-a-half times the price, there is some, if not a significant disincentive to purchase the Koss headphones — particularly when or where money is relatively tight.

The Stax headphones offer equally exciting performance at sound pressure levels below 110dB, and these headphones are strictly designed to be used and left at home. Their performance simply cannot be denigrated, and they still get full marks for frequency response and fidelity.

Whichever of these headphones you audition, it is unlikely that you will be disappointed with what you hear. In the event that you buy one pair or the other, hold onto your hat — because you will experience a fidelity, a transparency and realism of sound, the like of which you may never have heard before.

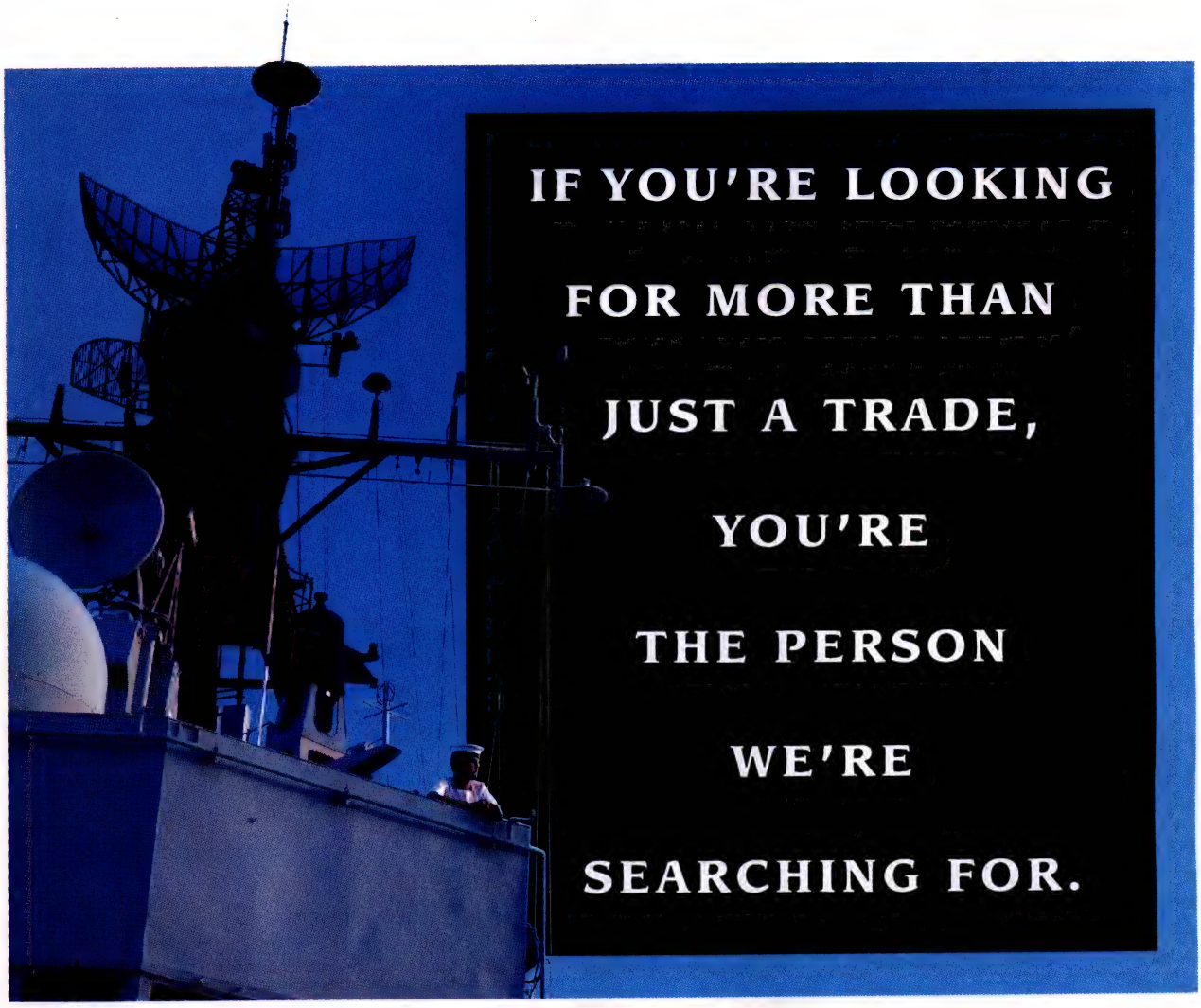
The Koss ESP/950 stereo headphones and matching E/90 Electrostatic Energiser have an RRP of $1799. Further information, if you need it, is available from the distributor, EDS Trading (A/Asia), of Unit 24, Block C, Slough Business Estate, Slough Avenue, Silverwater 2141; phone (02) 647 2009, or fax 648 5585.

The Stax SR-Lambda Pro Classic stereo headphones and driver unit Model SRM-Xh have an RRP of $1199, and further information is available from the distributor International Dynamics, of 78-80 Harold Street, Cheltenham 3192; phone (03) 585 0522, or fax 585 0179. ❖

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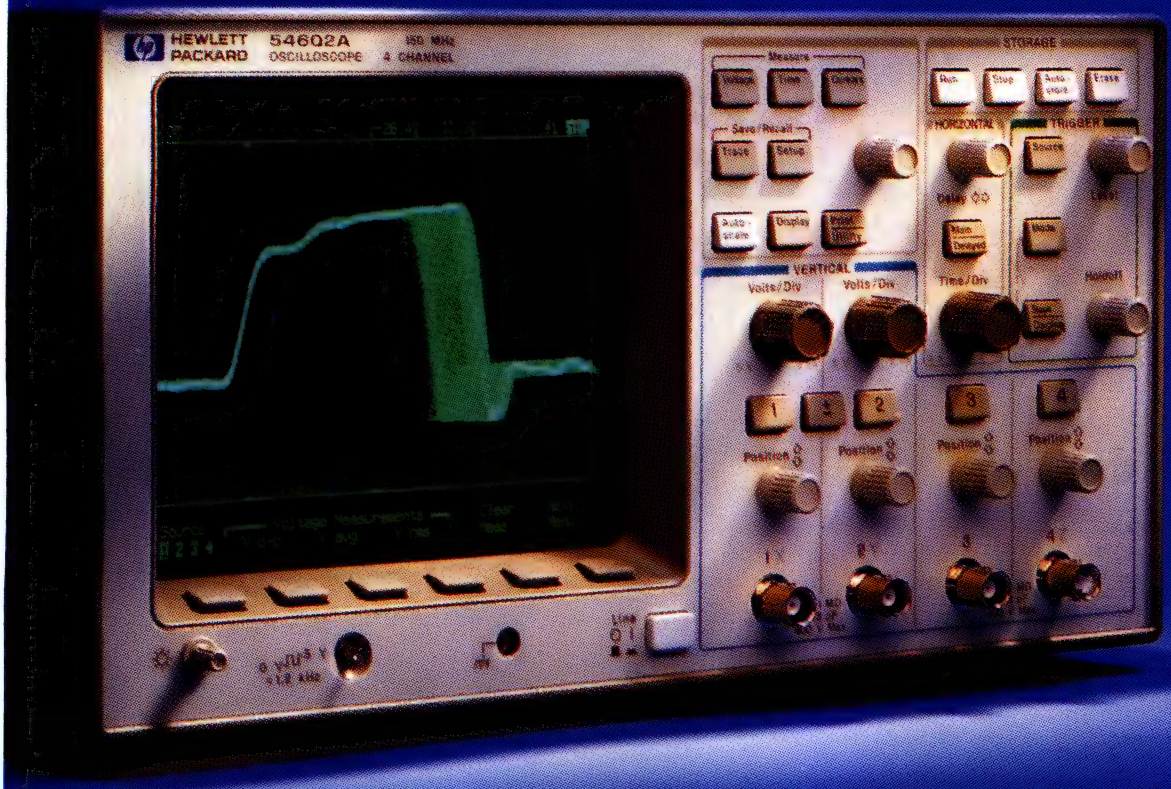
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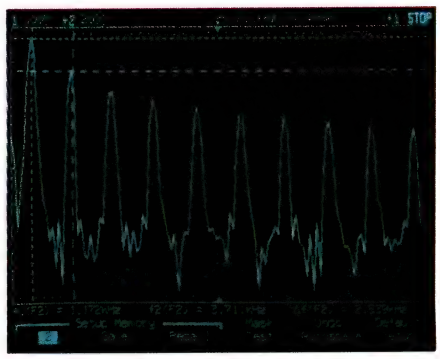
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70 years of radio broadcasting in Australia:

THE SEALED SET DEBACLE

Seventy years ago this month, Australia's first AM radio broadcasting stations began operating. But our broadcasting industry got off to a very shaky start in 1923, largely due to the so-called 'Sealed Set Scheme' proposed by AWA's Ernest Fisk. This is the first of two articles commemorating the start of radio broadcasting.

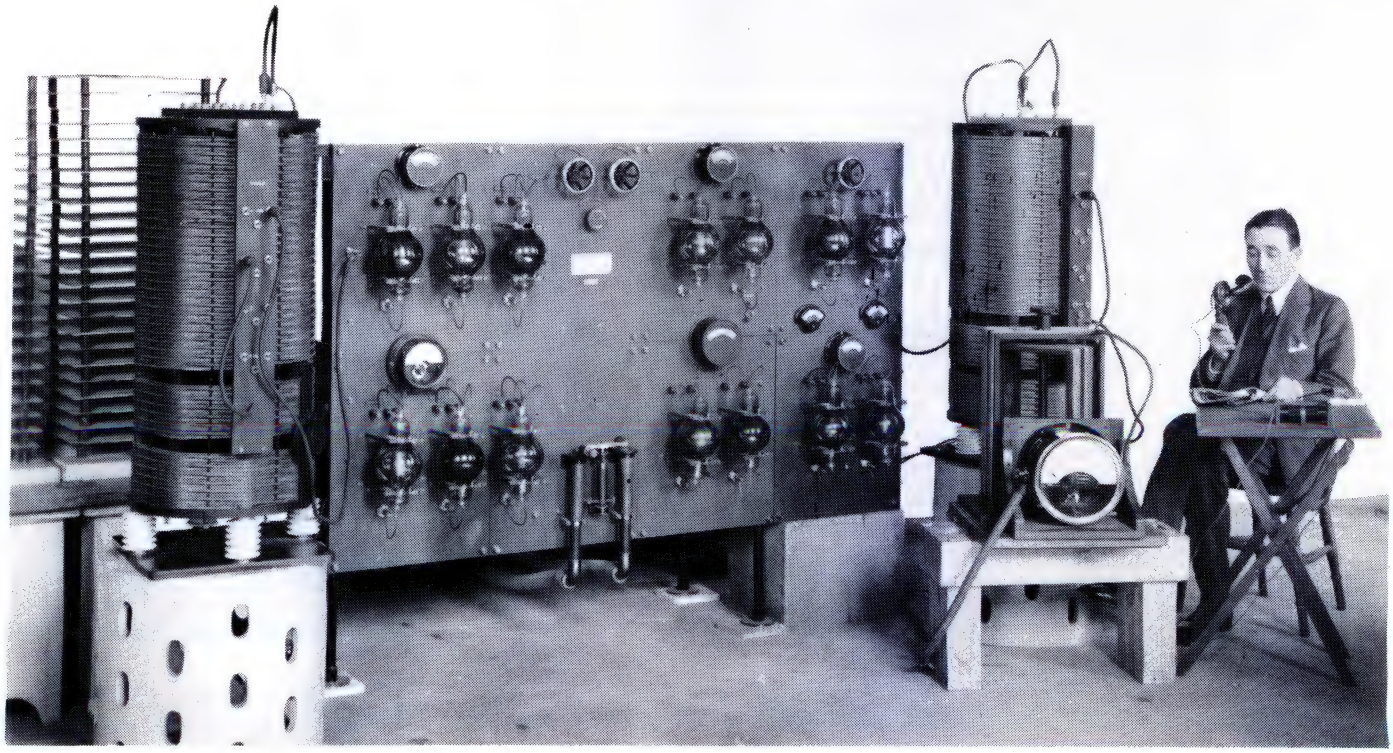
by COLIN MACKINNON, VK2DYM

Wireless experiments were carried out in Australia from around 1895, undertaken by PMG engineers, university scholars and a few private individuals who duplicated Marconi's system, with varying degrees of success. By 1904 the Royal Navy, on Australian Station, had several ships equipped with wireless and used it for ship-to-ship and ship-to-shore communications.

The Navy was not keen for anyone else to be dabbling with wireless, but private companies could see a lucrative market in providing wireless services to commercial shipping, and to communicate between islands where there were no submarine telegraph cables. The Government took control of the situation by enacting the *Wireless Telegraphy Act* of 1905, and the PostMaster General issued 'Temporary Experimental Permits' for experimental and commercial purposes from 1906 through to 1914. Upon the commencement of World War 1 on 5-8-1914, private experiments ceased, and in November 1915 all commercial wireless was placed under the control of the Navy for the duration of hostilities.

At this time the equipment used by the Navy, commercial stations and experimenters consisted of spark transmitters, with simple crystal or coherer receivers; Morse code was the only means of sending messages. However, by 1914 there were experiments overseas with voice transmission. Electronic valves had also been invented and were being introduced into military wireless for both transmission and reception. World War 1 prompted rapid development of these valve transmitters and receivers, as well as the introduction of voice telephony, and provided technical training to signallers — many of whom maintained an interest as experimenters after the war.

After World War 1 the Royal Australian Navy sought to retain control of wireless and tried to prevent private experiments. But there was a ground swell of interest, which forced Radio



In early 1920, the Marconi Company experimented with broadcasting of speech and music at Chelmsford in the UK, using this 6kW transmitter. Engineer W.T. Ditcham is shown at the microphone. (Courtesy Marconi Company).

Commander Creswell to grant 'Temporary Permits' for receiving-only in 1919.

The general public was very interested in wireless telephony, i.e., voice transmissions, and public broadcasting had commenced in the USA in 1920, whilst the BBC in the UK was making test transmissions of voice and music. In mid-1920 the Government again took charge and finally introduced new regulations in late 1922, allowing for commercial wireless operations and three classes of private licence. These private licences were:

Experimental Licence — transmitting and receiving: £1

Experimental Licence — receive only: 10/-

Broadcast Licence — news and entertainment: £5

The Broadcast Licence was a concession made by the PMG to satisfy the public interest in 'broadcasting'. The licence was intended for experimenters who wished to provide a limited news and entertainment service, but advertising was not permitted.

The rules and power limits were the same as for other experimenters and because of the high cost, not many took out this licence. But some experimenters did broadcast recorded music, lectures and live artists, which were eagerly sought by the listeners. However the public wanted more than just amateur broadcasting, and following the overseas trend the scene was set for the introduction of commercial broadcasting.

AWA made a public broadcast of speeches and live musical items in Sydney, in August 1920, and followed up with another demonstration at Parliament House in Melbourne, in October. But the government was slow to accept the benefits of broadcasting and nothing eventuated.

In November 1922, AWA submitted a proposal to the PMG whereby it would provide a broadcasting service for Australia — provided it had a monopoly and could charge accordingly. When other interested parties heard about this, they objected and in February 1923 Mr George A. Taylor formed the 'Association for Developing Wireless', whose members were dedicated to preventing any broadcasting monopoly.

Digressing for the moment, Taylor was an interesting person, who was very active in Army wireless, aviation, art and civil engineering. In 1910 he had formed the 'Wireless Institute of Australia' to fight for experimenters' rights, because they felt that the provisions of the Wireless Telegraphy Act were draconian. At that time the licence fee of £3 was considered to be too much for private experimenters, and the penalty for infringement under the act was a high £500 with no course of appeal. Negotiations with the PMG resolved most of their differences by mid-1910.

The 1923 Conference

To satisfy all parties interested in public broadcasting, the PMG called a conference which was held in May of 1923. A group of more than 40 people representing wireless manufacturers, retailers, prospective broadcasters, the media, listeners and experimenters sat down with Commonwealth officers to agree on a system for establishing broadcasting in Australia.



Ernest Fisk (later Sir Ernest) was one of the founders of AWA and for many years its managing director. He was the chief architect of the disastrous sealed set scheme.

The conference, in Melbourne, was opened by the Hon. W. G. Gibson, Post-Master General, who stated that broadcasting was now needed and as Australia had unique conditions compared to other countries where broadcasting was being introduced, he hoped the assembly would come up with a set of regulations which the Government could endorse as the framework for broadcasting.

Mr G.A. Taylor, President of the Association for Developing Wireless, was elected Chairman. Taylor called upon anyone with a proposal to place it before the meeting. Mr E.T. Fisk, Managing Director of AWA and a most influential force in wireless matters, stated that he had a complete proposal, but wanted to hear if anyone else had anything to say.

No-one else came forward, so Fisk made his presentation, which was of 13 points suggesting that a number of wavelengths be allocated for broadcasting, and licences issued to broadcasting companies for each wavelength. Proprietors of stations could charge listeners for their services, to be collected by way of subscription fees paid annually. Retailers and dealers were to be licensed and could only sell or rent a wireless receiver to a person in possession of a listener's licence, and would submit records of dealings to the government. The licence would be sold by the retailers, would be renewable annually, and would cost whatever the particular station set as its subscription fee, plus something for the Government. All manufacturers were to be licensed also.

Fisk's proposal

For the point of this story the pertinent item was Fisk's proposal (d), which stated:

Receiving licences to be issued for using apparatus capable of receiving on one wavelength only.

In other words, the listener had to choose which one of maybe one, two or three stations he wished to subscribe to and then purchase a licence and a wireless set tuned to that station only. The receiving set was to be 'sealed', and the proposals became known as the 'Sealed Set Scheme'. Fisk was a very persuasive and authoritative speaker, with the result that no-one else received a hearing. The conference simply debated and refined his submission, to come up with the proposed regulations.

Fisk wanted each receiver to be tuned to one station only, and argued it would be too hard to allow a set to receive any more, but an amendment was pushed through to allow a set switchable between two wavelengths. The listener would then pay two subscription fees, which might be say £3/3/- for one station and £2/2/- for the second service.

The Wireless Institute, represented by O.F. Mingay, H. Maddick and T.P. Court, argued that experimenters should not be restricted in the same way as listeners. Fisk brushed this off by saying they would be fully protected. Later events proved this false.

Fisk's reasoning was quite clever, as we shall see later. He wanted the chain of distribution of wireless sets closely controlled and recorded, with penalties for anyone making or owning an unlicensed set, and each set had to be of a design that was approved by a statutory authority.

Sealed Set Debacle

The Conference, as is the way with such groups, waffled on and on and digressed to topics such as one brought up by Harry Wiles, proprietor of 'Wiles Wonderful Wireless' — who was concerned that pigeons should be protected from extermination, by decapitation on thin aerial wires! A motion to have all aerial wires adorned with corks lapsed...

Fisk's proposals were accepted with very minor changes, and after due consideration by the Government the new Broadcasting Regulations were published in August 1923. The details for the receiving sets were as follows:

RECEIVING SETS

Only apparatus that will not cause the aerial to oscillate may be used. (Poorly adjusted regenerative receivers were a known cause of interference.)

Sets shall be sealed.

Broadcast receiving sets shall be so made as to respond to a certain wavelength, and a 10% variation only will be allowed.

Sets shall be stamped indicating the type, number and wavelength.

Only those sets or units of approved pattern shall be used.

ASSEMBLING OWN SETS

Those persons who assemble their own sets shall arrange them as stated under 'Receiving Sets'.

The tuning elements shall be enclosed suitably for effective sealing and shall be submitted to an authorised officer, who will test them to see that they conform to the regulations.

A charge of 2/6 will be made for this test, and if in compliance with the regulations the set will be sealed and shall not be broken except by the authorised officer.

MORE THAN ONE BROADCASTING STATION

Sets may be made to receive more than one broadcasting station, and may be used if the subscriptions be paid to each broadcasting station that the set will receive together with the Government licence fee of £1. (The licence fee was 10/- per annum, so for reception of two stations it would be 20/-, or £1.)

The previous Experimental Receive-only licence was cancelled by the new regulations and replaced by a Broadcast Listener's Licence costing 10/-, whilst the Experimenter's Broadcast Licence became a Broadcast Station Licence, costing £15 plus a £1000 bond. The Experimental Transmit Licence remained and still cost £1.

Each approved sealed set would have a label attached, reading:

Broadcasting Receiver Type No.....
..... metres.
Approved by P.M.G.

There was some confusion as to how the sealing should be accomplished, but it seems that the manufacturer was expected to fit the tuning capacitor inside a box, and after tuning to the required wavelength it would then be closed off with a lid covered with a sealing label, to prevent listener access. Plug-in or variable coils were not permitted.

Fisk had stated during the conference that if a person wanted to receive a second station, he should purchase a second set and another licence; but the regulations allowed for the original set to be modified, at a price. You will see below why Fisk was keen on increasing the number of receivers in homes.



William John Maclardy, who founded 'Wireless Weekly' magazine in 1922, and was also the driving force behind the setting up of Sydney radio station 2BL — later absorbed, along with 2FC, into the ABC network.

Returning now to Fisk's motives, once the manufacturers and experimenters were licensed and known, he sent out an 'AWA Licence Form Number 1' demanding payment for use of the patents AWA controlled at 12/6 per valve socket (17/6 for USA valves), and demanded that experimenters pay 5/- annually and sign his 'AWA Licence Form Number 4'.

There was an uproar over this impost but the Government, which after all owned just over 50% of AWA, supported Fisk. The experimenters dug in and AWA backed off, allowing a concession for free use of patents for private experimentation only. But they were not to resell their equipment, nor manufacture sets for others.

Most unpopular

Right from the start the 'sealed set scheme' was unpopular; in fact disastrous. Even before the regulations were announced the delegates started to have second thoughts. There was a suspicion that Fisk and others had 'stacked' the meeting to gain their own advantage, and the Victorian WIA felt the interests of experimenters had been sabotaged by O.F. Mingay — ostensibly the NSW WIA delegate, but also in the wireless business and closely allied with Fisk's interests.

Taylor denied the accusations, and appealed for the Sealed Set System to be given a fair trial. The PMG's Department remained neutral, saying that it was only introducing regulations that the body of wireless interests had wanted and agreed on.

Once the full details of the scheme were revealed, there was further dissent. The listeners' costs were high and AWA's patent fees considered outrageous. The paperwork was cumbersome, people resented not being able to listen to the other stations that were on air, and manufacturers had great difficulty making sets which complied with the 10% wavelength limit.

Part of the reason was that they made sets with the minimum number of valves, because of AWA's high royalties, and such sets were little better than crystal sets. There was a holdup in obtaining test equipment for the PMG, so that it was not ready to test sets submitted to it until November 1923.

At the end of 1923 there were only 20 models of receivers, from 14 manufacturers, passed by the PMG. These consisted of:

Crystal — 1
Crystal + one valve — 3
Single valve — 8
Two valve — 7
Three valve — 1

The pre-set wavelengths were 350 metres (2SB) or 1100 metres (2FC), with one set designed for 1720 metres (3LO). The United Distributing Company's Model 46 was the only one switchable for both 350 and 1100. By mid-1924 a total of only 61 receiver designs had been approved, out of 154 submitted.

In Sydney broadcast stations 2SB (later to become 2BL) and 2FC commenced in December 1923, 3AR in Melbourne in early 1924, and 6WF in Perth started transmission in June 1924 — all as 'sealed set' stations. The subscription

costs were to be: 2SB — 10/-, 2FC and 3AR — £3/3/-, and 6WF — £4/4/-.

2SB was able to charge only the 10/- PMG licence fee because it was subsidised by a number of wireless retailers, who were shareholders in the company running the station: 'Broadcasters Sydney Limited' or 'BSL'. They each paid 5/- per week for the upkeep of the station, and obviously hoped to sell many sealed sets tuned to 2SB.

Because most manufacturers could not meet the specifications, sets were not available; the listeners were not interested and the broadcast stations were soon in financial difficulties — they just were not getting their fees in.

Of course many people built their own sets from parts and didn't bother about licences anyway. Others woke up to the fact that it cost less overall to claim to be an experimenter, and obtain an experimental licence — with no restrictions on station tuning and no station fees. By mid-1924 there were only about 1200 licences issued to listeners, but over 5000 people had applied for an Experimental Licence!

In early 1924 the PMG was forced to send letters to the holders of experimental licences, warning that they must prove themselves to be bona-fide experimenters, not just listeners. As a consequence the number of Experimental Licences dropped dramatically during 1924-25.

Rigged comparison

AWA was determined to prevail with the sealed set concept, and even carried out tests at Moss Vale to prove its sealed set could receive signals in the 'country'. However to achieve this success, a team of field engineers spent a week testing and had installed a 200 foot (62 metre) dipole on 100 foot (30m) poles, with a copper gauze ground mat.

After AWA trumpeted the sealed set's win over an 'open' set, it was revealed by others that the AWA sealed set consisted of four valves with regeneration (which was frowned upon) — whereas the 'open' set was a simple detector and plus one audio stage, connected to a long wire 60' (18m) long and only 30' (9m) high.

The fact was that neither sealed sets nor open sets of comparable performance were satisfactory outside a very restricted radius from the broadcast stations.

The second conference

Public and industry resentment built to the point where another conference had to be called by the PMG, in Sydney in April 1924. Of particular note: Mr Fisk was not invited. The two aims of this conference were

(1) to abolish sealed sets; and

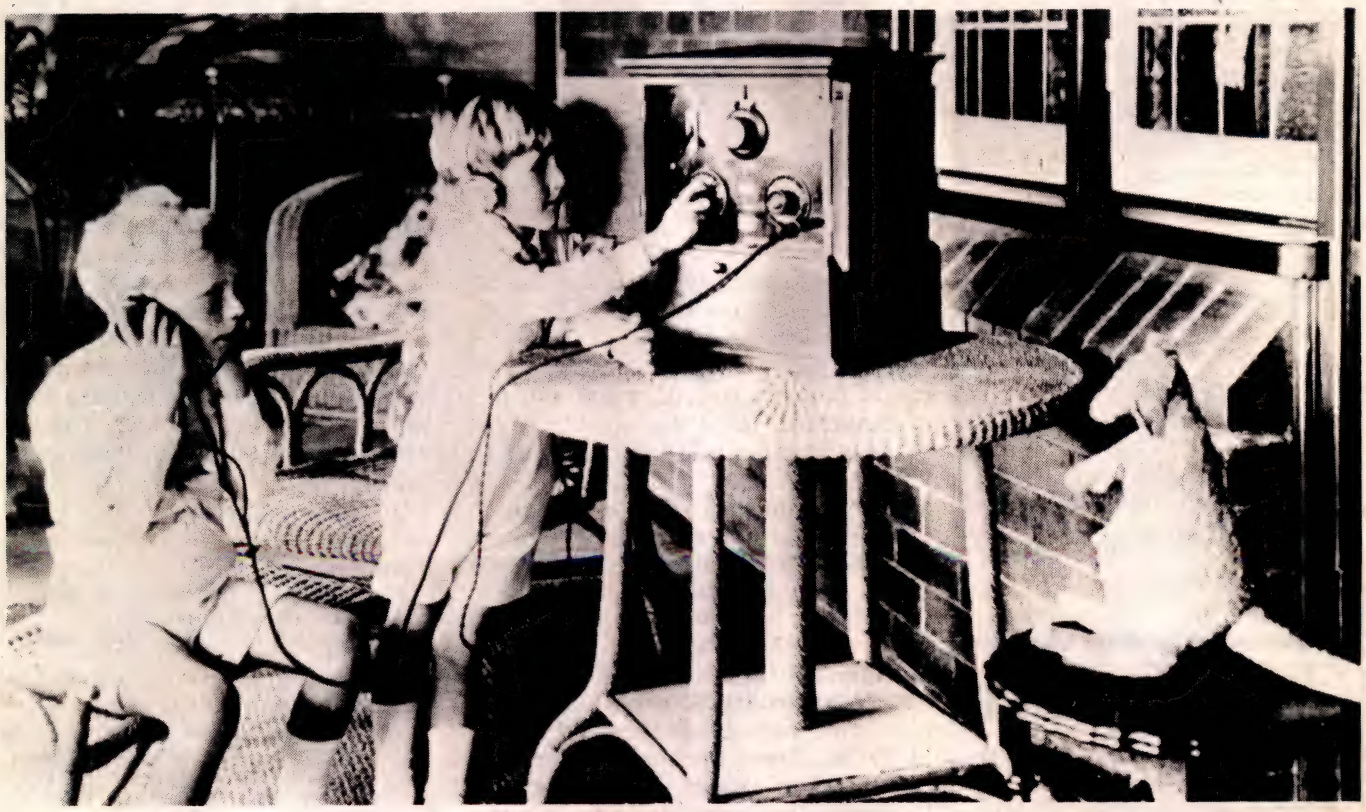
(2) to propose a workable scheme of broadcasting with adequate return for the commercial stations.

The participants were a number of state radio associations made up of manufacturers, retailers and station owners, plus the PMG. The chairman was Major C.W.C. Marr, a Member of the House of Representatives.

Whereas the previous conference had been dominated by Fisk and his proposals were readily accepted, this conference had many controversial moments, with some acrimony and even a couple of delegates walking out. Farmer and Company, which had the licence for 2FC and was closely associated with 3LO, refused to put its proposals to the meeting, claiming it wanted to negotiate direct with the PMG. The others suspected that Farmer & Co, which leased AWA equipment, wanted a broadcast monopoly and was in league with AWA.

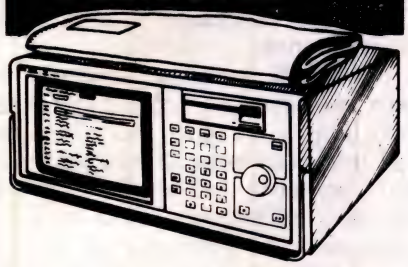
This time around, there were several proposals submitted. They dealt mainly with limiting the number of stations in each state, and ways in which commercial stations could receive compensation for their services.

But on the subject of receivers, the Association for Development of Wireless wanted open sets with no restrictions and a common licence of £2 (40/-) plus 5/- Government fee. They also wanted a



Ernest Fisk's two young sons Kelvin and Maxwell, using one of the AWA Radiola two-valve sealed sets on the verandah of their Wahroonga home. Maxwell was later killed during RAAF service when he walked into a revolving aircraft propeller.

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Sealed Set Debacle

board of administration in each state to control stations and oversee programming, operating times etc. Other proposals varied, but there was overwhelming rejection of sealed sets.

A couple of delegates made comments about experimenters which are worth repeating. Leslie Bean of L.P.R. Bean & Company, a retailer and manufacturer, stated that "if persons were intellectually fit to be genuine experimenters, they would not be impecunious, so therefore should pay the full broadcasting subscription".

He claimed that "the mere sending of dots and dashes did not constitute research work", and admitted he had never learnt the Morse code and never intended to. A strange admission for one who held an experimenter's licence, which required proficiency in Morse code!

Major Marr, MHR, the conference chairman, reckoned that "a man over 40 could not learn the Morse code".

The final proposals submitted to the PMG included open sets, a licence fee of £2 plus 5/- government fee, and two classes of broadcast stations: A class, sustained from licence fees, and B class, which would survive by accepting paid advertising.

Experimental licences were to be discontinued and replaced with an 'Expert Experimental Licence'. The total number of such licences was not to exceed 980, allocated as follows:

NSW	300
Vic	300
SA	100
WA	100
Qld	150
Tas	30

These licences were to be free, and issued on the recommendation of the Wireless Institute in each state.

The 40/- fee was lower than the subscriptions charged by the stations beforehand, but it was considered that the open set would make listening so popular that the stations would earn much more. In fact an extra million pounds of revenue was estimated. Manufacturers could claim compensation for converting stocks of sealed sets to open sets, but it seemed there were very few sets held in stock.

The PMG rejected some details of the proposal and instead issued its own version of the regulations, in July 1924. These allowed open sets and the two classes of stations, but set listener's licence fees according to the distance from the capital cities — ranging from 31/- to 25/-, and detailed the distribution of fees to the A class stations. These fees were reduced in later years. The Experimenter's licence cost 30/-, later reduced back to 20/-, and there were no limits on the number of experimenters.

Much more popular

The new regulations proved popular and whereas there had been only 1206 broadcast listener's licences issued in the year to June 1924 under the Sealed Set Scheme, by June 1925 there were 64,000 licences. By June 1926, a total of 128,000 had been issued. The number of licences issued jumped noticeably when popular programs such as an 'Opera Week' were announced.

The split-up of revenue from licence fees to the stations caused some continuing problems. For instance 2FC obtained 70% in NSW, whilst 2BL with 30% lost money for a number of years until alterations to the regulations changed the way in which broadcasting was controlled.

The AWA valve royalty was still very unpopular. Eventually, in 1927, the government heeded public grumbling and came to an arrangement to pay 3/- from each listener's licence to AWA to compensate it for loss of patents revenue.

In 1934 even that was cancelled. Consequently, the ARTS&P (Australian Radio Technical Services & Patents) Company was formed by AWA and other companies to pursue and protect their various patent rights.

Epilogue

Most of the few sealed sets that had been made were converted to tunable sets by removing the box covering the tuning capacitor and adding a tuning knob to the cabinet front, so very few genuine sealed sets have survived. I have heard of one or two so-called sealed sets, which appear to have been made well after 1924!

A friend once told me how, as a young lad, he helped his father who had a wireless rental business in the west, dump unwanted sealed sets down mine shafts outside Dubbo.

(To be continued) ❖

References:

Wireless Weekly, 1922 - 1925. Provides extensive coverage of the issue.
Australian Archives, PMG files under MP341/1
David Jones Archives, Historical Records 1923-1937, BRG 1/X7
OTC Archives, AWA files
Newspapers and other wireless magazines of the period also carried news and editorials relating to the 'Sealed Set Scheme' and its demise.
(Private collection, Colin MacKinnon)

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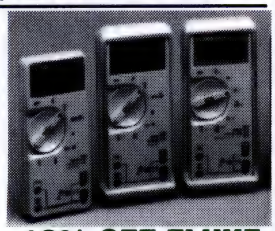
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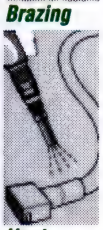
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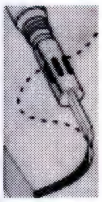
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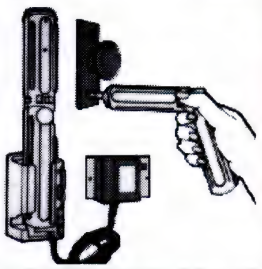
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READER INFO NO. 8


This month, NASA astronauts should be...
FIXING HUBBLE'S TROUBLES

Shortly after the Hubble Space Telescope was placed into orbit by NASA in 1990, it was discovered to have faults which significantly limited its performance. Although astronomers found ingenious ways around some of the problems, it was obvious that the telescope's defects would eventually need to be corrected. After the long process of designing and building the right correction/replacement parts, a team of astronauts are expected to attempt the rather daunting exercise of fitting them to the telescope early this month.

by KATE DOOLAN

In April 1990, a new window to the universe was ready to be opened. After years of frustration and delays, the Hubble Space Telescope (HST) had finally reached Earth orbit — where after a six month period of systems testing, it would begin a series of astronomical observations which would probably cause the textbooks to be rewritten. A development this significant for astronomy had not occurred since Galileo first used his telescope.

But on 27 June 1990, those dreams came to a crashing thud when the National Aeronautics and Space Administration (NASA) announced to a disbelieving public and scientific community that the billion-dollar Hubble program was hobbled. Problems with the HST's primary mirror meant that many of the astronomical discoveries would have to wait.

Now the waiting time is almost over, as the first Hubble Space Telescope Servicing Mission is scheduled to take place in early December. In a flight which could last up to 16 days, the seven astronauts of mission STS 61 will be making at least five Extra Vehicular Activities (EVA's, or 'spacewalks') to repair and maintain the ailing Hubble.

The NASA space shuttle program has certainly seen its share of dramas, but STS 61 will possibly be the most daring and ambitious shuttle flight ever attempted. The timing of the flight comes at a crucial time for NASA, which is eager to have a major success to overshadow the failure of the recent Mars Observer mission.

When the NASA planning staff originally began studies into the idea of placing a large optical telescope into Earth orbit, they came up with the concept of in-orbit servicing.

In 1979, the HST program requirements called for the retrieval, return to Earth, refurbishment and relaunch of the telescope every five years, and in orbit servicing to take place every two and a half years.

Six years later, contamination and structural loading concerns associated with a return to Earth by the HST called for these plans to be scrapped. Instead, the in-orbit maintenance program was deemed sufficient for the 15-year expected lifetime of the Hubble Space Telescope.

A schedule of in-orbit servicing was adopted, and servicing missions are planned for 1993, 1997, 1999 and 2002.

After the news of the aberration was made public, NASA administrator Dick Truly appointed Jet Propulsion Laboratory director Lew Allen to head a review board to investigate what had happened. The board's report, presented in November 1990, concluded that the main problem, a flaw in the primary mirror, was produced during the manufacturing of the mirror in 1980. The flaw had been left uncorrected due to discounting of the test results by main contractor Perkin-Elmer.

NASA was also brought to task, for failing to supervise the manufacturing process with 'reasonable diligence', but Congressional testimony revealed that NASA was hampered in its supervision by the Department of Defense.

Perkin-Elmer also produced optical systems for classified military reconnaissance satellites and because of this, the DOD restricted the number of quality control reporting staff which NASA could use.



A technician inspects one of the Corrective Optics Space Telescope Axial Replacements (COSTAR) mirrors. The instrument is designed to significantly restore the HST to its original imaging capabilities.

Risky, but achieveable

Whilst NASA views this month's Hubble Space Telescope Servicing Mission as 'risky but achievable', it has to be remembered that the HST was designed for in-orbit servicing. At the start of the HST development and construction in the late seventies, all of the spacecraft's components apart from the wiring, thermal control surfaces, structure, heaters and the Optical Telescope Assembly optics were to be serviceable in orbit.

Critical components are located in 50 types of Orbital Replacement Units (ORU's), which have been designed for easy access, removal and replacement.

Hubble also boasts some 80 metres of crew 'hand holds', and 31 portable 'foot restraint receptacles' on its surface. These were placed to allow a servicing crew to move across the surface of the spacecraft, position themselves at any servicing location and then reach the ORU's or related hardware.

Following the decision to eliminate a ground return by the HST, efforts were made to upgrade its in-orbit capability. By that time, budget constraints left only 20 ORU's with designs allowing complete Extra Vehicular Activities.

'Astronaut friendly' aids such as captive fasteners, wing-tab connectors, alignment decals and connector maps were added to the design of an additional 24 ORU's.

As noted above, the main problem with the HST is with the primary mirror; it is improperly shaped — causing *spherical aberration*. This means that light is im-

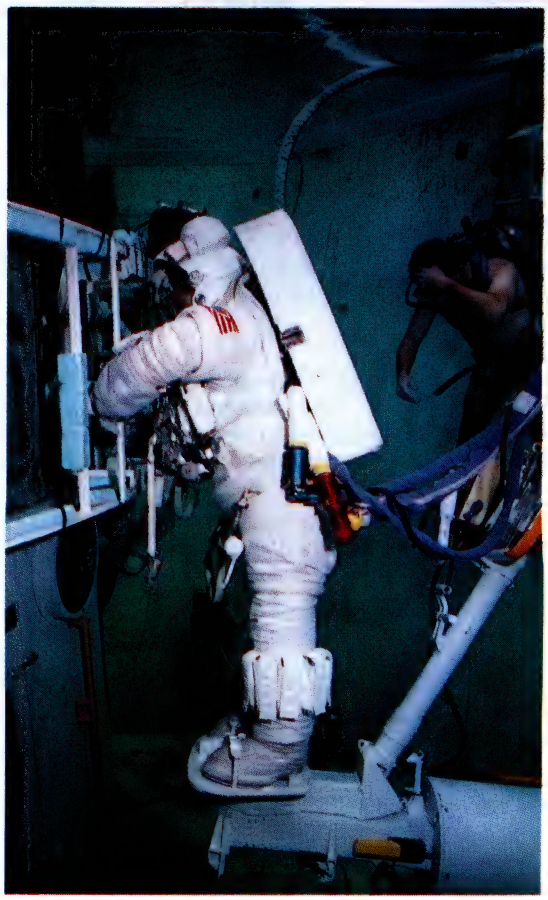
properly focused on the mirror's surface, which produces blurry images of distant astronomical objects.

The magnitude of the aberration was 1/50th of a single human hair. On any other telescope, this would not have any effect on operation; but because the Hubble is so finely ground, it is the equivalent of having 'fingerprints' all over the primary mirror...

The other problem is jitter induced by the solar power array, which also affects the quality of scientific data produced. More about this shortly.

To correct the spherical aberration, optical components known as 'reflective null correctors' — originally made perfectly flat — will be replaced with parts whose metrology (shape) has been altered to correct for the aberration.

The new parts have been dubbed 'Corrective Optics Space Telescope Axial Replacements', or COSTARs. The design of the COSTAR elements was determined by testing of a duplicate primary mirror retained in Earth, and from analysis of data from the HST in orbit. This allowed accurate characterisation of the primary mirror's 'radically symmetrical aberration', and hence showed how to correct for it by



Above: Wearing Extravehicular Mobility Units (EMU's), astronauts F.Story Musgrave and Jeffrey A. Hoffman use the giant pool of the Johnson Space Center's Weightless Environment Training Facility (WET-F) to rehearse for the Hubble Space Telescope repair mission. The two are working with a full scale training version of the Wide Field/Planetary Camera (WF/PC).

Below: Wearing an EMU, astronaut Kathryn C. Thornton uses the giant pool to rehearse for the repair mission. Standing on a mobile foot restraint connected to the Shuttle's robot arm, Thornton grasps a large structure which attaches to the Wide Field Planetary Camera (WF/PC). The current WF/PC on the HST will be replaced with WF/PC-2.

A total of five extravehicular sessions will be conducted during the mission.

polishing the opposite kind of surface correction into the COSTAR elements.

Of course even though the Hubble's primary mirror has been seen as 'flawed', scientists at the Space Telescope Science Institute in Baltimore, Maryland have been able to use computer enhancing to produce images that are *similar* to those the HST might have produced if it been working properly. Over the last three years, some spectacular images have been produced — including several of an atmospheric storm on Saturn in late 1990.

Quite apart from the primary mirror aberration, the HST currently has a set of solar panel arrays which create 'jitter' in the spacecraft, and interfere with its data taking stability. Provided by the European Space Agency, the current solar array design does not accommodate the thermal expansion and contraction caused when the HST moves in and out of daylight, during its 90-minute orbits of the Earth.

Because of the aberration in the HST's primary mirror, the Wide Field/Planetary Camera on Hubble will be replaced by the second generation Wide Field/Planetary Camera II (WF/PCII), which was modified to include corrective optics in its relay optics assembly. The COSTAR components will be used to introduce corrective optics into the optical paths of the other scientific instruments already onboard HST — the Goddard High Resolution Spectrograph (GHRS), the European Space Agency's Faint Object Camera (FOC) and the Faint Object Spectrograph (FOS) — by integrating them into the spacecraft in place of the High Speed Photometer, which will be returned to Earth.

Failures have also been experienced in the DF224 control computer memory, the GHRS, the magnetic sensing system and gyroscope assemblies, since the Hubble's deployment. These have caused additional activities to be added to the servicing mission.

So the main agenda of the Hubble Space Telescope Servicing Mission includes replacement of the solar arrays, installation of the COSTAR system, installation of the Wide Field/Planetary Camera II, upgrading of the flight computer, replacement of the gyroscope system, repair of the Goddard High Resolution Spectrograph and replacement of the magnetic sensing system.

The solar arrays, which provide the Hubble's electrical power, are two rectangular wings of retractable solar cell blankets which are fixed between a two-stem frame, as a dual-wing system in an 'H' configuration. Each wing measures 12 metres by 2.8 metres and weighs 160 kilograms. The wings have three main mechanisms for powered deployment and retraction, with a lifespan of five years. The system contains approximately 50,000 solar cells and has been delivering a power output in excess of 4.5 kilowatts, after two years in orbit.



Mission specialist Kathy Thornton, suited up in preparation for a training session in the weightless environment training facility at the Johnson Space Centre.

'Hubble's glasses'

The sole purpose of the COSTAR optical assembly is to correct the flaw in the primary mirror, and it can be likened to fitting Hubble with 'a pair of glasses'. A team from the Goddard Space Flight Centre in Greenbelt, Maryland and Ball Aerospace in Denver, Colorado developed the COSTAR elements and assembly in 28 months.

The complete COSTAR assembly measures 190.3 by 76.56 by 76.56 centimetres and weighs 296 kilograms. The astronauts will be sliding COSTAR into the HST in a device similar to a filing cabinet drawer. Three standard but different Hubble attachment devices will be engaged to hold the unit into the spacecraft. The drawer will seem relatively empty, but inside the most important of 5300 parts are crammed into the deployable optical bench, a telescoping boom anchored to a fixed optical bench and snuggled into the corner of the storage unit.

There are twelve DC motors inside the deployable bench, with some 600 wires coming out the back. The complete COSTAR assembly is approximately the size of a telephone box, but each COSTAR element is only the size of a 50 cent piece.

After the astronauts install the COSTAR assembly and verify the electrical connections, ground controllers will actuate the deployable bench to extend it into a cavity in front of the three scientific instruments on Hubble's main optical axis — the Goddard High Resolution Spectrograph, the Faint Object Camera and the Faint Object Spectrograph. Seven of the COSTAR mirrors are on four small arms which swing out near the end of the boom. They will then be moved into place, blocking the current light paths and setting up new corrected paths. Once all arms are verified by telemetry to be in place, installation will be completed.

The new Wide Field/Planetary Camera II comprises four camera systems — three wide-field cameras and one planetary camera. The three wide-field cameras provide the greatest sensitivity for the detection of distant objects. The cameras have an aperture ratio of f/12.9, a field of view of 2.67 arc minutes and a resolution of 0.1 arc-seconds per picture element.

The planetary camera facilitates high resolution studies of individual objects which include planets, stellar objects and galaxies. This camera has an aperture ratio of f/28.3, a field of view of 1.15 arc minutes and a resolution of 0.043 arc-seconds. This would allow the camera to resolve an object the size of a cricket ball from a distance of 440 kilometres.

When light comes to a focus within the cameras, it is transformed into electrical signals by charged-coupled devices (CCDs). All four WF/PC II camera systems are equipped with greatly improved CCD silicon chips, each of which contains 800 by 800 pixels (640,000 per chip). Trans-

mitted back to Earth and recombined as a mosaic, the images produced by the CCDs are 1600 by 1600 pixels — or more than 2.5 million picture elements per image.

The WF/PC II weighs 280 kilograms and consumes between 85 and 156 watts of electrical power. A system comprising a radiator, heat pipes and thermoelectric coolers keeps the CCDs at constant temperatures, between -22° and -90°C.

The DF-224 is the Hubble Space Telescope's flight systems computer. One of the computer's six memory units has failed, and another has partially failed. The HST requires only three memory units to function fully, so the failures have not affected its operations. However, to restore the memory redundancy and to augment the telescope's memory capacity, a coprocessor will be integrated with the flight systems computer — which will then increase both the flight computer's memory and speed up scientific operations.

Three gyroscopes are required to point and track the HST, with three more on board to act as a backup system. The first of Hubble's gyroscopes failed in December 1990, the second one failed six months later and the third one failed in November 1992. Whilst these failures have not affected the HST's performance, with all backups used there is no redundancy currently available. Replacing the failed hardware will therefore increase system reliability.

If the STS 61 astronauts have sufficient time, they will be replacing at least two sensor rate units, each of which houses a pair of gyroscopes, and one or more of their associated electronics boxes.

The Goddard High Resolution Spectrometer has two independent detector systems. Because the low voltage power supply for the detector on one side has functioned erratically, this detector is no longer used. Since that irregularity, all of the GHRSU science operations have been conducted using the remaining 'side two' detector. The GHRS 'repair kit' consists of a cross-strap relay box which will allow a commandable patch around the irregular power supply, in the event that the side one power supply problem re-occurs. This should again permit the use of the side one detector.

The HST uses magnetometers, which measure the Earth's magnetic field, to help with the spacecraft's attitude control. Some magnetometer channels are experiencing intermittent problems and as a result of those, a new magnetometer system is planned for installation.



Crew members are shown using Virtual Reality, which assists in refining positioning patterns for Space Shuttle Endeavour's robot arm. These Virtual Reality sessions are being used for the first time for Shuttle missions and are expected to enhance other, proven crew training techniques. Astronaut Kenneth D. Bowersox takes his turn manoeuvring the robot arm while mission specialist Jeffrey A. Hoffman, wearing the Virtual Reality helmet, follows his own progress on the end of the robot arm.

Extensive training

Astronaut training for the STS 61 Hubble servicing mission began in March 1992 at the Johnson Space Centre in Houston, Texas. Commanding the crew is Dick Covey, with pilot Ken ('Sox') Bowersox. The payload commander is Story Musgrave, with Mission Specialists Tom Akers, Jeff Hoffman, European Space Agency astronaut Claude Nicollier and Kathy Thornton.

The STS 61 crew are all highly experienced space shuttle veterans, who have made at least one space shuttle flight each. Covey and Hoffman will be making their fourth shuttle flight, while Story Musgrave will be making his fifth.

Because of the complex tasks involved with the HST servicing, four of the STS 61 crew have been divided into two teams to make the EVA's needed. Musgrave and Hoffman make up one team, with Thornton and Akers the other team. All of these astronauts have made spacewalks previously.

The training for the STS 61 crew has been more extensive and varied than for any other previous space shuttle flight. The four EVA astronauts have been trained for all servicing tasks and astronaut Greg Harbaugh has been named as a backup in case one of the STS 61 crew cannot make the flight. Among the training facilities being used for the STS 61 flight are the Weightless Environment Training Facility (WETF), which is an eight-metre deep swimming pool. This provides an environment that somewhat resembles the weightlessness that the astronauts will experience on their flight. To assist the astronauts in the testing of equipment, three space- walks took place on shuttle flights STS 54 (see *EA* June '93), STS 57 and STS 51 earlier this year.

In a first for the space shuttle program, 'virtual reality' is being used for the STS 61 training sessions. VR allows each of the astronauts to wear a helmet and specially designed gloves, to view computer displays that simulate their movements around the HST in the shuttle's payload bay. If this is successful, the VR techniques will be adopted for all future shuttle flights.

Busy timetable

At the time of writing, the launch of STS 61 is scheduled for early December. If all proceeds well with the preparations, space shuttle *Endeavour* will be launched from the Kennedy Space Centre in Florida at 2.00am (local time) on December 2. After the *Endeavour* successfully reaches

RIP Mars Observer?

On 25 September 1992, the Mars Observer spacecraft was launched from the Kennedy Space Centre in Florida to begin its 11-month journey to the red planet.

After a largely uneventful journey of 725 million kilometres, it was scheduled to be inserted into Martian orbit at 4:42pm (Californian time) on 24 August 1993. However three days earlier, ground controllers at the Jet Propulsion Laboratory in Pasadena, California lost communications with the spacecraft, and despite daily attempts to contact it, nothing has been heard since then.

Contact with the spacecraft was lost after its transmitter was turned off as a precaution when the thruster fuel tanks were being pressurised. Mars Observer was supposed to come back on air some 15 minutes later, but did not. There are several scenarios to explain what happened, and they include the failure of the transistors inside the spacecraft's computer clock. If this actually happened, further contact would not be possible.

Another scenario is that the pressurised fuel tanks exploded, destroying the spacecraft. This has been seen as unlikely, because the Mars Observer was built with a backup fuel tank system.

The Mars Observer's flight computers were built with a program to contact Earth, if contact had not been made for five days. Again, signals were sent to the spacecraft and it did not respond.

To investigate the loss of Mars Observer, NASA head Dan Goldin has appointed Dr Tim Coffey of the Naval Research Laboratory to head a review panel. The panel's report is expected to be made public in early December.

With the problems that NASA is suffering with Space Station Freedom, the Hubble Space Telescope and the Galileo spacecraft, the loss of Mars Observer could have not come at a worse time.

space, it will be inserted into a 682-kilometre high orbit. For the next two days of the flight, *Endeavour* will perform several rendezvous burns as it attempts to catch up with the HST. The crew during those two days will be checking out the orbiter's Remote Manipulator System arm, their own spacesuits and other flight systems in preparation for the spacewalks that will be taking place.

On flight day three, once the shuttle has made its rendezvous with the Space Telescope, Claude Nicollier using the RMS arm will 'grapple' the HST, capture it and place it into a Flight Support System in the payload bay — where it will remain for the next five days. On the following day, the first of the spacewalks will be taking place when astronauts Musgrave and Hoffman will be replacing the gyroscopes and preparing for the following day's solar array replacement.

The next day, astronauts Akers and Thornton will be shearing off the solar arrays currently on the Hubble and replacing them with the new set. On flight day six, Musgrave and Hoffman will be replacing the original Wide-Field/Planetary Camera with the new one. They will also install the new Magnetic Sensing System. On the following day, the most important spacewalk of the flight will see Akers and Thornton installing the COSTAR system and replacing the flight systems computer.

Hopefully the last spacewalk will take place on flight day eight, when Musgrave and Hoffman replace two more gyro units and install the Goddard High Resolution Spectrometer repair kit. On that same day, Dick Covey may perform burns with the shuttle to raise its altitude, so that the HST can be installed into a higher orbit.

On flight day nine, the Hubble Space Telescope will be released back into orbit, where it will begin five months of systems testing with its new equipment. Once this testing is completed, the HST should be 'as good as new' — or hopefully somewhat better. It will then play 'catchup', and start to perform the science that has been waiting for four years.

For the STS 61 crew, day 10 will see them having a rest day. The following day, after the traditional in-flight press conference, they will be making preparations for their return to the Kennedy Space Centre — where the *Endeavour* should be making a night time landing on 13 December at 1.00am (local time).

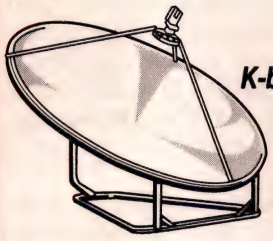
In case there are problems with the Hubble repair, the flight can be extended for a duration of up to 16 days. If required, one or two additional spacewalks can be made — although both NASA and the crew are hoping that these won't be needed.

So the waiting is almost over for the Hubble Space Telescope and the STS 61 crew — let the fun begin!

In closing, the author wishes to thank Debbie Dodds of the Johnson Space Centre, Jim Elliott of the Goddard Space Flight Centre and Kay Grinter, of the Kennedy Space Centre, for their assistance in preparing this article. The photographs are all by courtesy of NASA and Ball Aerospace. ❖

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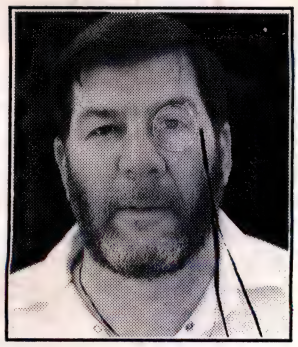
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READER INFO NO. 7

Moffat's Madhouse...

by TOM MOFFAT



What SHOULD be broadcast?

International broadcasting has always been involved with the dispersal of 'truth', as seen by the broadcaster. Truth usually represents a country's political stance, or it may be religious 'truth'. Megawatt transmitters are established to spread the traditional Christian message, as is done by the giant HCJB complex in Quito, Ecuador.

But other stations are operated somewhat differently, as evidenced by the story below. Should these stations be banned, or are they simply exercising their freedom of speech?

Late one afternoon, while I was tuning around the lower shortwave bands I found a weak, warbling signal on 5935kHz. It was a fellow with a real down-home Texas accent, doing what sounded like a stand-up comedy routine. He would spin part of a story in his 'Good Old Boy' style, and this would be followed by riotous laughter from his studio audience.

The signal was pretty marginal; I could tell what was taking place but I just couldn't make out the fellow's jokes. Anyhow, it was obvious everyone was havin' damn good fun.

An hour or so later I checked the 5935 frequency again, and this time the signal was much better. The comedian was gone and in his place the station was playing jazz records featuring old Benny Goodman stuff and more modern Dixieland recordings. It was pleasant enough, and I settled down to listen for awhile.

Then the music faded, and a very precise voice came over the top: "If you'd like to phone us, and you live in the USA, the number is 1-800-338-3030. If you live in the Caribbean, or Mexico, or India, or Russia, or Canada, or anywhere else in the world, then call us on 818-240-8151 and reverse the charges."

The music then faded up again. A minute or so later the music went under, and the announcement was repeated. This process continued, every minute or so, *ad infinitum*.

Now, Madhouse readers, those phone numbers are quite legitimate. The '800' number is the same as a '008' number in Australia, toll free. And the other one will take reverse-charge calls from anywhere in the world. But don't jump up and ring just yet, until you've read the rest of this.

Why would you want to ring the numbers anyhow? Well, that's exactly what I was asking myself, after 15 or 20 minutes of listening to that station. Over and over I was invited to ring, free of charge, but nobody had told me what for.

Ah, what the hell! It wasn't going to cost anything, so I took the phone off the hook and started to dial the international operator to place a reverse-charge call. When they answered, I would simply inquire why they were asking the whole world to phone them.

Wait a minute...

But then I got cold feet. Something wasn't right. As the old saying goes, there ain't no such thing as a free phone call. So I hung up the phone and sat back and listened some more, hoping the mystery would reveal itself.

The music continued, now moving into some good blues with Charlie Musselwhite playing the mouth organ. All the time the recorded message kept repeating, every minute, asking listeners to make that phone call. Why?

Then the music stopped, and another voice came on: "A hundred and ten! We've made a hundred and ten! And I want YOU to find out about the Secret Seven! C'mon! Make that phone call now!" The voice belonged to the stand-up comedian featured earlier.

The music and recorded messages started again. After a few minutes they paused for another recorded message:

"If you would like to write to Dr Scott, the address is PO Box 1, Los Angeles California 90053." Then the music resumed, overlaid with the phone call message.

Suddenly the recording was chopped in mid-phone number, and Dr Scott's gleeful voice came on: "Two-twenty! We've got two-twenty! Secret Seven! Secret Seven!"

And then his voice sort of hunkered-down: "Now Ah'm not gonna tell you what Secret Seven is, you gotta find out for yourself. Phone me now!" and then the recording with the phone numbers was played yet again.

What WAS this??? I was starting to get frustrated, by now wasting a whole hour listening to music and recorded messages and occasional cryptic bellows from this Dr Scott.

It was just coming up to 6:00pm; the station had to identify itself, so I lay in wait. And as the magic moment passed, all we got was another announcement saying "You are listening to a broadcast by Dr. Scott, which is already in progress". And that's all there was.

Well PHOOEY on him. I headed out to throw some steaks on the barbecue. And just as I went through the door, Dr Scott broke in and called after me: "Ah'm gonna tell ya what Secret Seven is now."

Well, so much for the steaks. I wheeled around, raced back, flopped into my chair and turned up the volume. And Dr Scott began, "Ah'm gonna tell you a riddle now, you've heard it before..." (I wanted answers, not riddles) "about these two men who had a lot of money and they decided to divide it up into sevenths, and one got three sevenths and the other got four sevenths, and when they added it up again they got eight sevenths, which was more than they started with, and that was a good way to increase their wealth..."

Huh? That one had me beat. But no worry, because Dr Scott was finally getting to the point: "Now what Ah want you to do is call us on those phone numbers and divide up your donation so that you pay three-sevenths by July and the rest before Christmas. It's easy then, and all it takes is ten thousand dollars from every one of you..."

TEN THOUSAND DOLLARS? If I ring that phone number, he wants TEN

THOUSAND DOLLARS? Well, yes, that's exactly what he wants.

But what if I had just rung out of curiosity? Well, when you make a reverse charge call, the first thing you must give is your own number. And once Dr Scott's organisation had my phone number, would I ever find peace again, even way down here in Tasmania?

What exactly would I be getting for my ten thousand dollars?

"You are giving because of the teaching. Ah am asking you to stretch your faith muscles and donate $10,000 each, three-sevenths by July and the balance by Christmas."

Later he changed the tune somewhat: "Why not send $10,000 now, and another $10,000 before Christmas?"

Well, I didn't quite feel like sending Dr Scott $10,000, or even $20,000. That's all right, he said. "Don't send any money unless I have taught you. It is between you and GOD whether you have got value from my teachings."

NOW I get it. If I have been listening to Dr Scott's fascinating broadcasts, but decline to make a donation, then God is going to throw a lightning bolt down from Heaven and split my brain apart.

Where will all this money be used? Throughout the broadcast, certain assets were mentioned. Among them were two clear-channel AM transmitters on 690 and 1610kHz.

In the USA, 'clear-channel' means you've got the frequency to yourself nationwide, and you can run 50,000 watts. Should you relocate your transmitter to Mexico, make that half-a-million watts. You can be heard clear across the land. That's how Wolf-Man Jack became famous.

Should you live in the Los Angeles area, you can watch Dr Scott on his very own UHF-TV channel. And in the Dallas/Fort Worth area of Texas, where Dr Scott appears to be based, you can watch him on UHF Channel 55 with a good strong signal — all three-and-a-half MEGAWATTS of it. And don't forget the shortwave transmitters — 5935kHz is only one of the station's frequencies; they mentioned another on 21,845kHz. They'd need a bit of power there, because they are head-to-head with Radio Moscow.

"Three hundred and ten! Three hundred and ten! We've made three million, but now let's go for five million!"

Dr Scott was beside himself with his success, and so he should be. The numbers he'd been yelling out were the count of his phone calls, each with a 10 thousand dollar donation. During the couple of hours or so I'd been listening, the operation had raked in more than three million dollars.

Now the format changed again, back to the stand-up comedy. But this time I could hear it correctly, and it wasn't comedy at all. Dr Scott was 'teaching'. This is what we were paying for. But why were the people laughing? I don't know. I really don't know.

Well, that was enough for me, and I shut off the radio. But a couple of hours later I got curious again and decided to have another little listen on 5935. They were still going at it, playing music interrupted every minute of so by the same recording asking listeners to phone in. But this time it was in Spanish.

No habla Espanol!

I gave it another 20 minutes, but there was no sign of Dr Scott himself. I suspect he 'no habla Espanol', so he's just letting his great automated vacuum cleaner suck in the money from South America, totally unattended.

Now how many people in Latin America could afford to cough up $10,000 to a radio preacher? But people there are deeply religious, and there may be some there who feel their $10,000 may buy them a place in Heaven. Let us hope THEIR God tells them not to waste their money.

Should Dr Scott's broadcasts be banned? It's a hard question, because to do so would be to violate his freedom of speech.

Now permit me to introduce you to another fellow in the USA who is not on shortwave — yet. But considering how he's saturated the states with his programs, he's just *got* to expand internationally, sooner or later. And talk about stirring the possum!

This gentleman's name is Rush Limbaugh. He runs a talkback program on AM radio that appears to originate in New York and is distributed all over the country on network.

Talkback is achieved via a national 800 toll-free number. Rush Limbaugh expounds HIS beliefs, and then lets his listeners comment on them. But callers are carefully screened, and those who don't agree with Rush are not allowed through. He freely admits this on air; those are just the rules. *His* rules.

And as for his beliefs... I was in the USA at the time the US was sending troops into Somalia, and I happened to stumble across Limbaugh's program on the car radio.

Part of the troops' mission was to put a stop to groups within Somalia that were hijacking incoming aid and then selling it to those who needed it, when in fact the aid was supposed to be free. Limbaugh's opinion was that the people hijacking the aid were just exercising their right of free enterprise.

The only real Australian news I heard during the whole American trip was that the Australian government had decided to allow homosexuals into the military. This was breathlessly announced by Rush Limbaugh, as an intro to a 'gay-bashing' session that ran a good two hours.

In New Mexico where I was staying, Limbaugh's national morning program was followed by a local afternoon talkback with the name of 'Back-Rush' or something similar. This was for all the people who knew they wouldn't be allowed on Limbaugh's program, so they vented their anger at him on this alternative program. Talk about a hornet's nest — but neither show was ever boring!

I suspect that someone like Rush Limbaugh would never get on the air in Australia, because pressure groups or governments could easily prevent it. And the balancing 'Back-Rush' program would be impossible because of defamation laws.

Limbaugh might be an evil person in most people's eyes, but at least he gets a chance to be heard. Those who oppose him also get their say. It seems that these things are possible only because the American Constitution has a water-tight guarantee of freedom of speech.

In Australia we see a writer banned from the country because he holds unpopular views about the holocaust. We hear of laws making it a crime to make a remark that may be construed as racist. We hear an ABC broadcaster named Terry Lane bemoan the fact that his colleagues constantly pound on him with a feminist, politically-correct sledgehammer. He's still on the air, but I wouldn't be the least surprised to see him get the boot unless he agrees to undergo an appropriate 're-education'.

A recent Terry Lane interview was with a fellow from the 'Voltaire Society', which promotes the concept of free speech within Australia. This comes from Voltaire's idea that 'I disagree with what you say, but I respect your right to say it'.

Don't forget that international broadcasting came about in the first place so that alternative ideas and philosophies could be tossed over the borders of countries that forbade free speech. Should the Voltaire Society be unsuccessful, there's always the good old shortwave set as a source of alternative thinking. You may even get to hear Rush Limbaugh! ❖

Project to preserve Middle Head Radio Station

A new club for radio amateurs has been started in central Sydney, with an inaugural project designed to commemorate the first radio patent of Marconi in 1896. As the author explains, the project involves creation of a national amateur radio communications centre and museum, on a site of historical significance.

by PETER R. JENSEN, VK2AQJ

Just about everyone in New South Wales has heard the promotional slogan of the Municipality of Manly: 'Seven miles from Sydney and a thousand miles from care'. A fine trip it is too, whether for tourist or regular commuter, going out to Manly from Circular Quay on the ferry.

If you make that journey sometime, you will pass one of the State's perhaps unintended, but nevertheless best kept, secrets. As you sail along the channel to Manly, you will see right at the end of Middle Head — if you look hard — an array of antenna masts and a 30m high freestanding tower. These are the remains of a military radio station, which appears to have been established either just before, or at the start of the Second World War.

In more recent times, the station was operated by the Department of Communications. No doubt some of *EA*'s readers will even have worked there. However in 1985 the whole area, including the radio station, was handed over to the State of New South Wales. Since that time the station has been entirely unused — although fortunately, the only signs of this abandonment are the collapse of a couple of the dipoles and their feeder wires.

Realising that this was an extremely valuable asset, particularly for the radio amateur community — located as it is in the very heart of Sydney — some of us have established a new radio amateur group to attempt to preserve what is there. The new group, known as the Sydney Progressive Amateur Radio Club or 'SPARC', was formed in recent times with the specific aim of rescuing the valuable antenna systems at Middle Head and putting them back into use. The Club has made submissions to the State Government and is actively pursuing the idea of using the Middle Head establishment for what we believe is an important and appropriate purpose.



The station as it exists at present on Middle Head. The mast visible is one of many nearby, along with a 30 metre high free-standing tower.

Comms centre, museum

The remoteness of Australia has had the most profound impact upon the character of Australians, their language and their relations with other national groups. For this reason the conquest of the 'tyranny of distance' has represented a highly significant part of the development of modern Australia and has played a more important role than has been the case with most other countries. The notable exception to this generalisation is America, where physical isolation has led to a similar enthusiasm for any technology which could help to break down the barriers of distance. It is perhaps no coincidence that the history of the development of communications technology and its use in Australia has followed a somewhat similar path to that which occurred in America.

At the present time, while various elements of the technology of communications have been included in a number of museums and similar institutions, there has been no attempt to draw together in one place all the relevant components of the total system of international communications which has developed in Australia historically. Those of us involved in establishing SPARC therefore believe it's desirable to create some form of national repository and exhibition of communications technology, in its own right.

Such a facility should be concerned both with the historical and contemporary aspects of communications, and also present the material in an interactive and entertaining fashion. It should be of interest to both young and old, and should also appeal to the tourist, interested in the manner in which Australia has developed its contemporary form.

Given the emergence of Sydney as a city of world significance and as, potentially, the most significant centre of communication and finance in the Southern Hemisphere, it therefore represents an ideal location for such a National Amateur Communications Centre.

And surely this would also be an entirely appropriate way of preserving and using the Middle Head site.

At present, the radio station forms a small part of a much bigger area of relatively flat land at the end of the Middle Head peninsula. Apart from the very substantial system of radio masts and towers, the station has a fine stone house of the Federation era as its centre of operations. In the adjoining open area are located three Federation era houses, whose use by the National Parks and Wildlife Service is unknown.

There is also a substantial area of land into which, later, environmentally sensitive structures could be introduced. These structures would allow other elements of the National Amateur Communication Centre and Museum to be accomodated.

Amateur radio initiative

A major consideration, in establishing a National Amateur Communication Centre and Museum, is to find a group of individuals with sufficient enthusiasm and energy to tackle the immense task of physical construction and associated fund raising. As a group, the radio amateurs of Australia represent a quite substantial body of enthusiasts who are considered likely to lend support to an enterprise, which would allow a significant expansion of their interests in modern telecommunications. Apart from this, it is considered that the collecting of artifacts, which would reflect many of the most important developments in the history of radio, would be supported by this group.

The proposed site at Middle Head represents an exciting and challenging project of restoration and development, and its existing facilities, when restored and made operational, are likely to be of considerable interest to amateur operators.

It is anticipated the Middle Head project would take about three years to establish initially, based on the efforts of radio amateurs. After that initial period, which would be needed to consolidate both the support group and the facilities at the site, it would be possible to induct other interest groups.

At about year four it should be possible to create a 'Site Development and Management' Trust to administer the project, and from about year five the project might be expected to develop a degree of self-induced momentum, of the sort observed in similar developments elsewhere (such as the Zig-Zag Railway at Lithgow).

By about year 10, it should be possible to consider the creation of a structure to accommodate the various different communications groups together, rather than dispersed around the site in the existing buildings, if they are available. Otherwise the existing radio station building would have to accommodate the demand of all participants in the project during the initial period, until a larger structure could be created to house them.

As suggested earlier, the second major stage of the project would involve the creation of a purpose-built structure to accommodate all the participants and to serve as a repository of records and artifacts.

Given the extreme visibility and sensitivity of the Middle Head site, it is probable that some form of wholly or partially subterranean structure would have to be considered. This is in any case entirely appropriate, in the context of the existing underground fortifications in the area.

An invitation

If you are intrigued by the prospect of operating a radio station in the heart of Sydney, or supporting a Museum of Communications, why don't you go out and have a look at the Middle Head facility? It is located at the end of Military Road, beyond the Military encampment and takes a little effort to find.

However, one of the immense advantages of this slightly inaccessible location is that, so far, it has been saved from the attack of vandals and the antenna system is almost entirely complete. It would take very little effort to get the antenna system back into action, and this is what SPARC is endeavouring to do as soon as is feasible.

If you manage to get out to see the radio station at Middle Head and if you find what you see there interesting, you might consider giving your support to SPARC in its rescue efforts. If you are interested in this you could contact me, Peter Jensen VK2AQJ on (02) 960 1486 or alternatively you could ring the Secretary of SPARC, Alan Avery VK2AXA on (02) 969 6721.

We are hoping to hear from you, because it seems probable that only by having a large number of people interested in preserving the Middle Head radio station is there likely to be any positive activity by the State Government.

At the present, meetings of SPARC are being held monthly on Sunday afternoons at 2.30pm, at locations to be advised. You are cordially invited to attend, and you will be made very welcome.

Footnote: Since this material was assembled, advice has been received from New Zealand that an organisation exists which lays claim to the use of the name SPARC. This organisation, which has well-known shortwave correspondent Mr A. Cushen MBE as its Secretary, is known as the South Pacific Area Radio Club. The club is said to be an 'umbrella' organisation catering for the interests of shortwave listeners in the southern regions.

In advice received from Mr Cushen as to the existence of this group, the proposal was made that the Sydney Progressive Amateur Radio Club abandon the use of its club name and the acronym SPARC, in order for the NZ based group to maintain its control of the southern Australasian region. After due deliberation, the members of Sydney's SPARC have regretfully declined to accede to this proposition — believing that there is no real likelihood of confusion or conflict between the two groups.

So perhaps after a period of many years' absence, there may soon be 'sparks' once again flying across the Tasman Sea! ❖

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- *Frequency*
- *Capacitance*
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- *Memory offset*
- *Holster*

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- *0.5% accuracy*
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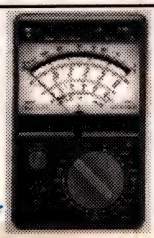
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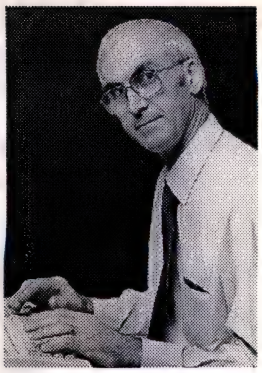
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FORUM

Conducted by Jim Rowe



Saving power by putting our PC's and their monitors to sleep, when they're inactive...

I thought we'd spend some time this month looking closer at the US Government's 'Energy Star' initiative, which I mentioned briefly in last month's leader. It's likely to have ramifications which will reach most of us, in one way or another, and I thought you'd be interested in some more details. There's also a gratifying response to the item in the October column about an Australian firm renting service manuals.

As I mentioned last month in the leader, the US Government and its Environmental Protection Authority (EPA) really seem to have taken the initiative, when it comes to reducing the energy consumption of the world's rapidly growing hordes of personal computers. They've brought in the Energy Star rating system, whereby US Government departments are now only able to buy computer gear which meets a set of specifications for energy saving. And although the scheme is a 'voluntary' one, manufacturers are hurriedly redesigning their gear to meet it — because the US Government market is probably the largest single market segment in the world. So we're all likely to benefit from the initiative in the long run, it seems.

But perhaps you're wondering why this is such a big deal. Is the energy consumed by PC's really that significant? Yes, it's certainly becoming quite a problem — not so much with computers used in homes, but certainly with those in office situations. In case you haven't noticed, they're multiplying like rabbits.

The American EPA started looking at the figures recently, and became rather concerned. In terms of total US energy demand, desktop PC systems were responsible for the fastest-growing load component of all. There are now 35 *million* PC's in the US alone, and already account for 5% of total commercial energy consumption. By 2000, the EPA estimated that this could well rise to 10%, if something wasn't done.

By the way, the problem isn't just the energy used by the computers and their peripherals alone. Since most of the energy consumed in a computer turns into heat, additional energy then has to be consumed in order to cool both the computer gear itself and the offices it's used in. In fact the air conditioning systems in many office buildings are becoming quite overloaded, as they were never designed to cope with so much internal heat dissipation...

Anyway, in response to what the EPA found, President Clinton and his Vice President Al Gore (both keen environmentalists, as well as being enthusiastic about computers) directed them to come up with a policy which would address the issue. And the Energy Star scheme was the outcome. By courtesy of NEC Australia, here's part of what vice president Al Gore said when he unveiled the first equipment to conform to the new rating system:

"The creation of energy-efficient computers for the marketplace is a landmark in the development of environmental technologies. They show how economic development and environmental protection go hand-in-hand. US manufacturers and workers profit from creating the first ever energy-efficient computers in the market, and the environment benefits because increasing energy-efficiency decreases pollution."

"On Earth Day President Clinton signed an executive order directing the Federal Government — the largest computer buyer in the world — to purchase only Energy Star computers and printers. This Administration is putting its money where its mouth is. We're leading by example in developing markets for environmentally friendly technologies."

"Our efforts are expected to save taxpayers about $40 million a year, and consumers as much as $2 billion a year by the year 2000."

I presume his figure of US$40 million per year is for the expected saving in Government power bills, while the US$2 billion figure is for overall savings by US consumers.



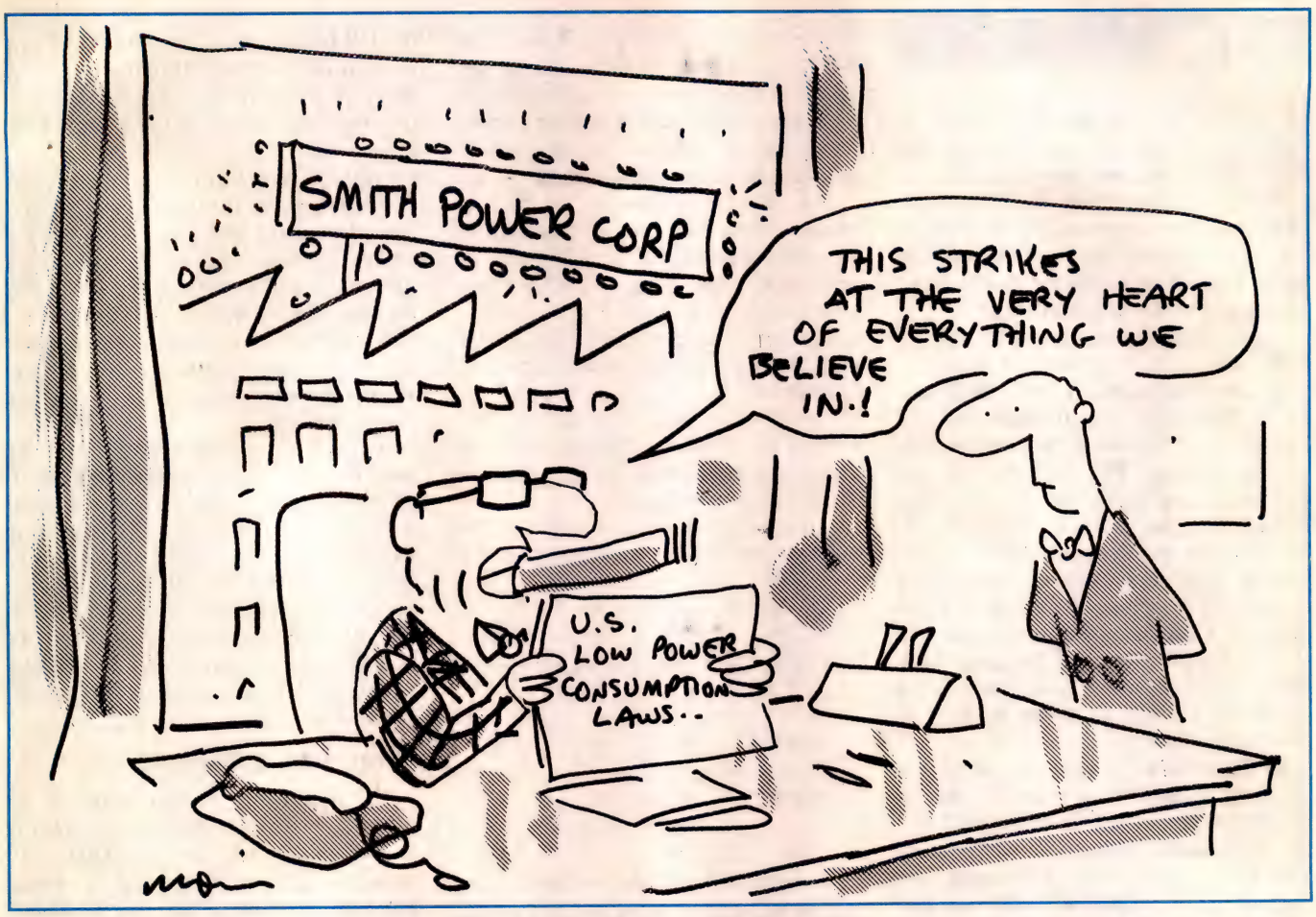
Fig.1: The official Energy Star logo.

Official logo

Now for a little more of the detail. The equipment which conforms to the new Energy Star program will be able to carry the official logo, which I've reproduced here in Fig.1 so you can keep an eye out for it.

The basic requirement of the program is that each piece of equipment — the PC itself, the video monitor, printer and so on — should be able to drop back automatically into a low-power 'sleeping' mode of operation, when it has not seen any activity for a certain time. The specified maximum power level for *each piece* of equipment seems to be 30 watts — but as yet, the precise time delay before the device drops into its standby mode doesn't seem to have been set.

Whether by chance, intuition or advance warning, microprocessor makers like Intel have already developed chips which are capable of switching into this kind of power-saving 'sleep' mode. I suspect they did this initially because of the demand from makers of laptop machines, in order to extend and maximise battery life; but whatever the reason, Intel now has a full range of chips with the 'SL' power management feature — including the current top of the range



Pentium. The SL chips now seem likely to end up in most desktops as well, thanks to the Energy Star initiative.

Of course it's fairly easy for the microprocessor 'brain' in a PC to know when it hasn't been asked to do anything significant for a while, and put itself to sleep until things change. It isn't so straightforward when it comes to video monitors, both because they tend to somewhat 'dumber' devices, and also because it isn't all that easy for a monitor to tell when there's nothing much changing in the video it's displaying.

VESA's signalling

Because of this, the US Video Electronics Standards Association or 'VESA' got together recently and worked out a system whereby the computer and its video graphics controller can 'signal' to the monitor, to *tell* it when to 'sleep' and when to 'wake up'. Known as the Display Power Management Signalling or 'DPMS' system, it controls the levels of the horizontal sync, vertical sync and video signals fed to the monitor, in various combinations. This actually allows the computer to signal the monitor for *two* different levels of 'sleep' — known as 'standby' and 'suspend', respectively — as well as directing it to turn completely off. (How the monitor would be able to turn itself back on again, after turning right off, is not explained.)

The details of the DPMS signalling system are shown overleaf in Fig.2. The 'suspend' state is apparently the one where power consumption drops right down, to below 30W.

VESA apparently chose this sync/video signalling system in order to maintain compatibility with existing monitors and video graphics controllers. So monitors able to respond to the new DPMS signalling can still be used with older computers and video cards which don't send the control signals, and vice-versa, until the system becomes used throughout the industry.

Firms like NEC have already released monitors which incorporate VESA's DPMS system, as we've noted in recent issues. So as soon as video graphics controllers capable of sending out the DPMS signals to the monitors become available, these new monitors will be able to put the system into practice.

The other main peripheral items which use significant power are laser printers, some of which can draw up to 700W or so when printing. Many laser printers draw around 90-100W even when idling, and reducing this figure isn't easy because a major slice is drawn by the heater used to fuse the toner powder onto the paper. Simply turning the heater off in 'sleep' mode isn't really feasible, because the conventional type has a fairly long thermal time-constant and must reach the correct temperature before a page can be printed.

Japanese firm Canon is said to have solved this problem by developing a new fast-warmup fusing heater, using a proprietary technology known as 'surface rapid fusing' or SURF for short. No doubt other laser printer makers are hurrying to achieve the same result, and it may not be long before we can buy lasers which meet the Energy Star specs.

Moving closer to home, you're no doubt wondering at this stage whether there have been any moves to implement an Australian equivalent to the US Energy Star program. It's a good question, as they say — generally when they don't know the answer!

It's probably inevitable that those of us in what the Yanks call the 'rest of world' or ROW market will get the benefits of the US program eventually, simply because the world's equipment makers will adapt their designs to meet the US needs, and will then use the same models for us as well. (Although we might find our-

selves used to dispose of the stocks of 'old' energy-hungry equipment in the short term, if we don't watch it...)

But *is* there any move by Australia to implement an energy-saving program of its own? Surprisingly, something *does* seem to be afoot; but as yet it all seems a bit bogged down in bureaucracy.

Again thanks to the material sent by NEC Australia, I gather that around a year ago (7th December 1992) the Council of Australian Governments met and endorsed the National Greenhouse Response Strategy. This initiative was apparently in recognition of the need for a nationally coordinated approach addressing the problems caused by greenhouse gas emissions, following Australia's signing of the United Nations' Framework Convention on Climate Change. Over 150 countries have signed the framework convention, and it is 'in the process of being ratified' in Australia. I quote:

In the National Greenhouse Response Strategy, a number of specific sectoral strategies are identified, and the third of these is entitled 'Industrial and Commercial Energy Use'. One of the objectives stated is 'to influence industries and businesses to adopt behaviour practices, technology and equipment that minimise their use of energy with greenhouse gas implications, or lead them to switch to energy sources with lower greenhouse gas emissions'.

In achieving this objective, the strategy undertakes to introduce energy efficiency standards, codes and labelling programs for new industrial and commercial equipment:

'Governments will develop and implement new energy labelling programs and energy performance standards for industrial and commercial equipment where it is technically feasible to do so, taking account of the costs and benefits of the proposed standards... The Commonwealth will initiate a review of the adequacy of existing energy performance and energy measurement standards for industrial and commercial equipment'. (National Greenhouse Response Strategy, page 14.)

The Energy Management Conference (EMC) of ANZMEC (Australian and New Zealand Minerals and Energy Council) was commissioned to undertake action which would give effect to this statement. A study of Energy Labelling and Energy Performance Standards for Industrial and Commercial Equipment, for which the Commonwealth through the Department of Primary Industries and Energy is the managing agent, is approaching the task from the perspective that 'there is little experience either in Australia or overseas' with regard to labelling of this nature.

The study is currently in its first phase, during which parameters will be identified and evaluated. The terms or reference for Phase One are summarised as follows:

(i) Identify the nature and extent of existing labelling and performance standards in Australia

(ii) Perform desktop analysis of practices in EC countries, USA, Canada and Japan and assess their transferability to Australian circumstances

(iii) Select factors which will act as criteria in prioritising specific equipment for development or implementation of labelling/standards in Phase Two

(iv) Identify and prioritise equipment which appears to be amenable to labelling and establishment of minimum performance standards

(v) Identify barriers and costs in the labelling process, the principal stakeholders who should be consulted, and the scope of a national labelling and standards framework

Phase One of the study will be completed by 10 January 1994. Proceeding to the second phase will be a matter of consideration for the EMC, in light of the outcome of the first phase.

MONITOR OPERATING MODE	HORIZ. SYNC SIGNAL	VERT. SYNC SIGNAL	VIDEO SIGNAL
ON	YES	YES	YES
STANDBY	NO	YES	NO
SUSPEND	YES	NO	NO
OFF	NO	NO	NO

Fig.2: The way VESA's Display Power Management Signalling (DPMS) system works, manipulating the sync and video signals to control the video monitor's operating mode.

As you can see, it's *some* kind of action, but at the same time it all seems to me a bit evasive — and somehow inventing hurdles where none may exist.

Other people must have had the same impression, I suspect, because NEC Australia's PR firm Markom Marketing tried contacting the Commonwealth Minister for Primary Industries and Energy, for some kind of official statement of Australia's position with regard to the US Energy Star program. Their enquiry produced the following response, from Mr Peter Webb the Assistant Secretary of the Department's Energy Programs Branch:

I refer to your letters of 30 August and 2 September 1993 to the Minister for Primary Industries and Energy, concerning energy efficiency ratings for computers and printers. The Minister has asked that the Department reply to your letters.

You are of course aware that a study has been commissioned on behalf of the Energy Management Task Force of the Australian and New Zealand Minerals and Energy Council on Energy Labelling and Energy Performance Standards. This was one of the response actions called for in the National Greenhouse Response Strategy which, among other things, required Governments to 'develop and implement new energy labelling programs and energy performance standards for industrial and commercial equipment where it is technically feasible to do so...'

'Requires a review...'

The processing of this response requires a review of existing energy performance and energy measurement standards for industrial and commmercial equipment and this is the first undertaking in the current study. The study consultants will also investigate equipment types, identify the broad order of costs and benefits, propose an order of priorities and investigate the features of a consistent, national framework for introducing labelling/standards.

The consultants are also required to assess overseas experience, principally in EC countries, North America and Japan. During the course of this investigation, the nature and impact of the US Environment Protection Authority's (EPA) 'Energy Star' scheme will certainly be considered.

You would also be aware that research and development for computer equipment sold in Australia is primarily influenced by overseas developments, principally standards developed for the North American market.

I understand that major manufacturers of computer equipment sold in Australia have apparently taken account of the EPA initiative, have commenced manufacturing equipment that at least meets 'Energy Star' rating standards and will be introducing this new equipment to the Australian market in the course of the next few months.

There would be little point at this stage of my commenting further on the future for energy labelling and energy perfor-

mance standards regimes in this country until the results of our study are known early next year. I would say, however, that the objectives of the current study are consistent with the views of all Australian Governments on the merits of extending labelling/standards beyond domestic appliances to other areas, for example the buildings sector, where there is economic and technical justification for pursuing this course.

Thank you for drawing attention to the EPA's 'Energy Star' initiative, which I trust will contribute to useful energy efficiency gains in this country once equipment responsive to this standard becomes available on the local market.

In short, it seems that Australia *has* set its bureaucratic wheels in motion, but it may be quite a while before any decisions are made and actions taken. (Funny how long it takes Australia to decide to catch up with other countries in this sort of situation, isn't it? I suspect this effect has something to do with the ratio of a country's politician and public service bureaucrat population, to its GDP...)

Not to worry, though — as Mr Webb seems to be saying, we'll probably get the benefits of the US Energy Star program anyway. Somewhat before we have an Australian energy-saving policy, I suspect!

Service manual hire

Now let's change the subject, back to one we've looked at a few times in recent months: the question of service technicians and other people getting hold of adequate information on equipment, in order to fix it efficiently.

You might recall that in the October column, I passed on some information I spotted in a recent issue of *Tastronix*, a newsletter published by TETIA and TESA in Tasmania, about a firm in Cooma, NSW called High Country Service Data, which is hiring out service manuals. As well as reprinting the story and commending the firm concerned for their initiative, I also suggested that they might consider extending their manual hiring service to cover we technical people who service our own equipment — even though we may not be officially 'in the trade'.

Well, within a couple of days of the October issue being published, I received a phone call and fax from the general manager of High Country Service Data, Mr Stephen Rendell. It seems that Mr Rendell was delighted with the response he'd received already from *EA* readers, and was ringing to say 'thanks' for the mention. Not only that, but he had good news about my suggestion that they extend the manual renting service. But I'll let him tell most of the story, by reprinting his fax:

Reference is made to our telephone conversation of this date regarding Service Data Library Facility.

I thank you for the kind words you have written in your publication, and hasten to advise that we have actually extended the facility to include those individuals who are involved in any aspect of the service industry (including hobbyists!).

Our preferred method of payment is Bankcard/Mastercard/Visa, and we can set up a new facility over the phone in less than five minutes, with phone orders thereafter being processed within 45- 60 seconds on the phone.

We do wherever possible provide copies of the COMPLETE Manufacturer's Service Manual, rather than simply schematics. As a technician myself with more than 25 years' experience, I appreciate the necessity of the complete manual with PCB overlays, part numbers, and so on.

We currently have support from many of the manufacturers, to produce and SELL copies of their manuals also.

So as you can see, Mr Rendell's excellent service is indeed now available to hobbyists as well — not just to service technicians. What more could we ask?

Incidentally, Mr Rendell confirmed that High Country Service Data has no objection to people photocopying circuits, etc., from the manuals they hire — but they do stipulate that staples or other binding must not be removed. Which seems very reasonable, I think you'll agree.

Listing available

Mr Rendell also told me that HCSD can provide a listing of the manuals they currently have available, in either printed form (over 200 pages!) or as a compressed file on a floppy disk. These cost $50 and $10 respectively. But since new manuals are being added all the time, it might be just as easy to ring them and ask about any particular manual.

Manuals currently available for both sale and rental include those for TV's, videos, audio gear and microwave ovens by firms including Akai, Pioneer, Toshiba, Hitachi, General, Sherwood, Aiwa, Casio, HMV-Healing, Kambrook and Goldstar. So if you need to fix your colour TV, VCR, audio gear or microwave oven, but can't justify the cost of buying a complete service manual, it's well worth considering the idea of renting a manual from HCSD. Here again are the address details: Private Bag 3, Cooma NSW 2630, or phone (064) 52 5322; fax (064) 52 5301. Renting a typical manual costs around $5.00 for the minimum period of one month.

By the way, as well as renting and selling service manuals, HCSD also runs a remote-access computer system which — among various other services — has a 'bulletin board' with servicing information including model cross references, manufacturer's modifications and fault listings.

Mr Rendell tells me that both professional service tech's and individuals can gain access to this free and continuously updated on-line service, simply by filling in one of HCSD's Bureau Services Application forms. The data you provide on the form allows HCSD to provide the correct terminal emulation, etc., to suit your computer and comms package.

Thank you!

That's about all we have space for this month, but before I end up I'd like to thank a couple of readers who responded to my request in the September column, for copies of the Jung and Marsh articles on choosing capacitors for audio applications. You may recall that Tean Tan referred to the articles in his response to the letter from Graham Byrnes, who had criticised his claims about the 'high distortion' of polyester capacitors.

Mr Vic Burgess from the CSIRO Division of Applied Physics (National Measurement Laboratory) at West Lindfield in NSW very kindly sent me copies of both articles, and also drew my attention to a relevant item in the fourth edition of Langford-Smith's classic *Radiotron Designer's Handbook* — showing that concern about capacitor behaviour is by no means new. Then, a couple of days later another copy of the second Jung and Marsh article arrived from Mr Mike Hammer from Mordialloc in Victoria, who also sent me a copy of some other relevant material from the UK magazines *Electronics & Wireless World* and *Hi-Fi News & Record Review*, together with some op-amp data from Analog Devices. My thanks to both of these gentlemen, for their generous assistance.

Since Graham Byrnes himself has also responded to Tean Tan's comments in the September issue, I suspect that our topic next month has more or less chosen itself. Still, arguing about audio distortion caused by capacitors makes a change from arguing about audio distortion removed by fancy cables, doesn't it?

I hope you'll join me here next month. Don't forget to bring your low distortion polypropylene capacitors with you! ❖



When I Think Back...

by Neville Williams

FRED PATON: From screwdriver and pliers to purpose-built test equipment

Almost to a man, it seems, old-timers from the Australian radio industry share a sentimental regard for test equipment manufactured under the 'Palec' brandname by the former Paton Electrical Instrument Company of 90 Victoria Street, Ashfield, NSW. But what of its founder? This month, with the co-operation of former Palec employees, we glimpse the poignant life story of the late Frederick Henry Paton.

The level of reader interest in Paton/Palec was evidenced by the response to a panel cut into an article on Slade/Calstan test equipment, in our May 1993 issue. Palec emerged from the replies as the dominant brand of 1930's-style Australian test equipment, presumably because, unlike Charles Slade, Fred Paton did not diversify into the receiver/amplifier market, his resources being directed primarily into electronic instrumentation.

The reaction of industry veterans was typified by a letter from Brian Syme of Indooroopilly, Qld. I quote:

Dear Neville,

'When I Think Back' (page 39, EA May '93) contains an error in tense. Under Paton and Palec your text reads: 'Many of the instruments once treasured by Australian enthusiasts...', etc. Wrong!

After 50 years on the test bench, I still have my Palec MCA multimeter, which I use daily and certainly more than any other instrument. It still works, although it's a bit like Murphy's anecdotal axe, having been fitted with the odd new handle and the occasional new head!

It sits on the shelf, between an auto-ranging digital thing and a 100k ohms/volt machine, but remains the instrument of choice. Your text should read 'still treasured'. With kind regards...

Brian Syme.

Other correspondents were no less keen about venerable Palec valve testers, oscillators and signal generators — partly because of their historical interest, and partly because of their relevance to the restoration of vintage valve receivers.

By contrast, factual information about Fred Paton and the inner workings of his company proved much harder to come by from the usual sources — 'vintage' industry literature and personalities, including yours truly!



Fig.1: From an early 'Wireless Weekly', this pen drawing of Fred Paton gives no hint of the daunting physical handicaps with which he had to contend throughout his business life.

Even though a regular advertiser in this and other magazines, my own contact with Fred Paton and/or his staff was limited to the occasional telephone call. The same was true for other members of the *EA* staff — or the industry at large — whom I contacted. They *knew* of Fred, but they had never met him. Helpfully, Alan Whitford of Balgowlah, NSW, rang to warn that Fred should not be confused with his contemporary Jack Paton, who had been Chief Engineer and Production Manager for Norman Gilmour's Lekmek Radio. Alan himself had once worked at Lekmek as an assembler/wirer.

However, the panel in the May issue also prompted a response from a number of readers who *had* known Fred Paton, having once worked in his Ashfield factory. While not necessarily able to offer much in the way of direct information, they did come up with the names of employees who 'would have known Fred better then me'.

Personal pattern

Being a small company, expecially in its early stages, such information followed a distinctly personal pattern.

Mr Bill Field, a technician now living in Runaway Bay, Queensland, mentioned 'Bert' Meyer as an associate during the period 1940 - 48, mainly to do with the machine and plating shop.

At age 79, Herbert Meyer described his one-time role at the Ashfield factory as a handyman/fitter. He said that he had often been seconded to do special jobs for the boss who, for reasons that will become apparent, needed a lot of support.

Bert Meyer, in turn, nominated Noel Rose as a man who had been a co-director and confidant of Fred Paton over many years. He went one better by tracking Noel, a couple of years his



Fig.2: In the original 'machine shop, circa 1935. The woman in the right foreground is winding meter coils.

senior, to retirement at Tea Gardens on the NSW North Coast. Contacted by phone, Noel Rose said that the story he could tell would be too long to relate in a letter or over trunk telephone. If only we could get together...

I finally persuaded Noel to borrow a cassette recorder and commit his story to a tape cassette, which could be mailed in a PostPak for a dollar or so. Noel was dubious at first, but excelled himself in the actual exercise. He thought through the events leading up to his first meeting with Fred Paton, put them on tape, then switched off while he planned the next segment, and so on. In this way, the story was covered in a series of 'takes', involving much less stress than a single prolonged session. At the listening end, the contents were likewise easier to cope with than a long, rambling tale.

Thanks, Noel, for setting a pattern which I am encouraging other would-be raconteurs to emulate.

Where it all began

By way of introduction, Noel Rose said that he, personally, had completed a tech course in the late 1920's, with the firm intention of being self-employed — his own boss! In the Great Depression, when the going got really tough, he had supported himself by resorting to a mix of electrical contract work, radio servicing, and stints as an on-call chauffeur.

A notable businessman who used his services was Sir Frederick Stewart, operator of a private busline which ran between Parramatta and Central Sydney around 1930. He will be remembered by some as a wireless enthusiast, who donated the aerial system at Dundas which enabled radio station 2CH to begin transmission for the NSW Council of Churches. (See also the photo on page 23 of the *EA* publication *The Dawn of Australia's Radio Broadcasting*, by Philip Geeves).

Stewart's pet private car, which Noel Rose had to drive, was a Stanley Steamer!

Noel recalls that, one day in the early 1930's, Sir Frederick mentioned a business acquaintance who was seeking a personal assistant who could also act as his chauffeur. His name was Fred Paton, and he lived in Victoria Street, Ashfield, in Sydney's inner west.

Noel called on him as a matter of courtesy, to discover a seriously disabled returned soldier, who needed an unusual level of personal assistance. Working from his home, he had set up a small company in 1929 to market radio receivers, but was losing the man he had hired to install and maintain them. Noel felt sorry for him, but launched into his spiel about not wanting to work for a 'boss'. Fred Paton saw that as no problem — suggesting that, with his background, Noel could fill the role of a business partner and co-director, servicing radio receivers and doing other jobs that Fred could not handle himself.

On that basis, Noel finally joined Fred Paton in 1932 as a nominal co-director, chauffeur, electrical and radio expert, valet and nursing assistant. It was a demanding assignment, but Noel says that they had a good working relationship; there was no 'boss' and no orders!

The young Fred Paton

As a youth, it seems, Fred Paton had been brought up near Bowral, in the Southern Highlands of NSW. On leaving school he joined the Maritime Wireless Co of Randwick (founded by Father Shaw), where he served a four-year apprenticeship.

At the outbreak of war in 1914, Fred enlisted as a field engineer and saw service at Gallipoli, being subsequently transferred to France. There, he suffered a shrapnel wound in the left shoulder which damaged his spinal cord — crippling his legs to the point where he had to rely on crutches.

Invalided back to Australia in 1917, he dreamed up a motor-cycle/sidecar combination, with the handle-bars and controls extended above the sidecar. Seated in the sidecar, he could manage



Fig.3: Assembling meter movements around 1935, in the so-called 'Roundhouse' — virtually a converted garden shed. Fred Paton insisted that every meter be subjected to an eight hour 'to-and-fro' exercise before despatch.

the outfit reasonably well on country roads; but it proved too cumbersome when the family re-located to suburban Ashfield. Fred had little choice but to rely on a car and driver.

When his condition began to deteriorate, doctors decided that a spinal operation might help. But it was not to be. The operation paralysed him completely from the waist down, robbing him of what little control he had of his legs and adversely affecting his right arm, as well. As a result, he could move around only in a wheelchair and then with great difficulty and/or the help of an attendant.

When Noel joined Fred Paton in 1932, he discovered that his predecessor's radio service 'equipment' had comprised a screwdriver and a pair of pliers. Convinced that he could do a better job with the aid of a meter, Noel ordered a Weston movement from the USA and set about assembling a basic multimeter.

When Charlie Slade happened to call by a few days later, he was quite taken with the instrument, and said he could use one himself. Indeed, he went further and suggested that, with a professionally finished panel and case, it should find a ready market.

Short-lived 'partnership'

It seemed like a good idea to Fred and Noel and, in due course, Charlie Slade joined the group, responsible for sales promotion. That, according to Noel, was the real genesis of the Slade/Paton test equipment initiative and, as he recalls, relationships were harmonious for about 18 months. At that point in time, Charlie Slade headed off overseas and, for reasons that Noel never fully understood, Fred Paton in collaboration with his solicitors decided to terminate the arrangement. I quote:

"So when poor old Charlie came back, he was out of business!"

Having heard various rumours about a one-time partnership between Messrs Paton and Slade, the above account seems more likely than most to approximate the truth, with the two principals becoming eventual competitors rather than collaborators in the instrument business.

As production of the original multimeter got under way, Noel Rose says that he spent long hours at night in the machine shop making up the special switches they required. These along with other key aspects were patented,



Fig.4: A Paton valve and circuit tester restored and still used by Dennis Seymour of Papatoetoe, Auckland, NZ.

and ended up returning to the company and/or those responsible modest but useful royalties.

In 1938, Fred Paton decided to register the business as a 'Pty Ltd' enterprise, naming himself as Managing Director, with his wife Charlotta as a further director and secretary.

Recalling notable personalities in those early days, Noel mentioned in particular:

- Eric Packer, a man with a severe hearing disability but a wizard with textbooks and slide rule. As Chief Engineer, he rationalised coil turns, spring torque and magnet gauss for 1mA to 50uA meters to a few deft to-and-fro movements of his 'slip- stick'!
- Arthur Mutton, an enterprising uni student, who came up with a highly successful range of CRO's with 5cm to 17cm diameter screens.

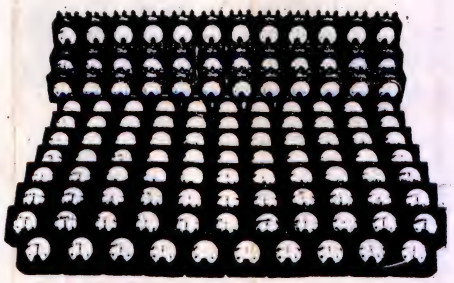


Fig. 5: As pictured in 'Radio & Electrical Retailer' for July 10, 1941, 123 special centre-zero meters destined for the Federal Government. Described as I-Q (Intensity-Quantity) meters, they had three terminals and were intended to measure voltage and current.

- Gordon Weeks, now retired in Lidcombe, NSW, who was in charge of large meters and also apprentice training supervisor.
- Joe Dunne, a 19-year old 'lad' who was committed enough to meter movements to make a significant contribution to production at Paton, before pursuing his own separate career in the industry.

The Paton factory

In those early days, the Paton factory was anything but pretentious. Bill Field, mentioned earlier, says that when he joined the Company in December 1940, "the factory was still very small, of fibro and timber construction with office and instrument assembly area adjacent to each other... It was fronted by a machine shop housing a South Bend lathe, drilling machines and a good quality engraver." (Fig.2.)

The complex "was situated close to Fred Paton's house and was connected to it by ramps, to make it easier for him to move from one place to the other". Bill says that he remembers Fred principally as a businessman, who relied on others for technical expertise.

Even in 1940, he says, the Company "was still very much in its infancy" and largely limited to the production of meter movements (Fig.3), multimeters and a unit known as the 'VCT' or valve and circuit tester (Fig. 4).

In delving back into the past, Bill acknowledges the prompting of Ray Cooper, a former workmate who joined the company in 1938.

Meter movements were housed in 2", 3" and 5" round cases, square cases and the popular fan shape, all moulded on site. Most were of the moving coil type, but a range of moving iron types was also produced, along with DC and AC ammeters, and even a few electrostatic voltmeters.

The multimeters were identified as the MCD (DC only) and MCA (AC volts as well), both using a 1mA (1000 ohms/volt) movement. The companion MXA/MXD multimeters boasted a sensitivity of 20,000 ohms/volt, the MXD being the DC-only version.

Concerning the VCT, Bill Field recalls that it could indicate the emission level of a useful range of radio valves, as well as testing for inter-electrode shorts. Other features included the ability to test electrolytic capacitors, both low and high voltage types and to measure potentials to 250V AC and 1000V DC.

Looking back over the years, Bill says

that people who come readily to his mind from the 1940 era include:

- Mort Anderson, who helped Fred Paton manage the business and accompanied him on visits to Fred's bayside retreat for boating and fishing excursions.
- Noel Rose and Kevin Murphy, responsible for meter production.
- Bert Meyer, in charge of the machine and plating shops.
- Jack Knight, in charge of stores.
- Ernie Waters (Eng Dip), responsible for instrument production, along with three techs including Bill Field himself.

The war years

Faced with escalating war work, a new cream rendered-concrete factory was constructed in front of the original complex, carrying it forward to the Victoria Street alignment.

1941 saw the departure of some members of the original staff, their replacement with new recruits and a sharp increase in the level of production. They now had the Aeronautical Inspection Directorate looking over their collective shoulders, as also Army Ordinance in their quest for adequately tropic-proofed meters, instruments and 'sundry other bits of equipment'.

Taking up the story, Noel Rose recalled how overhead gas heaters were installed in the general factory area to help limit temperature extremes. The entire instrument section was sealed off, with large double doors, and fully air conditioned to maintain a temperature of 70°F.

Early in the war, anticipating construction of the new factory, a high official of the Ministry of Munitions had examined their facilities and indicated that, if Paton was to produce 'the kind of stuff we want' they would need additional good quality production equipment. According to Noel, they were told to nominate whatever they needed and it would be supplied 'on lend-lease'.

"So they put lathes in — they put everything on for us. Everything we wanted was ours (for the asking)!"

"To the best of my knowledge, we never paid a penny for it. But it was worth a lot of money, and when the place was ultimately sold, somebody may well have made a killing!"

For all practical purposes, Noel said, the factory became self-reliant during the war years. They had their own tool and machine shop, did all their own spray painting and vulcanising, glass cutting and drilling — didn't have to send *anything* out.

Paton/Palec products

They produced a vast number of 1" (25mm) diameter meters for field equipment, ruggedised and waterproofed, along with larger movements ranging up to 8" (200mm).

'Suspended coil' meters (without springs) were also made to order, suitable for use on trains and ships — but not on warships, where they did not take kindly to the shock waves from heavy armament.

Other products included thermocouples, meters and valve testers for the PMG, photoflash equipment, photo exposure meters and hearing aids manufactured under licence from the UK. Bert Heinemann, now retired in Fairfield, NSW, says he remembers well this diversion into conservative but reliable non-radio products.



Fig.6: The Palec SG-1 signal generator, as illustrated on a leaflet circulated in 1946. Already finding industry acceptance, the price was quoted as £54 plus 12-1/2% sales tax.

When the British hearing aid company later began supplying the Australian market direct, Paton sued them for breaching the terms of the licence and won $6000 damages — a windfall in those days. They won similar damages when a European company released equipment in Australia, contravening a licensing arrangement covering a Paton-designed switch.

Paton also put a lot of effort into the production of moving-iron meters. Featuring patented, inbuilt overload protection, these found their way into mines and practically every power station in Australia, as well as in New Zealand.

In service, according to Noel Rose, they were "utterly reliable — virtually overload-proof" — to the extent that he could not remember one ever having been returned for repair.

Reflecting further on personalities, Noel picked out 'Bertie' Meyer as a long time mate, with whom he munched his lunch virtually every day. "A wonderful chap".

And there was Kevin Murphy whom he hired at age 16, ultimately becoming his 'right-hand man' in the workshop and remaining in the job for 39-odd years — almost as long as Noel himself.

As for Fred Paton, he had two main diversions as a younger man: fishing and drinking — the latter preferably enlivened by female company.

A change from work

Involved as his chauffeur, Noel remembers weekend pub crawls and Saturday afternoon sessions outside the Strathfield pub, drinking 'black velvet' — champagne and stout. "We used to iron ourselves out beautifully... I don't know how we ever got home — except that it was only a couple of streets away."

Fred Paton subsequently gave up the drink and tobacco and married a German lass — Charlotta, mentioned earlier, whom he had met in hospital. Together, they became deeply involved in the Christian Science church.

The marriage was eventually annulled, but Fred apparently maintained the church connection. Convinced that he could regain the use of his limbs, Noel says, Fred spent long hours agonising over the quality of his faith and dragging himself along between parallel bars, by way of futile exercise.

He continues: "When Fred Paton made up his mind about anything, that was it. If you crossed him, you were gone!" That, presumably, was the way it was for Charlie Slade.

Noel's own turn came in November 1939, when he argued that the factory should be closed over the Christmas holidays. Fred rejected the idea, but finally had to concede that Noel was right.

It soured their relationship such that Noel limited his commitments to the role of chauffeur and factory production, leaving personal care of Fred to a couple of nursing aides.

In the early days, Fred's interest in fishing was satisfied with weekend or spontaneous weekday jaunts to one or other of the nearby rivers but, later on, he invested in progressively more ambitious fishing boats in a quest for bigger and better catches.

His ultimate pride and joy was the 'Celap' — Palec spelt backwards. A 38-foot (11.5m) flying-bridge cruiser, built from New Zealand Kauri, it cost an initial £10,000 plus whatever else went on fittings and furnishings and the GM diesel engines.

It boasted the largest on-deck toilet one could imagine — 10 x 8 feet — to

accommodate Fred's wheelchair. In addition, the back of the boat could be dropped down to form a bridge so that the chair could be wheeled straight on board from the Pittwater marina.

The Celap was used for fishing jaunts and for entertaining clients, including people from the Ministry of Munitions. Said Noel: "We had a hell of a time with that boat!"

One of Fred's mates from the Celap days was Jack Hill from the toolshop. Amongst other things, Jack had designed and patented a soldering iron that outperformed anything on the market at the time. It was left on in the Palec factory for two years without burning out. He also made up a personalised fishing reel for Fred Paton, which Noel still has among his keepsakes.

At one stage Noel Rose said that he and other senior employees initiated a move to have Fred Paton's original war service recognised, along with his contribution to the WWII war effort. It culminated in a visit by a Vice-Regal party of eight dignitaries, headed by the Governor of NSW. They stayed for three hours and showed considerable interest, but the only outcome was an enthusiastic article in the paper. I quote: "That's all that Fred ever got out of it, the poor bugger!"

The post-war years

Bill Field says that, in late 1944, with the War drawing to a close, planning began for the production of more advanced test equipment for the post-war commercial market.

Radio engineers John Larkin and Eric Palmer joined the company in that year with this objective in view, and Bill says that he, along with another technician, were seconded to assist Eric Palmer in the development of a modulated oscillator, an advanced signal generator, a vacuum-tube voltmeter, an electronic flash unit for photography and sundry other bits of equipment.

Bill adds that, to assist in the calibration work, particularly of the SG-1 signal generator, they were supplied with an RCA AR88 receiver. He remembers it as a magnificent piece of equipment and wonders who became its ultimate owner.

I certainly remember the modulated oscillator and the SG1 sig gen — we ended up with one of each in the old *R&H* lab. Much later I picked up a battered SG1 from Harry Carter of Ace Radio, refurbished it and used it on my own workbench. In fact, I still have it! (*I picked up one too* — Ed.)

From Fred Whitehouse of Muswellbrook, NSW, I received an original leaflet dated 1946 and a Palec/Paton Electrical advertisement from the *Electrical and Radio World* for September 1951, the latter indicating the then-current range of products. It is impressive, to say the least:

- Meter movements as already listed, plus fan-shaped pyrometers and shield-shaped oven temperature gauges;
- Model SG1 signal generator;
- Model VCT-2 valve and circuit tester;
- Model M30 multimeter;
- Model VTM vacuum-tube voltmeter and probe;
- Model PA dynamometer type power analyser;
- A range of electronic photoflashes, 60-1000W;
- An exposure meter; and
- A hearing aid.

Unfortunately for Paton Electric, the immediate post-war period proved to be the calm before a commercial storm.

In short order, the Australian market was flooded with war surplus equipment, including test instruments and Ferranti, Weston, Jewell and other such meter movements, the latter by the boxfull for a few shillings apiece. I remember myself picking up up a 50uA US Army multimeter for next to nothing, complete with high voltage probe!

No less to the point, from the wheeling and dealing a new breed of dealers emerged with the know-how and resources to import new equipment, in competition with traditional suppliers.

End of an era

At this critical stage, Fred Paton became gravely ill with bowel cancer, the existence of which had been masked by his physical condition. After a brief 'retirement' he was admitted to the Masonic Hospital across the road from the factory, where he died within a few months.

Noel Rose says that with the death of Fred Paton, management of the company became 'a shambles'.

A 1932 document which would have authenticated Noel's right to a say in Paton's affairs could not be found. Effective control of the company passed into the hands of nominees from the Christian Science Church, and Fred's divorced wife reappeared on the scene to be reinstated as a director.

But whatever the skills of the new team may have been, they did not include the production of electronic equipment, or the management of technical personnel for what had become a fiercely competitive market.

Morale, loyalty and commitment suffered and, as company performance faltered, management response was to import substitute lines which failed to win the acceptance of the local product. According to Noel Rose, dedicated workers like those mentioned above resigned or retired — for the most part, with little more than their memories.

To cap it off, Paton Electric merged with University Graham Instruments which was itself in mounting trouble. In short order, the joint organisation lost its skilled workforce and became 'just another importer' and a pale shadow of its one-time components.

The last word in this present story belongs to Fred Field:

"Some years ago, I had the opportunity to visit the old workplace in Ashfield. It was sad to see packing cases, crates and filing cabinets occupying the work areas which had once been the scene of bustling activity. The ghost of Fred Paton would not have looked kindly upon that spectacle!" ❖

The Dawn of Australia's

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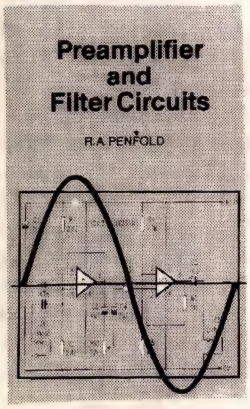
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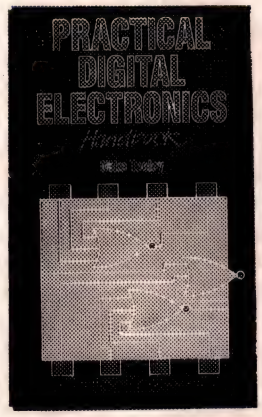
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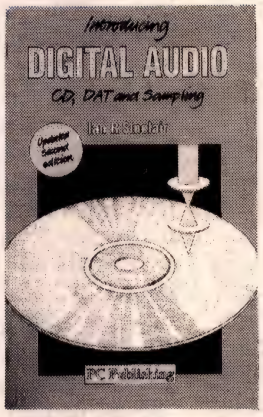
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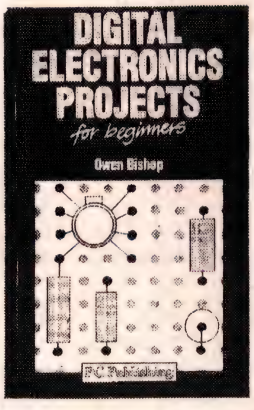
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THE SERVICEMAN

Tracking down a bad solder joint — which was jolly hard to find!

This month I'm going to give myself pride of place, with the first of our stories — it's about a very strange example of an all-too-common fault. Then there's another 'alarming' story from the world of security systems, and finally a review of a fairly typical day in the life of a serviceman. But back to my own bench, to start the ball rolling...

I've just finished off a short job that really should never have been needed. The fault was quite a simple one, but was caused by what can only be called a manufacturing defect — even though it has taken more than 15 years to show up. The set was a Hitachi colour TV, a model CEP288. This is a 20" model, first released about the time colour TV began here in Australia.

This model, and indeed the whole Hitachi range, has been notably reliable. There have been the usual run of dried-out electros, a few dry joints, one characteristic failure of a feed resistor on the horizontal drive board, and so on; but by and large the model has not given the industry any particular worries. Except for one thing.

The most recent job started a month or two back. The customer complained that the set had simply stopped. No bangs, no smoke, it just wouldn't work.

When I got it on the bench, the set had come good and was working like a new one. But that didn't last long. Next time I tried to switch it on, it was dead again.

Whenever this type of fault shows up, it's a fair bet that the set is suffering from a dry joint. The fact that the set will sometimes come good is proof that there are no faulty components present. It can only be an interruption to one of the circuits, and a dry joint is as good a reason for that as any other.

In the CEP288, the power supply delivers 120 volts to the line oscillator and the line output stages. All the other rails are derived from the line output, so when the set appears dead, there are two things to look at.

The first is the 120 volt rail, which is easily checked at fuse F750 on the deflection board at the right hand side of the chassis. The second check is for correct operation of the line output stage — although, with experience, you can deduce the likely result of this test from the results of the first one.

In my case, the 120 volt rail measured 150 volts. This told me straight away that the line output circuits were not working. The high voltage comes about as a result of the type of regulator used in this set. It comprises a series-pass regulator transistor (in this case three transistors in parallel), connected across a high current bypass resistor.

A characteristic of this type of regulator is that it only exercises control of the output voltage during normal current or high current conditions. In a low or no current state, it loses control of the voltage and the 150V output is the result. And since this set draws virtually all of its operating current through the line output stage, failure of that circuit will cause the overvoltage condition that I found at F750.

Whenever a CEP288 comes to me with the symptom of being 'dead', my first check is the voltage as described above, and the second is at R731 on the horizontal oscillator board. This is a 56-ohm fusible resistor, usually fitted inside a ceramic flame-proof sleeve. This has a habit of burning out — but that's another story. In this case it was intact.

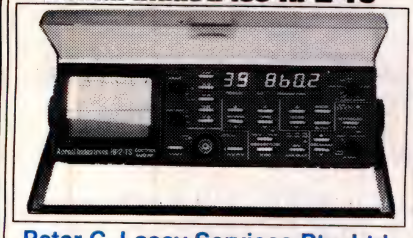
Next, I checked at the collector of TR59, the line output transistor. At this point there was no voltage, as good a reason as any for the set not working. Yet between the collector of TR59 and F750, there is only the primary winding of the line output transformer!

Sinking feeling

At this stage I had that sinking feeling, since line transformers for sets this old are expensive and often not easy to come by. So I determined to trace all the associated wiring, *before* I condemned the tranny. In fact, it didn't take very long at all to find the trouble. I started at the TR59 collector and almost immediately found that there was 150 volts on the copper track adjacent to the transistor securing screw, but nothing on the screw itself.

It took only a quarter turn of the screw to restore continuity to the circuit and the set to rousing good health. (The elderly owner had been worried that she might have had to buy a new set. I was able to reassure her on that point.)

All of that happened a month or so back, and I had no reason to suspect that the set would be back so soon. But it was, and with exactly the same symptoms. This time I went straight to the collector of TR59, and once again found the dreaded 150V. The only difference was that the screw was still tight and the voltage was present at both the copper track and the mounting

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screw. So, although the symptoms were the same, the problem was obviously different to the last time...

Now, if a transistor is not short circuited, and has a reasonable voltage on its collector, the only reason why it isn't working must be that it is not being switched on. Or so I thought at the time.

My next test was for line oscillator operation, and this is most easily done at plug ZE on the top of the line output transistor PCB. Pin 1 of this plug should carry line switching pulses — and in this case, it did. So the transistor had switching pulses on its base, and a high voltage on its collector, yet still wouldn't work!

I've had lots of shorted line output transistors, but very few open circuited ones. It began to look as though I had just found one of that rare variety.

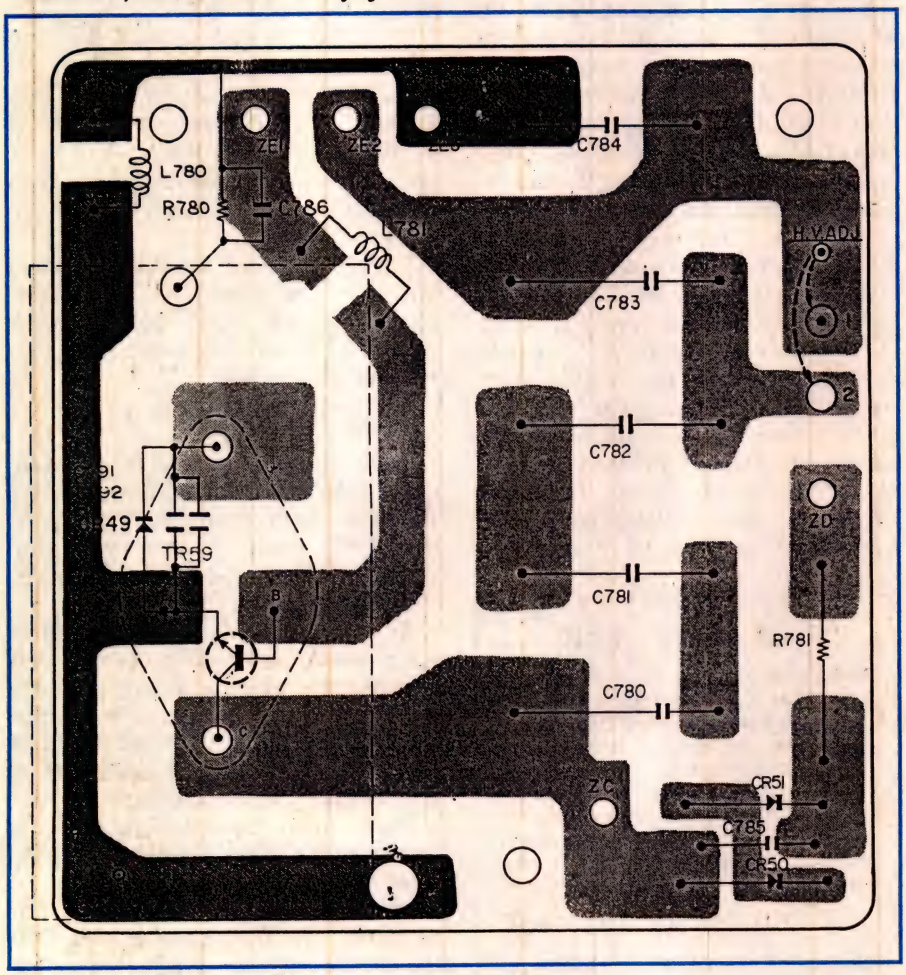
The PCB that carries the line output transistor is very easy to remove from this chassis. Just three retaining clips hold it in place, and three plugs connect it into circuit. In no time at all I had it on the bench for a closer examination.

First off, I checked for dry joints. There are only a dozen or so joints on the board, so that check was soon completed, with no result. By this time the soldering iron was hot, so I quickly removed the transistor. Unfortunately, it tested perfect; so I had to admit to being on the wrong tram with that one.

So if the drive and supply voltage was OK, and the transistor was not faulty, what else could there be? Then it hit me. What would happen if the emitter circuit was open? Although this point is nominally at ground potential, it still has to carry the entire current and a cracked board has been known to kill the line output stage.

The emitter is returned to ground through a small inductor L780 and pin 3 on plug ZE. A few seconds with the multimeter showed me that there was no continuity between the emitter and ZE3. Which meant that I had either a cracked track, or an open-circuited L780.

But as that last component was only eight turns of heavy copper wire, it was unlikely to be o/c. Which left only a broken track.



Shown here is the small PCB which carries the horizontal output transistor TR59 and its associated parts, on an Hitachi CEP288 colour TV — the subject of this month's first story. It turned out to have a very unusual fault.

Really unusual

Well, to cut a long story short, it wasn't a broken track. But it was an open circuit, of the most unusual kind. The circuit between the emitter and ZE3 comprises about three inches of copper track, broken in the middle to accommodate the quarter-inch long L780. And the problem lay with one of the two solder joints securing the inductor.

To all intents and purposes the joint was perfect. It was clean, and as shiny as all the other joints on the board. It was also rigidly attached to both the PCB and the inductor's pigtail. Yet there was no continuity between the copper track and the solder. There was perfect contact between the pigtail and the solder, but none between the solder and copper!

One fault I have found with these kind of symptoms has been a loss of continuity around the edge of the solder. Some kind of impurity in either the solder or flux etches a hairline discontinuity along the edge of the solder.

In this case, a microscopic examination of the joint showed no evidence of such a fault. The only thing left was to remove the solder and to remake the joint. And this revealed the culprit.

As soon as the iron touched the solder, it rolled back like the Red Sea parting! It remained attached to the pigtail but made absolutely no contact with the copper pad. And it was the appearance of the copper that suggested the cause of all the trouble.

The pad wasn't silver, as might be expected if the solder had made proper contact, nor reddish-gold as the native copper should have looked. Instead, the pad showed an all-over dull, dark gray colour, almost as if a thin plastic insulator had been fixed to the pad. Whatever this material was, it had been present under the solder since the set was made. Or else it was some kind of impurity that had been growing under the joint until it lifted the solder right off the pad. Either way, it created a perfect insulator between the solder and copper, and effectively killed the set.

An unusual aspect of this fault was the tenacity with which the impurity held the solder and copper together. Although there was no electrical connection, there was a physical bond at least as strong as any good solder joint. There was no way the fault could be detected, short of removing the solder to allow a visual examination.

None of my soldering fluxes would make the solder take to the gray matter.

Not even Spirits of Salts would cut through the deposit. The only way to repair the joint was to take a sharp knife and scrape away all traces of the pollution, right down into clean copper.

I have seen this same kind of trouble in other Hitachi sets, except that it has always been under the screws holding the line output transistor. In fact I had suspected this as the cause of the screw trouble mentioned earlier in this story, but that was not to be. I can't ever recall seeing it under an otherwise normal solder joint.

But we live and learn, don't we?

Sound an alarm!

Now we come to another of those alarming stories from A.L. of Beverley Hills, in NSW. As you might expect, A.L. again tells of a problem in the security industry. Yet this tale could also develop into a serious medical one. He calls it:

The Ultimate RFI Problem

A new jewellery store was fitted out with a 'back to base' type alarm. The system was commissioned, and no problems were experienced until the alarm had been set for about three hours.

Then a series of inexplicable alarms occurred. From about 8.30pm until after midnight the alarm went off at random intervals, then settled down for the remainder of the night. When the alarm technician tested the system no fault could be found, yet the following night the same series of false alarms occurred.

The sector alarms were quite random, indicating that the cause was common to the entire installation. The power supplies and control equipment were tested and no faults were evident. All common equipment was replaced and still the problem persisted — with the same degree of randomness at about the same times, and again settling down after midnight.

On the fourth night, a Friday, the first tangible clue occurred: the alarms persisted until long after midnight. This suggested that the problem was environmental and that intense RFI was being generated in the area.

An inspection of the area revealed a prime suspect, a take-away food shop four doors away. The take-away was equipped with the usual fish-fryer, hamburger plate and three microwave ovens. Maybe one of the microwaves was leaky — but it would have to be in a very dangerous condition to affect an alarm system 40 metres away.

The owner of the food shop was approached, and he agreed to have the microwaves tested for leakage, if we paid for the service call. We agreed to foot the bill and the service call was arranged.

We met the engineer from the microwave distributor at the take-away, and he assured us that his company's products did not leak microwaves. He demonstrated this by placing a coffee mug of water in each of the ovens, starting the ovens, then running the leakage detector around the door seals. There was no detectable leakage, and we were about to abandon this avenue of enquiry when the store owner opened one of the microwaves to remove the mug of water.

Then all hell broke loose. The needle of the leakage meter slammed full scale. An audible alarm sounded. The engineer slammed the door of the microwave shut and switched the oven off at the power point. The other microwaves were switched off and all were examined closely. It was then found that the door interlock of one oven had been jammed closed (by one of the cooks), in order to avoid having to reset the microwave during busy periods. The remains of a paddle-pop stick were removed from the interlock and all the ovens were tested for proper operation of their interlocks.

The owner and his staff were advised to have medical checks for possible radiation damage. We did not hear the result of any medical checks, but the false alarm problem was resolved and no further trouble occurred from this source.

Modern security equipment is designed to withstand intense electromagnetic radiation. But 850 watts of microwave energy at 2.4GHz is well in excess of any RFI immunity that could reasonably be designed into commercial equipment...

Well, what can I say after *that* one? I have no sympathy for the cook, and very little for the take-away owner. But I do care for the unfortunate, unknowing customers of the shop. For how long had they been subjected to microwave irradiation?

It would be bad enough for customers who ordered food to be cooked or heated in the ovens. They could be said to be innocent contributors to their own trouble. But what of those who only wanted a ham salad and got a side serve of RFI as well? It's just too scary to consider.

I think I'll take a microwave detector with me next time I go into a take-away! Thanks, A.L. More stories, please, but I hope they won't be as worrying as that one was.

House call saga

Now, for something more down-to-earth, we turn to G.S. of Blair Atholl in South Australia. G.S. is one of a dying breed — servicemen who do house calls — and his story is one of variety and interest.

As you will see, a routine day for a serviceman is not made up of a succession of mind-bending problems. Ninety percent of jobs are repeats of work done yesterday, or last week or last month. A large part of a serviceman's skill is remembering earlier experience.

It's only the first time that we see a particular fault that it gives any trouble. Read through G.S.'s story and see how many times he solves the problem by recalling previous contact with the model he's currently working on.

I am employed by a large company and do in-home service calls on TV, VCR and audio equipment. Most of the

Just for a laugh!

The TAFE college Radio & TV Course examination paper commented 'The TV image suddenly becomes very weak and snowy after an electrical storm', then posed the questions:
Q1. What part of the set has become defective? And...
Q2. What is the most likely component to have failed?
One candidate with more wit than wisdom answered:
A1. The TV station has been struck by lightning! And...
A2. The technician who was up there at the time!
(Sent in by William Archer, of Berriedale in Tasmania.)

Fault of the Month

Sharp VCR, VC-A502X
SYMPTOM: Odd malfunctions, as with a dirty mode switch. However cleaning the switch, and even complete replacement, made no improvement.
CURE: IC701, an IX03222GE, was intermittent. This IC is a servo control interface, handling input to the main systems microprocessor, and it was sending incorrect data to the micro.

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.

calls are covered by either the company's rental plan or by the company's service agreement, and I only collect cash occasionally. I cover a dozen or so calls per day, and kept a diary of a recent day's work.

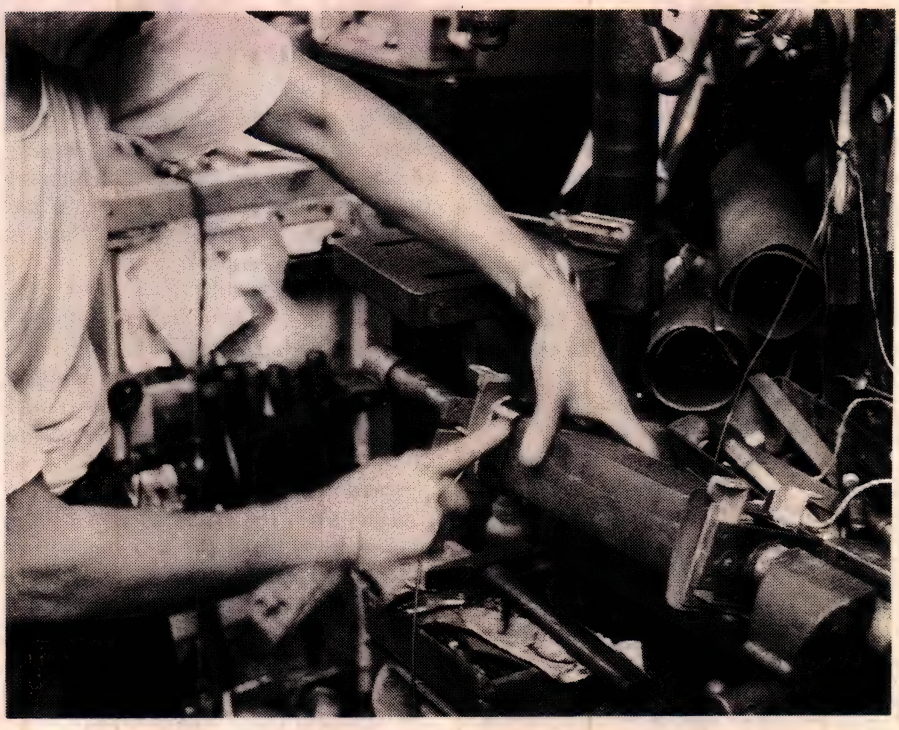
The first job was on a 14" Kriesler (37-107). The set was dead, and I found the power supply output fuse to be blown, but not violently. When I looked at it closely, I found it to be an ordinary two amp 2AG fuse, but the board was marked T2A. The customer said that the set had been worked on recently and as the fuse was not dusty, it had probably been fitted then. I replaced it with a delay type fuse (indicated by T) and the set then worked perfectly. I collected some money from the customer, and left. This was my only chargeable job for the day.

The next call was on a Panasonic TV TC68A61 ('The One!'). The sound was OK, but the screen was black. A look through the slots in the back cover revealed that the CRT heaters were not lit. I took the cabinet back off, and had a close look at the CRT board. The heater pin positions were screen-printed on the board and a cracked solder joint was evident on one of them. A minute's work with the soldering iron and the set was fixed. It took longer to get the cabinet back refitted — it is always a bit tricky on these sets.

The next call was on a Philips TV KL657, which repeatedly jumped channels. I breathed on the touch-pads and the channels went berserk. There were small children living in this house, and there was also an evaporative air-conditioner running in the room. The goo from little sticky fingers collects in the corners of the touch-pads and absorbs moisture. As this is conductive, the channels jump quite intermittently. This was an unusual fault for a hot (39°) day — it's usually a winter problem. I cleaned the pads with a toothbrush, CRC 2.26 and a rag. No problem now.

The fourth call was on a Sanyo VCR VHR5300 which had very weak sound on tape-play only. A clean of the audio-CTL head had this one fixed. I took the opportunity to clean the video heads and tape path, and even then I was on my way in 10 minutes.

The next call was on a new Panasonic VCR NVSD20A, with the customer complaining that they could not watch any library tapes without the picture shaking. It was connected to a Philips TV with a KL9 chassis. On this model the only channel position with an automatic sync-mod is marked 'U'. The customer had chosen channel '0' for his VCR channel, so a few seconds work on the TV's tuning panel had this one fixed. A few more minutes work to check the clock, calendar, channel tuning and to skip the unused channels, and I was off to the next one.



As a follow up to our photos in the June column, of a low cost Hong Kong-made welder, Mr A.J. Lowe of Bardon in Queensland sent this photo of one of these welders being made in a Hong Kong street.

This next call was on a Sanyo TV CTP8653. This one uses one of the many versions of the 79P chassis. The set did not work, but R902 and R903 were running very hot. These are 200-ohm resistors in series with the power supply, and running hot usually indicates a shorted horizontal output transistor. A check of the history card revealed that the transistor had recently been changed, as had C485, the usual cause of a dead transistor.

I checked the transistor, and it was OK. But measuring from the 220 volt rail to ground revealed only 10 ohms! No wonder the power-supply was stressed...

After much unsoldering and checking using the meter's ohms range, I found that the collector of the horizontal output transistor was shorted to the heatsink. When I removed the transistor from the heatsink, I found a piece of foreign material on the insulating washer which had punctured the mica. I fitted a new washer, resoldered everything and the set sprang to life.

After lunch I went to a Sanyo VCR VHR4100 which lacked colour on tape-play only.

Another technician had been to this one a day or two ago and he had resoldered many joints on the chroma board. I could make the colour come and go by bending and tapping the chroma board. I could not see anything amiss, so I sent this one to the workshop. This board had many surface-mounted components on it, and the customer's loungeroom floor is not an ideal place to work with parts of this size.

Confusing connections

The next call was on a Philips compact stereo system AS5015CD which had low audio output on all functions. The customer had recently moved the unit and had connected the speakers to the 'surround' sockets instead of the 'front' sockets. The outputs are not very clearly marked on this unit.

The ninth call was on a Sharp VCR VCA111X which tangled tapes, and had other strange mechanism problems. I removed the white plastic part which houses the mode switch, and flicked off the mode-switch rotor. The stator contacts were dirty and slightly tarnished. I cleaned the rotor and stator with a cotton-bud and CRC 2.26, and reassembled the VCR. This is a common problem with all Sharp VCRs which use this deck. This unit works OK now.

The next job was on a Philips TVKH658. This has a K12 chassis, and

would not be on many technicians' favourite list. I tapped the chroma module and the colour was very intermittent. The two ICs are in sockets, and the only proper way to fix intermittent colour problems in this chassis is to remove the sockets and solder the IC's directly onto the board. This I did, and the set was working normally again.

The next call was on a Philips TV 20GR1055 which had a very snowy picture. It was perfect on tape play, which pointed to the antenna system.

I had noticed on the way into the house that the antenna was a Hills TL3, with a Teleray balun, and coaxial cable. I measured across the plug and it showed a very high resistance. This installation should show only a few ohms. I arranged for the antenna installer to call, and left.

The next job was on a Samsung TV CB677Z which had severe top foldover. The usual cause is a faulty vertical output transistor. This one was no exception, and a new BD203/BD204 complementary pair put it right. These are not the correct transistors, but seem to work OK. The original transistors (and al so the replacements) run far too hot for my liking. I think there may be a design problem there. I also replaced an electrolytic capacitor which sits very close to the heatsink and looked rather cooked. I soldered the new one underneath the board.

The last call for the day was on a National VCR NV300A. This is an old unit now and lacked sound on E-E only. The tuner-camera switch had dirty contacts. I removed the bottom, front panel, dropped the mainboard and cleaned the switch with contact-cleaner. It all worked properly then.

This was a reasonably typical day and I had encountered none of the unpleasant things that sometimes haunt us — e.g., nasty dogs, nasty customers, filthy houses etc. I would have to detail several hundred jobs to get a proper insight, but I hope this one day gives an idea of a field technician's work.

Yes, G.S. One day in your life does give a very accurate illustration of many days in our lives. As I mentioned earlier, many of us have cut out 'road work', but your story was very similar to my experiences only a few years ago.

And do you see what I mean about remembering the last time you saw a particular problem?

If you forget prior involvement, then you have to re-invent the wheel — every time. And that's time consuming and unprofitable.

Photo sequel

Now before I go, just a word about the photo reproduced here. It was sent to me by Mr A.J. Lowe, of Bardon in Queensland, as a follow-up to the photo of the Hong Kong-made welder in the June column.

According to Mr Lowe, this photo shows one of those welders actually being made — wound by hand in a workshop set up in the street. It would seem that the operator keeps the count of turns in his head — there's no mechanical counter to be seen. Imagine the concentration needed to keep count of the primary turns, amid the rush and bustle of Hong Kong traffic!

Well, that's all for this month. Apart from our 'Just for a Laugh', that is. Don't forget, you can earn an easy $25 just by telling us about the funny experience you had recently. See you all next time. ❖

A Basic Guide To Colour

TV & VCRs

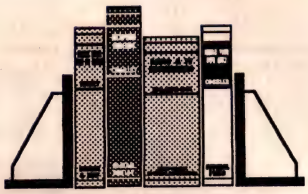
Two very popular series of articles, published in Electronics Australia in the late 1980's, have now been combined into a separate publication. Students, the home handyman, even the serviceman, will find that the latest publication from Electronics Australia gives a wide and comprehensive insight into the electronics involved in colour television and video cassette recording.

The author, David Botto, is a television, video and electronics service engineer with many years of 'on-the-bench' experience. He's also designed, constructed and maintained a wide range of test instruments. David's wealth of experience and vast knowledge of colour television and VCR's have been put together to give you the facts, figures and basic knowledge you need, to understand just how these entertainment machines work.

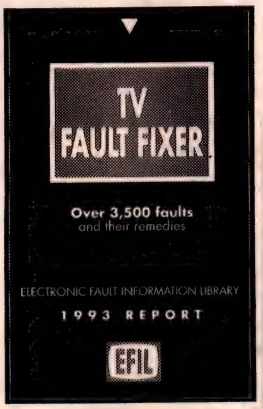
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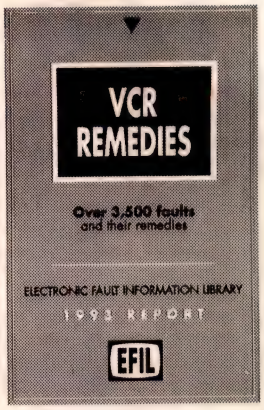
NEW BOOKS



Servicing aids







TV FAULT FIXER and VCR REMEDIES, published by Electronic Faults Information Library (EFIL), PO Box 969, Airlie Beach, Queensland 4802. Two A4 volumes, each 210 pages. Annual subscription $250, which includes backup enquiry service.

Lists of equipment faults, with their remedies, exist in servicing workshops all round the country. Since the lists originate from dozens of sources, they exist in as many formats, and the user often has trouble deciding if he is reading about one fault with two different descriptions.

I've often thought that if I could retire from active servicing, I might gather all these lists together, sort them out and publish the results for the benefit of my fellow servicemen. Well, it seems that someone has beaten me to it.

In these two volumes the 'Electronic Fault Information Library' (EFIL) presents over 7000 CTV and VCR faults, carefully sorted and catalogued, in two volumes. The library also offers contributors regular quarterly updates as well as a credit against their next subscription, for all new (unpublished) faults contributed to the database.

Where a particular fault or symptom is not covered in the database, and providing the reader has made reasonable efforts to solve the problem himself, the library will try to find the answer through enquiries to the manufacturer or manufacturer's agent.

The review copies of the 1993 VCR and CTV reports each contain 210 double sided A4 pages of close packed information. As well as the principal 'faults and cures' content, the volumes also contain very useful cross reference tables and lists of the addresses and phone numbers of the various manufacturers and their agents.

The cost of the EFIL volumes may seem a little daunting at first glance, but it does include the quarterly updates and also access to a low cost query service which must be a real benefit in a busy workshop.

For those of us long of tooth and grey of hair, our existing faults lists probably contain over three quarters of the material in EFIL's first two volumes — even if it is scattered around the workshop and therefore hard to access. Personally, I couldn't justify the expense. But for young technicians, or older techs just starting in domestic service, the EFIL *TV Fault Fixer* and *VCR Remedies* volumes represent years of experience and will earn their keep very quickly indeed. (J.L.)

Radios as art

RADIO ART, by Robert Hawes, with photography by Paul Straker-Welds. Published by Green Wood, London, 1991. Hard covers, 305 x 240mm, 128 pages. Price $49.95.

Robert Hawes notes in his introductory sleeve notes to this volume that radio receivers have come in all manner of shapes and sizes since they first appeared at the turn of the century — and no doubt many of *EA*'s older readers will have seen at least a reasonable number of them, at least in pictures. But it's most unlikely that you'll have seen some of the really unusual models he features here. I know I certainly hadn't realised just how many varieties *have* appeared over the years, until I saw them in this book.

Even back in the crystal set days, it seems, there were sets built in all kinds of disguises — including Felix the cartoon cat, a hand-cranked wall telephone and a china figurine of 'Uncle Tom': a dandy with a cat's whisker detector formed between his bow-tie and a 'diamond' shirt stud (with the coil wound on his top hat!). Later on there were special sets built in marble slabs for priests, in the armrests of wicker chairs, inside world globes (rotated for tuning) — and of course one built in a metal 'saucepan' for use in Africa.

Author Hawes and photographer Straker-Welds lovingly capture and present here a large number of rare and interesting models, virtually all of them in superb colour. Hawes has also provided a well-written and interesting account of the development of receivers and their styles, so it's not just a coffee-table picture book, but a worthwhile reference volume as well — for the interested lay person and art student as well as the collector and vintage radio enthusiast.

In short, an excellent production and a fascinating read.

The review volume came from the Australian distributor, Resurrection Radio of 51 Chapel Street (PO Box 1116), Windsor 3181 (phone (03) 529 5639), who can supply it direct by mail to anywhere in Australia, for the price quoted. (J.R.) ❖

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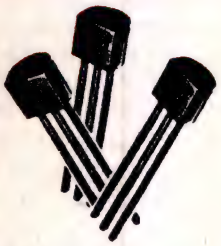
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Silicon Chip Dec'93

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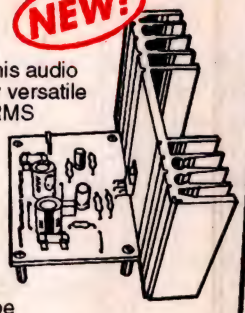
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NEW!

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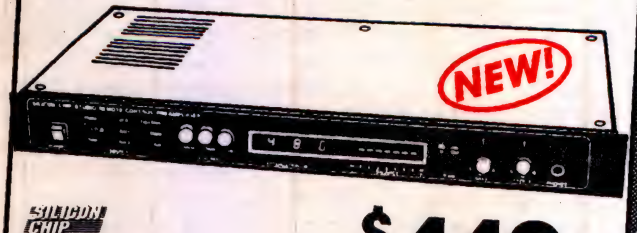
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Silicon Chip Sep/Oct/Nov '93

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ARRL Radio Handbook, 1993

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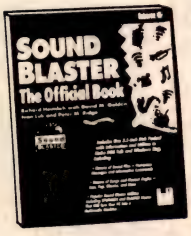


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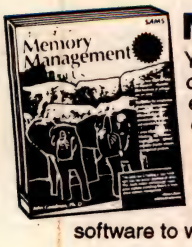


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The one and only book endorsed by Sound Blaster's manufacturers Creative Labs, it covers the whole family of Sound Blaster cards including Sound Blaster Pro, the new Sound Blaster 16 and the Soundblaster Multimedia Kit. Comes complete with a 3.5" disk packed with information and utilities.

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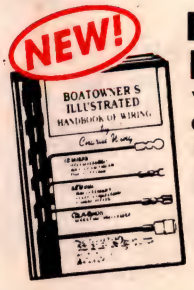


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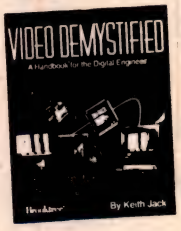


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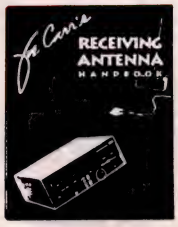
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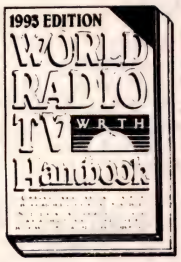


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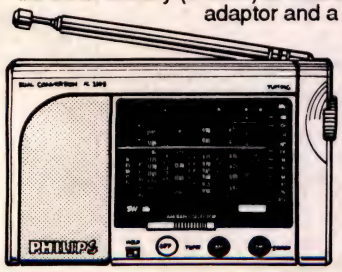
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$99.95

PHILIPS



'Shortwave Listening Guide', 1993

The whole world's talking on shortwave radio and this book tells you how to listen in! It contains everything you need to know about shortwave; selecting the right shortwave radio, how reception conditions vary, how to operate a shortwave radio correctly, profiles of international stations and more!

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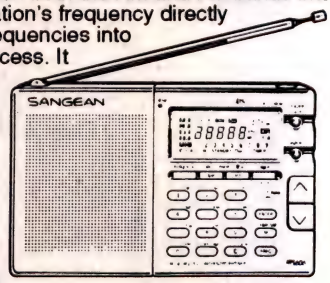
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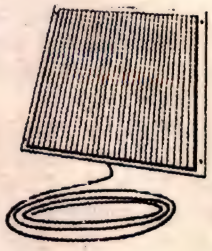


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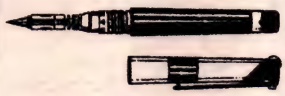


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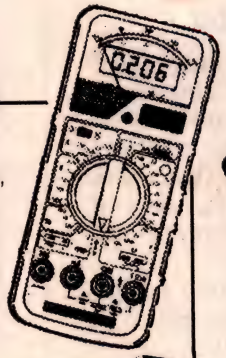
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Cat Q-1702 **$215**



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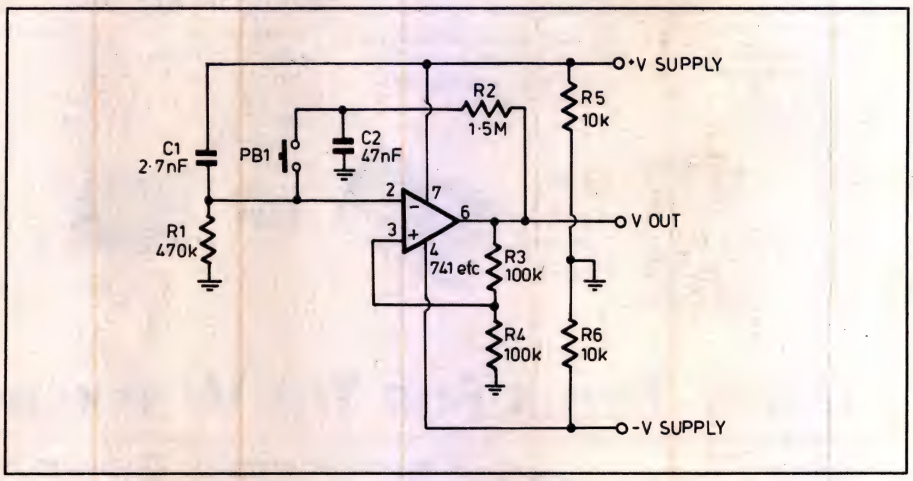
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B 1610

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.

Op-amp toggle



This is a design for a push-on, push-off type switch, based around an op-amp flipflop. It should work for any general purpose op-amp like the 741. Its operation is as follows:

Initially, the output is low and positive feedback via resistors R3 and R4 keeps it low. Capacitor C2 charges fully to its negative voltage after about 0.25s.

If pushbutton PB1 is activated, then C2's negative voltage appears at the inverting terminal (pin 2) of the op-amp. This voltage is lower than the voltage at the non-inverting input (pin 3), so the output at pin 6 goes high.

Normally, this would result in oscillation if the button were kept pressed; however, this is prevented by resistor R1, which reduces the circuit gain below unity while the button is depressed.

After PB1 is released, capacitor C2 charges to a positive voltage, and the circuit is then ready to be 'flipped' back to its low state by a second press of PB1. But this flipping cannot happen until after a 0.25s delay, which means that the circuit is immune to switch bounce and contact noise.

The initial polarity of the output is governed by capacitor C1. Connecting this high (as shown in the schematic) causes an initial low; connecting it instead to the negative rail will cause the initial output to be high. The ground point should be taken from a potential divider as shown; if it is grounded otherwise then the start-up polarity can be unpredictable.

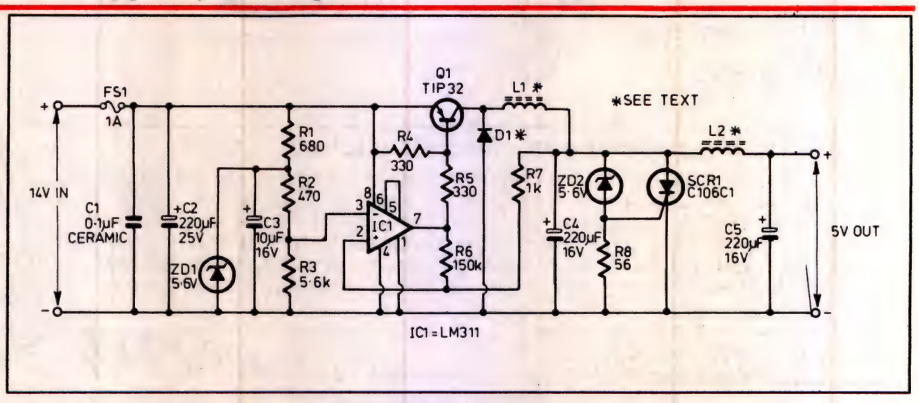
As mentioned before, resistor R1 prevents oscillation. If it is removed, then the circuit will become an astable multivibrator with its frequency governed by resistor R2 and capacitor C2.

This may be useful in some instances. The output may be used to drive a small load directly, or an electronic switch for signal control.

Julian Phillips,
Temuka, NZ

$40

Efficient +5V regulator



When you need to run a board full of current-hungry 5V digital ICs from a relatively high supply voltage, using a traditional linear 5V IC regulator might well mean dissipating much more power in the regulator's heatsink than in the load itself. That's why I designed this simple switchmode regulator circuit.

By using it to replace a 7805, I was able to reduce the regulator input current (at 14V) from 950mA to 480mA, with a regulator efficiency of just under 80%.

Comparator IC1 (LM311), via R7, compares the voltage across C4 with 5V derived from zener diode ZD1. Depending on whether it's below or above, it turns switching transistor Q1 on or off.

Resistor R6 provides a small amount of hysteresis to ensure operation at an appropriate frequency, about 17kHz in the original.

Diode D1 is a high speed 1A 40V Schottky barrier rectifier (Tandy Cat. No. 276-1165) which maintains the current flow in inductor L1 during the periods that Q1 is in the off state. A 1N4936 should also work, but at reduced efficiency. Inductor L2 and capacitor C5 form a low-pass filter to reduce the approximately 70mV p-p ripple across C4 to less than 10mV p-p at the output.

Under normal conditions zener diode ZD2, resistor R8 and silicon controlled rectifier SCR1 do nothing at all; but in the event of a fault which causes the output voltage to increase above 6.2V, SCR1 triggers and 'crowbars' the output, blowing the fuse and protecting the load.

Inductors L1 and L2 are wound on small iron powder toroids, Dick Smith Cat. No. R-5410. Since — apparently — these won't be stocked in future, Jaycar Cat. No. LF-1240 looks like a suitable alternative. L1 is 100 turns and L2 is 75 turns of 0.5mm enamelled copper wire.

This circuit can deliver at least 1A output, and should be adaptable for other input and output voltages, provided that transistor Q1's base current is kept at about 40mA and ZD1's power dissipation is about 50mW.

Bob Parker,
Carlton, NSW

$50

Temperature compensated charger

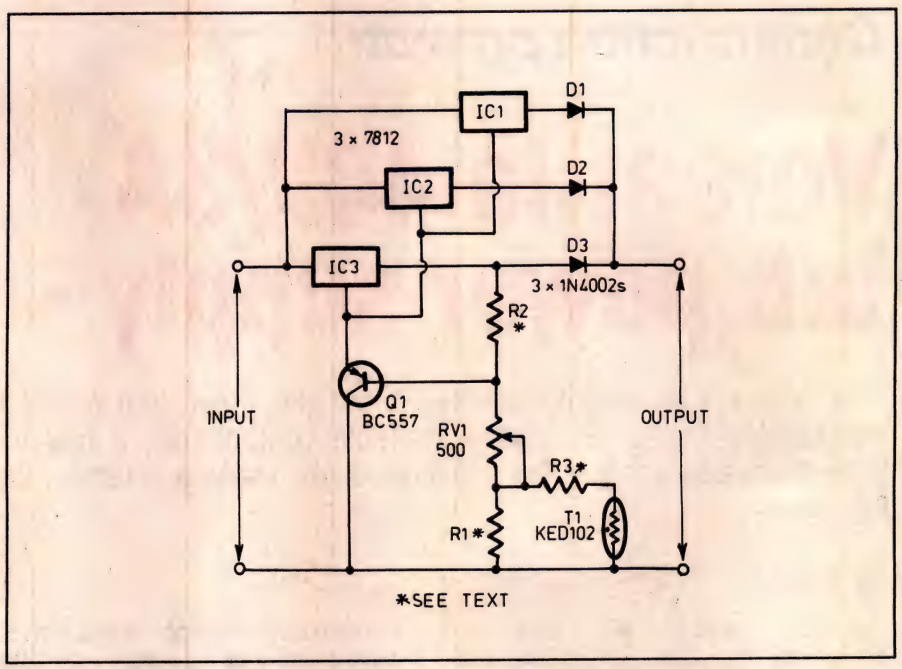
Most sealed lead-acid battery chargers ignore the fact that, as the battery temperature increases, its terminal voltage decreases. Temperature compensation is necessary in applications where they are exposed to extremes of outside temperatures. For example, a terminal voltage of 14.2V at 0°C will drop to 13.5V at 30°C.

This need for temperature compensation explains why once I only just rescued my video camera battery from destruction at the hands of its charger. I had taken it from a warm car to top up the battery charge, but an hour later it was still busily charging away.

It had become almost too hot to touch and had begun to vent that distinctive H_2SO_4 smell. Because it was warm at the start, the battery could not reach a sufficiently high enough terminal voltage to tell the charger that it *was* fully charged!

I have therefore developed a circuit which will provide almost ideal charging voltages for 12V batteries in most ambient conditions. It also allows several voltage regulators to be connected in parallel to get any required output current.

The temperature sensor T1 (KED102) is an NTC thermistor which should be mounted to sense the battery's temperature. It is fed through a resistor network to an emitter follower Q1 (BC557) which supplies a common voltage to the voltage regulators. It was necessary to buffer this input to the regulators as, in my experience, different manufacturers can have quite different currents in the common lead of the regulators.



To run the voltage regulators IC1-IC3 in parallel, it is necessary to protect their outputs with diodes (D1-D3). This occurs because, if the output lead is forced even slightly above its preset value by another source, the 7812 will attempt to sink this excess voltage via its common lead. The resulting currents will play havoc with a control circuit like this one and will often destroy a 7812.

Table 1 gives three alternative sets of resistor values for float, cyclic and general charging.

Table 2 gives a second set of values which allow the charge mode to be easily changed by varying only one value. Table 1 values should give almost exactly the ideal voltages required, though some adjustment of RV1 could be necessary to compensate for tolerances in the component values. The second set of voltages will not be quite as ideal, but are still acceptable.

Float charging is used for applications where the charger is continually replacing any charge as it is removed from the battery, to keep it almost fully charged; whereas cyclic charging is used to quickly and fully charge up after it has been discharged. General charging slowly replaces any charge that may have been removed by using, for example, a solar powered supply.

David Millist,
Dalby, Qld **$40**

TABLE 1

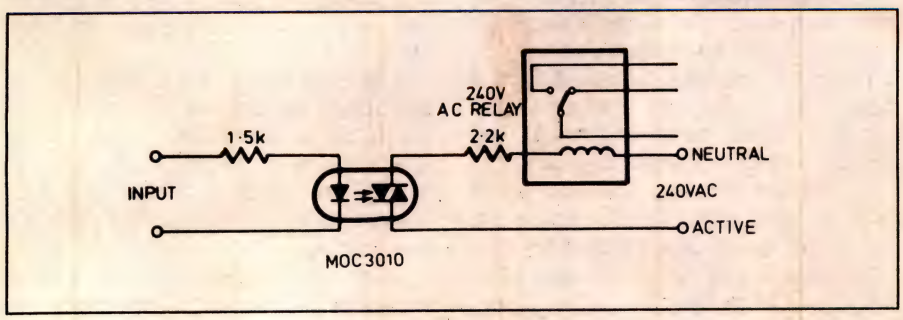
	R1	R2	R3
float	1.5k	8.2k	560
general	1k	4.7k	150
cyclic	820	3.3k	82

TABLE 2

	R1	R2	R3
float	1k	5.7k	150
general	1k	4.7k	150
cyclic	1k	3.7k	150

Switching 240V relays

After building many solid state relays, 'power relays' and the like, I have found that in most applications the following circuit is the most efficient and economical. It has no problems with high current heat-sinking, inductive loads, RFI, etc., and has a typical isolation of 7.5kV. Its only limitation is, of course, switching frequency, which is irrelevant in most isolated mains switching applications.



The circuit will work with just about any opto-isolator with a triac output. I use an MOC3010. The input can be 12V DC or the output from logic gates, etc.

In a lot of kits there is commonly a warning like: 'This project has mains potential voltages; only constructors with the relevant experience are to attempt...' I've often wondered how one would get this relevant experience without tackling one of these kits?

Maybe a circuit consisting of three components could encourage the inexperienced to master the mains?

C. Fortune,
Mentone, Vic **$40**

Construction project:

Versatile 40V/3A lab power supply - 1

This new supply should handle all but the most specialised tasks on a home or professional workbench. Based on readily available components, it has full electrical and thermal overload protection, adjustable current limiting, dual meters, and can be used as either a single or dual-tracking supply.

by ROB EVANS

In the August 1991 issue of *Electronics Australia*, we presented a 'mean, lean, recession-compatible' 18V/1A benchtop supply, which included what we felt were the essential features for a useful but low-cost unit. This turned out to be a very popular project, and we subsequently described two beefed-up versions rated at 18/2A and 30V/1A in the following October issue.

It's a safe bet however, that there are a reasonable number of us that need a rather more elaborate supply, and are prepared to pay the associated premium — provided of course, that it still represents good value for money. Such a supply would need to have a higher output voltage and current capability and a wider range of features, while hopefully maintaining the simple construction techniques and cost-effective design of our original 18V/1A unit.

To achieve this end, we once again took a careful look at just how such a supply is mostly used, and included features into the new design based on this knowledge — while keeping a close eye on the cost of the individual components.

Our final design bears little resemblance to the previous 18V/1A supply as it happens, and uses a larger case and power transformer, has meters for both voltage and current readings, sports two heatsinks on the rear panel, and uses a much larger circuit board and number of components.

Until you notice the additional '0V' binding post on the front panel, the unit looks like a reasonably conventional 40V power supply with variable current limiting. It's the combination of this connector and the current limiting control that sets the design apart from all previous efforts, since now we effectively have a dual-tracking supply *with* fully variable current limiting.

These two features have been quite mutually exclusive in the past, where single-ended supplies tended to offer variable current limiting, and dual-tracking units would have a fixed maximum current limit to protect the supply itself. One reason for this shortcoming in dual-tracking supplies is the difficulty in deriving a simple circuit which is able to both monitor and shut-down the current in each half of the supply, yet can be adjusted by a single 'dual tracking' current limit control.

FEATURES

- Single or dual tracking operation
- Variable current limiting in two ranges
- Individual Volts and Amps meters
- Over-temperature shutdown
- Output load switching
- Current setting switch
- Fully floating circuit with separate earth terminal
- Dropout (output ripple) indicator

In our new circuit however, we've come up with a relatively straightforward arrangement using just three op-amps, which monitors the current in both sections of the supply, produces an output proportional to the *greater* of the two, then limits the supply's output in response to this level when compared to a preset current limit control. And as a bonus, its output can also drive the supply's current meter, which will then display whichever current is greater.

In practice though, both the meter readings and current limiting action are just as you would expect from a conventional supply, and you're not aware that the circuit is picking the higher figure. Note that the two currents will be almost identical when the unit is used as a single-ended or dual-tracking supply, and one will be at zero when only one half of the supply is used — so in all cases, both the meter and the limiting circuit are responding to a realistic level.

The end result is a very flexible arrangement, allowing the supply to perform a wide range of tasks with a minimum number of controls.

As you can see from the summary panel it offers both a host of useful features and impressive performance, and by our reckoning, represents excellent value for money. To be optimistic about Australia's economy, we might present this project as a mean, not so lean, *recovery*-compatible power supply...

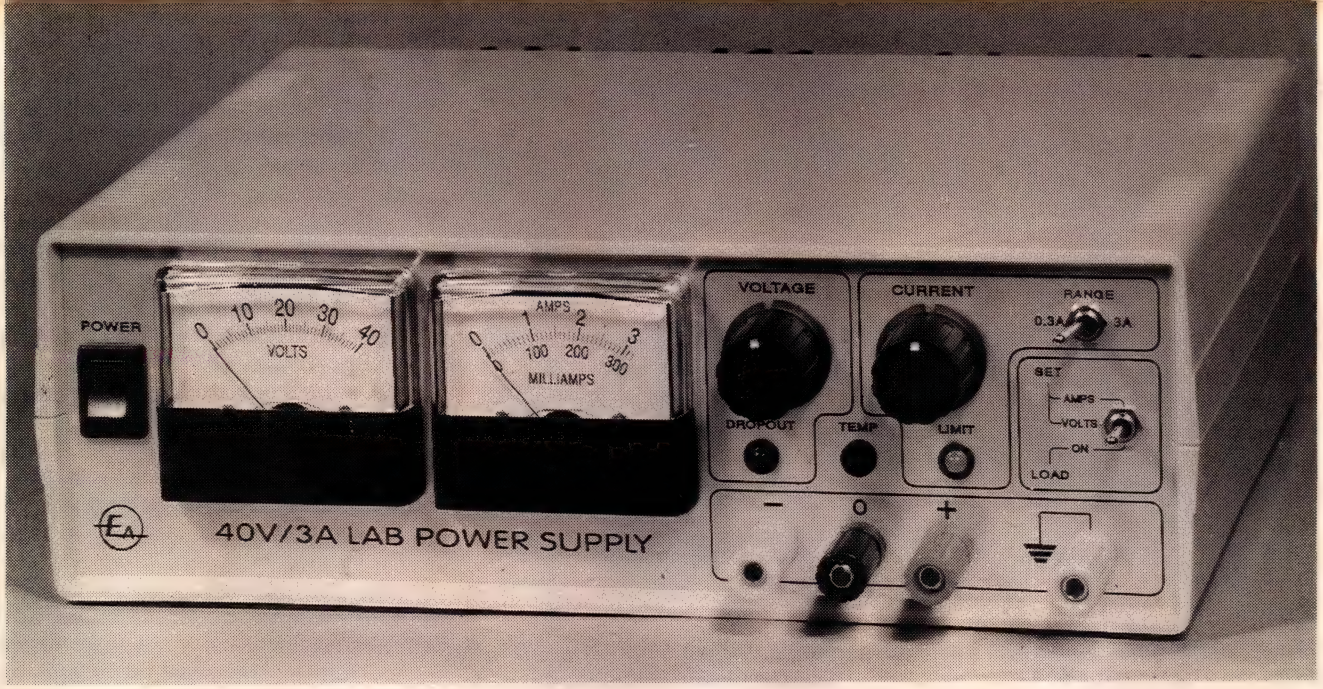
Circuit description

As you can see from the schematic, we've used a number of op-amps to perform the supply's various functions, rather than calling on one or more dedicated regulator ICs (such as the LM723) as used in the previous circuits. This allows for a more flexible design approach and poses few restrictions on the unit's performance or features.

Despite the reasonably high component count though, the circuit itself is quite straightforward and can be divided into several sections, with each op-amp and its associated components performing quite a distinct function.

In general terms, IC1A (with Q1 and Q2) forms the positive regulator stage, and IC1B 'measures' its output current across R4 or R5, while IC2A (with Q3 and Q4) and IC2B (with R14 and R15) perform the same functions for the negative supply.

Other than that, IC3 acts as a temperature detector, IC4A senses the



overall output current, and IC4b monitors the supply's output terminals for excessive ripple.

In more detail, power for the supply is derived from the 15-0-15 volt secondary winding of TX1, and full-wave rectified by the encapsulated diode bridge BR1 producing a raw supply of about +/- 21V (referenced to 0V or ground). This in turn is filtered by reservoir capacitors C1 (positive supply) and C2 (negative), then applied to both the main circuitry and the 12V regulators IC5 and IC6 — these provide +/-12V rails for the low-powered circuitry.

The main positive regulator circuit is based around IC1A, and can be considered as a standard non-inverting amplifier, with its output current capability boosted by the darlington pair formed by Q1 and Q2. This stage has a gain of two, as set by the combination of R1 and R2, includes both the darlington pair and resistors R4 to R5 in its feedback loop, and has its input connected to the wiper of the Voltage pot, RV1.

Note that to assist in understanding and faultfinding the circuit, we've included a range of typical voltage readings on the schematic itself. These are for an output voltage setting of +/-10V (20V overall), and correspond to a 1A output current — which would be flowing into a load of 10 ohms per side (or 20 ohms overall) connected via the output switch SW2.

If we also assume for the moment that the voltage across RV1 is constant (at around 10.5V) and the wiper is set to a level of 5V as shown, then the positive regulator's output will be at 10V since the op-amp will drive its output so as to make the voltage at its two inputs (pins 5 and 6) at the same level (in this case, 5V). And of course if the output voltage is say tending to fall, the reduced level at the op-amp's inverting input (pin 6) will cause its output to rise, thereby increasing the drive to Q1 and Q2 and correcting the fall.

The remaining parts of this stage include C4 to restrict the overall bandwidth, C3 to remove any stray interference induced in RV1 (as it's remotely connected to the PCB), and power supply bypass components R3, C8 and C9.

R3 has been included to reduce the overall voltage applied to IC1 to a safe level of around 32V when the supply is unloaded, where the raw positive rail rises to about 22V. Without the small drop induced by the 680 ohm resistor, the voltage across the TL072 would be around 34V, which is uncomfortably close to the IC's maximum supply rating of 36V.

Next in line is the current sensing stage, based around the differential amplifier IC1B, which monitors the voltage across the regulator's current sensing resistors R4 or R5/R6 as selected by the current range switch SW1. In this circuit the two input networks (R16 to R19 and RV2) set the *differential* gain to 4.5 and the *common mode* gain to near zero, so that voltage levels common to both inputs (the supply's output voltage) are ignored and only the voltage drop across the sensing resistors (proportional to the supply's output current) will be amplified.

In the situation depicted in the schematic, R5 and R6 are bypassed by SW1A (shown in the 3A position), which leaves R4 as the sensing resistor. As is indicated by the voltage levels, the 1A current flowing into the load induces a drop of 0.22V across R4, which is then amplified by IC1B to produce an output level of 1V at the cathode of D3 — more about this diode in a moment.

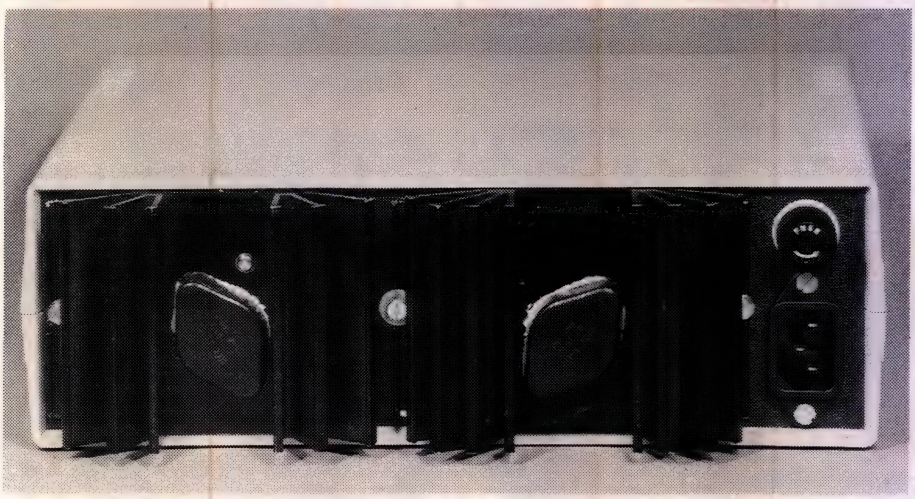
As you would also expect, when the load is disconnected and the voltage drop *across* R4 falls to zero, the differential amp's output will drive to 0V — in short, we have a current-to-voltage converter with floating inputs, where in this case, the output rises at a rate of 1V per amp. This then drives the current reading meter M1 (via RV6 and R32), and the following current limiting stage based around IC4A.

When we wish the supply to have a current reading and limiting range of 0.3A rather than 3A as above, SW1 is moved to the 0.3A position where R4 is bypassed and R5 and R6 are now in circuit. If the parallel combination of these resistors had the value of 2.2 ohms, we would then have a theoretical output rate of 1V per 100mA from the differential amp — the required ten-fold increase in sensitivity.

In practice however, we have made up the required value from the parallel combination of a 2.7 ohm resistor and a 12 ohm 'padding' resistor, where the latter is used to adjust the overall value so that we have *exactly* ten times the resis-

SPECIFICATIONS

Output voltage: 0 to 40V (0 to +/-20V)
Output current: Up to 3.5A (see Fig.1)
Current limit: Approx 30mA to 3.5A in two ranges
Load regulation: Better than 0.2% at 3A output current
Output ripple: Less than 5mV at 3A output current
Overload duration: Indefinite



The rear panel holds the heatsinks for the series-pass transistors Q1 and Q4, plus the mains fuseholder and IEC connectors — note the plastic insulating caps fitted to the transistors.

tance that was present when SW1 is in the 3A position.

Since the resistors involved won't precisely match their rated value, and SW1 and its associated wiring will effectively add resistance to R4, we need to adjust one of the sensing resistors so that both the current readings and limiting settings make sense between ranges.

While our prototype supply showed only a small error between current ranges with just a 2.2 ohm resistor installed (rather than the parallel pair), we felt that the variables involved would surely work against some constructors, and the trimming scheme was required. Fortunately, the adjustment process itself is quite straightforward (see 'Setting up, testing' in part 2).

The remaining components in the differential current amp are the input balancing trimpot RV2, and the output isolating diode D3 — which allows two of these stages to control a single output line in an OR fashion — as you've probably noticed, the negative supply based around IC2A drives an identical current sensing amp, formed around IC2B, which despite having negative rather than positive voltages at its inputs, operates in the same manner.

While a first sight this ORing scheme appears quite simple — since two diodes alone form an OR gate — its actual operation is quite subtle. Considering the action of IC1B with the voltages as shown on the circuit, you can see that any fall in the final output voltage (at the cathode of D3) will be automatically corrected by the negative feedback action via R19 — note that D3 is always forward biased in this scenario.

However, if the final output is tending to rise (say, pulled high from some other drive source), the negative feedback action will force the op-amp's output (pin 1) to drive low, in an effort to correct the situation. Diode D3 then becomes reverse biased, and the op-amp is no longer driving the output, which continues to rise. As you've no doubt gathered, this 'other' drive source is in fact the output from the negative supply's current sensing amp (IC2B), which is (say) responding to an increase in load current.

Thus we have a situation where the section of the supply (that is, positive or negative) which is handling the most output current will be driving the current meter and limiting circuits. With the voltage levels shown on the schematic, the negative supply is handing slightly less current than the positive, and consequently, the output of IC2B (pin 7) has driven low. Of course, if the output current was flowing *directly* from the positive to negative output terminals, this would mean that the negative current sensing circuit has a slightly lower sensitivity to that of the positive current sensor.

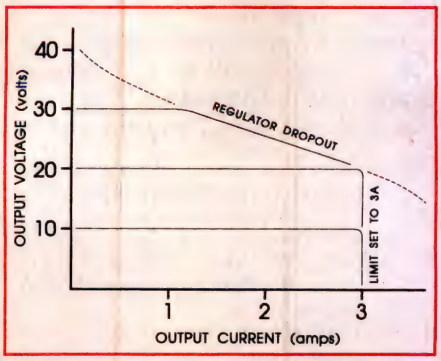


Fig.1: The supply's output current capability at voltage settings of 10, 20 and 30 volts, with the current limit set to 3A.

By the way, R24 has been included to provide a standing bias current through whichever diode is conducting (D3 or D4), so that it cannot become reversed biased when the output voltage is close to zero.

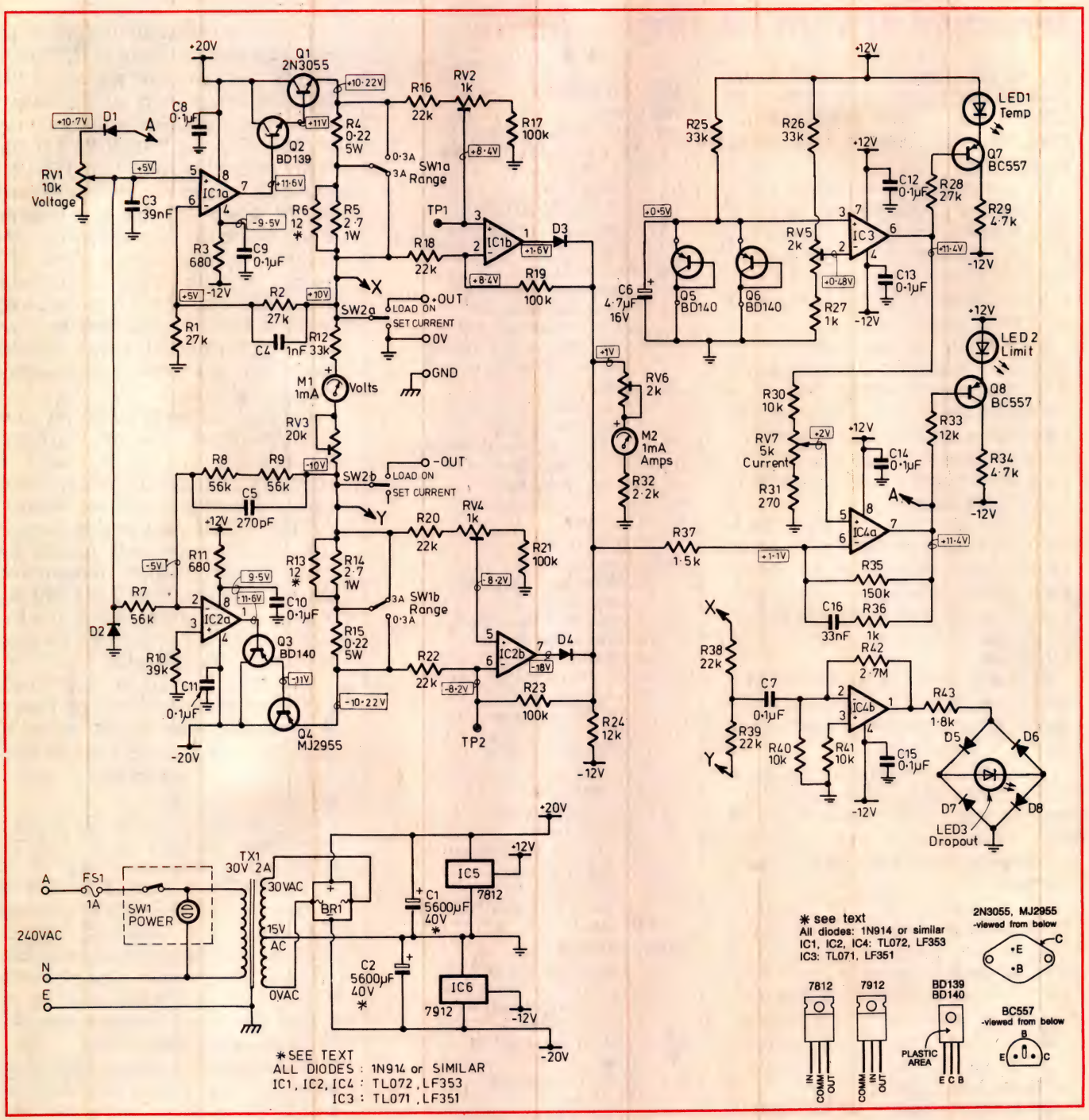
The current sensing output is applied to the metering circuit (M1) as mentioned, and the current limit detector based around IC4A. The best way to think of this stage is as a simple comparator, where a preset level is applied to the non-inverting input from RV7 (Current) and our voltage representing the supply's output current is applied to the inverting input — if the latter exceeds the former, the op-amp's output will swing low.

With the voltages as shown on the circuit, the Current pot (RV7) is set to detect a level corresponding to 2A (2V) and the current detector is generating a 1V level in response to the supply's output current of 1A. In this situation, the output of IC4A is at a high level (around 11V), Q8 is biased off via R33, and the limiting indicator LED2 is off. And most importantly, the high level at pin 7 of IC4A is passed to the Voltage pot RV1, via isolating diode D1 — providing the supply's overall reference voltage (note the connection at point 'A' on the schematic).

If the supply's output current rises above 2A however, the level presented at IC4A's inverting input will exceed that at its non- inverting input (as set by RV7), and its output will swing low. This then biases Q8 on via R33, which in turn activates LED2 via limiting resistor R34, indicating that current limiting is taking place. As you expect, the fall at the output of IC4A will also cause a similar drop in voltage across RV1, which reduces the regulator circuit's source voltage and causes the supply's output level to fall.

This in turn reduces the current flowing into the load and the voltage level applied to IC4A's inverting input, which halts the downward trend at the op-amp's output, and so on. Thus the whole feedback process causes the output voltage to balance at a point where our preset current (set by RV7) is flowing into the load.

Despite this seemingly convoluted process, the comparator stabilises quickly and smoothly, as IC4A has its gain set to 100 by R37 and R35, and the transient response is tailored by feedback components C16 and R36.



The supply's overall schematic diagram. The voltage readings shown on the circuit correspond to an output voltage of +/-10V (20V overall), and a load current of 1A.

Any voltage changes at the wiper of RV1 also effect the *negative* regulator circuit, as you'd expect. This circuit is based around IC2A, and acts as an *inverting* amplifier with a gain of two (rather than a non-inverting stage as for the positive regulator circuit). So for a source voltage of 5V, the negative regulator will produce an output of -10V.

In this circuit the gain is set by the combination of resistors R7 to R9, the bandwidth restricted by capacitor C5, and the output current capability boosted by PNP transistors Q3 and Q4. Other than that, R11 restricts the supply voltage as before, C10 and C11 bypass the IC2A's supply pins, and R10 locks the non-inverting input (pin 3) to ground. Finally, D2 has been included to prevent the source voltage swinging below -0.6V — which won't occur in normal circumstances, by the way.

The final parts of the supply's circuit concern the output ripple detector based on IC4B, and the temperature cutout stage formed around IC3. The temperature sensing circuit uses IC3 as a conventional comparator, where a reference voltage is applied to the inverting input (pin 2) via a voltage divider formed by R26, R27 and RV5, and the inverting input (pin 3) monitors the voltage across transistors Q5 and Q6.

These PNP flat-pack power transistors (BD140's) are effectively connected as diodes, where the current supplied by R25 flows through their base-emitter junctions to ground.

And as you would expect from the natural temperature response of the silicon junctions, the voltage drop across the base-emitter connections (Vbe) will

fall as the transistors become hotter. Note that we've also bridged the base-collector legs on each device, and included a filter capacitor (C6) across the junctions.

Referring again to the voltage levels shown on the circuit, you can see that if the combined voltage drop across Q5 and Q6 falls below 0.48V then the output of IC3 will swing low, and LED1 will illuminate via Q7 — indicating a temperature shutdown.

Since the two B-E junctions are connected in parallel, the hottest transistor will dominate the voltage drop in a natural OR fashion, and that device will trigger the shutdown. In the final supply, Q7 is attached to bridge rectifier BR1 via a small heatsink bracket, and Q6 is bolted to Q1's heatsink.

The first idea here is to protect both the bridge rectifier and power transformer from thermal failure, by sensing the rectifier's temperature — which will increase as the transformer's secondary current rises in response to heavier load conditions.

So over a period of time, the rectifier's dissipation will reflect that of the transformer, allowing protection of both components with one sensor.

Note that if the supply is delivering a high current at a moderate output voltage, the series pass transistors have a *low* voltage across their collector-emitter junctions and therefore dissipate little power.

For example, if the positive regulator is supplying 3A at an output level of 10V, the raw supply rail will have dropped to around 12V, leaving just 2V across Q1 and a resulting dissipation of only 6W — the heatsink will be relatively cool, but both the rectifier and (eventually) the transformer become quite hot.

On the other hand, if the regulator is delivering only half of that current (1.5A) into say a short circuit, the full supply rail (around 20V at this current) is impressed across Q1, forcing it to dissipate a much higher power level of about 30W — in this case, the rectifier and transformer remain relatively cool, but the heatsink becomes hot.

So as you've no doubt gathered, the second temperature sensor attached to Q1's heatsink is intended to protect the series-pass transistors against thermal failure. While the temperature of the negative regulator's pass transistor (Q4) is not sensed directly, its dissipation will be very close to that of Q1 in virtually all circumstances.

PARTS LIST

Resistors

(All 0.25W 5%, unless noted): 1 x 2.7M, 1 x 150k, 4 x 100k, 3 x 56k, 1 x 39k, 3 x 33k, 3 x 27k, 6 x 22k, 2 x 12k, 3 x 10k, 2 x 4.7k, 1 x 2.2k, 1 x 1.8k, 1 x 1.5k, 2 x 1k, 2 x 680 ohms, 1 x 270 ohms, 2 x 12 ohms (see text), 2 x 2.7 ohms 1W, 2 x 0.22 ohms 5W

Variable resistors

1 10k single-gang linear pot
1 5k single-gang linear pot
1 20k horizontal-mounting trimpot
2 2k horizontal-mounting trimpots
2 1k horizontal-mounting trimpots

Capacitors

2 5600uF 40VW PC-mount electrolytics (see text)
1 4.7uF 16VW PC-mount electrolytic
9 0.1uF MKT polyester
1 33nF MKT polyester
1 39nF metallised polyester
1 1nF ceramic
1 270pF ceramic

Semiconductors

1 2N3055 NPN transistor, plus mounting hardware
1 MJ2955 PNP transistor, plus mounting hardware
1 BC139 NPN transistor
3 BD140 PNP transistors, plus 1 insulating washer
2 BC557 NPN transistors
3 TL072 or LF353 dual opamps
1 TL071 or LF351 opamp
1 7812 +12V regulator
1 7912 -12V regulator
1 PW04 400V/6A bridge rectifier (or similar)
8 1N914 or 1N4148 signal diodes
2 5mm red LEDs, plus mounting hardware
1 5mm yellow LED, plus mounting hardware

Miscellaneous

1 PC board 149 x 113mm, coded 93ps9
1 Plastic instrument case, 260 x 190 x 80mm
1 30V/2A center-tapped power transformer
2 radial-finned heatsinks, 105 x 70mm
2 TO-3 plastic insulating caps
2 MU-45 type meters, 1mA FSD
1 DPDT miniature toggle switch
1 DPDT miniature toggle switch, centre off, momentary action on one side.
2 Plastic knobs
4 Banana-type binding posts (yellow, black, red & green)
1 miniature rocker power switch, with internal neon
1 Panel mounting IEC-type mains plug (male)
1 3AG panel mounting fuse holder, with 1A fuse

Solder lugs, heavy-duty hookup wire, mains-rated hookup wire, rainbow cable, PCB pins, aluminium plate, heatshrink or cambric tubing, nuts, bolts, lockwashers, etc.

The actual temperature shutdown action occurs as the output of IC3 (pin 6) swings negative (to around -11V), reversing the polarity of the voltage across the 'current set' voltage divider — R30, RV7 and R31. If RV7 is normally presenting IC4A (pin 5) with a reference voltage of say 2V, as shown on the schematic, this will immediately swing to about -2V as the divider's source voltage from IC3 swings negative. This in turn will cause the output of IC4A to also swing negative by its normal comparator action, which removes the source voltage from RV1 and reduces the supply's output level to zero.

The final section of the supply's circuit is the output ripple (dropout) detector based around IC4B, which is effectively configured as high gain dual-input amplifier. This senses the output of the negative and positive regulators via R38 and R39 respectively, isolates any AC component (such as 100Hz ripple) through high-pass filter C7 and R40, and amplifies the remaining signals by a factor of around 120 — as set by the combination of R38/R39 and R42.

This amplified signal then drives LED3, via the current limiting resistor R43 and a full-wave rectifier formed by D5 to D8, which ensures that both positive-going and negative-going swings are passed to the LED.

So in practice, if the supply's output ripple exceeds a level of about 30mV, there will be sufficient voltage at the output of IC4B to overcome the forward voltage drop of the rectifying diodes and LED3. The LED will then illuminate, indicating a dropout condition — that is, one (or both) of the regulators have run out of voltage headroom, allowing ripple from the raw supply rails to pass to the output terminals.

So that's it for the various stages in the supply's circuit. The final regulated outputs are passed to the load switch SW2, which isolates the load in the 'set volts' position, connects the load when 'load on' is selected, and shorts the positive output to 0V in the 'set current' position so the maximum output current can be set in advance.

The voltage meter (M1) and its associated resistors (R12 and RV3) are tied between the supply's positive and negative outputs, and will therefore respond to changes in the unit's overall output voltage.

Unfortunately, that's all the space we have available in this issue. In the next and final part, we'll look at constructing and setting up the lab supply.

(To be continued) ❖

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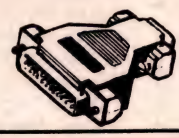
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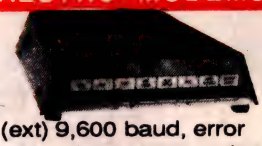
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ROD IRVING ELECTRONICS

SALE! SALE! OUR BIGGEST AUDIO SALE EVER! SALE! SALE!

SAVE HEAPS ON AUDIO MIXERS FOR THE AMATEUR OR PROFESSIONAL

FOUR CHANNEL SPECIAL EFFECTS MIXER

SAVE $40



At last a console or freestanding mixer with eight inbuilt special effects. Allows sounds and special effects to be mixed into existing soundtracks without the aid of additional external sound generators. As the MM6 is designed for both DJ and studio use, the following inputs are provided: 2 x turntables • 4 x line inputs • 2 x low impedance microphones. Eight special effects are programmed into the unit:
• siren • telephone • machine gun • bombing • shooting • ambulance • thunder • laser. Studio outputs are available for connection to a power amplifier and a recording tape or cassette deck. Other features include bass and treble controls, headphones (cue) monitoring CH1 to CH2 cross fade, microphone talkover switch, master voice level control and left and right LED

A12013 Was ~~$299.00~~ Sale Price Just $259.00

FOUR CHANNEL MICROPHONE MIXER

SAVE $20



Its size and simplicity makes this mixer portable and easy to operate. This will accept up to four low impedance microphones and mix them through to one microphone output. Each microphone volume can be individually controlled and a master volume control attenuates the overall audio output level.

A12001 Was ~~$69.95~~ Sale Price Just $49.95

VIDEOCAM / VCR AUDIO MIXER

SAVE $70



A professional audio mixer designed for the serious home video movie maker through to the home video camera user.
Background music and effects can be faded in and out so they can be added to existing video tape soundtracks. Ideal for weddings, family, sporting and other recordings.

A12013 Was ~~$299.00~~ Sale Price Just $229.00

MM-4 4-CHANNEL BALANCED MIXER

SAVE $40

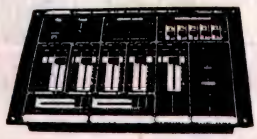


The MM-4 is a 4 channel stereo mixer with balanced in/output. The trim control corresponds with all input signals, and it can control without any distortion by PEAK LED. Also the EFFECT control is provided as a kind of line. Each output level can be controlled L/R independent volumes. It can be used as a DI-BOX so that the output is balanced. And it does not choose a space because of its compact size. The MM-4 is a mixer designed at musician's request.

A12017 Was ~~$299.00~~ Sale Price Just $259.00

UNIVERSAL STEREO MIXING CONSOLE

SAVE $70



Compact portable desk mount or panel mounting stereo mixer with 5 band graphic equalizer and twin LED display UV meters. It also has a 5/8" screw adaptor for mounting microphone holders or goosenecks directly onto the console.
• 1 x low impedance microphone input-switchable.
• 3 x stereo magnetic turntable inputs-switchable
• 3 x stereo line inputs-switchable
• headphone monitoring channels
• 18dB talk over switch.
• Output sockets for both the amplifier and tape deck

A12012 Was.~~$399.00~~ Sale Price Just $329.00



MULTI COLOURED MICROPHONES

A range of inexpensive coloured body microphones complete with anti "pop" grilles, on/off switch.
• Type: Uni directional
• Impedance: 600 ohm
• Freq. Response: 100Hz to 15Hz
• Sensitivity: -76dB
• Cord Plug: 3 metre / 6.35mm plug
• Colours: Black, Blue, Gold, Red, White, yellow

A10132
~~Was $15.95~~ each
Sale Price: $12.95

Save $10



TIE TACK WIRELESS UNI DIRECTIONAL MICROPHONE (ECM550)

: Tunable: 88 - 108MHz
Freq. response: 50-16kHZ
Field Strength: 15uV /100m
Cord / plug: 5 metre 3.5mm plug
• Battery: 1.5V (LR-44)
Type Electret condenser

A10127 Was ~~$39.95~~
Sale Price: $29.95

Save $10



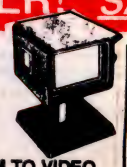
TIE TACK ELECTRET MICROPHONE

Miniature tie tack microphone fitted with on/off switch. Simply attach to your shirt lapel and plug into any low impedance microphone socket. Comes complete with tie clip, plug adaptor and wind screen
SPECS:
Type: Omni directional
Freq: Response: 50Hz - 16kHz
Battery: 1.5V (1 x AAA/UM4)
Plug: 3.5mm or 6.5mm adaptor

A10137 was ~~$39.95~~
Sale Price: $29.95

New Catalog out NOW !!
Free at all our Stores or one will be sent out with each mail order

Save $10



SLIDES /FILM TO VIDEO CONVERTOR

Transfer home movies and slides onto video tape.
• Simply project the slide or movie projector at the mini screen on the side of the convertor, then aim your video camera at the front of the convertor where the image has been reflected to and record.
• Adjustable height pedestal makes setting up easy.

A11464 Was $70.95
Sale Price **$59.95**

SAVE BIG ON SPEAKERS



8" TWIN CONE FULL RANGE SPEAKER

Foam edge, black cone, black wizzer cone
SPECS:
• Sensitivity: 98dB
• Freq. Responce: 45-16kHz
• Impedance: 8 ohms
• Power RMS: 30 watts RMS
• Magnet Weight: 13 oz.

C10224 Was ~~$29.95~~
SalePrice: $22.95

Save $10



8 "WOOFER HIGH POWER SPEAKER

Cloth edge, dark grey cone, rubber mounting seal, cloth dust cap.
SPECS:
• Sensitivity: 90dB
• Freq. Resp: 60-4kHz
• Impedance: 8 ohms
• Power : 40 watts RMS
• Magnet Weight: 20 oz.

C10226 **Was ~~$39.95~~**
Sale Price $29.95





MIDI EXPANDER

This MIDI (Musical Instrument Digital Interface) expander is a parallel box desinged espesially for Digital interfacing of most keyboards, sequencers and musical instruments with 5 pin DIN MIDI socket outputs. Switching allows one keyboard / sequencer to control up to eitgh keyboards or two keyboards / sequencer to control up to four keyboards each.

A12014 Was $110.95
Sale Price.$87.95

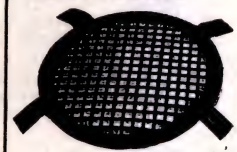
SPEAKER GRILLE SPECIALS



4" SPEAKER GRILLE

White plastic frame
White mesh

C10805 Was ~~$5.95~~
Sale Price $4.95



HEAVY DUTY SPEAKER GRILLES

Robust black thick metal mesh speaker grille with rubber surround. Each grille comes complete with four right angled mounting brackets, bolts and self gripping nuts designed for wooden speaker enclosures

8" HEAVY DUTY SPEAKER GRILLE
C10818 **WAS ~~$12.95~~**
Sale Price $9.95

10" HEAVY DUTY SPEAKER GRILLE
C10810 **WAS ~~$15.95~~**
Sale Price $11.95

12" HEAVY DUTY SPEAKER GRILLE
C10808 **WAS ~~$19.95~~**
Sale Price $14.95

15" HEAVY DUTY SPEAKER GRILLE
C10815 **WAS ~~$24.95~~**
Sale Price $17.95

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SOLAR PANELS



SAVE $20

9 Watt Solar Panel

Size: 370 x 370 x 17mm
• 12V Voc 16V (max) 18V
Isc 400mA (ax) 500mA
Z19028...Was ~~$99~~
Now Just $79.00

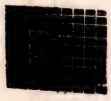


SAVE $30

18 Watt Solar Panel

12V Voc 16V (max) 18V
Isc 800mA (max) 1000mA

Z19036...Was~~$199~~
Now Just $169.00

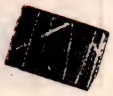


SAVE $70

27 Watt Solar Panel

12V 16V (max) 18V
Isc 1200mA (max)
1500mA
Z19038.....Was~~$299~~
Now Just $229.00

SOLAR CELLS



ENCAPSULATED SOLAR CELL MODULE 0.45V 200mA

Z19001 Was~~$2.95~~
Now Just $1.95



SAVE $5

SOLAR PANEL 3, 6, 9 VOLT

Simple and easy to use, this solar panel converts the sun's energy to electrical power supply of 3, 4.5, 6 and 9 volts for different electrical appliances. An ideal & conveinient power supply for powering small calculators, radios battery operated toys etc. This product also doubles as a battery charger for "AA" size rechargable batteries

Z19013 Was~~$24.95~~
Now Just 19.95



SOLAR PANEL WITH MULTIPLUG

Provides extra power for your portable radio / cassette player, simple to use, easy and convenient. Clips to your belt or pocket as a solar battery charger for rechargable batteries.

Z19015.....Only.$12.95

SOLAR BATTERY CHARGERS



SAVE $10

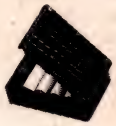
SOLAR CAR BATTERY CHARGER

Never worry about your car battery giong flat when left without being used over a prolong period of time. Simply place the solar power unit on your dash or near a window in your garage and plug it into your car cigarette lighter. The unit consists of solar cells in a housing with 1 metre of cable and cigarette plug.

Z19054 ..Was ~~$29.95~~
Now Just $19.95

SUPER SOLAR CAR BATTERY CHARGER

Z19052.....$69.95



1/2 PRICE

SOLAR BATTERY CHARGER FOR "AA" SIZE BATTERIES

2 Cells & 2AAA cells
Z19050 Was~~$18.95~~
Now Just $9.95



SAVE $10

"C" & "AA" SIZE SOLAR BATTERY CHARGER

One of the cleverest battery chargers ever made. This battery charger doesn't just charge "C" size batteries it also chargers "AA" batteries Never be without powe again. Great for camping, fishing, boating etc. So compact it can be taken anywhere.

Z19051 Was~~$10.95~~
Now Just $9.95



KEYCHAIN BATTERY ANALYZER FOR TESTING ALL SIZES OF BATTERIES

Z19062.....Only $4.95

SOLAR LIGHTS



SOLAR CAR EMERGENCY LIGHT AN CHARGER

Use this great device as an emergency light/blinker. or as a torch light for repairing your car etc. in the dark. The solar panel can be adjusted to different angles for better absorbeion of sunlight. Can also be used as a straight forward battery charger for for charging rechargable batteries Comes with 2 NC standard rechargable batteries.

Z19053 Was ~~$29.95~~
Now Just $27.95



SOLAR MUSICAL KEYCHAIN WITH LIGHT

Never lose those keys again with this clever little device. The solar powered keychain with light will let you know where you left your keys just by listening for the music. The solar powered light will always let you find that illusive keyhole in the dark.

Z19060.....$4.95



SAVE $10

RECHARGEABLE SOLAR LIGHT

- Automatically turns on at night and turns off during the day.
- Detachable solar panel for indoor or outdoor use. • Unique protection for low voltage discharge ciruitry makes charging easy and quicker!
- Easy to install, equipped witha ccessories for easy asseembly beside the house number, pathway, side of the house, in the garden, sitting room study room etc.
- Speedy Charging - Only 6 hours of charging will give 12hours of use at night. (Depending on location and time of year)

Z19060 Was~~$40.95~~
Now Just $39.95



SOLAR EMERGENCY LIGHT

Never worry about getting caught in the dark when your batteries go flat in your torch. This Solar Rechargeable emergency light stores energy from the sun during the day so that the light can be used during the night.. Great for reading so searching in the car. Ideal for camping, Barbecues etc.

Z19061.....Just $19.95

SOLAR RADIOS



SOLAR MINI FM RADIO

Take this solar FM radio anywhere. It's lightweight & con convenient Can be hooked onto a keychain or clip it onto your belt or clothing. It can be charged off the sun or incandescent light. • Unique feature: This radio is equipped with an external DC jack (3.5mm) for quick recharge and operation during or no light.

Z19069 Was ~~$29.95~~
Sale Price..$24.95

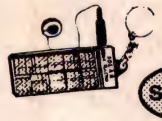


SAVE $20

DYNAMO & SOLAR AM/FM RADIO WITH 4 WAYS POWER BACKUP.

This is the radio that every traveller should have! You will never run out of energy sources for this little radio because it has four different power sources: Solar power, Manual dynamo winding, DC charging, "AA" batteries.

Z19064 was ~~$49.95~~
Sale Price $29.95



SAVE $10

SOLAR AM/FM RADIO KEYCHAIN

Pocket size AM/FM radio with keychain and clip for easy listening anywhere, anytime.Where ever your keys go so does your solar radio.

Z19068..Was ~~$29.95~~
SalePrice.....$19.95

SOLAR EDUCATIONAL TOYS



SOLAR MOTOR KIT

This is a great starter kit consisting of a 0.9V 400mA solar cell and a small motor with a 48" wire. Great for beginners or just the curious.

Z19040... Was ~~$9.95~~
Sale Price $7.95



EDUCATIONAL SOLAR ENERGY KIT.

Learn what solar power is and how to build your own solar system. With this great kit you can make an electrical circuit. Learn how to increase voltage, current and how to make a solar panel and produce energy from the sun.

Z19042 Was ~~$22.95~~
Sale Price...$17.95



1/2 PRICE

SOLAR WOODEN MODELS

Build great little solar powered wooden models with these kits! There are 3 different kinds of models to choose from. A helicopter with working motor, an aeroplane with working motor or a gramophone that plays music. Each kit contains a set of precut plywood, PVA cement, assembly instruction sheet, solar cell module, musical IC or small DC motor, wire and sandpaper.

Z19044 Aeroplane
Z19046 Gramophone
Z19048 Helicopter
Were $19.95 Each
Sale Price $9.95 each



SAVE $15

SOLAR VENTILATOR

Specially designed to circulate the air inside your house, apartment, home unit, kitchen, toilet, bedroom etc.
- Ventilate the hot air slowly & smoothly with soft air, not a violent breeze which can untidy & dusty. • Works directly from the sun. Does not need a battery.

Z19055...Was ~~$39.95~~
Sale Price.....$24.95

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NEW DUAL CD ROM DRIVES

The CD ROM drive is fast becoming a standard feature in home computers. Why? Because an average 1.2 Gigabytes of data can now e stored on a single CD using these new dual speed CD ROMs. A key component to multimedia is the CD ROM Drive as multimedia applications are data intensive and a CD is capable of holding so much information without filling up your hard drive. A CD ROM drive will also fit into any 5.25" half height dive bay on your IBM compatible (XT's not compatible.)



A range of Multimedia packages exist and are available from Rod Irving Electronics.

PERFORMANCE PACK

- SOUND BLASTER 16
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- BUNDLED CDS INCLUDE:
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- ANIMALS SAN DIEGO ZOO
- JUST GRANDMA & ME
- WHERE IN THE WORLD IS CARMEN SAN DIEDGO? (DELUXE)

X17160.....$799.00

PREMIUM PACK

- SOUND BLASTER 16
- DUAL SPEED CD ROM
- MICROPHONE, SPEAKERS, VOICE ASSIST (Voice Recognition Software)
- BUNDLED CDS INCLUDE:
- SOFT TOOLWORKS ENCYCLOPEDIA
- ALDUS PHOTOSTYLER
- ANIMALS SAN DIEGO ZOO
- MACROMIND ACTION PRESENTATION PACKAGE
- AUTHORWARE STAR-MPC DEVELOPMENT PACKAGE
- MATHAMATIC TEMPRA • PC ANIMATE PLUS
- HSC INTERACTIVE-MPC DEVELOPMENT

X17170.....$1199.00

X17175 .....(+ $150 for Sound Blaster 16 ASP)

HUGE SAVINGS ON SOUND BLASTER CARDS

SOUND BLASTER DELUXE II

The Sound Blaster Deluxe is the ultimate sound board that easily plugs into any slot in your IBM, PC, XT, AT, 386 etc.

- Text to Speech synthesizer
- 11 Vice FM music synthesizer
- Digitized Voice output with 4 KHz to 44, 1KHz Sampling rate.
- Digitized voice input (8 Bit Analogue to Digital conversion)
- Built-in Midi Interface for connecting Musical instruments
- Built-in joystick port
- Built-in stereo Power amplifier
- Bundled software includes: Sbtalker for reading ASCII files & Dr Sbaitso

•Voxkit Voice development toolkit for recording • Sounds talking, Parrot mimics your speech • FM Intelligent organ creates orchestra like music using your PC keyboard as input. • Jukebox - A Windows three application • Creative wave studio • Creative talk Scheduler • Creative Mosaic.

3.5" Version Now X17080.....**Only $119.00**

SOUND BLASTER PRO DELUXE

X17082 Now Just.....$199.00

SOUND BLASTER 16 ASP

*16-bit CD-quality stereo sound sampling and playback with auto dynamic filtering ensures low noise and crystal-clear recording
* Enhanced 4-operator, 20-voice FM music synthesizer with realistic instrument sounds
* ASP (Advanced Signal Processing) technology for downloading and performance complex algorithms
* Improved stereo digital mixer with 10 channels, 32x2dB steps, tone control and recording input mixer
* MIDI interface: MPU-401 UART and Sound Blaster modes
* CD-ROM interface
* Joystick port
* Wave Blaster Upgrade Option: Daughterboard that expands your music synthesis horizon to the professional level
* Compatible with Sound Blaster, Windows 3.1, MPC and OS/2 2.0
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ALSO AVAILABLE

Dual Speed CD-ROM & aldus Photostyler CD (for use with Sound Blaster Pro, Pro V2, SB 16, SB16-ASP)
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NEW TURBO Accelerator Card (Paradise) $185

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With a 131M HD 4M RAM	$2070	$17 0
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With a 345M HD 4M RAM	$2335	$1930
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(3 Slot Local Bus Motherboard)

486DX-50 256K Cache SYSTEMS		
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With a 212M HD 4M RAM	$2485	$2050
With a 260M HD 4M RAM	$2565	$2120
With a 345M HD 4M RAM	$2700	$2230
With a 424M HD 4M RAM	$2920	$2410
With a 525M HD 4M RAM	$3320	$2740

(3 Slot Local Bus Motherboard)

486DX2-50 256K Cache SYSTEMS		
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With a 260M HD 4M RAM	$2470	$2045
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With a 424M HD 4M RAM	$2825	$2330
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(3 Slot Local Bus Motherboard)

486DX2-66 256K Cache SYSTEMS		
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(3 Slot Local Bus Motherboard)

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PRICE ONLY WITH SYSTEMS **MS DOS 6.0.. $99**
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Digital voice channel
Voice imput (digital sampling)
Games port - MIDI interface
Built in Amplifier
FM intelligent organ
Talking Parot

Only $119.00

SOUND BLASTER PRO

20 voice, 4 operator FM
Music synthesizer
Joystick port
Built in MIDI interface
Microphone and line inputs
High performance CD ROM interface.....Only $199.00

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VERBATIM DATALIFE

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387SX SL....$179 387DX.....$189
387DX-40....$179 387SX-40...$179

High speed modem users
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Construction Project:

IMPROVED DECODER FOR ACS SIGNALS - 3

To round off our description of Bob Parker's improved low cost decoder for ACS signals, this article describes how to fit it into a Realistic 12-625A AM/FM portable mono radio, readily available from Tandy stores. This conversion is even simpler than with the Digitor model discussed last month, and can be performed without even removing the set's main PCB from the case.

by JIM ROWE

Before we get into the details of fitting Bob Parker's new ACS decoder module inside the Realistic radio, I should perhaps explain how this further 'application story' came about.

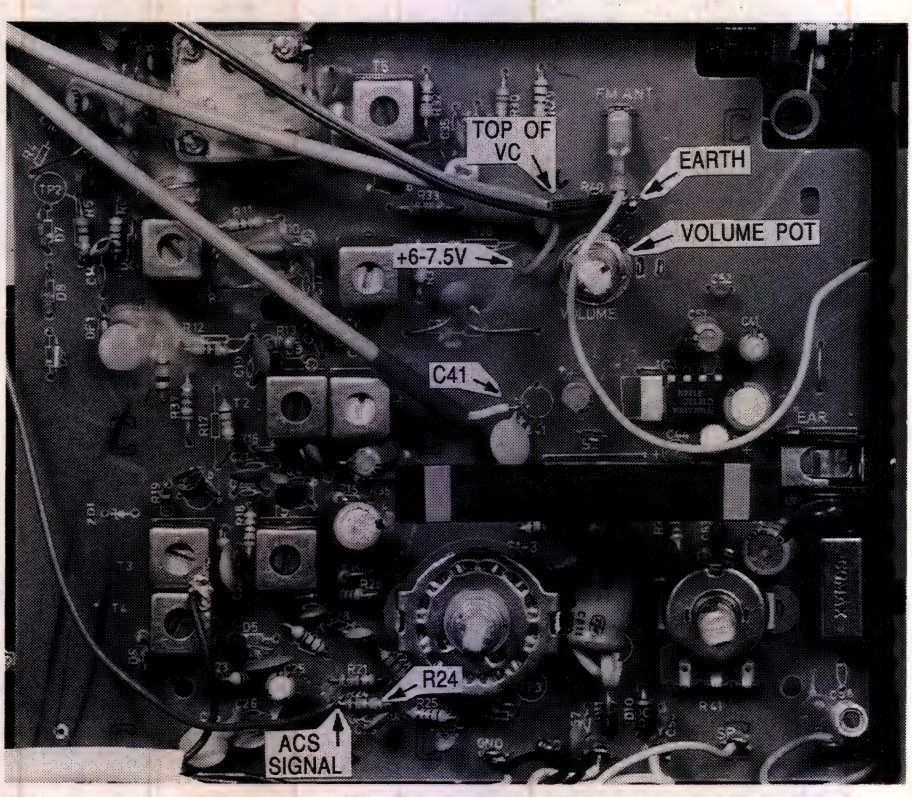
As it happens, I had started to work on a new ACS decoder design myself, before we learned about the Parker design. And during a discussion with Bob Barnes, of RCS Radio, it was suggested that a radio which might well be suitable for conversion to ACS reception was Tandy's Realistic model 12-625A — a reasonably priced set with AFC on the FM band, a good slider-type tuning dial, and a respectable 100mm speaker.

So a sample set was obtained courtesy of Tandy, and I carried out some tests. However with the PLL type of ACS decoder design that *I* was pursuing, it turned out that the level of ACS subcarriers present at the FM detector of the 12-625A was not really sufficient to produce clean and low noise decoding.

I concluded at the time that this was possibly because the set had been designed for only mono reception — presumably the FM IF strip was of relatively narrow bandwidth, and the filtering at the output of the detector itself fairly severe.

It was soon after discovering this complication that I learned of Bob Parker's successful development of his decoder. And when I heard the performance of *this* design, there was no doubt about which one we would publish. My own design was quietly scrapped, and we encouraged Mr Parker to try fitting his decoder into another readily available set: the Digitor A-5235.

This conversion worked extremely well, and showed just how good the slightly unorthodox Parker decoder was, at producing really clean and low distortion ACS audio from relatively weak signals. In fact the performance with the Digitor was *so* good that it made me wonder — would the Parker decoder perhaps give satisfactory results with the Realistic mono receiver, too?



Taken after the prototype receiver had been converted, this photo shows where the various connections are made to the main PCB. Note that the 'upper' lead of capacitor C1 (centre) is cut to provide a take-off for the 'normal' audio.

The only way to answer this was to try it out, so the Realistic set was reopened and temporary connections made between it and a decoder. The results were not only satisfactory, but again excellent — virtually indistinguishable from those with the Digitor in fact, although the Realistic does seem to need a slightly stronger signal from the antenna.

So that's the background to this third article. As you can see from the photos, I went ahead and worked out how to fit a decoder into the Realistic neatly, and in a fairly convenient way. You don't even need to remove the main PCB from the case, as it happens...

To make this conversion a little different from that adopted by Bob Parker for the Digitor, I have deliberately used



a pair of miniature toggle switches rather than a rotary switch for the power/audio/subcarrier switching.

Apart from showing you how to fit the Parker decoder into another readily available and low cost receiver, then, this article should also give you more ideas about converting *any* suitable FM receiver or tuner.

Conversion details

If you're careful, the full conversion of the Realistic 12-625A receiver can be done with the front of the case detached from the rear, and merely 'swung out of the way' without disconnecting any of the wires connecting the two.

All of the connections to the main receiver PCB can be made from the component side, without removing it from the case rear, as mentioned above. There are only six holes to be drilled in the case rear to mount the two additional toggle switches and decoder PCB, and if you carefully use a hand drill and reamer, even these can be carried out without damaging any of the components or wiring.

The front of the set can be detached and swung away for these operations simply by removing the four recessed screws at the rear of the case, and also removing the knobs for the volume control, tone control and AM/FM switch. All three knobs are splined and simply pull off the shafts — but you may need to use a pair of very thin knife or spatula blades to loosen them initially, as they fit quite tightly. Take care not to damage either the knobs or the front of the case, of course.

The Realistic set uses mainly discrete components and a fairly standard 'ratio detector' type of FM detector, as you can see from the partial schematic. The output composite audio is developed across both capacitors C24 and C25 (500pF), and normally fed through a two-stage filter consisting first of resistors R21 and R24 (6.8k) with capacitor C29 (10nF), and then resistor R25 (1k) and C30 (10nF).

These filters not only provide the usual FM de-emphasis, but since this is a mono set they also remove the stereo pilot tone and difference signal — along with the ACS subcarriers. The signal reaching the 'FM/AM' mode switch is therefore purely mono audio.

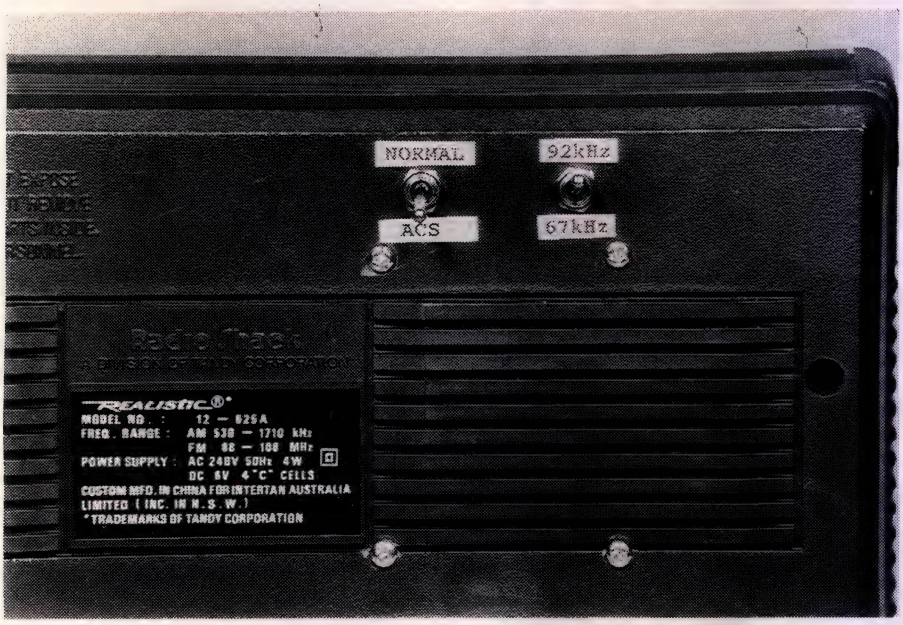
To pick up the ACS subcarrier signals for our decoder, then, we need to tap into the ratio detector right at the reservoir capacitor C25 (10uF) — at one end or the other, it doesn't make any difference. It turns out that there is adequate subcarrier level at these points to operate the Parker decoder, despite the modest IF bandwidth and filtering already provided by resistors R22/R23 and capacitors C24/C26.

I elected to tap in on the R24 side, as you can see. This point is easily accessible on the PCB, and if you're careful you can solder directly to the lead of resistor R24 itself on the end nearest C25, on the component side of the PCB. Just use a small, well-tinned iron, and be fairly quick so you don't damage the resistor or melt the solder under the PCB. (It helps too if you scrape the lead of the resistor clean with a scalpel or hobby knife, before you make the joint.)

With one of the two miniature toggle switches (SW1) used purely for switching the decoder's filtering between the two ACS subcarrier frequencies, the other switch (SW2) is used for both ACS power control (SW2b) and switching between 'normal' and 'ACS' reception (SW2a). This keeps everything surprisingly straightforward.

Happily Bob Parker's decoder is not particularly critical in terms of supply

Improved decoder for ACS signals - 2

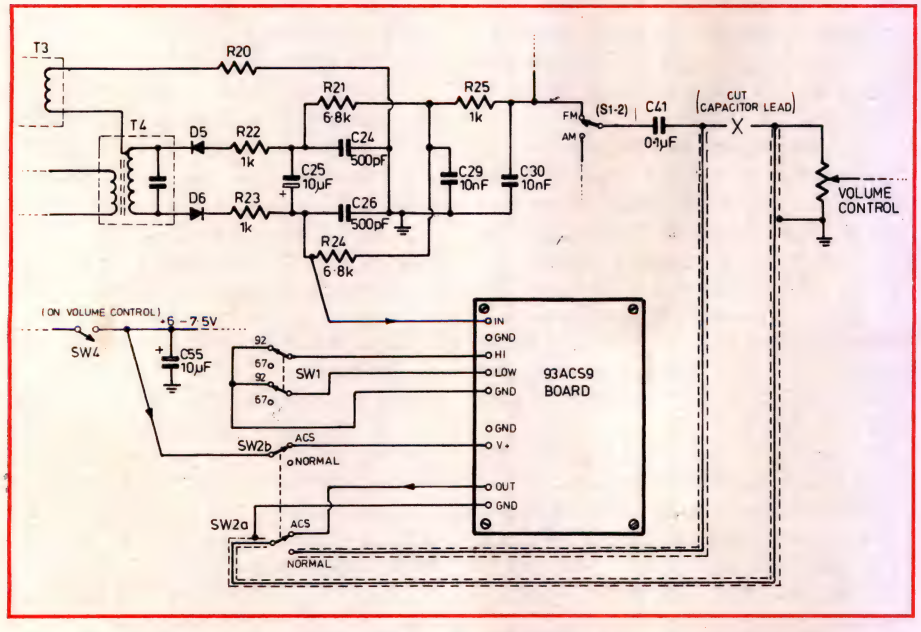


This rear view of the converted receiver shows the location of the mounting screws for the decoder module, and also the two miniature toggle switches.

voltage, operating on anything between about 6V and 30V DC. This allows us to derive its supply directly from the main positive rail in the Realistic set, which varies between 6V when batteries are being used, and 7.5V when the mains supply is operating.

The most convenient point to make the supply tap is at the 'load' side of power switch S4, which is on the set's volume control. The appropriate lug of the switch is again accessible from the top of the PCB, via a small hole which is just to the left of the volume control spindle (looking from the front).

The remaining connections and switching are for the audio signals. With this set, the easiest approach turns out to be breaking the link between coupling capacitor C41 (0.1uF) and the top of the volume control, and using shielded leads to switch SW2a to allow selection of either the original audio signal from the AM/FM switch



This partial schematic shows how the ACS decoder is connected into the circuitry of the Realistic receiver. Only two of the leads used to make the interconnections need to be shielded, as shown here.

(via C41), or the new ACS audio from the decoder.

The track connecting C41 and the volume control is itself under the PCB, but it's quite practical to cut the appropriate lead of C41 itself, to save removing the board for this one step. The capacitor is a reasonably sturdy disc ceramic type, and since we only need to solder the active conductor of a short length of shielded wire to its 'free' lead, there isn't any great likelihood of damage if you're careful.

We don't need to solder to the pad under the PCB, because the connection from the rotor of SW2a can be made to a lug at the volume control itself. So the trick at C41 is to cut its 'top' lead (i.e., the one nearer the volume control) as close to the PCB as you can, leaving as much lead as possible still attached to the capacitor. I found this fairly easy, using a small pair of sharp side-cutters.

(Note that even if you *did* manage to damage the capacitor, it wouldn't be a tragedy. All you'd need to do is crush it with a pair of pliers, to leave only the 'lower end' lead still connected to the PCB. Then you can solder a replacement 0.1uF metallised polyester ('greencap') or similar to this lead.)

Note that the shield braid of the lead from this free end of C41 to switch SW2a is only connected at the switch end, being cut off and taped at the capacitor end.

The second shielded lead runs from the rotor of SW2a to the volume control, and here we are again in luck as the three lugs of the control are again accessible from the top of the PCB, protruding slightly through three holes above the spindle.

As you'd expect the 'top' lug is on the left, the 'bottom' (earthy) lug on the right, and the rotor lug in the centre. So it's a fairly simple matter to solder the active conductor of the shielded lead to the left-hand lug, and the shielding braid to the right-hand lug.

And that actually completes the connections to the set's main PCB and circuitry. I've taken a photo of the modified set, which should make the procedure a little clearer.

Switch, PCB mounting

As you can see from the photos, the decoder PCB can be mounted quite neatly inside the rear of the case, between the power transformer and the main receiver PCB, and just above the area occupied by the speaker magnet when the case is assembled. The two miniature toggle switches are also mounted on the case rear, just above the

decoder itself; the leads to the switch lugs don't conflict with the tuning dial pointer or cord, if you're careful.

The trickiest part is of course drilling the four 3mm holes for mounting the decoder PCB, and the two 6mm holes for the two switches, in the rear of the case. I drilled the four holes for the PCB first, after carefully marking their positions on the outside rear of the case using the decoder PCB itself as a template.

(I suggest you use the outside rear photo as a guide too, as to the correct position. Note that the two lower screw holes are actually in the lowest 'ventilation groove', while the other two are in the flat area above the topmost groove.)

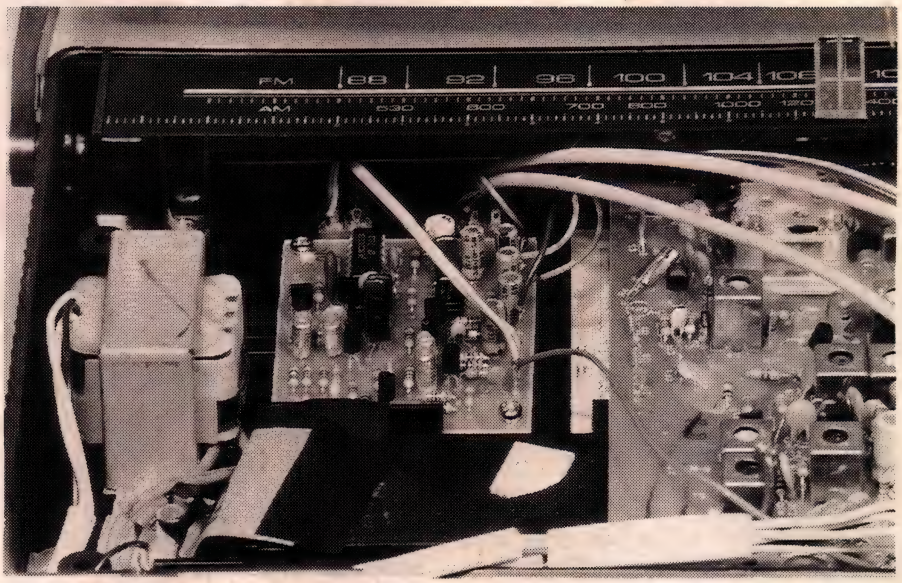
After drilling these holes carefully with a hand drill, I then marked the two switch positions carefully (again on the outside), and drilled these also with the 3mm drill. Then I used a tapered hand reamer to enlarge each hole carefully, until the threaded switch ferrules *just* slipped through. By taking care, the reamer didn't cause any damage to the tuning dial or cord inside.

(Thus encouraged, I even had the temerity to drill a 1.5mm hole below each main switch hole, to take the spigot of their anti-rotation washers. This probably wasn't necessary, but I *hate* toggle switches that rotate out of position!

The correct location of the small holes was found using one of the washers on a switch, on the outside, to scribe a tiny arc below each main hole. The holes were covered up using the small labels added to mark the switch functions, visible in the rear photo.)

I elected to mount the decoder PCB in the case using four short tapped plastic spacers (10mm long). This allows clearance for the soldered joints, etc under the PCB. As the spacers come with relatively short 3mm round-head screws, I therefore had to lightly 'counterbore' the mounting holes on the outside of the case rear, using a 7mm drill, to allow the screw heads to be recessed and give the threads adequate entry into the tapped spacers. The same drill was also used to de-burr the holes inside the case.

To begin the assembly, I attached the mounting spacers to the decoder PCB, and then completed all of wiring between the switches, decoder PCB and receiver PCB — with both switches and decoder module sitting loosely on a sheet of stout cardboard, just above the transformer and dial (but roughly in their final positions, to allow the final lead lengths to be judged).



As you can see from this further internal view, the decoder board and switches fit neatly between the receiver's power transformer and main PCB — behind the tuning dial, and just above the rear of the speaker when the case is assembled.

After finishing the wiring the conversion could even be tested in this 'loose' state, and the decoder preset pot adjusted to set the ACS audio level so that it matched the 'normal' audio.

Note that only two of the leads in the whole conversion need to be shielded: the audio leads, between SW2 and C4 and the volume control. The shields of both these cables connect together at the switch, and a short length of insulated hookup wire used to connect this 'earth' to a decoder PCB 'GND' pin. The other end of the shield on the lead to C4 is insulated, as mentioned earlier, but that of the volume control lead is connected to the main PCB earth at the volume control, and actually forms the earth return for the decoder.

The remaining leads between the switches, decoder PCB and main PCB can be run in ordinary insulated hookup wire. But keep them as short as possible — only allow just enough length so that they'll run without strain, from one connection point to the other. Excessive length could cause instability or noisy ACS reception.

Once all of the wiring is completed, it's then a fairly easy matter to mount the two toggle switches and decoder PCB inside the rear of the case, to finish the main part of the conversion. Just make sure that the leads to the switches do not foul the tuning dial pointer or its cord — try turning the tuning knob to move the point along the scale and back again, to check that there's no fouling. If there is, you may need to tape them out of the way.

With this done, you should be able to turn the set on again, and check that everything still works as it should. Providing there is an FM station or two with ACS subcarriers, with a reasonable signal strength in your area, you should be able to tune in the signal normally on FM, then switch to 'ACS' using SW2, and then listen to either one, or either of the ACS signals simply by selecting them using SW1.

You may need to 'tweak' the preset pot on the decoder board slightly at this stage, using a small long-bladed screwdriver, to achieve a proper balance between the ACS and normal audio levels. Other than that, if all seems well it's purely a matter of re-assembling the receiver case and fitting the main knobs again. Your ACS conversion should then be complete, although you may want to add some little labels to the rear of the case as I did, to mark the switch functions.

Happy ACS reception — but don't forget, although you can legally listen to the ACS signals, our understanding is that you can't record them or cause them to be 'publicly performed' by feeding them through a public address system, telephone 'music-on-hold' facility etc., without the authority of the programme provider. ❖

PARTS NEEDED FOR THE REALISTIC CONVERSION

- 2 Miniature toggle switches
- 4 Insulated tapped spacers, 10mm long with matching 3mm mounting screws
- 2 Lengths shielded audio cable, each about 200mm long

Various lengths of insulated hookup cable

Construction Project:

DIGITAL PHOTO TIMER

This microprocessor-controlled timer has a keyboard to enter the required time delay, and an onboard relay to drive a load. It can measure in minutes and seconds or hours and minutes, and features a four-digit LED display. It's very simple to build and use — thanks to the microprocessor.

by JEFF MONEGAL

We've called this project a 'photographic' timer, as this is the need that prompted its design. However, a timer is a timer, regardless of where you use it, and one that has an onboard relay is likely to find many applications.

A feature of this design is how easy it is to use. You enter the required time delay on the 12-key keypad. When a key is pressed, its value is shown on the display, shifting to the left as subsequent keys are pressed. Once the time is entered, you start the timer (and energise the relay) by pressing the crosshatch (#) key.

Pressing the crosshatch key again will stop the counter and turn off the relay, with the display showing the remaining time. The countdown can be continued by pressing the crosshatch key again.

The star key (*) will also stop the timing sequence. Here the relay is turned off, but this time the display reverts to showing the previously selected time delay. Pressing the star key again resets the time delay (and the display) to zero.

The timer has a maximum countdown time of 99 hours and 99 minutes. You can enter a time of say, three hours 78 minutes, but once the timer has counted to three hours 0 minutes, the next count will show two hours 59 minutes.

If you select it, the counter will also count in minutes and seconds. Here you can either fit a switch and toggle between timing modes, or permanently enable one mode or the other with a link on the PCB. When the link is fitted, the counting mode is hours and minutes.

If the timer is set to count in minutes and seconds, a buzzer will sound by pulsing once a second during the last 10 seconds of the programmed delay time. And to let you know it's operating, a LED located in the centre of the display is pulsed at 2Hz when the timer is counting down.

The onboard relay is rated at 5A 240V. The PCB layout is designed to take 240V wiring via the relay contacts, so you can use the timer to directly switch an enlarger or other low power mains-operated equipment. The maximum load the relay can safely switch is around 1000W.

However to keep the mains away from the timer, we suggest you use the onboard relay to switch another relay — particularly if you want to switch loads of more than 500W.

Here you would use the onboard relay (and possibly the 12V DC supply of the timer circuit) to operate the external relay, which then has all the mains wiring. The rating of the external relay (which could also be a solid-state relay) then determines the maximum load power you can control. The timer is powered from a 12V AC plugpack, again to keep mains wiring away from the timer, and to keep the case size to a minimum.

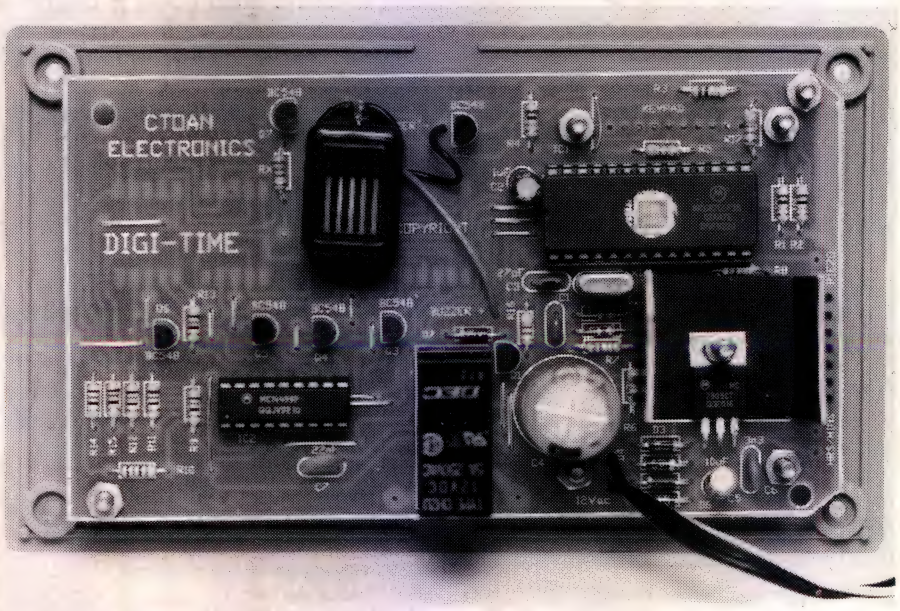
Now that you know what it does, here's how the timer works...

How it works

The timer is based around a Motorola 68705P3 microcontroller, which is supplied already programmed. If you've built the 68705 development system described in March 1993, then you might want to devise your own program. But for the cost of the kit (see end of article for details), you probably wouldn't bother.

The microcontroller IC1 constantly scans the keypad, waiting for a key press. This IC also drives the display via IC2, and does all the timing. Timing pulses are supplied to the microcontroller via its interrupt input. These pulses are derived from the 50Hz mains supply, which are as accurate as you need for all but the most critical timing operations.

The AC mains is sampled at the 12V secondary of T1 and conditioned by R6, R7, D1, D2 and C1. D1 clips the positive



This photo shows the component side of the PCB. The board is held to the lid of the case with screws fitted through standoffs. The keypad is held to the PCB with four screws, through 9mm high standoffs. Notice that one of these screws is close to a link — make sure the two don't connect.



excursions of the 50Hz signal, limiting it to +5V, while D2 clips the negative half cycle and keeps it from going negative. R6 and C1 filter the signal and R7 forms a potential divider with R6.

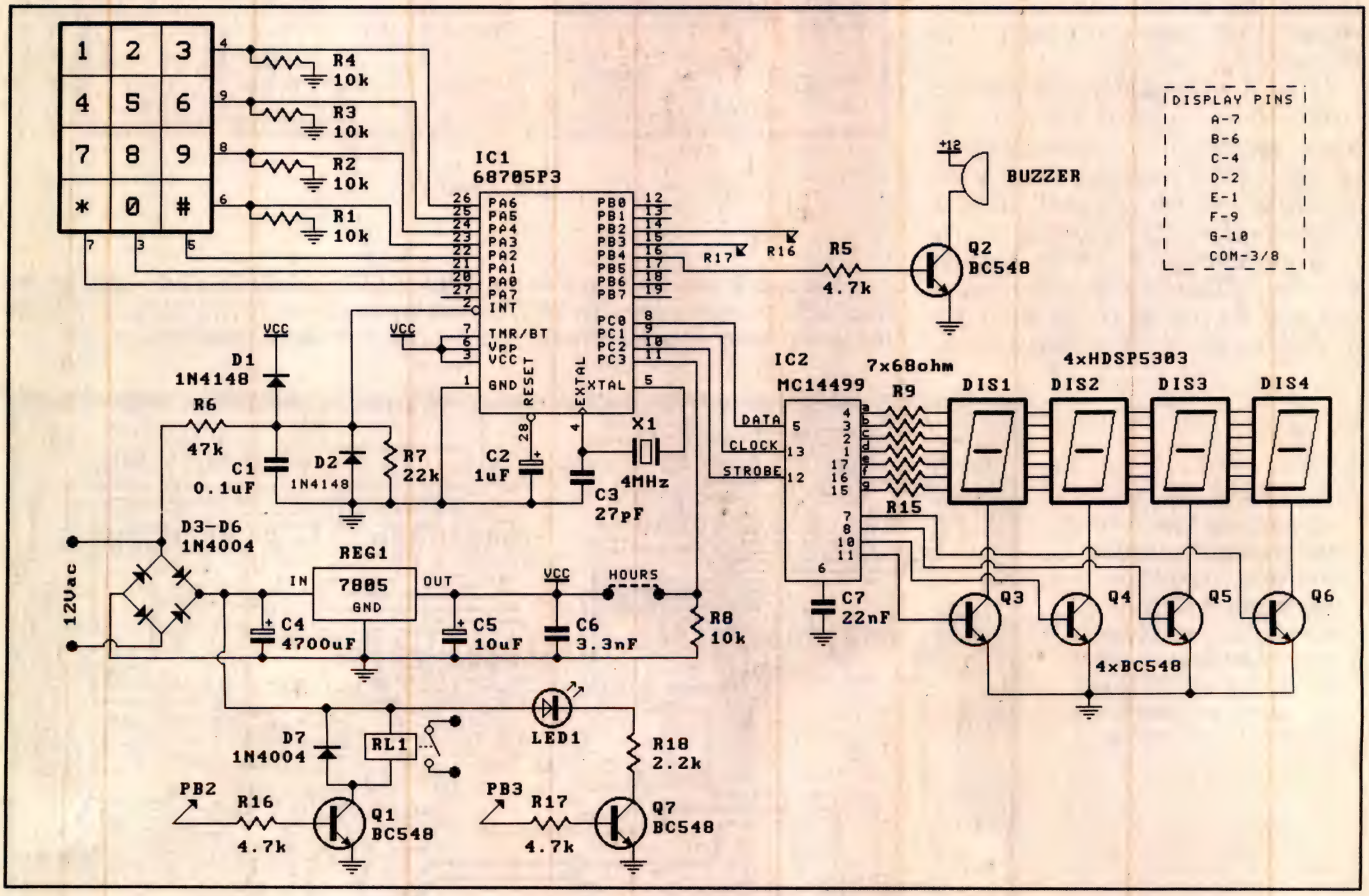
Data is sent to the display in serial form by IC1. The microcontroller firmware converts the parallel data (four bits per digit) into two 8-bit serial words, before sending them to the data input of display-driver IC2. To transfer the data, clock pulses are produced by the microcontroller and sent to the clock input of IC2 (pin 13).

After the two 8-bit serial words have been transferred, the microcontroller sends the strobe pin (pin 12) of IC2 low. This loads the data into the display latches in IC2, which then updates the seven-segment displays. The four common-cathode displays are multiplexed via transistors Q3 to Q6, which are driven by IC2.

The relay is driven by Q1, which in turn is operated by IC1's output port B, data line 2. Diode D7 limits the back EMF produced by the relay coil when Q1 turns off. Port B, data line 3 operates Q7, which drives LED 1 so it pulses at a rate of 2Hz when the timer is counting down.

The buzzer is driven by Q2, in turn operated by port B, data line 4. The buzzer pulses during the last 10 seconds of the timing cycle, but only when the timer is set to count in minutes and seconds. The timing mode is set by the link between pin 11 of IC1 and the +5V supply. As you can see on the circuit diagram, pin 11 of the microcontroller is data line 3 of port C. The program senses the logic level at this input, and a logic 0 sets the mode to minutes and seconds, while a logic 1 sets it to hours and minutes.

Therefore without the link, pin 11 is pulled low by R8, giving a logic 0 and setting the mode to minutes/seconds.



The pre-programmed 68705P3 Motorola microcontroller continually scans the keyboard and operates the display via IC2. It drives the relay, buzzer and LED1 through Port B. Timing pulses are derived from the mains, and applied to the interrupt input (pin 2) of the microcontroller.

Digital photo timer

When the link is added, the +5V supply is applied to pin 11, setting the mode to hours/minutes. The link can be replaced with a switch if you want to be able to select either mode.

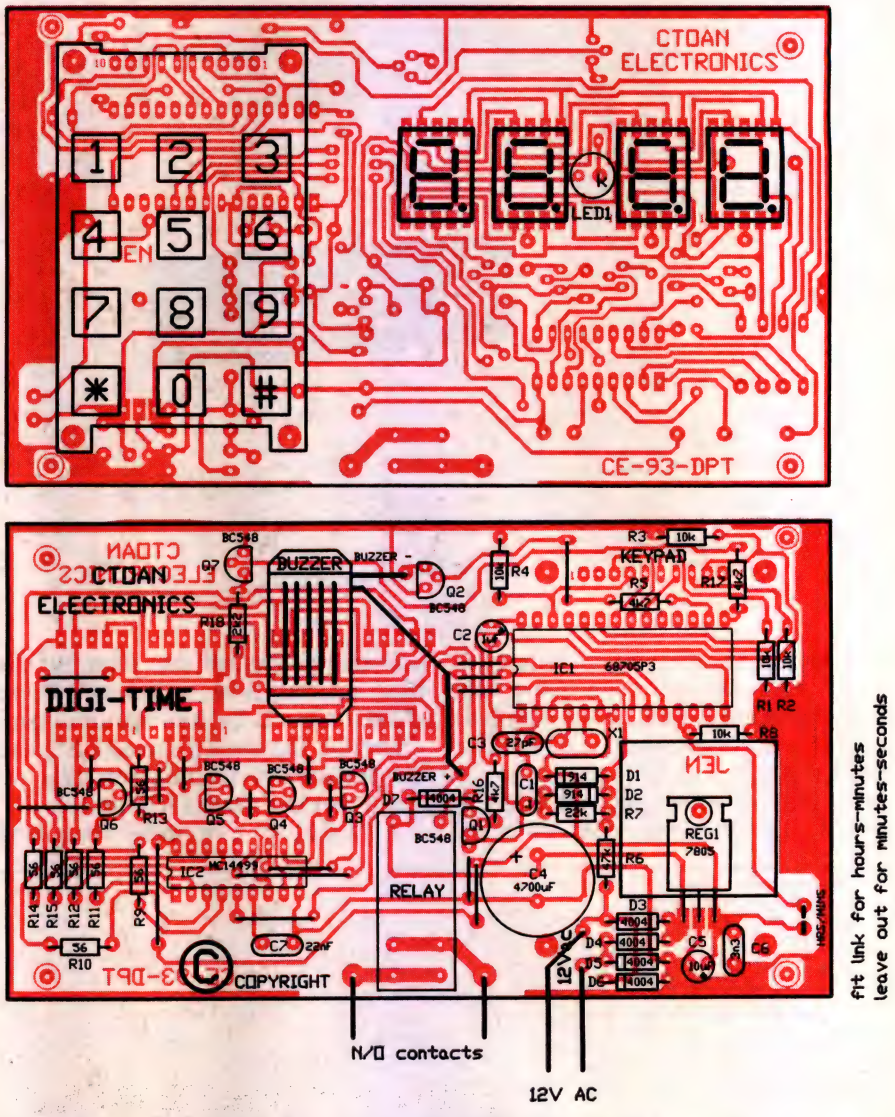
Power is supplied by a 240/12V AC plug pack, rectified by the fullwave bridge of D3-D6 and filtered by C4. This capacitor is unusually high in value, but has been chosen to ensure the supply is as stable as possible. Microcontrollers do not take well to noisy or unstable power supplies! The full DC output from the bridge rectifier supplies the relay, LED1 and the buzzer. The +5V supply is regulated by the 7805 regulator and filtered by C5 and C6.

Construction

All components mount on a single-sided PCB. The four displays, the LED and the keyboard are mounted on the track side, and should be fitted last. Everything else is on the component side, as shown in the photo of Fig.2.

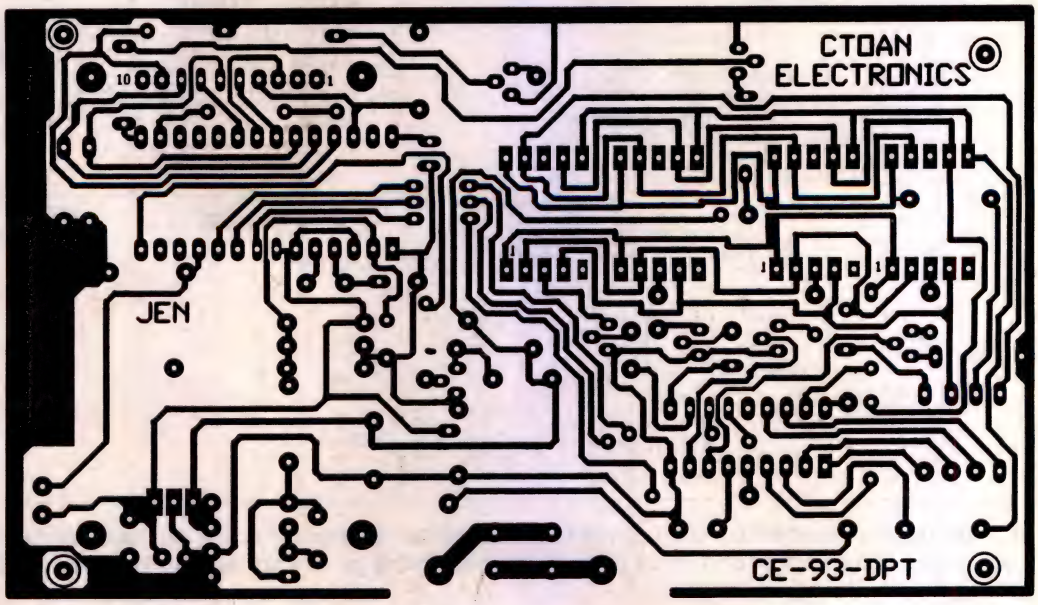
There is nothing otherwise special about constructing this project, although you should take precautions to prevent damage due to ESD (electrostatic discharge) when handling IC1 and IC2, as these are MOS devices.

As usual, make sure that all polarised components are correctly orientated. Use a small soldering iron to prevent accidental short-circuits between soldered joints, as some of these are quite small and close together. Follow the component overlay diagram, although the PCBs supplied with the CTOAN kit are silk-screened and have the overlay on the board. We recommend you use IC sockets, to make



The layout is in two diagrams, as the display, LED and the keypad mount on the track side. You can connect a SPST switch in place of the HRS/MINS link, to make the timing mode selectable from the front panel. Note the links under IC2.

The PCB pattern is reproduced here for use by individual constructors only. The pattern is copyright to CTOAN Electronics, and boards cannot be sold by other firms. See the parts list for how to purchase the various components.



IC removal and replacement easier should the need arise.

We especially suggest using an IC socket for IC1, as CTOAN Electronics will be updating the software from time to time. You'll be able to take advantage of any updates by sending your 68705P3 back to CTOAN, rather than buying a new one. However, reprogramming can only be done if the IC pins are clean and not covered in solder.

Start with the wire links, then follow with the passive components (resistors, capacitors, diodes), the IC sockets and then the transistors. A heatsink should be fitted to the voltage regulator, which is held in place with a bolt through the heatsink, the regulator and the PCB. The buzzer can be glued to the PCB to hold it in place.

Once you've completed the top side of the board, mount the displays, the LED and the keyboard on the track side. The displays should be about 10mm off the board.

You'll need to bend the end of their leads to give a right-angle, so you can solder the leads to the track in surface-mount fashion. The displays mount so the decimal point is facing the centre of the PCB. The top of LED 1 should be level with the top of the displays.

The keyboard is mounted so the tops of the keys are about 4mm to 5mm higher than the LED displays. The keyboard fits through a cutout on the front panel, while the displays are behind a red transparent cover glued to the back of the front panel. The keyboard leads push into the holes in the pads and are trimmed off at the component side.

Testing

As usual, before testing the unit, check your work carefully to see there are no accidental short-circuits or bad connections. At this stage, don't fit the microcontroller IC into its socket. If you haven't fitted the mode link, the timer will be in minutes and seconds mode.

Connect an AC supply of between nine to 14 volts to the PCB, then measure the voltage between pin 1 (ground) and pin 3 (positive) at the IC socket for IC1. This should measure +5V.

If so, then switch off the power and insert IC1. Switch on again and press any key. The least significant (rightmost) display should show a '0'.

Now enter a time value, checking that the display shifts left as each key is pressed. When you press the crosshatch (#) key, the relay should operate and the display should start counting down, indicated by the LED flashing at half-second intervals. The delay will depend on the position of the mode link (or switch if you've added one).

Pressing the crosshatch key should start and stop the counting function. Pressing the star key should turn off the relay and make the display show the original time delay. Pressing the star key again should clear the display to zero.

If all is well, then it remains to finish the front panel. If the unit is not working, *don't* immediately suspect IC1. All microcontrollers are tested before leaving CTOAN Electronics and they are quite rugged and reliable devices despite their complexity. If you are still unsure, then CTOAN will test it for you, free of charge.

The prototype was fitted in a jiffy box, measuring 50 x 90 x 150mm. The PCB assembly attaches to the lid with standoffs between the PCB and the lid. You'll need to cut a rectangle (about 43 x 55mm) out of the lid for the keyboard, and another (about 22 x 70mm) for the display. This cutout is then covered with a suitable piece of red transparent plastic. Make a label of some sort to cover any holes in the lid.

File suitable relief holes in the bottom of the box for the AC supply and the wires to the relay. Then you're ready to put the timer to work. ❖

PARTS LIST

Resistors

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

R1-4,8	10k
R5,16,17	4.7k
R6	47k
R7	22k
R9-15	68 ohm
R18	1k

Capacitors

C1	0.22uF monolithic
C2	0.1uF monolithic
C3	27pF ceramic
C4	4700uF 16VW electrolytic
C5	10uF 16VW electrolytic
C6	3.3nF ceramic
C7	22nF ceramic

Semiconductors

D1,2	1N4148 silicon signal diode
D3-7	1N4004 silicon power diode
Q1-7	BC548 NPN transistors
IC1	MC68705P3 8-bit microcontroller pre-programmed with timer program V2.01
IC2	MC14499 4-digit LED driver, serial input
REG1	7805 TO220 5V regulator
LED1	5mm red LED
DIS1-4	HDSP5303 seven-segment red LED display
X1	4MHz quartz crystal

Miscellaneous

PCB, 138mm x 78mm coded CE-93-DPT; 12V AC 500mA plug pack (not supplied in kit); PCB mount relay 12V coil; 12-key 4 x 3 matrix keypad; 12V DC buzzer; plastic case to suit; heatsink for REG1; strip of red perspex to cover display; hookup wire; solder; nuts, bolts etc.

A complete kit of parts (except plug pack) for this project is available from CTOAN Electronics for $59.95. Add $5.00 for post and packing.

Individual components are also available as follows:

Programmed 68705P3 (IC1)	$30.00
MC14499	$8.00
PCB	$15.00
Packing and postage	$4.00

Completely assembled and tested units (PCB assembly only) are also available. They do not include the plug pack, but come with a 12-month warranty. Cost is $94.00 plus $6.00 post and pack.

CTOAN Electronics also offers a full back-up and repair service for the kit. Cost of any repair, excluding the microcontroller is $20.00 plus return postage of $5.00. Microcontroller chips will be tested free of charge if packed in the proper anti-static packaging and accompanied with $5.00 for return postage and handling. Order or phone:

CTOAN Electronics
PO Box 211,
Jimboomba, Qld 4280
Phone (07) 297 5421

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All kits are reduced to clear. Min 15% off till stocks last, including

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SHORTWAVE LISTENING

by Arthur Cushen, MBE



Radio Australia beams into Asia

Radical changes in the role of Radio Australia have taken place recently with the transmitting mast at Shepparton being realigned towards Asia. Also, two additional 250kW transmitters are being installed at Cox Peninsula near Darwin, and Radio Australia's English programme is becoming available 24 hours a day on satellite.

The transmitter site at Shepparton in Victoria has had a major reorganisation of its aerial systems, and the station will now use its 100kW transmitters to broadcast into Asia. Some of the historic services from that site have come to an end. The transmitter aerials towards Africa have been demolished, while the antennas for South East Asia and Papua New Guinea will remain as they are.

In the past, there were nine aerial systems covering a portion of the South West Pacific and a long path to Europe — these nine arrays have been dismantled. Five new TCI curtain arrays have been installed, and came into operation with the schedule change on September 28.

Information from Nigel Holmes, the Frequency Manager of Radio Australia, indicates that there are two new 250kW Thomson transmitters being installed at the Cox Peninsula site near Darwin. These will add to the present three 250kW transmitters already in operation. There are no changes at the Carnarvon, Darwin or Brandon sites, as they have already been programmed to service the Asian area.

A further innovation at Radio Australia is the introduction of a 24-hour satellite service, which operates in conjunction with the television transmissions from Australia, using a sub-carrier on that channel.

Radio Australia was established by the Australian Government as a wartime measure to present the Allied case, as seen in Australia, to the peoples of Asia and the Far East, to send news from home to Australian forces overseas, and to counter enemy broadcasts. Originally known as Australia Calling, Radio Australia — the overseas service of the Australian Broadcasting Corporation — was inaugurated by the Prime Minister, Sir Robert Menzies in December 1939.

Initial language transmissions included English, German, Dutch, French and Spanish, to which were soon added a service in Afrikaans to South Africa and broadcasts in Italian. By the middle of the war, the emphasis had shifted from west to east, reflected by services in Mandarin, Japanese, Malay, Thai, Dutch, French and English.

In 1950 Radio Australia became a permanent division of the ABC, thus ensuring its independence from the Australian Government — an important factor in maintaining the station's credibility and acceptance abroad. In 1960, Japanese, which had been abandoned in 1947, returned to the airwaves. Vietnamese broadcasts started in 1962, and Cantonese two years later. The Papua New Guinea service started in 1973 with English programmes, expanding to include Tok Pisin within the first year of operation.

Radio Australia has a staff of 220, the majority working from a modern centre in Melbourne. This centre houses 18 studio and control booth areas, two news-reading booths, and a multi-track production suite for recording complex music and spoken word programmes.

It is amongst Indonesians that Radio Australia finds one of its biggest audiences, according to a booklet celebrating Radio Australia's first 50 years. The Indonesian service broadcasts morning and evening sessions, providing a mix of news, information and entertainment. One of its most popular programmes is the daily English language session.

Australia Calling was initially relayed from existing 10kW transmitters at Lyndhurst and Sydney. The escalation of the war in Europe, and its extension to the Pacific, necessitated the construction of an alternative high power station at Shepparton, 192km north of Melbourne. This station began transmission in 1944, operating with one 50kW transmitter. Two further 100kW units were added before the war ended.

The 1960s saw an increase in high frequency transmissions by many international broadcasters into South East Asian areas. This led to the opening of a second station on the Cox Peninsula near Darwin in 1969. The third station, located at Carnarvon on the central coast of West Australia, also serves the South East Asian region. In 1984, the station was upgraded with the addition of a powerful 300kW transmitter — the most powerful in the Radio Australia network. The Carnarvon aerials can be directed to any part of the Asian region, from the Indian sub-continent through to China and Japan.

1989 saw the opening of Radio Australia's fourth transmission station, an interim facility at Brandon, near Townsville. The station makes use of three 10kW transmitters, relocated from the Lyndhurst station which was closed in 1988.

WCSN for sale

The Christian Science Monitor has announced that it is selling its 500kW transmitter, WCSN Scotts Corner, Maine as a going concern. It will be adding a further 500kW transmitter as a replacement at its site of WSHB, Cyprus Creek, South Carolina. Programme changes have also been made, and the station now carries hourly sessions instead of a two hour block as in the past.

It was apparently cheaper to sell the WCSN site to another broadcaster than to remove all the equipment and antennas down to the South Carolina location. The whole operation cost the Christian Science Monitor Church US$16.5 million over the past year, and just under half was used in keeping the transmissions running. Once the WCSN site is sold, it should result in a saving of US$1.5m a year.

AROUND THE WORLD

ERITREA: Broadcasts from Asmara used to be received on 7380kHz, where the station used the slogan Voice of the Broad Masses of Eritrea. Now the operation is more of an international broadcast and — according to a verification received from PO Box 872, Asmara — it operates in several East African languages, but with no English transmissions. The language of Afar is carried at 0330 - 0400 and 1430 - 1500 on 5000 and 7020kHz. The frequency of 7380kHz opens at 0330; at 0400 it carries a broadcast in Arabic and at 0500, Amharic. This transmission is also available on 3940kHz.

ISRAEL: The Israel Radio Broadcasting Authority from Tel Aviv has English at 0500 - 0600 on 7465, 9435 and 17,545kHz; 1100 - 1130 on 15,640, 15, 650 and 17,575kHz; and at 2000 - 2030 on 11,603, 11,675 and 17,575kHz.

KUWAIT: The latest English schedule is 1800 - 2100, and broadcasts are on 9840 and 13,620kHz. News is carried at 1830.

NETHERLANDS: Radio Nederland from Bonaire is using 9720kHz from 0730 - 1025, replacing 11,895kHz. The earlier transmission at 0730 - 0825 is carried on 9630 and 9720kHz. At 0930 English is also heard on 9810kHz, with these broadcasts originating from Petropavlovski in the CIS.

NEW ZEALAND: The RNZI, Wellington schedule up to March 19 1994, when Daylight Time ends in New Zealand, is: 1650 - 1958 on a new frequency of 9550kHz, broadcasting Monday - Friday; at 1959 - 0658 on 15,120kHz, Sunday - Friday; on Saturday sign-on is 1900 - 0658 on 15,120kHz; and 0659 - 1206 on 9700kHz daily. When there is international sport, RNZI will use 9610kHz after 1207 up to 1648.

USA: KTBN, operated by the Trinity Broadcasting Network (a television service in the United States), runs an audio service on shortwave for 24 hours of the day. The transmitter of 100kW is located in Salt Lake City, Utah, though the mailing address is: PO Box A, Santa Ana, CA 92711, USA. Transmissions are noted on 15,590kHz, closing at 0100 when a frequency change to 7510kHz is announced. This signal provides fair reception around 0600.

The other facility operated by the Church is KHBI on Saipan; and that transmitter will continue, though there is to be some reduction in the schedule to Asia. The station has done some research on its listening audience — which is a difficult undertaking for international shortwave stations — but it estimates it has around nine million listeners each week.

As well as broadcasting on shortwave, Christian Science Monitor has access to American Public Radio. It finds that the international audience is much larger than its internal audience within the United States, so its shortwave broadcasting is very important. The whole operation depends on the sale of WCSN, Scotts Corner, Maine; and it is estimated that it will be 18 months before that transmitter is sold and the replacement transmitter installed at Cyprus Creek, South Carolina. WSHB broadcasts to Australia in several transmissions, and reception at 0800 - 1000 is on 9840kHz.

Clubs united

Since 1982, four of the radio clubs in the South Pacific have been joined together under an umbrella organisation, the South Pacific Association of Radio Clubs.

SPARC works collectively on their behalf, and is affiliated with similar groups in North America (the Association of North American Radio Clubs), and in Europe (the European DX Council).

Of the four clubs in SPARC, the oldest is the New Zealand DX Radio Association, which has recently celebrated its 60th anniversary. It continues to function with its headquarters in Dunedin, and the address is; R. Dickson, 88 Cockerell Street, Brockville, Dunedin. 'Tune In' is the monthly publication of the NZDXRA; and its next Annual Meeting is to be held in April 1994 at Stag Valley, near Dunedin.

The New Zealand Radio DX League was formed in 1948 from the old New Zealand DX Club, which had a history going back into the 1930s. The NZRDXL for the past 20 years, had its Administration in Invercargill, and the writer was National President for 13 years.

The Administration has now moved to Auckland, and the address of the NZRDXL is: PO Box 3011, Auckland, New Zealand. Over those 20 years, the Annual Meeting of the League has always been held in Oamaru, but this year its 45th meeting was held in Auckland over the weekend of 16 - 17 October.

The Southern Cross DX Club in Adelaide was established in 1973, and it celebrated its 20th anniversary in June with a special publication of *DX Post*. The Southern Cross DX Club had very small beginnings, but it has now spread to cover all aspects of radio listening and to provide a variety of information for its members. The address of the Southern Cross DX Club is PO Box 1487, Adelaide 5001.

DX Australia, which has its publication *DXer's Calling*, also has a wide variety of information in its monthly publication, and it has increased in circulation and strength since its founding 11 years ago. Details concerning DX Australia are available from PO Box 285, Mt Waverley, Victoria 3149.

The SPARC clubs have achieved a lot in helping their members, with a major task being the compilation of a past and present Countries List. Conventions have also been a chance for members of the four clubs to meet socially, being held in both countries. In 1992 at Marlo in Victoria, members attended from Australia, New Zealand and the United States; while the 1994 convention will be held at Camp Iona near Oamaru in the South Island of New Zealand from 15 - 17 April. Information concerning this SPARC convention is available from Basil Jaieson, PO Box 179, Oamaru, New Zealand.

Many club branches hold regular meetings, often monthly. These occur in Sydney, Christchurch, Dunedin, Auckland, Oamaru and Invercargill; while other groups meet on an informal basis. All clubs are happy to provide sample copies of their magazines, and details concerning membership and other activities.

Saipan stations

The operation of stations in Saipan goes back to March 1945 when the Voice of America commenced broadcasting on mediumwave with KSAI. In August, the same year, the Armed Forces Radio Service was noted on WXLD, 660kHz with 1kW. These were the first broadcasts heard after the war. Later, several commercial mediumwave stations commenced operation.

It was on October 1, 1983 that the Far East Broadcasting station KFBS commenced operation, and this was an interesting aspect of broadcasting as they used a 100kW transmitter formerly operated by the Voice of America on Okinawa. Okinawa was given back to Japan and the VOA relay base had to close. In 1982, Super Rock KYOI was a familiar signal throughout the Pacific area, broadcasting commercial programmes to Japan in English and Japanese; but in 1987, this transmitter was purchased by the Christian Science Monitor and became KHBI. ❖

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 11 hours behind Australian Eastern Daylight Time and 13 hours behind NZ Daylight Time.



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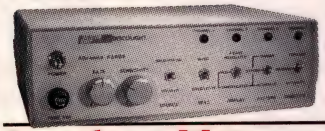
This Month Only $75

K 5795 Two Tube Option **$16.50**

DiscoLite Chaser & Colour Organ Kit

(SC July-Aug '88) The Discolite flashes party lights on and off in beat with music from your amplifier. **Features:** • 4 light channels controlled by 4 separate audio channels • Forward reverse and auto-reversing chaser patterns • Simultaneous strobe on all four channels • Alternating light patterns • Music modulation available on chaser strobe and alternate patterns • Inbuilt microphone or direct inputs for beat triggering or audio modulation of lights • Sensitivity control • Individually pre-settable sensitivity levels for each channel • Front panel LEDs mimic light display • Altronics Kit pre-punched and silk screened

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Specifications Z 1450-Z 1456:
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Drain Current:.....8A
Body Drain Diode:.....8A
Total Body Dissipation: ...125W

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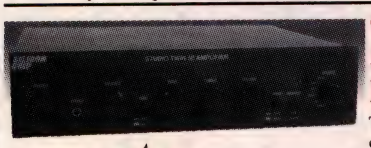


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K 2551 Fully Built-Up Version **$119.95**

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This fantastic amp has all the features of commercial units costing hundreds of dollars more. Using TIP 142/147 transistors it is capable of producing a total of 47 Watts per channel RMS into 8 ohms. Features 6 inputs, bass, treble and balance controls, headphone jack, tone defeat switch etc etc. Incorporates polyswitch protection.

Impress Your Friends with this Quality Stereo Home Amplifier!

K 5045 Normally $299.00, **This Month Only $250.00**

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Here is a fantastic kit which allows you to create great fades and wipes when editing on your VCR. It can wipe left and right as well as fade to black or white. Complete with professional screen printed front panel and manual controls for fades and wipes. Simply plugs in between the two video machines when recording from one to the other.



K 5870

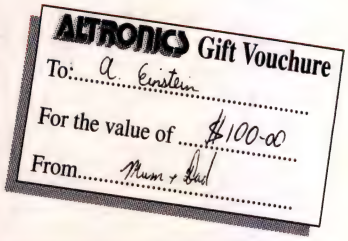
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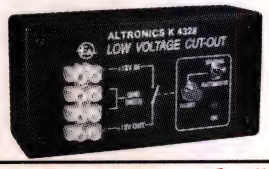


Low Voltage Cut-Out for Cars and Boats Kit

Adjustable Cutout Variable from 10.9V to 11.9V. Includes Automatic or Manual Voltage Reset Function.

(SC Jan '92) Build this simple little device, and avoid getting caught out with a flat battery during your holidays. It simply connects into a 12V accessories power line, and shuts off the flow if the battery voltage drops to a dangerously low level. Ideal for battery powered camping fridges etc.

K 4328 $24.95



Low Cost "Karaoke" Adaptor Kit

(EA Nov '91) It's time to bring out all those hidden vocal talents that you've always known were there. With this project you can remove the lead vocal from almost any recording, and replace it with your own via a standard microphone. It's a great way to liven up a party! This project works on the assumption that the lead vocal in most stereo recordings has been placed mid-way between the left and right channels, or is in fact a mono signal. Requires 2 x 9V batteries.

K 1170 Normally $34.95

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Simply Connects in line Between CD or Tape Deck & Amp



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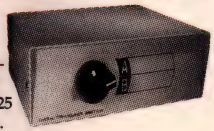
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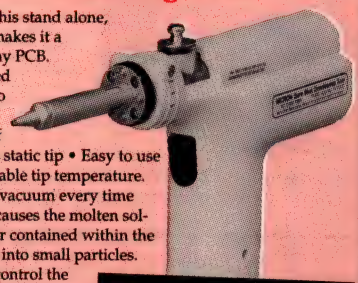


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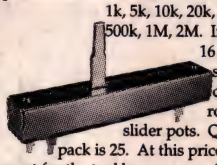
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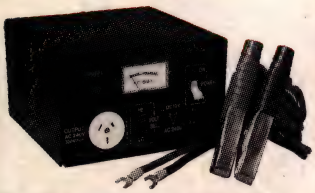


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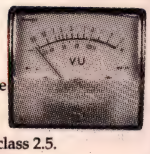
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AUTOMOTIVE ELECTRONICS



with MAJOR AL YOUNGER (USAR, Ret.)

Getting your car to tell you what's wrong

Many readers of this column have asked what they can build or use, in the way of electronic devices, in order to fix computerised motor cars. The answer is surprisingly simple: a standard personal computer. This is nothing new — PC's have been readily available for years, and most of the hardware needed to use them for diagnosing car ECU problems can be bought 'off the shelf'. The crucial part is *software* — which you'd think would have to be custom-written to suit every different system. But there *is* another way...

Trying to sell a tangible item is rather simple. To sell a voltmeter, you just explain why someone should buy yours. You explain the features, the accuracy and perhaps what it will do that other voltmeters won't. The purchaser can see it, feel it and even try it out.

But to sell an *intangible* item takes a different approach. Here, you must define the customer's needs, then come up with a solution to satisfy those needs. Nothing new here either — after all, when we purchase an insurance policy we tell the salesman our needs and he writes a policy to satisfy those needs.

What's the point of this preamble? Well, the car industry has not set down and defined a unified approach for fixing a computerised car. What industry? Well, not 'Detroit' of course; their interest's only in the vehicles they manufacture, and every manufacturer has their own approach towards fixing their vehicles. There's no standard system, or as I call it, philosophy.

The companies that *should* be interested are the after-market service industries — i.e., the manufacturers of automotive diagnostic equipment. But *they* don't talk to each other, and they sure won't listen to me (I've tried).

What it boils down to is that the autotech is *told* what he needs to fix a car; he has no input. So, he spends much money and then time, learning to use new equipment. Which to my mind is an insult to the repair industry.

If you have been reading my articles, you most likely have figured out my philosophy. A few readers have 'read between the lines' and have noticed my frustration, from some of my satirical remarks. To me it's tragic, that we as an industry have no input when it comes to providing the tools we need to fix the modern car. I have given lectures to autotechs, many of whom agree with me, but still no-one seems to be listening. So let me 'unload' on you readers. I am sure you computer-oriented blokes will have to control your laughter, when you find out what it takes — simply putting a personal computer to work.

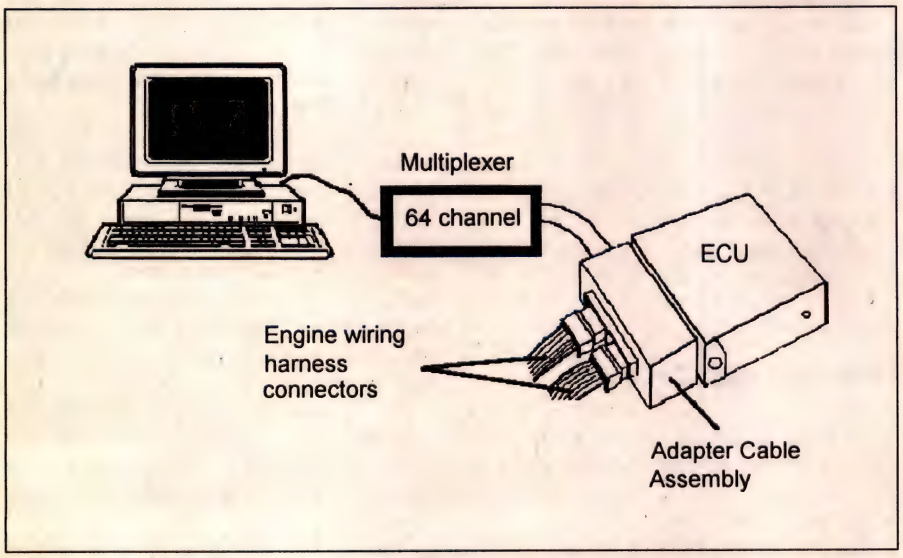


Fig.1: A 64-input multiplexer and 'adaptor cable assembly' can be used to interface a PC to a car's ECU which lacks a 'data stream' communications port.

Engine analysers

Ignition analysers are a critical tool in fixing a car. New digital units are readily available and their use should precede any interrogation of the ECU. Most analysers will interface with a PC to allow data storage. I have converted units that had no external port (connector), but had a built-in printer. This article goes beyond this 'normal' interfacing of engine analyser data to the PC.

When it comes to the design of ideal diagnostic equipment for fault-finding in modern car ECU's, my philosophy is simple: there should be NO books, charts or tables required to operate the equipment. There should also be NO lengthy or continuous training programs required, to use the equipment. Most important, it must be capable of 'talking to the world' — i.e., it should have a communications port.

Of course this really means that we need a computer, with the proper interfacing hardware — and most important, the right software. In other words, 'it takes a computer to fix a computer'. So why shouldn't we be able to use a standard PC?

I know, there's nothing new here. But you electronics and computer types might be surprised to learn that it's not yet available, to the auto repair industry.

Oh sure, the auto manufacturers have

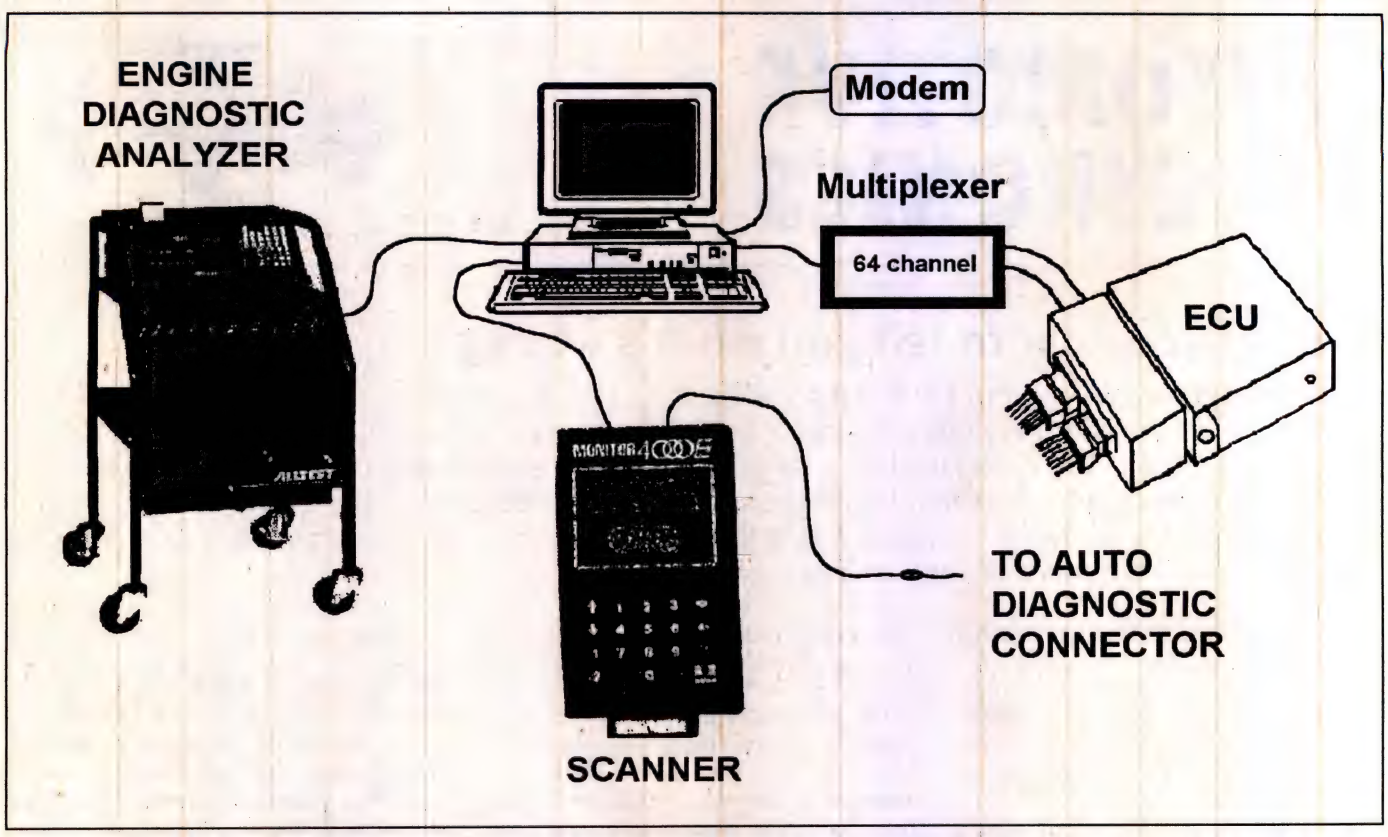


Fig.2: The complete PC-based auto diagnostic system proposed by the author. All of the hardware is available off the shelf right now — only the software needs to be written, to produce a fully practical system.

some systems, but they're custom setups which are only designed to fix *their* cars.

The facts are that 95% of all the world's vehicles are fixed by independent shops, which cannot afford to purchase every piece of factory test equipment from all the manufacturers. In any case, many of the manufacturers only sell their diagnostic systems to their own 'dealer network'.

Software requirements

When it comes to diagnostic software, my philosophy is this: all the operator should have to do is read. The PC should do the rest:

1. Display hook-up and procedure instructions.
2. Read and display code (number, circuit/function).
3. Interpret codes (parameters for setting code).
4. Read and display the ECU's data stream.
5. Provide diagnostic data to fix the fault.
6. Store all data (codes, data stream, car, date, etc.).
7. Provide a technical database (schematics, connector pin-outs, etc).

We still have a problem, of course, since at this stage not all vehicle ECU's have data stream output. For vehicles with no data stream, additional interfacing hardware is required.

Additional hardware

For ECU's that do not have data stream or active data output via an RS-232C port, additional equipment is required in order to interface a PC to the system, for 'reading' and 'capturing' data. Luckily most of this additional interfacing hardware is now available as 'off the shelf' items.

The main item we need is a *multiplexer*, to scan 64 lines (channels). I say 64, because Ford uses 60 pins on their ECU. To hook up to the ECU via this multiplexer we can use readily available 'Vehicle Adaptor Cables', such as OTC's 3226-XX series. The cables are optional items for OTC's '80-pin Universal Breakout Box'. The cables make a bridging or 'T' connection into the vehicle's wiring harness, at the ECU location (see Fig.1).

Different approaches

Assuming we can connect up to the car's system, as with all computer solutions there are several possible ways to go: hardware only, hardware and software, and software only.

The 'hardware only' approach is the factory method and is inevitably dedicated to only one manufactured vehicle. Forget this approach, it has limited marketing value.

The mixed 'hardware plus software' approach is available in commercial diagnostic gear, such as OTC's Monitor 4000E. (Incidentally, in a previous article I noted that the Monitor had had a badge change, to become the Churchill Monitor. They have since reverted back to the original scanner nomenclature. In the trade it's known as the 'Monitor'.) Firmware plug-in 'chips' provide the software (really firmware, in ROMs) for various vehicles and allow viewing on a terminal. Additional optional software is available to interface to a PC.

This approach provides active monitoring, graphing and data storage. Cables are provided to hook-up to all vehicle systems, whether engine, transmission, ABS (anti-skid braking system), etc. But at the same time this hardware/software solution lacks the multiplexing capability to connect to an ECU system which has no data stream capability.

All the systems currently available, including OTC's, still do not meet my software philosophy. However, OTC's are certainly are the closest. More about that later.

The 'software only' approach requires special cables, but that's about all — providing the ECU has a communica-

tions port. Such a solution is already on the market for GM systems.

Of course if the ECU has data stream capability, an 'off the shelf' RS-232C communications program can also be used to collect and save the raw data. But interpreting the data and making full use of it can still take extensive programming by the user...

Where to start

To those who have written to ask what equipment they can build, then, a good place to start would be a 64-channel multiplexer for connecting to systems without a communications port. It should be computer controlled through a standard RS-232C port, to allow using a 'laptop' PC, for portability.

For you programmers, the best is yet to come. Oh yes, some wrote to enquire about an integrated program that does 'point of sale', job booking, etc. — forget it. The diagnostic system must be separate — unless it's networked, which is very expensive. From experience, networking also often conflicts with repair functions.

The real answer

The solution to fixing anything is *data*. When the electronic motor car first hit the scene, I lifted the bonnet and measured all the voltages. No, books giving voltages were not available at the time. Then the books arrived — with the factory data. This data most often reflected the design-centre parameters, or 'the way things should be' under ideal circumstances. This is of course not what happens in the 'real world'. So, with a network of 25 fellow shops, we started collecting representative data manually.

There's no real reason why we can't do the same thing with a PC. We have all the necessary equipment to 'capture' the ECU data, regardless of ECU type, and file it all away for reference. Keep in mind my philosophy, as I paint a word picture for you. Here's how it would work:

1. We hook up to every new car model we can get our hands on. We perform a standardised series of tests on each, capture the data and store it in a database on the PC.
2. Enter the faulty car. Again we hook up, and perform the same series of tests. We then compare this data against the database reference. The resultant 'difference data' should enable the autotech to fix the car.

By now, some of you programmers will be laughing. Yes, I know — writing programs to things like this is what you do for a living. But, as far as I am concerned, it has not yet been done, for the car repair trade. So what about it?

The frosting on the cake would be to add a general information system that contains all the schematics, pin-outs, engine specifications (timing, etc) and factory bulletins for each model. Initially on floppy disk, perhaps, but only until CD-ROM technology becomes cheaper.

The total system

Fig.2 shows what's needed now to facilitate total system diagnosis, using a PC. Guess what — it's all interim, until all vehicles have a communications port. Then all we'll need is a PC with the right software.

It's true that some auto manufacturers are contemplating an ECU that will also do basic engine analysing. But don't hold your breath. There's also millions of cars out there now, that need to be fixed.

The beauty of the system I'm proposing is that it uses currently available equipment. It has only to be tied together with the right software.

It has always amazed me that auto diagnostic equipment manufacturers make so many pieces of equipment as 'stand alone' — meaning that no other equipment is required to make it work. Many such 'stand alone' devices have full-blown processors with their own software or firmware. Whereas in the computer field, we just add peripheral equipment or cards, all reasonably standard and controlled by the one PC.

When the auto equipment industry *does* change, they'll most likely use a PC which is not compatible with current industry standards — forcing the autotech to purchase *theirs*.

ECU tester

I test ECU's with data stream by disconnecting components and watching the read-out data for changes. If a sensor's resistive, I connect a 50k pot in the circuit in its place. I can then tell how the ECU's reacting to changes. This method can also be applied to ECU's with code only, but some older units take a long time to 'throw' you a code.

A computer controlled simulator using the same technique could also be built with 'off the shelf' items. Such a tester could be used to test ECU's out of the vehicle. The hardware is not the problem; it's the software, to control and set-up, or read, the parameters for every vehicle ECU.

Of course, we would let the computer fix itself. We would download data from a good ECU and store in a database, and then use this for comparison with faulty ECU's. Such a tester will find a ready market in the automotive field — or you could set up your own test facility for hire.

At present, most ECU's are tested 'by replacement'. And guess what? Most of the 'replaced' ECU's are good. Why? Most often, it's due to bad cables or connectors. In other words, poor diagnosis...

Conclusions

It's time to put the PC to work, with some realistic software, as a low cost and potentially easy to use automotive fault diagnostic tool. The hardware needed is already available on the market, so the only hurdle is the software. It's definitely a programmer's world nowadays, isn't it? Mind you I have always said that 'programmers will fix the world' — eventually!

I recently heard that a US manufacturer is taking the processor out of his engine analyser and using a PC. Good on yah, mate! (Must have been reading my mind...)

The solution to the ECU servicing problem, for most autotechs, is to 'use a computer to fix the computer' by obtaining operating data from good ECU's and then using this data for reference. This ECU data is not readily available from the manufacturer, so we must generate our own.

I learned a long time ago that if you want vehicle data, raise the bonnet and start measuring. My search for ECU data started in 1970, and nothing has really changed since then.

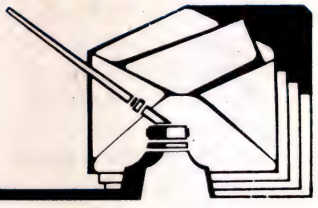
Here's an interesting note. I just read an employment advert in the local newspaper, which read '...an electronics technician that can fix equipment without schematics'. That's essentially what is needed to fix ECU's. Don't ever expect to see a schematic of an ECU, or any source references. Don't even look for one — you'll be wasting your time. Besides, look at the challenge!

If anyone's interested in building equipment or writing software, drop me a note on your letterhead. I'll give you more specifics. I have a feeling that once the 'computer industry' enters the automotive repair field, as a 'new market area', it will be the end of our problems.

My booklets are still available, by the way: *Maintaining the Electronic Motorcar* ($25), *The Code Book* ($35) and the *Ford EEC-IV* ($60). Send to: Major Al Younger, PO Box 477 Double Bay, NSW 2028. ❖



Information centre



Conducted by Peter Phillips

A Christmas 'gem', DSB reception and more on fuses

Most people associate a barbecue with food and a good time, particularly over Christmas. But a reader has another use for the home 'barby', as you'll see in this month's offerings. There's also an in-depth discussion on the May/July 1993 80-metre DSB Transceiver, plus the usual range of interesting letters.

Information Centre has included many gems of information over the years, but I think this one might take the cake. It concerns making printed circuit boards from a photocopy image of the artwork, and follows a review we ran in the August '93 issue (page 110) about a product sold by the Queensland firm Palmtech. The product reviewed in August is special paper, with a water soluble layer which lets you use heat to transfer a photocopy image of the track design directly to PCB laminate. Thereafter you simply etch the laminate.

Following this review, a reader (Eric) ordered the special paper from Palmtech, but impatience got the better of him. While waiting for the paper to arrive, he decided to experiment — and has now discovered another, cheaper way! He has since phoned our office with the details of his experiments, which I now present as a Christmas bonus to all our readers.

If this method works as well as Eric suggests, it will revolutionise home manufacture of PCBs. Now you can throw away your UV light source, photographic chemicals, ovens and other paraphernalia. All you need is a hot plate and a photocopy image of your artwork on — wait for it — normal photocopy paper!

Apparently Eric used his barbecue to heat a solid 30mm thick piece of iron plate to around 150°C. This plate was large enough to cover the entire PCB. He put a rubber strip on the ground, then his PCB material (copper side up), with the photocopy of the image (face down) on top. The hot plate was then put on top of the paper and left for five minutes. Next Eric dropped the PCB and paper into a bucket of water, left it a few minutes, then used steel wool to scrub off any paper which was still sticking to the PCB. Every attempt was successful, and he had none of the problems of lifting tracks and so on that Peter Murtagh mentioned in his review.

It's probable the trick is in the use of a hot plate, rather than a steam and dry iron to do the toner transfer. So using Palmtech's paper would no doubt produce the same (or perhaps better) results.

However, the intriguing thing is that you can actually *scrub* the transferred toner with steel wool to remove any adhering paper. And you can use conventional photocopy paper. Obviously a direct print-out from a laser printer would also work, and be likely to give better results, as it's a 'first generation' copy.

I've yet to try the method myself, but I promise a full description as soon as I do. If anyone else beats me to it, write and share your experience.

Now let's get technical, with a discussion about our DSB transceiver...

DSB Transceiver

It's not often an *EA* project designer and an *EA* reader get to converse in these columns. The discussion that follows concerns the Low Cost 80m DSB Transceiver, described in the May and July '93 editions. We start with a letter from a reader, who is not quite convinced the project can work as described...

I hope Mr Leon Williams will forgive me for any implied criticism and accept my interest in his work as a compliment. The output of the DSB transmitter is of the form A x cos(at) x cos(wt). Application of some elementary mathematics shows this to be equal to 0.5A x cos[(w+a)t] + 0.5A x cos[(w-a)t], which represents the two sidebands.

In these expressions, t is time, A and a the original audio amplitude and angular frequency respectively, and w the carrier angular frequency at the transmitter.

In the receiver the operation of the NE602 is somewhat obscure and I would have appreciated an explanation as I do not have a comprehensive set of data sheets. A simple guess is that the mixer multiplies the received signal by the output from the local oscillator (synthesiser). The result is:

A x cos(at) x cos(wt) x cos[(pt)-e] where p is the angular frequency (radians per second) of the local oscillator in the receiver and e (radians) is the phase relative to the carrier in the transmitter. The ideal condition would be p = w and e = 0, allowing easy recovery of the audio signal giving A x cos(at).

Even with stable crystal oscillators in the transmitter and receiver, w and p are likely to differ by something of the order of 150rads/sec, or say 25Hz. Applying the same mathematics again, the product of the three harmonic signals can be written as the sum of four simple harmonic signals, giving:

0.25A x cos{[(a+w-p)t] - e}
0.25A x cos{[(a-w+p)t] + e}
0.25A x cos{[(a+w+p)t] + e}
0.25A x cos{[(a-w-p)t] - e}

The third and fourth components are removed by the bypass capacitors and low pass filters. This leaves the first and second, which will combine to form a signal which beats at twice the difference (error) frequency, giving:

0.5A x cos(at) x cos(w-p) x t - e

If (w-p) = 0 and e = 0, this becomes:
0.5A x cos(at)

However, this is the unattainable ideal case. If (w-p) is small, the output of the receiver will resemble a Wurlitzer theatre organ played with excessively heavy use of the tremulant. If (w-p) is a little larger, the result will be like the voix angelica rank on a pipe organ. For (w-p) of the order of 70rads/sec, the sound will be unpleasantly discordant.

For higher values of (w-p), the sound will become less discordant, but due to the highly non-linear response of the human ear, the listener will hear the beat frequency as a spurious component at 2(w-p)rads/sec. What happens to the human voice when it's subjected to this treatment?

If one sideband had been removed at the transmitter then the audio output of the receiver would be the original audio signal shifted a little in pitch. The shift, being additive rather than proportional, would ruin music but would not be noticed in speech. This SSB transmission of speech was invented by J.R. Carson around 1925 and has been used extensively in public telephone systems since that time.

Returning to the Low Cost 80m DSB Transceiver, I note that no frequency trimming control is provided on the front panel. Therefore, when receiving signals from other DSB transmitters, the difference frequency is likely to vary in a random manner from contact to contact over a range of say 0 to 150rads/sec. I would like to know how Mr Williams found speech quality and intelligibility in these circumstances.

Incidentally, I notice that while IC5a is described as a differential amplifier, it is rather unbalanced. A 1nF capacitor should be connected from pin 3 to ground and a 2.5k resistor should be connected from the junction of C29 and R21 to the junction of R24 and C32. Refer to Information Centre, January 1989 for an explanation.

If the internal circuit of the NE602 is isolated at audio frequencies then it will be driven up and down at half the output voltage appearing on pin 1 of IC5a unless the 2.5k resistor is fitted. This could have some interesting side effects when receiving a very strong signal.

I look forward to reading EA for some years to come. (R.H., Killara NSW).

Now it's Leon Williams' turn...

Thanks for the opportunity to respond to the comments made by R.H.

The aim of the DSB Transceiver project was to show how easy and inexpensive it is to build a full voice transceiver capable of good performance. An SSB transceiver was not described because it is a good deal more complicated and expensive. It would therefore have defeated the purpose.

The problem of the reception of a DSB suppressed carrier signal on a DSB receiver is not easily overcome. In fact the receiver's local oscillator should be exactly the same frequency and in phase with that of the transmitter if correct demodulation is to take place. It's possible to do this without a reference carrier, but a complicated arrangement of demodulators and a phase-locked loop is needed to maintain the correct frequency and phase of the receiver's oscillator.

One common use for DSB suppressed carrier is stereo FM broadcasting. Here



the L-R signal is sent separate to the L+R signal as a DSBSC signal with a carrier frequency of 38kHz. It appears at first glance that the same problem exists; however the difference here is that a 19kHz pilot tone is sent, which is used by the receiver to generate a local 38kHz carrier which has the same frequency and phase as the transmitter's carrier.

It would have been possible to include a trimming control on the PLL reference oscillator to fine tune to the received signal, but even this would not guarantee perfect results. In the end I decided to discard a control because just about all contacts will be with stations using SSB transceivers.

An SSB signal is easily demodulated in a DSB receiver and also a DSB transmission is no trouble for an SSB receiver, as one sideband is removed prior to demodulation. This arrangement works out fine, and in fact most SSB operators don't know it is a DSB signal unless you ask them to listen on the other sideband.

The NE602 IC has differential outputs and so it follows that when used as a demodulator, a differential audio stage could be used. I agree that the first audio stage is somewhat unbalanced with regard to input impedance. However the circuit works very well and I recommend it over an unbalanced arrangement at such low signal levels, because of its common-mode rejection. It would of course, be simple to modify the circuit as discussed. However I have had no problems with the circuit and have used it a number of times.

I am pleased there is some interest in the project and that it has stirred some comment on theoretical matters. It goes to show that even the simplest of circuits can contain complicated concepts and operation. (Leon Williams VK2DOB).

I'm reminded here of the scientists who proved mathematically that the bumble bee can't possibly fly. The mathematical proof given by R.H. seems reasonable to me, and yet the circuit works well in practice according to Leon Williams. I've long since learnt in electronics that you never question a circuit that works, only those that don't.

My thanks to R.H for his excellent critique of the project and to Leon for his reply. I'm sure quite a few readers will be encouraged to build the project as a result.

Electric Fence

As a rule, we don't offer advice about projects more than five years old. However I'm publishing the following letter in the hope a reader may be able to help.

I recently bought an Electric Fence Controller Kit from Jaycar and by their recommendation, I'm writing to you about the problems I've encountered.

I built the kit as per the instructions, but it refused to work. At first the problem seemed to be on the high tension side, because there was no output voltage. When power was applied, transistors Q1 and Q2 burnt out.

I checked the circuit components around the transistors and everything was working according to the instructions, except the operating frequency was 10kHz rather than 5kHz. After this I changed all the components, including IC1 and IC2. The only components I could not replace were transformers T1 and T2, as there is no supplier for these.

Can you please advise me of names of companies who can supply these trans-

formers and a list of repairers of Jaycar kits. (J.P., Hinchinbrook NSW).

I think you are referring to the Electric Fence Controller published in December 1985, although there are two others, with a possible contender being the controller published in October 1986. There are no errata on our database for the first, but one was published in February 1987 for the October 1986 project.

Without having the exact circuit details, it's not easy to assist. Obviously the oscillator frequency is a clue, although the transistors probably burnt out because the oscillator wasn't functioning at all. Of course, we cannot discount the possibility of a constructor induced fault, such as swapped transistors, accidental shorts and so on. For example if your unit is the design published in December 1985, accidentally swapping transistors Q1 and Q2 would almost certainly cause them both to burn out — as well as producing no oscillations or output.

Concerning repairers, I suggest you read EA's Marketplace section where you'll find several kit repair advertisements. There's also advertisements for transformer design and manufacture. However, I doubt if the transformers are faulty. If any reader can help I'm sure our correspondent will be most appreciative.

68705 programmer

It seems the 68705 development kit described in the March 1993 edition has been very popular. A large number of kits have been sold and most constructors got their system working first up. However there have been a few problems, all traceable to constructor error.

The following letter is from a reader who's convinced he's found an design flaw in the project, when it might be constructor error after all...

I purchased the 68705 development kit earlier this year from Oatley Electronics, and found that it was not working on some machines. I think the problem is related to the pulse width of the data being sent to the programmer board via the PC.

My machine is a 386DX-33 and it was not sending the correct information to the RAM in the programmer. I also tried programming the 68705 on a 486DX-33 and it gave similar results. The only machine able to successfully program the microcontroller was a 386SX-33. I then figured that the speed had something to do with the error, and I tried the program on my machine with the turbo switched off. It worked successfully.

From these results, I conclude that the programmer is sensitive to machine speed and should work on any '386 with the turbo switched off, or on an AT/XT. Perhaps this problem could also be solved by using a 74HC4040 in place of the slower CMOS 4040.

I hope this information might be useful to others. (M.H., Sunnybank Qld).

After receiving this letter, I spoke to the designer of the project, thinking this information would be useful to him. However, it turns out that he (and many others) are using the system with 486 machines without any problems. He suggests that you might have accidentally installed a 100nF capacitor for C24 or C22 instead of the recommended 10nF.

These capacitors are needed to get rid



of noise, but if too large a capacitance they will kill or reduce the width of the data pulses. Apparently a few constructors have done this, and like our correspondent have assumed the problem was a design error. Oh ye of little faith!

Digital transmitter

We often get requests for assistance with a design need, and as it happens we *can* help out with this one...

I look forward each month to receiving my copy of EA. My thanks to Mr Phillips for his informative contribution to the magazine. (I'm blushing as I type these words — thank you!) *I'm hoping you can assist me with a technical problem.*

Not long after completing my Electronics Engineering Degree, I was asked about the possibility of designing a circuit to transmit and receive digital signals through the air, over a distance of about 500 metres. As you are probably aware, my engineering course gave me more of an idea where to find information, rather than how to design and build circuits.

So far my attempts to find detailed circuit diagrams or information about the transmission and reception of digital signals, using air as the transmission medium, have been unsuccessful. Can you assist? (R.M., Bendigo Vic).

There are two ways that come to mind. The first is to use a conventional UHF (304MHz) transmitter/receiver combination. We have published several of these, although they will need modification to accept digital data from an external source. The most recent (12-channel UHF Remote Control system) was described in March 1993.

The modification is to remove the trinary encoder and to modulate the transmitter directly with the required digital data (in serial form). The receiver then reproduces this data for subsequent processing. Again the trinary decoder is not needed in the receiver.

The problem with sending data on a UHF carrier is possible reception by others. As I understand it, the 304MHz band is also shared by just about every remote control, garage door opener and so on. Therefore use of the band is restricted to short bursts of data lasting no more than a few minutes. There is therefore a risk of reception of other transmissions.

Infrared beam

Another method is to use an infrared laser beam. This assumes, of course, that you have line-of-sight between the transmitter and receiver. I mention this method as I have recently prepared for publication just such a project. Costing around $55, the complete kit will be sold by Oatley Electronics (who also developed the aforementioned UHF Remote Control system).

The project could even be in this issue, but otherwise it will appear in a future edition as soon as space permits. It allows the transmission of either audio (speech, music) or digital data, and has the advantage of absolute security.

I'm surprised you can't find any information on sending digital data by wireless, as it is a popular form of data transfer. And let's face it, it was the first method ever used, with a spark transmitter sending Morse code to a nearby coherer. Marconi then took the technology to sea, and the rest is history...

In September I stuck my neck out and gave a few opinions about the use and ratings of glass fuses, particularly the

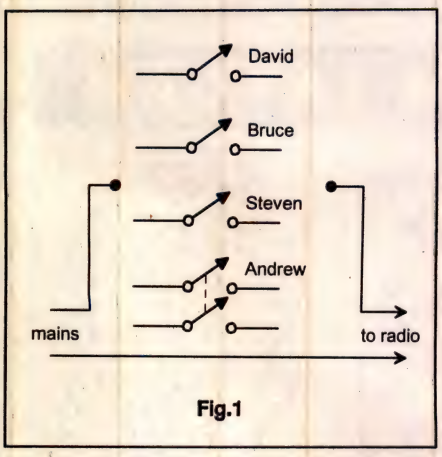


Fig.1

3AG types. I made the point that the fuse holder represents a major part of the rating, and went on to say that 'I further suggest that all 3AG fuses can be used safely with 240V AC, providing you have the right kind of holder. I would however caution against using glass fuses with a current rating of more than 5A in a 240V circuit'. But not everyone agrees, as the following letter illustrates...

I have been an avid reader of EA for many years now and have often been tempted to put pen to paper (or finger to keyboard) regarding subjects you discuss in your column. Such things as those fancy audio interconnect whatsits (oh yeah! we're not talking about that any more are we?) have tempted the pen to no avail. However, when I read things that seem to suggest that we should disregard the voltage rating of glass fuses, I must take you to task. So here's letter number one from this reader.

Having seen the results of a 3AG 32V rated fuse attempting to interrupt a 240V AC circuit on more than one occasion, I must advise your readers that it is not the fuse holder alone that plays a part in the rupturing capacity of the humble automotive glass fuse, even at current ratings of 5A or less.

While I could go into lengthy discussions about the type and shape of metals used for fuse elements and the blowing characteristics of each, the best advice is that if it doesn't have a marking stating it's suitability for use in a 240V AC circuit, then don't use it in a 240V AC circuit.

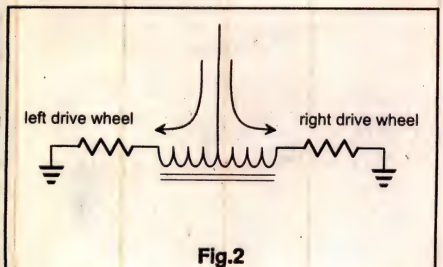


Fig.2

One should never underestimate the importance of ALL the characteristics of a fuse. I am reminded of a Fluke DMM that literally blew itself to bits, killing the user in the process, because the fuse had been incorrectly replaced with one that had all the correct ratings except the rupturing capacity. (This is not a joke, by the way!)

I believe fuses should be discussed fully in your column or elsewhere in the magazine, as this is a safety related issue. It has not had space devoted to it for a very long time, if at all. (D.W., Kelmscott WA).

I agree that a discussion on fuses typically used in electronic equipment would be a very worthwhile topic. I will try to research it myself, but I invite readers to contribute. Perhaps you might send me some details about the type of metals used for fuse elements and the blowing characteristics of each, D.W., as this is the area least understood.

Regarding your comments, I certainly didn't say (or intend to suggest) that it's OK to use a fuse rated at 32V in a 240V circuit. My comments are about those 3AG fuses that don't have *any* voltage rating, which seems to be the majority of them.

I would hazard a bet that the glass fuses found in most commercial 240V electronic equipment (TV sets, computers, audio gear) are only marked with a current rating. There's also a wide variety of fuse holders used in this type of equipment, ranging from open to fully enclosed. I stick to my original comments that the holder has an important bearing on the characteristics of the fuse.

Concerning the Fluke DMM, I think you are referring to the fuse that protects the 10A current range. This is a special HRC fuse sold by Fluke, and there are plenty of warnings about replacing it with the right type. I agree great caution should be applied here, as in all fuse replacement. Again I ask readers to contribute to this topic, as there is a dearth of information and I think we would all like to know a bit more about the correct use of 3AG fuses. Thanks D.W. for your letter, and hopefully it will serve as a catalyst.

What??

The question this month was sent to me by 'Dr Henry Choke'(!). It has apparently been around for a while, but is new to these columns. While Dr Choke sent me the question, he didn't include the solution. Fortunately, a colleague (Barry Duncan, of Rockdale) has supplied an answer, which (as usual) will appear next month. Here's the question:

Four technicians, David, Bruce, Steven and the boss Andrew work in a laboratory. A radio provides background music, but the guys can never agree about when it should be on or off. To stop arguments, they installed a switch on each workbench, wired to control power to the radio, but in such a way that a majority vote determines whether the radio is on or off.

Andrew, being the boss, has a switch worth two votes, while the others get one vote each. That is, the three underlings can out-vote the boss, or the boss and any *one* of the others can out-vote the other two. The switches are shown in Fig.1. Andrew's is the DPST switch, and the rest are SPST. How are the switches wired?

Answer to November's What??

The action of a car's differential can be simulated with a centre-tapped choke as shown in Fig.2. Note that power is not delivered in differential mode. There is only a small differential component when cornering, so perhaps we should call it a 'common-modal! ❖

ELECTRONIC TEST GEAR TO BUILD

Volume 2

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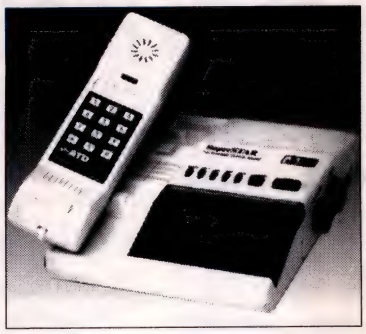
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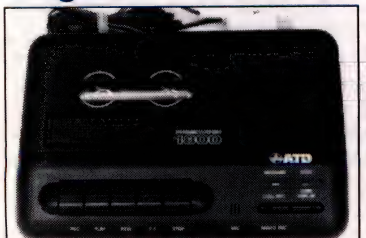
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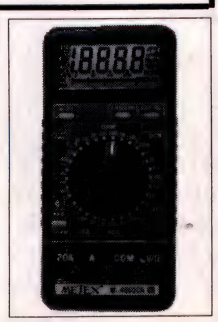
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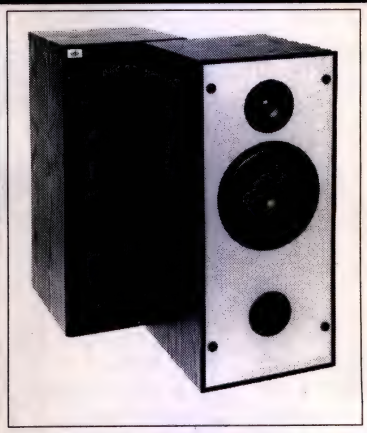
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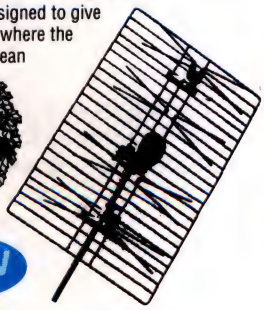
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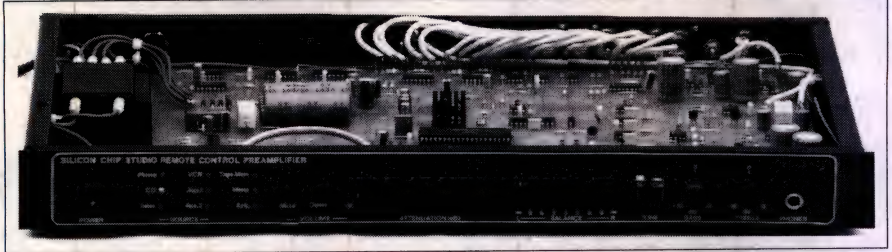
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REMOTE CONTROL PREAMP KIT



REF: SILICON CHIP SEP/OCT/NOV 1993
BUILD YOUR OWN HI-TECH REMOTE CONTROL HI FI PREAMP

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Jaycar will of course be producing a standard version of this project. This version will include the fluorescent choke-type power transformer, nickel plated RCA sockets, Scotchcal panelling, carbon film resistors and standard screened cabling as well as the other parts specified in the projects part list. In addition to this, however, we will also be making available a fully Blueprinted kit which will include (but not limited to) the following features:

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- specially written step-by-step instructions
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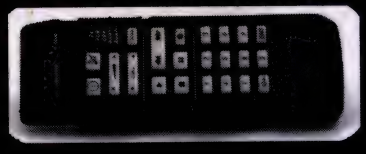
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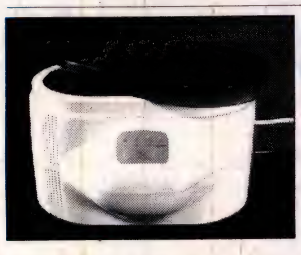
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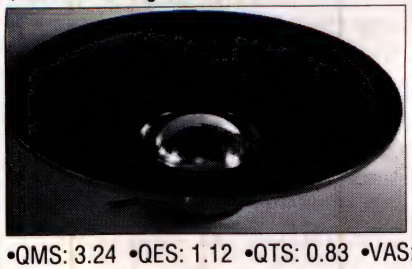
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NEW

Ref E.A. Sept 93.
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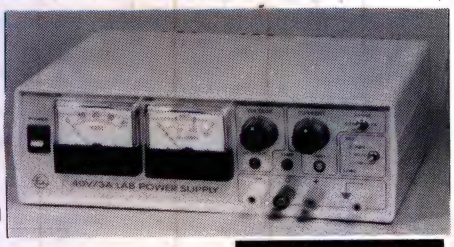
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REF: Electronics Australia Dec/Jan 94
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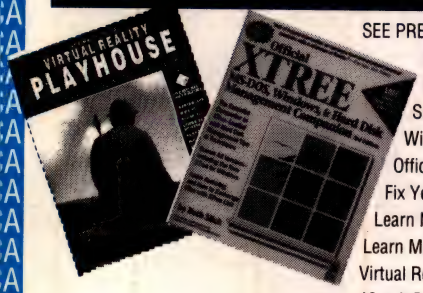
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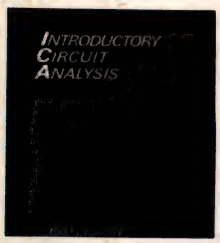
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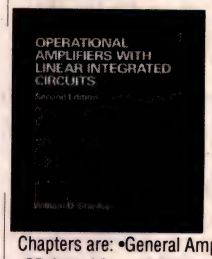
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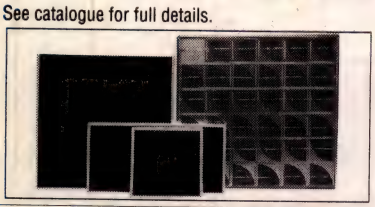
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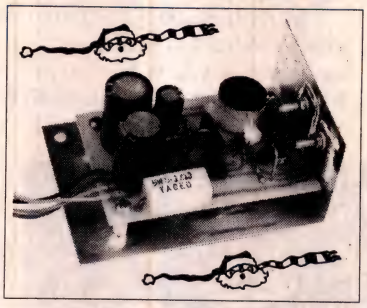
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See catalogue for full details.



SOLAR BATTERY CHARGER KIT



REF: Silicon Chip Nov 91
Will hadle solar panels up to 25 watts and 2 amps. Kit includes PCB, pot cores, heatsink and all specified components.
Cat. #: KC-5102
$34.95

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As used in subwoofer project in Electronics Australia June 1992. The cabinet utilises a bandpass design whereby the speaker is mounted in a partition in the cabinet, the front compartment being 14 litres and the rear 38 litres. The speaker features a massive magnet assembly, 80W RMS power handling, butyl rubber cone suspension and a super rigid frame. Copies of the project are available for viewing at Jaycar stores.

Rated Power	80 watts rms
Frequency Response	35 - 5kHz
Sensitivity	90dB - 1W/1m
Voice Coil Impedance	8Ω @ 400Hz

WARRANTY 1 YEAR
Cat. #: CW-2150 **only $99.50**

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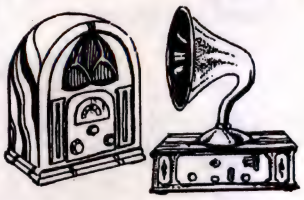
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Vintage Radio

by PETER LANKSHEAR



A Russian Radiola

There is usually a certain sameness about receivers that have had similar origins. Occasionally though, a lucky or enterprising collector will acquire an exotic radio that adds considerably to the interest of a display, and warrants extra study. Recently a friend of mine did just that. He was offered a Russian receiver which had been a prized possession of a Bulgarian who had migrated about 35 years ago. It was a rare opportunity to study Russian technology of the late 1950's, and the offer was accepted with enthusiasm.

Until recently, a lot of what went on behind the Iron Curtain has been not at all clear, but there has been a widespread impression that Russian technology lagged behind and was inferior to that of the West.

On seeing my friend's acquisition, my first impression was of a large and well finished table-top cabinet with attractive inlaid veneers and in appearance quite different from locally made contemporary models. It is somehow bigger than it looks — measuring 350 x 450 x 600mm — and is quite heavy. The front curves inwards, effectively removing any suggestion of boxiness, and the top lifts up to provide access to a turntable and monaural pickup. But more of these later.

What is the brand name? In the middle of the speaker baffle is a metal badge in Cyrillic script. With the aid of a Russian guide book, I transliterated this as 'Loocs' (Lux?). There may be some significance, but Lux has been a Swedish radio brandname. Indeed, the quality of construction and general appearance give an initial impression of the chassis having German or Scandinavian influences...

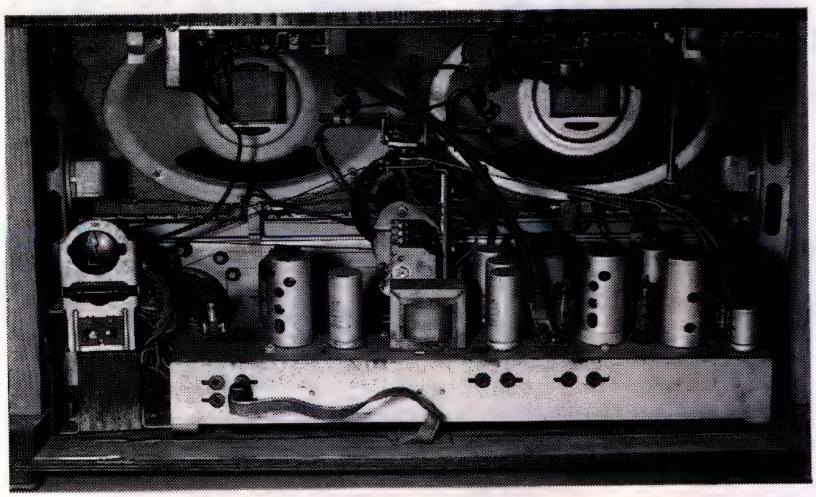
Label surprise

Together with several labels identifying terminals and controls, the logo also appears on the back cover. But above it was my first surprise: a word which when converted to our Roman alphabet says 'Radiola'!

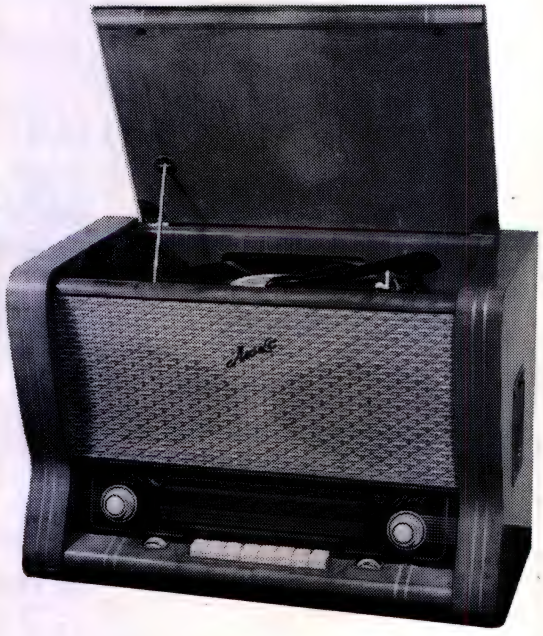
The term *Radiola* has long been associated with RCA and their Australasian associate, AWA. In fact, right from their founding, RCA had called their receivers Radiolas and almost certainly held the copyright. In Levallois in 1921, the French installed a transmitter for what was named the Radiola Station. My guidebook says that the Russian for a radio is 'pryeeyomnyeek' and a record player is a 'praheegrivahtyehl'. Perhaps 'Radiola' is a generic term much as 'Hoover' or 'Gramophone'.

Grouped with the inevitable CCCP (USSR) is what appears to be the manufacturer's logo. This is very stylised, in what looks like Roman script initials VEF above the name RIGA. V and F are not Cyrillic letters and of course Riga is the capital of Latvia. (On the dial, the same logo has Riga in Cyrillic script). It would seem likely that the Radiola was made in Latvia, which perhaps significantly is very close to Sweden.

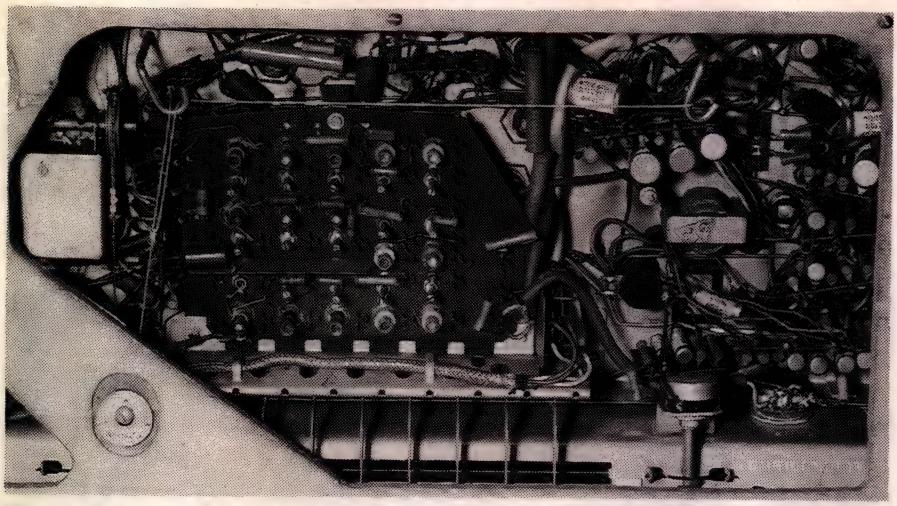
Still at the rear, there are plenty of



Above: The rear of the set with the back removed. Although only a mono receiver, there are four parallel-connected elliptical speakers.



Right: In its distinctive tabletop cabinet, the Russian radio/record player would stand out in any collection. There are a total of six receiving bands, including an FM band centred on 67MHz.



Many of the components are mounted on tagboards to achieve a compact layout. Note the cord, linked to the tone control, for adjusting the IF selectivity.



Larger value capacitors are especially well made, with glazed ceramic bodies, solid metal ends and low inductance leads.

sockets to sort out. First there is a modified octal socket with a plug to select mains voltages of 110, 127 or 220 volts. The standard Russian supply is 220V at 50Hz, but there are some variations. As was common European practice, the mains plug is captive on the back cover to prevent operation with the chassis exposed.

There is a socket for a VHF dipole for FM reception, and the usual aerial and earth connections are provided for the AM frequencies. There is an extension speaker socket and although the record player pickup is internally connected, there is provision for an external pickup, indicating perhaps that the chassis was intended for installation in non-record playing cabinets.

Extensive coverage

Across the lower front of the cabinet is a well laid out glass dial, the scales giving an idea of the extensive coverage of the receiver. Calibration of all six bands is in metres and is as follows:

Longwave 800 - 2000m (375 - 150kHz)
Broadcast 200 - 550m (1500 - 545kHz)
Shortwave III 55 - 75m (5.45 - 4.0MHz)
Shortwave II 40 - 55m (7.5 - 5.45MHz)
Shortwave I 23 - 32m (6.9 - 9.37MHz)
VHF (FM) 4.3 - 4.7m (69.7 - 63.8MHz)

The shortwave and broadcast band frequency ranges are conventional with good shortwave bandspread, but the others need some comment. With its vast distances, Russia finds the longwave band very useful. FM tuning is very restricted, covering a portion of what here is Television Band I.

As was common practice at the time, the dial is decorated with station locations — recognisable names of Russian cities including Moscow, Leningrad (now St Petersburg once again), Stalingrad, Kiev, Minsk and Odessa. What I was not prepared to find listed were European cities including Luxembourg, Oslo, Paris, Prague and Hilversum! Obviously, the Iron Curtain did not screen radio transmissions...

Band selection uses a method internationally popular at the time, by means of a row of piano-type key operated switches. Depressing a key switches the band or pickup and connects the mains supply. The extreme left hand key switches the power off.

Either side of the row of keys, and partly recessed into the cabinet, are edge operated tone control knobs, with bass on the left and treble on the right. Overall, the control range is wide and each has a clever little music clef scale in front of an illuminated red cursor indicating the setting.

There are two main controls, both of them of the dual concentric variety. One pair is on either side of the dial. At the left is the volume control, concentric with a knob for rotating the internal long- and medium-wave ferrite aerial for best signal pickup. This is accomplished by means of an ingenious arrangement of a cable, guides and jockey pulleys. On the right, a similar pair of knobs control tuning, with the inner control for the AM bands and the outer for FM. Gearing ratios are well chosen to provide comfortable tuning.

No 45rpm...

The record player has a spring mounted 10-inch turntable. One convenient feature is a pair of clips that can be flicked into position to lock the springs for transit.

I was astonished to find that the turntable has only two speeds — 78 and 33rpm. It would seem that the Russians did not recognise the 7" 45rpm disc which was so popular elsewhere. Was it because this format was first developed by America's RCA? In the West, the 45 single was a cornerstone of the record and entertainment industry and very important to youth culture. Perhaps this is another example of how much the old Socialist regime was out of touch with the needs of their people.

The crystal pickup has two stylii on a common leaf and selected by a little lever which rotates the assembly a few degrees. This system simplifies stylus se-

VALVES USED IN ЛЮКС RECEIVER

VALVE TYPE	FUNCTION	EQUIVALENT
6К4П	R.F.& I.F AMPLIFIERS	6BA6/EF93
6И1П	M.F.& H.F. MIXER	6AJ8/ECH85
6Х2П	DIODE DETECTOR/AGC	6AL5/EAA90
6П14П	OUTPUT STAGE	6BQ5/EL84
6Н2П	AUDIO AMPLIFIERS	SIMILAR TO 12AX7
6Н3П*	F.M. OSC/MIXER	NO EQUIVALENT
6Е5С	TUNING INDICATOR	6U5G/EM35

* V.H.F. DOUBLE TRIODE

lection, but it does mean that there is additional mass waving about to affect pickup performance.

Four speakers

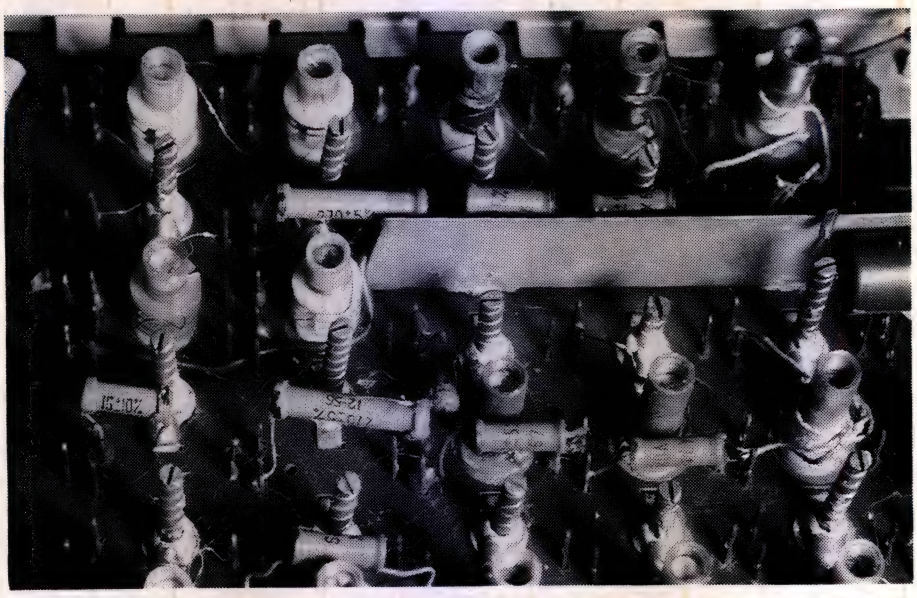
Although no open-back cabinet can be ideal acoustically, the quality of sound produced is very good. Some of this can be attributed to the provision of four parallel loudspeakers, which must be a record number for a monaural mantel radio cabinet. There are two 200mm by 125mm units on the front baffle board and one 75mm by 125mm on either side of the cabinet.

Around about now I had intended tracing out the circuit, but after a close study of the chassis I concluded that too much of what is euphemistically known as 'reverse engineering' (pulling apart) would be involved. However, a fair evaluation is possible without such drastic action.

The IF and audio amplifiers are common to both FM and AM, but there are independent RF sections. The FM section comprises a slug-tuned unit and a double triode oscillator/converter valve, connected directly to the aerial without the benefit of an RF stage. This is probably the weakest part of the whole design. There is an optional internal FM aerial made of 300-ohm ribbon tacked around the interior of the cabinet.

The AM section of the receiver has a conventional RF stage, and a triode/hexode converter.

The IF amplifier has an unexpected refinement. A cord around the treble tone control shaft is connected to the IF transformers. This acts as a windlass, adjusting the physical spacing of the windings in what is one of the best variable selectivity systems.



The coil assembly is on a large fibre board, making access for alignment very easy. With the wavechanging switches directly underneath, leads are very short, contributing to stability and efficiency.

Familiar valves

Following the detector, the quite elaborate audio amplifier has two double triodes and a push-pull pair of output pentodes. Naturally, I was very interested in the valves and ascertaining just what types are their equivalents, involved a bit of detective work. A magnifying glass and an AVO valve tester were indispensable.

As can be seen from the table, most are international types with only one, the high mutual conductance VHF double triode, having no close Western relative. Although it has a noval base, pin connections are completely different from any American or European types. The characteristics of the two audio double triodes are intermediate between the 12AX7 and the 12AT7, but the filaments of the two sections are internally connected in parallel.

The remaining valve types are very familiar and with the exception of the tuning indicator, were preferred types internationally. One at least, the 6BA6/EF93 was sold in the West under the CEI label.

The rectifier is a large selenium flat pack bridge labelled 'ABC 120-270', the figures no doubt referring to the ratings.

A hardboard base plate with its mounting screws in keyhole slots is readily removed to give access to the wiring and small components. First impression is of an orderly array of the fairly large number of components needed for a complex receiver. Most are mounted on tagboards and the wiring is tidy.

Virtually all large capacitors have glazed white tubular ceramic cases with very solid metal ends. Components of this quality are normally found only in military or the highest grade industrial equipment. Smaller capacitors appear to be ceramic types, and what appears to be date codings on some of them confirm the age of the receiver as being about 35 years. Resistors are all one colour — green — and appear to be spiral cut deposited carbon. Values are not colour coded, but printed on capacitors and resistors. Rather than the usual wire connections, resistors and capacitors all have low inductance copper ribbon leads.

There is good access for alignment. As can be seen from the underchassis photographs, the ferrite cored RF coils and well made ceramic trimmers are mounted on a large fibre panel which is effectively part of the switch assembly. Thus the coils are effectively mounted directly on the wavechange switch, with virtually no connecting leads. This method of construction is far superior to the use of a rotary wafer switch, and would be nearly as efficient as a turret.

Overall this receiver is a very well conceived and designed piece of equipment, which gives a first impression of having Northern European origins. Its good quality goes some way in rebutting the common misconception that Russian products have been inferior to and below the standard acceptable in the West.

In short, it's a worthwhile addition to any radio collection. ❖

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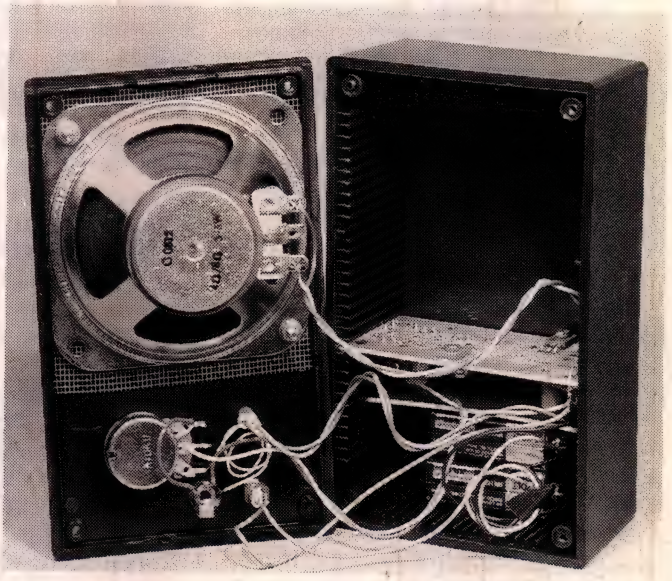
Experimenting with Electronics

by PETER MURTAGH

Power amp module

How about building a small power amplifier unit to boost the output signals from various projects? Then you can listen to them as nice 'clean' (undistorted) sound, at a reasonable volume level. This month's 'power module' can deliver the required several watts of power to a small eight-ohm speaker to do just this.



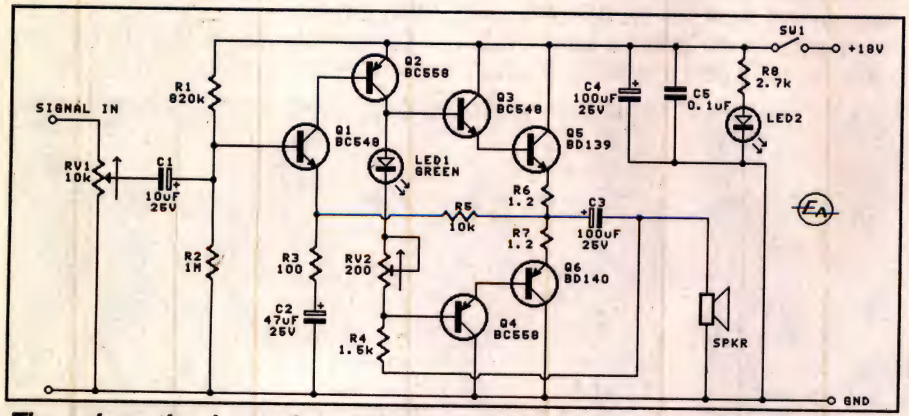


It's a tight fit inside the box with the 87mm speaker. Note how the PCB slots in just clear of the speaker, while another PCB off-cut holds the two 9V batteries in place.

There are various different types of amplifiers (more on these amplifier 'classes' later) which can be used to drive a loudspeaker. If you look at many of our earlier projects, you will see that we have often used a one-transistor class A amplifier to drive, via a 1k:8-ohm transformer, a mini 8-ohm speaker. The transformer is needed to match the high output impedance of the transistor to the low impedance of the speaker. Without it, there will be an impedance mismatch, which will result in an inefficient transfer of the signal to the speaker, lowering the volume. But even using a transformer to match the impedances, you will find that such a simple amplifier still cannot deliver a very powerful signal — and what it does deliver is quite distorted.

So we thought that it would be quite handy to have a better quality, stand-alone power amplifier, capable of providing enough volume to fill a normal room with an undistorted signal. This also means that, for future projects, we can dispense with the last stage of the circuits — their outputs can be amplified by this month's power module. This module is actually a refinement of the power amplifier stage used in October's ultrasonic receiver.

Depending on how powerful you wish your unit to be, we are offering two alternatives. You can power your unit from one 9V battery, in which case you can safely use BC328/338s for your power transistors; or you can increase your supply voltage to 18V (see the later section on 'Supply voltage' for why) by using two batteries in series. In this case, the 800mW BC328/338s can't cope with the extra power, so you will need higher rated 8W BD139/140 transistors. (A



The schematic shows the two sections of the receiver circuit: the voltage amplifier is built around transistors Q1 and Q2, while the two Darlington pairs Q3/Q5 and Q4/Q6 form the current amplifier. The bias for the class AB amplifier is set by LED1 and trimpot RV2.

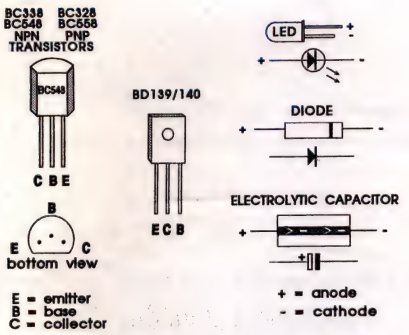


Fig.3: All the BC transistors mentioned in this project have the same pin out, which is different to that of the BD power transistors. Be careful to identify the NPN transistors correctly — Q3 is the BC548, Q5A is the BC338 (not the 328), while Q5 is the BD139.

BC328/338 pair costs about 70c while a BD139/140 pair costs about $2.30 — which isn't that much more expensive.) We opted for these higher power transistors and the 18V supply rail.

When driven flat out, even the BD139/140 transistors become quite hot, so they really need heatsinks. If you build your module on our PCB pattern, you will get the added advantage of a built-in heatsink — the large areas of copper track, on which we have directly mounted the power transistors.

By bolting the metal faces of the transistors to the copper surface, the transistors can dissipate the heat they generate far more quickly, and so reduce the possibility of over-heating.

Construction

Because we believe that this project will be used quite often, we have mounted it in a jiffy box, with a front panel. The PCB is designed to slot sideways into a 150 x 90 x 50mm box. If you use this size box, and mount your speaker inside it, then you are limited to a speaker diameter of 83mm (3-1/4") or less. Altronics provides a suitable 3W 3-1/4" model, and Jaycar a 1W 3" one. Of course, you can decide to use a larger box, or connect a better quality speaker, perhaps one reclaimed from a TV set, etc. You could even use a speaker socket, so that plugging in an external speaker disconnects the small, internal one.

Start your construction by cutting all the necessary holes in the lid of the plastic box, for the speaker, input socket, power switch and volume pot. Use a copy of the front panel artwork as a template to position the holes. The bolts used to fasten the speaker to the box will be hidden under this artwork.

Next, move on to the PCB. Begin here with the power transistors (Q5 and Q6), since they will be the most awkward components to place. Position them, metal face down, on the copper surface; then mark where the three leads have to be bent to go into their holes. Hold the leads at this point with a pair of pliers, and bend them around the pliers until they make a 90° angle. Bend the leads away from the plastic face (top) of the transistor.

Now insert the leads into their holes on the PCB, and check that a bolt will go through the transistor into its mounting hole. If not, modify the size or position of the hole — don't risk re-bending the transistor leads. We used 6BA bolts (2.8mm diameter), as the more common 1/8" ones were just too large. Of course, make certain that you use the NPN transistor (BD139) for Q5 and the PNP (BD140) for Q6.

Because the metal plates on both the BD139 and BD140 transistors are joined to their collectors, there is no need to insulate the transistors from the copper track. A quick look at the schematic diagram will show that the BD139's collector goes to the positive supply rail, while the 140's goes to ground. A smear

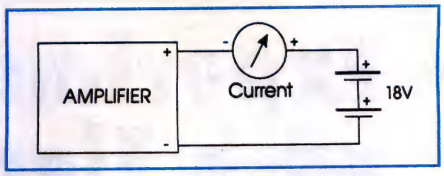


Fig.4: Insert an ammeter as shown to measure the overall current drawn by the circuit. A marked increase in quiescent current indicates that you have set the operating bias too high with trimpot RV2.

of thermal grease (if you have some) can be used between the surfaces to increase the efficiency of heat transfer.

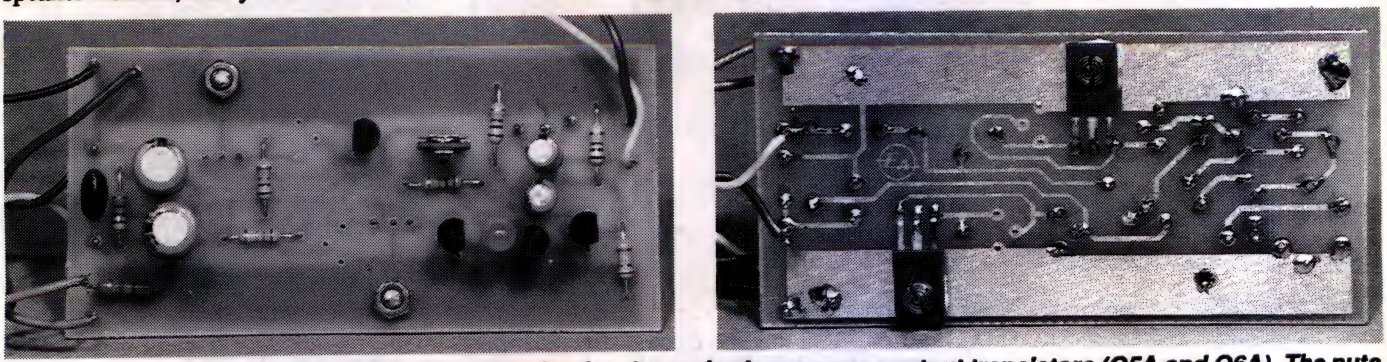
If you have decided not to build the higher power version of the module, then ignore the above instructions, and simply place your BC338 and BC328 transistors into positions Q5A and Q6A, respectively. Note that, for this pair of transistors, the lower number 328 is the PNP version, with the 338 being the NPN — the reverse to our usual models, the BC548 (NPN) and 558 (PNP).

Because the same board allows you to use different transistors, (which unfortunately have different pin-outs) take care that you don't accidentally insert another component in the spare spot. Use only the spots for *either* Q5 and Q6 *or* Q5A and Q6A.

Solder in the various components in the usual order: resistors, capacitors, LED and transistors. Check with Fig.3 for the various pinouts. This shows that all the BC transistors which are used have the same CBE pin-out — only the BD models are different.

Don't be confused by the positions of the BD139/140 leads as shown on the PCB overlay diagram (Fig.1); this shows the identification of the leads when viewed from the *top* (non-copper side) of the board — the order will be reversed if you view them from the copper side, where these transistors are actually located.

Connect the various leads to the input socket, volume control and speaker. If



Left: The top of the PCB show the spare slots for the alternative lower power output transistors (Q5A and Q6A). The nuts and bolts fasten the high power ones (Q5 and Q6) to the copper side of the board. Right: This photo shows the BD139/140 transistors fastened to large sections of copper track which act as heat sinks.

you are using an 18V supply, use two 9V battery snaps, and join the black (negative) lead of one to the red (positive) lead on the other.

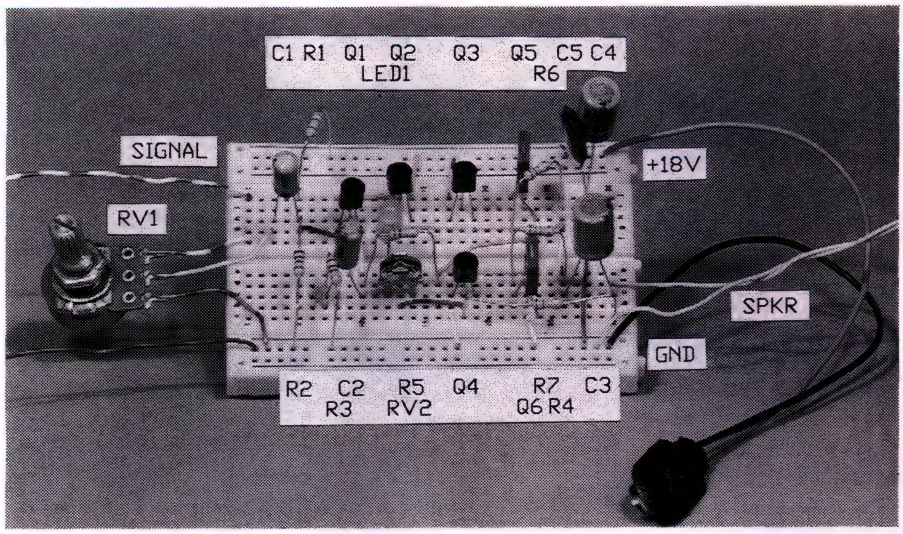
Then solder the red lead of the first snap to the on/off switch SW1 (which is connected to the positive rail on the PCB; and solder the black lead of the second snap to GND. (See Fig.1.)

Setup

Once construction is complete, it is time to adjust trimpot RV2 to remove any crossover distortion in the power transistors. Because the amount of bias applied to the power transistors increases as the resistance of RV2 increases, start by rotating RV2 fully anticlockwise (viewed from the front, that is, the side facing the GND track). This should give a resistance of zero. Do this before turning on the power, to avoid accidentally applying too much bias.

Ideally, for this adjustment, you need a 1kHz sine wave input. As you listen to the speaker, you gradually rotate RV2 clockwise until the distortion disappears.

The increase in sound quality will be quite obvious at this point. However, check that you haven't set the bias too high, because this can cause large quiescent currents to flow through Q5 and Q6.



The breadboard layout for the higher power version of the amplifier. Note that the power transistors are inserted vertically on the board — the three leads from left to right are the emitter, collector and base.

If these transistors feel quite hot to touch — without any input signal — then reduce the setting of RV2.

Setup is more difficult without an oscillator. One method is to connect an ammeter as shown in Fig.4, and adjust RV2. Increasing RV2 will increase the current, but the rate of increase will become far more rapid as transistors Q5 and Q6 turn on more. Once this happens, reduce RV2. On our prototype with its 18V rail, this rapid increase occurred with a meter reading around 14mA (3.5mA for a 9V rail).

Another method uses trial and error. Start with RV2 about mid position, and continue to check the power transistors each time the resistance is increased. If they don't seem to be getting hot, then continue to rotate RV2 a bit further clockwise. Our distortion ceased at about the three-quarter position. While yours won't necessarily be the same, this should give a reasonable guide to the trimpot's final position.

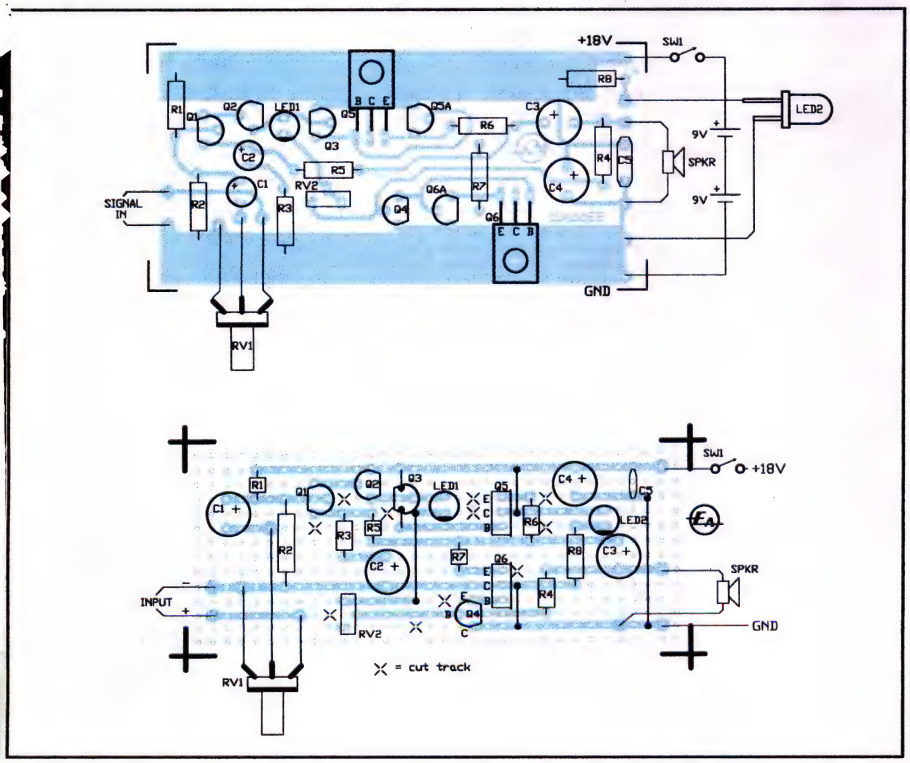


Fig.1 (top): The component layout for the PCB. Note that, because the two transistors are mounted upside down on the copper side of the board, the pin order shown for Q5 and Q6 seems to be backwards.

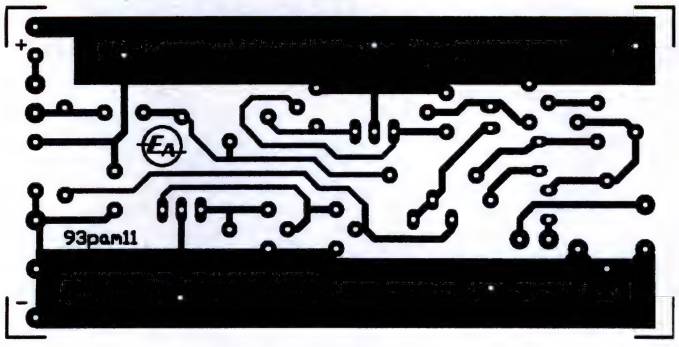
Fig.2 (below): The layout diagram to build the amplifier on strip-board. As usual, make sure that you break the copper track at all the locations marked as 'cut track'.

Changes

The power module has been designed, with an 18V supply rail, for a maximum input signal of about 50mV (or 20mV with a 9V supply). With signals larger than these, the volume control will act as a potential divider to reduce the signal, and so prevent distortion.

However, if you wish to use a very much smaller signal (say, just a few millivolts), then you really need a preamplifier. Alternatively, you could try increasing the value of the 10k feedback resistor R5, and so increase the amplifier gain above the 11 (the ratio of (R3+R5):R3) which we have chosen for this design. Don't reduce the value of R3 as this will alter the frequency response of the amplifier.

Other changes concern input and output sockets. You could save some money by dispensing with the audio input socket, and just clip your input to the PCB pin which is connected to the top of the volume pot RV1. Or, you could add an



The PCB pattern for those who wish to etch their own.

output socket, to allow you to plug in a better quality external speaker.

The power-on LED2 uses a 2.7k resistor to limit the current to around 6mA. Decrease this value to 1.2k if you are using a 9V rail. The resistor values could be decreased slightly to make the LED glow more brightly, but this will shorten the life of the batteries.

Amplifier classes

The various amplifier classes are defined in terms of the amount of bias that is applied at the input of the amplifier. They vary between the two extremes of Class A and Class C — the former is permanently and fully biased on, while the latter only conducts on the peaks of the signal. In between these extremes, are Classes AB and B. In our design this month, we have used Class A and Class AB.

If you refer to the schematic diagram, you will see that the first stage of our amplifier has both its complementary pair transistors Q1 and Q2 arranged in the *common emitter* mode, to give a high voltage amplification. However, its output impedance is quite high, which means that it is not suitable for driving an 8-ohm speaker directly. Hence, with this setup, the need for an impedance-matching audio transformer (as mentioned earlier).

This first amplifier stage is actually a Class A amplifier, because there is sufficient bias applied by resistors R1 and R2 to keep the transistor pair permanently turned on. The amount of bias has been chosen to place them in the middle of their conduction range, so that they may react to both the positive and negative swings of the input signal. But the price that we pay for a Class A design is that there is a continuous quiescent current flowing, whether or not a signal is actually being amplified.

To reduce the wastage of the quiescent current, another class of amplifier, Class B, uses a pair of complementary transistors which are not quite biased on. The complete signal is amplified by using the NPN transistor to react to the positive voltage components of the input signal, while the PNP reacts to the negatives. At any instant, only one of the transistors is ever on. You can easily see why this setup is called 'push-pull' — when the NPN transistor (set up like our Q5) turns on, the output voltage is 'pulled' up towards the positive supply rail, while turning on the PNP (like Q6) 'pushes' it down towards ground.

Class B solves the quiescent current problem of class A amplifiers, but introduces another — 'crossover distortion'. Because the first part of the signal is used to complete the turn-on bias for each transistor, you end up with distortion in the output whenever the input signal swings between positive and negative (or vice versa).

Enter the Class AB compromise. Class AB also uses a pair of complementary transistors acting in the same push-pull arrangement, but it adds sufficient bias between the base-emitter junctions to *just* turn on both transistors when there is no signal. When a signal is applied, one of the transistors will be turned on more and the other turned off — which one does what will depend on whether we are dealing with the positive or negative sections of the signal.

A diode in series with an adjustable resistance (as in our circuit), or the controlled output voltage of another transistor, is normally used to apply the precise bias. If this bias is too small, then there will still be some distortion; but if it is

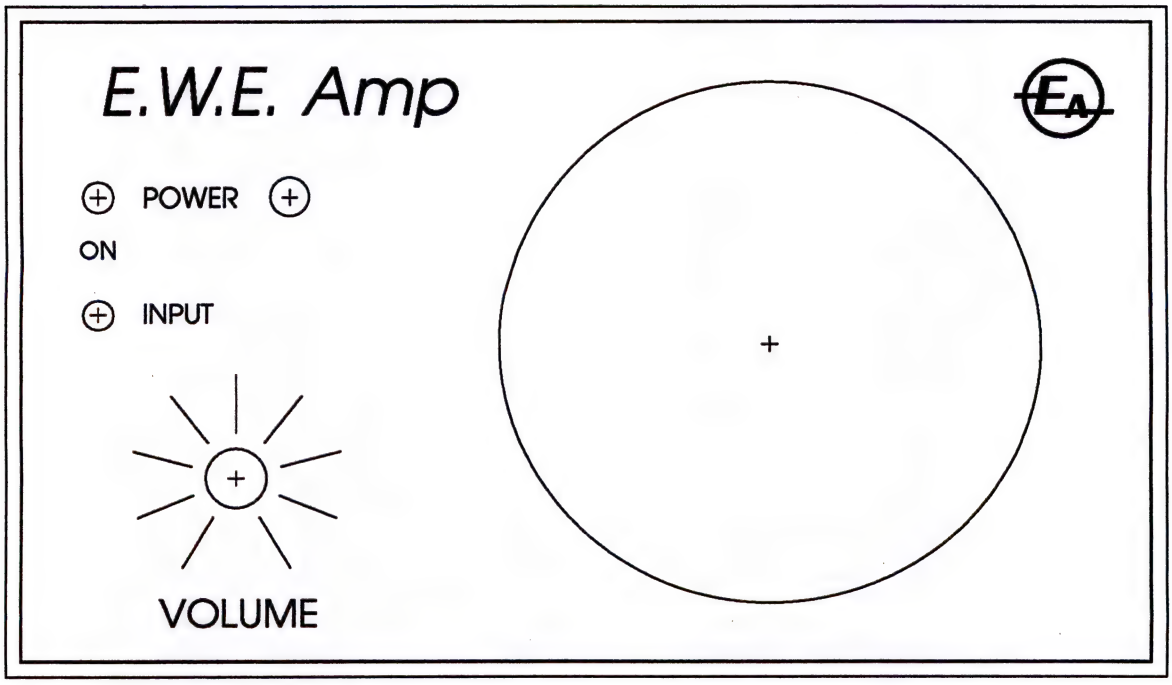


Fig.5: The art work for the front panel of the jiffy box, for those who wish to mount the amplifier in a permanent case.

too large, an increased quiescent current will flow which will waste power.

Referring again to the schematic, you can see that that this second stage of our amplifier is set up as an *emitter-follower*, with the load is connected to the emitter of the transistor, rather than to the collector (as in the first stage). The voltage at the output 'follows' the voltage at the input — they are the same value, apart from the 0.65V drop across the base-emitter junction. The advantage of this setup is that it produces a large output current, at a low output impedance — ideal for driving a speaker.

Now let's investigate the bias needed to remove the crossover distortion — which is the special feature of the Class AB amplifier. Because our circuit uses two Darlington pairs in the final amplifier stage, the bias voltage needed to just turn on Q3-Q6 should be about 2.6V (4 x 0.65V). This is supplied by the voltage drop across the green LED1 and the trimpot RV2.

Here are the results of some measurements we made, after adjusting RV2 to remove crossover distortion. With a 9V supply rail, the bias voltage was 2.26V — 1.86V across LED1 and 0.40V across RV2. The collector current of Q2 was 2.14mA, and the resistance of RV2 was 187 ohms (0.40V/2.14mA). With an 18V rail, the LED voltage was slightly higher (1.93V), the RV2 voltage lower (0.12V), the collector current greater (5.44mA) and RV2 resistance was smaller (22.1 ohms).

Hence, the 200-ohm value for RV2 was chosen to be able to cover these two extremes (22 - 187 ohms); but its maximum value was kept as low as possible, to prevent anyone accidentally setting the bias far too high. This is also the reason for using a green LED (and not another colour), because its voltage drop is less than, but close to, the minimum bias required.

How it works

Transistors Q1 and Q2 form a complementary pair for the audio voltage amplification. The advantage of using two transistors for this stage is that the arrangement has a very high input impedance, and hence does not load down the input signal — that is, it draws very little current from the previous stage. The load for transistor Q2 is the green LED1, the resistance of RV2 and resistor R4. Note that R4 is not joined, as you would expect, directly to the GND rail, but indirectly via the speaker. This setup is called 'bootstrapping' (and will be explained later).

The current amplifier also uses pairs of transistors (Q3/Q5 and Q4/Q6) to increase the input impedance. As mentioned earlier, this stage also has small value emitter-follower resistors R6 and R7, to help stabilise the circuit. Voltage changes produced across these resistors act as negative feedback, and so help to counteract any alterations in current caused by increased temperature or the different gains of particular transistors, etc.

There is also an overall negative feedback loop via resistor R5, which provides 100% DC feedback, and a degree of AC feedback also. The amount of the latter is determined by the voltage divider effect of resistors R3 and R5 (ignoring the impedance of capacitor C2).

PARTS LIST

Miscellaneous

PCB 88 x 43mm, coded 93pam11
UB1 Jiffy box 150x90x50mm
2 (or 1) 9V batteries (see text)
2 (or 1) battery snaps
8 ohm loudspeaker (e.g. Cat. Nos.: Altronics C-0612, Jaycar AS-3006)
1 mono panel socket
1 SPST toggle switch
2 8mm 6BA nuts and bolts
hookup wire, solder, PCB pins, etc.

Resistors

All 1/4W, 5%

1	820k	R1	grey-red-yellow
1	1M	R2	brown-black-green
1	100	R3	brown-black-brown
1	1.5k	R4	brown-green-red
1	10k	R5	brown-black-orange
2	1.2	R6,R7	brown-red-gold
1	2.7k	R8	red-purple-red
1	10k log pot		RV1
1	200 ohm 5mm vert.trimpot		RV2

Capacitors PC-mount electrolytics

1	10uF,25V	C1
1	47uF,25V	C2
2	100uF,25V	C3,C4

Capacitors polyester (greencap)

1 0.1uF C5

Semiconductors

1	green LED	LED1
1	red LED	LED2
2	BC548 NPN transistors	Q1,Q3
2	BC558 PNP transistors	Q2,Q4
1	BD139 (or BC338) NPN transistor	Q5
1	BD140 (or BC328) PNP transistor	Q6

Bootstrapping

Bootstrapping is a technique which allows you to 'unlock' the DC and AC operations of an amplifier, in order to get an increased power output. In some ways it is like the operation of an inductor, which has a low DC resistance but a high AC impedance.

The smaller DC resistance of the bootstrapped load does not restrict the current flow, while the higher AC impedance results in a large voltage being generated across the load. Combining high current with high voltage gives high power (P = E x I).

In general, bootstrapping provides *positive* feedback from the output to the input of a 'unity gain' amplifier, in such a way that a particular point in the circuit is 'pulled up by its own bootstraps'. The signal voltages at the opposite ends of the bootstrap rise and fall together, with virtually the same AC signal appearing on both sides — providing a higher impedance load for the driver transistor than its ohmic value would indicate.

Let's see how this works in our circuit. Resistor R4 is the bootstrapped load, connected between the emitter and base of the emitter-follower output stage. Because R4 is connected after capacitor C3, the bootstrap is effective *only* for the *AC* signal; and the extent of the multiplying effect will be determined by the true voltage gain of the nominally 'unity' gain amplifier.

Suppose that the amp had true unity gain. Then the AC voltage at both ends of resistor R4 would be exactly the same. With no AC voltage drop across R4, no current would flow through it, so it would have an effective infinite resistance.

Now, suppose that the voltage gain is a more realistic 0.9. This means that the voltages at the top and bottom of R4 would be 'V' and '0.9V', making the voltage drop across it '0.1V'. This is only one-tenth of the full 'V' which would occur if R4 were connected directly to ground. Hence, R4's 'bootstrapped' resistance is 10 times greater than its 1.5k value; so, to the driver transistor Q2, R4 now provides an AC load impedance of 15k! The closer the gain approaches unity, the greater the effective impedance provided by the bootstrapping.

The advantage of such a setup is that transistors Q1 and Q2 achieve a higher AC voltage gain, because their output is developed across the higher value load resistor. If resistor R4 were not bootstrapped, but simply connected directly to ground, the value of R4 would have to be increased to 15k, to achieve the same effect. But such an increase would result in the base currents of transistors Q4 and Q6 (which also flow through R4) developing a far larger voltage across the resistor. This voltage can easily be large enough to shut off driver transistor Q2 on the negative sections of the signal, preventing its voltage swing going anywhere near ground.

To illustrate: an 8-ohm speaker dissipating 1W of power draws an RMS current of 354mA ($P=I^2R$), or a peak current of 500mA ($354x\sqrt{2}$). If the current

Continued on page 103

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Experimenting with Electronics

Continued from page 101

gain of each of transistors Q4 and Q6 is 30 (a likely figure), then the base current of Q4 is 556uA. This small current still produces a voltage drop across 15k of 8.3V, restricting the negative output voltage swing to only 0.7V (9-8.3)! Obviously, the driver transistor Q2 will shut down long before the amplifier delivers a peak current of 500mA to the speaker.

Hence, the advantage of bootstrapping — the multiplied resistance of the load resistor gives us an increased AC voltage gain from the first stage of the amplifier, without decreasing the AC current from the second stage. This results in a higher power output.

Supply voltage

The discussion above should also explain why increasing the supply voltage will increase the volume of our output. Increasing the rail simply means that the input signal to the power stage can have a greater voltage swing before clipping, which then results in a greater swing for the output. If the same current still flows, then doubling the voltage (RMS, or root mean square) will double the power output. (You can calculate the RMS value for a sine wave by dividing the peak voltage reading by $\sqrt{2}$.) To illustrate this, we measured the power output of our module at various supply rail values (V_{CC}). To do this, we replaced our speaker with a 5W 8-ohm resistance, fed in a 1kHz signal, and viewed the output waveform on an oscilloscope.

Note that we had to adjust the setting on trimpot RV2 each time that the supply rail voltage was altered, decreasing its resistance with increasing voltage.

Next we adjusted the amplitude of the input signal to achieve the maximum output signal without distortion (this was done by viewing the waveform on the CRO). Then we measured the AC voltage across the load resistor with a digital voltmeter — this gave us the approximate RMS value (You need a true RMS meter to get the exact value). The power dissipated in the 8-ohm load was then calculated using the formula:

$$P=(V_{RMS})^2/R$$

which gave the following results:

V_{CC}	V_{RMS}	$P_{8\text{-ohm}}$
9V	1.70V	361mW
12V	2.34V	684mW
15V	3.13V	1.22W
18V	3.67V	1.68W

So you can see that any V_{CC} increase gives a substantial power increase; and doubling its value gives four times the power!

It should be obvious that large power amplifiers (hundreds of watts) need very high value supply rails. For example, the 140W per channel Pro Series 1 design published by *EA* (in December 1989) used supply rails of ±70V — so our design with its single rail would have to be 140V to achieve this power level!

As well as having built a very useful power module, we hope that now you can now inspect the schematic of any standard commercial power amplifier, and understand how it works.

Transparencies

As usual, 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. ❖

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.

December 1943

Secret weapon: A new 'gyroflux gate' compass has been guiding Allied bombers to their objectives and home again. The compass, which uses the earth's magnetic field for developing electrical impulses to turn the compass indicator, is not disturbed in a dive or climb.

Nerve discovery: The American Medical Association Journal says that, for the first time in medical history, nerve sections from dead bodies have been grafted to the severed nerves of living people. The new technique uses a special vitamin fortified glue, and makes possible a restoration of the functions of peripheral nerves. This will be particularly useful in treating war injuries, as statistics from the battle fronts show that from 1 to 3% of war casualties are peripheral nerve injuries.

December 1968

High powered transistors: RCA is carrying out research in the USA with experimental transistors, which could rival valves for power output. A transistor has been built with a new laminated construction, that generates 800W at 1MHz.

The laminated transistors are formed on two separate wafers of silicon, which are fused under heat and pressure into a single monolithic structure, which incorporates ballast resistors to avoid secondary breakdown.

Airborne weather radar: Storm hidden in cumulo-nimbus clouds have long been a major problem for aircraft.

Now the development of airborne weather radar permits aircraft crews to detect and avoid storms in the route ahead, thus contributing significantly t passenger comfort and safety.

The first time airborne radar was use to look at a thunderstorm has never bee established, but towards the end o World War II pilots noticed that storm would produce a large, bright echo, wit rounded characteristics and fuzzy edges on their general-purpose radar screen — even though this equipment was neve designed for such an application. Late these pilots, trans planted to the cockpit of postwar airliners, told of their ex periences, and the airlines began takin steps to develop similar electroni devices for their planes.

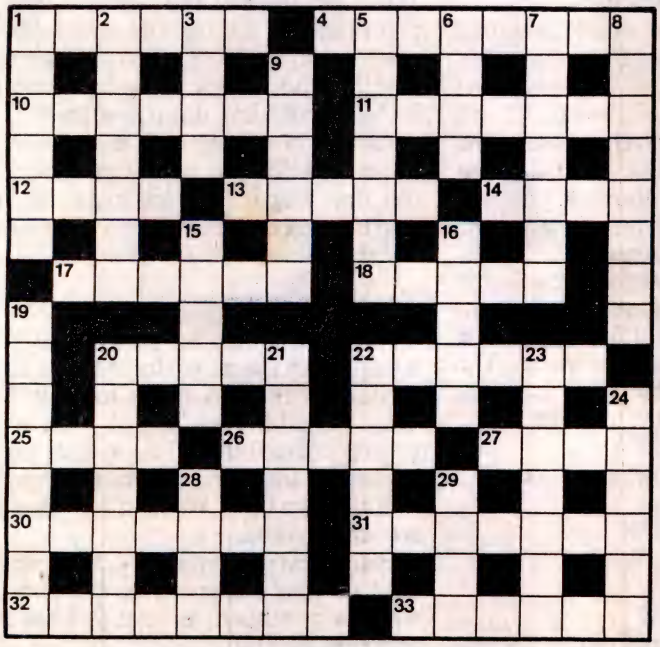
ILS installed at Sydney airport: The Department of Civil Aviation is current ly installing an Instrument Landing Sys tem (ILS) at both Sydney's Kingsfor Smith Airport, for use with the new north-south runway, and at Melbourne' Tullamarine Airport. The equipment i both cases has been supplied by STC, o behalf of its UK parent.

The function of the ILS is to enable pilots to make a safe approach an landing in conditions of bad weathe and poor visibility. In England, plane are regularly landed completely auto matically by ILS systems. ❖

EA CROSSWORD

ACROSS

1. Suitable exercise in the lift lobby. (4-2)
4. Archimedean force. (8)
10. Process of getting rid of space junk? (5-2)
11. Type of piano, obviously sound. (7)
12. Opposite of do up. (4)
13. Terminates a telephone conversation, or —— up. (5)
14. Seek amateur radio response, or —— up. (4)
17. A powerful electric bilge pump would be quick on this. (4)
18. The zener —— has an upper voltage limit. (5)
20. Image (with inbuilt connection) on the wall. (3-2)
22. Unaccentuated musical note. (6)
25. Coincide in space and time, or —— up. (4)
26. This is used to hook up. (5)
27. Where light is detected at sun-up. (4)
30. Put into 'down' mode. (7)
31. Fraudulent plot where the complete picture can be seen! (5-2)
32. What the toast did when ready. (6,2)
33. A minor glitch in a slide control? (4-2)



DOWN

1. Tonearm. (4-2)
2. What an EA train controller can do. (5,2)
3. These are used to heat up. (4)
5. Hooked up via a connector. (7)
6. Short of funds, or —— up. (4)
7. Improved; assign to a higher status. (7)
8. Add up. (8)
9. Modernise. (6)
15. These enable you to power up equipment. (5)
16. With an electric detonator these can be blown up. (5)
19. Raised to operating temperature. (6,2)
20. Normal thing to do in the lift lobby. (5,2)
21. Upland where land doesn't go up. (7)
22. Boost. (6)
23. Fully aware. (5,2)
24. Type of transformer. (4-2)
28. Instrument used for orchestral tune-up. (4)
29. Move freely from upper level. (4)

SOLUTION FOR NOVEMBER 1993

D	O	O	R	B	E	L	L		A	U	S	T	E	L
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REVIEW OF THE NEW HEWLETT-PACKARD LASERJET 4M 600DP POSTSCRIPT PRINTER

INSTRUMENT MAKER VDO INVESTS $2.5M IN 'CLEAN' SMT PLANT

THE LATEST MODEMS & DATA COMMS PRODUCTS

NEW 32-BIT VESA LOCAL BUS GRAPHICS ACCELERATOR CARD FROM ACTIX SYSTEMS SUPPORTS 1024 x 768 NI RESOLUTION





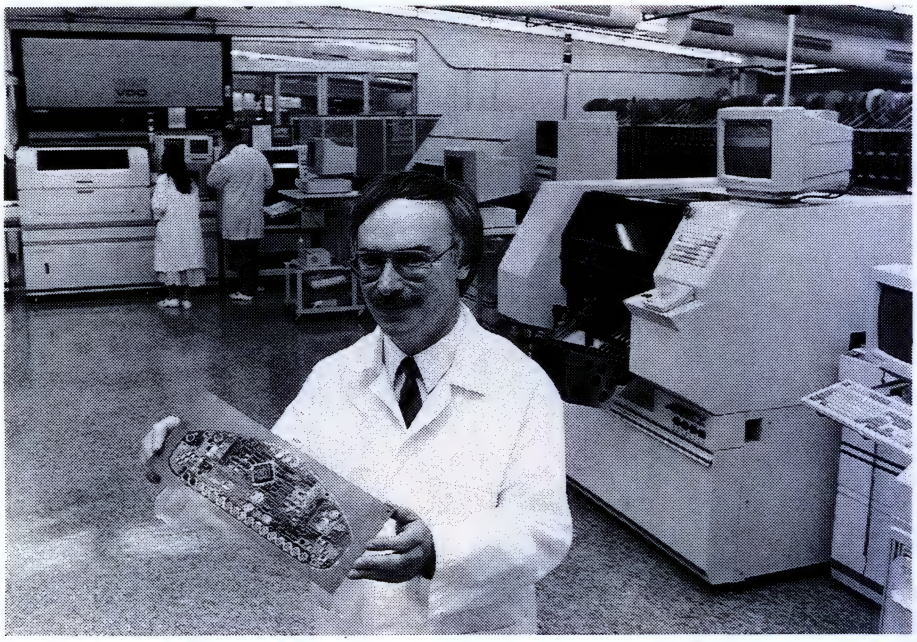
NEC'S NEW DIGITALLY CONTROLLED 4FGe MULTISYNC MONITOR HAS 80MHz BANDWIDTH, REFRESHES AT 76Hz FOR NEGLIGIBLE FLICKER IN 1024 x 768 NI MODE

NEWS HIGHLIGHTS

VDO INVESTS IN 'CLEAN' SMT

A $2.5 million investment in new manufacuring systems by Melbourne-based electronic instrument specialist VDO Instruments Australia is claimed to be taking Australia to the forefront of the industry worldwide. The new system uses 'environmentally friendly' surface mount technology to manufacture printed circuit boards.

The investment is the latest phase of a $16 million three year program to give VDO the flexibility to increase its electronics design and manufacturing capabilities.



A key part of the SMT system operates in a nitrogen atmosphere, which removes the need for chlorofluorocarbons (CFCs) to clean the circuit board assemblies at the end of the process.

VDO is the first Australian electronics manufacturer to embrace the 'clean' technology. The company is the largest supplier of original equipment automotive instrumentation and electronics in Australia, with more than 70% of the local market.

Mr Egon Vetter, managing director of VDO Instruments Australia (pictured), said the new system gives VDO a significant market edge and has contributed to winning two major export contracts.

"The new technology was a decisive factor in winning European contracts with Mercedes-Benz and BMW for the supply of Australian made instrument clusters and fuel pump assemblies", said Mr Vetter. "The system is fully automated and extremely flexibile in its ability to place more components on the circuit boards, providing more functions within a given instrument."

HP AUSTRALIA WINS ISDN CONTRACT

A major contract to supply test and measurement equipment to Germany, as part of the European pilot Broadband-ISDN project, has been won by Hewlett Packard Australia through its Australian Telecommunications Operation.

The HP team won the contract against stiff European competition, confirming the local company's leading international edge in this major new direction for telecommunications technology.

According to HP-Australia's Managing Director Mr Bill Hilliard, time to market was a key element of the company's major win on the European market.

"We already had the products to suit the specifications and will be moving into the second generation of these systems when our competitors are still developing their first," he said. "Our ATO team started looking at Asynchronous Transfer Mode (ATM) systems some time ago and we are well down the track with products to suit the needs of the emerging European networks. Our success is confirmation of the world class expertise of the ATO operation."

Under the contract, Hewlett Packard is supplying modular systems of its HP 75000 Broadband test systems family to DPB Telekom, to be installed in the three hubs of the pilot network, at Berlin, Hamburg and Koehn/Bonn. The pilot project, being explored by 13 countries across the European Economic Community, is timed to start at the beginning of 1994.

The technology will allow the simultaneous transmission of voice, text, data and images at a variable transmission rate of up to effectively 139Mbps in a single network. It will deliver applications such as high speed data communication, vastly enhanced computer networking, multi-media communications and video telephones.

Inside Germany, the pilot project will be expanded to include Stuttgart and Muenchen, with expansion to the other European Broadband Networks in the near future.





Engineers at the University of Wales in Cardiff are using two artificial intelligence concepts — neural networks and fuzzy logic — to develop expert systems for visual quality inspection of mass produced components. The project also makes use of the parallel processing capabilities of the British developed transputer chip. The University team is lead by Professor Duc Truong Pham.

"The new SMT system is the latest phase in our commitment to quality and is a major part of an overall electronics assembly system which produces a circuit board that is cleaner at the end of the soldering process than at the beginning."

VDO despatched two senior engineers on a fact finding mission to Europe, the US and Japan before deciding on the final configuration of the assembly system.

GROUP TO SUPPLY HK WEATHER RADAR

An international consortium headed by Australian system engineering company The Ambidji Group has been awarded a contract with the Royal Observatory, Hong Kong, to establish a Terminal Doppler Weather Radar System for the detection of wind shear for the new Hong Kong Airport.

Ambidji has teamed with the US-based weather science group, Weather Information Technologies Inc, and the Hong Kong arm of leading US environmental, engineering and architectural firm, Greiner International Ltd.

The project entails the siting, specification and acquisition oversight for a radar to allow the RO to alert aircrews of potential low level microburst and wind shear events that may present a hazard to aircraft taking off or landing. The contract is scheduled over 3-1/2 years and is synchronised with the development of the new airport at Chek Lap Kok, planned for opening in mid 1997.

Doppler weather radar technology has recently emerged from a prototype developed initially by the US Federal Aviation Administration (FAA) in the mid 1980's. This has resulted in a contract for the production and installation of 47 radar systems at critical airports across the USA.

The Royal Observatory is the designated meteorological Authority in Hong Kong for the provision of meteorological services for international air navigation and is charged with the responsibility of setting up meteorological facilities for the new airport.

WINNER OF OUR KENWOOD PRIZES

In our July, August and September issues, we ran a promotion for new and existing *Electronics Australia* subscribers — offering a superb prize of Kenwood top-of-the-range hifi equipment: an L-A1 Integrated Amplifier and an L-D1 Series CD Player, with a total value of over $8000.

The lucky winner of this promotion was Mr G.P. Inwood, of Sawtell in NSW, who will have received his prize by the time this issue is published.

We congratulate Mr Inwood on his win, and trust he will receive many years of listening pleasure from his new Kenwood equipment.

TOSHIBA HEMT QUIETEST AT 12GHZ

Toshiba Corporation has announced it is to start marketing a new high electron mobility transistor (HEMT) which has a noise output of only 0.45dB at a frequency of 12GHz. The new device offers the lowest output noise level of any commercially available HEMT, cutting signal noise by 35% more than earlier devices.

HEMTs are widely used in satellite



Believe it or not, Sony sent out this picture to promote its three-chip CCD camera, the BVP-T70P. Apparently the camera was mounted on a sky diver's back for shooting dramatic footage for a recent Sony commercial...

downconverters. HEMTs amplify weakened 12GHz signals from satellites, filtering out unwanted noise, before the signal is converted to the 1 - 1.5GHz frequency level for further processing. Low noise is required in the amplified signal in order to reproduce high quality images and sound.

The new device achieves the world's lowest noise figure of 0.45dB even when housed in a resin package. While resin packages are cheaper and easier to mount on printed circuit boards than ceramic packages, the latter have usually been used with HEMT, as they achieve lower distortion. Toshiba's new resin package design both matches the characteristics of ceramic packaging and promotes lower unit costs.

Lower noise in the HEMT was achieved by adopting indium-gallium-arsenide (InGaAs) rather than GaAs for the channel where the electrons flow. Optimised indium doping cut resistance in the layer, the main cause of noise, and improved electron flow rates by 40%. An enhanced crystal structure in the aluminium-gallium-arsenide (AlGaAs) layer, the layer that supplies electrons to the channel layer, has also improved performance.

Toshiba has used its electron beam process technology in production to achieve a T-shaped gate structure with a gate length of only 0.1um. This increases response sensitivity to the signals and reduces resistance at the gate.

JAPANESE FIRMS GET SIEMENS LICENCE

Siemens has set a world standard in the technology of photo-structurable insulators for microelectronics. It has recently also granted licences to the Japanese companies Asahi Chemical and Sumitomo Bakelite, for the manufacture and use of a new generation of these materials.

Siemens had created an initial material basis for this technology by granting licences on the world market as early as the 1980s. The new materials are compatible with established photoresist technology and can be processed in an ecologically-sound way. They also exhibit even better thermal and electrical properties.

The market for photostructurable insulating materials currently amounts to only several million dollars worldwide. As a key product however, they have a leverage effect on the entire microelectronics market with a volume of several billion dollars.

Photostructurable insulators combine the properties of photoresists with those of standard insulators. Suitable insulating structures can be generated by exposing them with an appropriate mask. The insulators required for the multilayer circuitry of electronic components can thus be generated in a highly effective way.

The technical trick lies in initially structuring the materials like a photoresist, and then converting the resulting structures chemically into highly heat resistant insulators by heating.

WINNER OF *EA* SUB AT BRISBANE EXPO

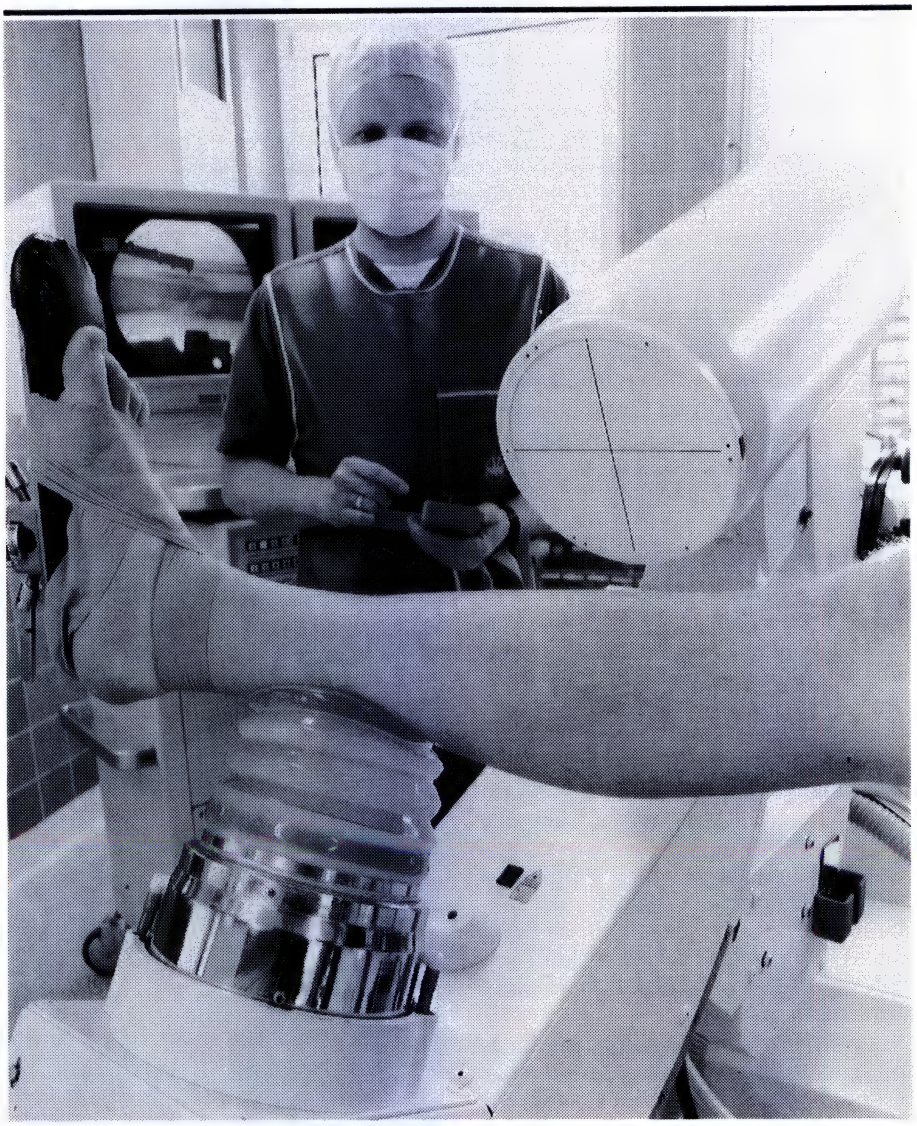
At the recent Brisbane Computer Expo, visitors to the stand shared by *Electronics Australia*, *Your Computer* and *Australian Small Business & Investing* were invited to leave their business cards to participate in a draw, to win one year's free subscription in their favourite magazine.

The winner of the free subscription to *EA* was Mr Ross White, of Downs Radio & TV Service in Toowoomba. Congratulations to Mr White, and we hope he enjoys reading the magazine for the next 12 months.

NEW NATA SYSTEM FOR SMALL FIRMS

A new quality certification system designed specifically for small businesses has been announced by the National Association of Testing Authorities, NATA.

NATA's new Q-Base system has been developed to provide a cost-effective way for small businesses to achieve a standard of third-party certification commensurate



German hospitals are using a new ultrasonic apparatus made by Siemens to assist in the healing of bone fractures. Apparently bone healing is helped by bombarding the fracture with concentrated ultrasonic energy — which is believed to work by 'roughening' the fractured surfaces.

with their business needs and the expectations of their customers.

The new system, which NATA says is the only quality system in Australia developed specifically for small business, is based on a modification of the AS3900/ISO 9000 set of standards.

TI DEVELOPS SYNCHRONOUS DRAMS

Texas Instruments (TI) has announced its development of synchronous dynamic random access memory (SDRAM), claiming it to be one of the most sigificant advances in DRAM design since the inception of the semiconductor memory devices. SDRAM is said to resolve the current system bandwidth challenge, by closing the performance gap between high speed microprocessors and standard memory.

"This new type of memory device will dramatically impact the way memory systems are designed in the future," said Bob Harrison, MOS memory marketing manager for the TI Semiconductor Group. "If SDRAMs are used for main memory, a microprocessor with a 100MHz clock could function without wait states."

"Initial tests of TI's synchronous memory show that significant improvements in memory bandwidth will be attainable," said Greg Armstrong, manager of application specific memory development. "Its speed and synchronous operation will enable the breakthrough in memory systems design needed by high performance processors of the 90s.

Applications where SDRAMs will initially be used include main memory, secondary cache displacement, hard disk drive data buffers, and high bandwidth buffers for data transmission and communications.

According to Harrison, SDRAMs combine recent industry advances in fast DRAM architecture, high speed interface and miniature packaging to provide one widely sourced device type with the potential for giving the industry access to fast, high volume semiconductor data storage. The heart of TI's SDRAM is its 'state of the art' 16-Megabit DRAM, using 0.5-micron CMOS technology, a scaled process that provides high performance and reliability at low cost. This new SDRAM complies with the JEDEC SDRAM standard.

With SDRAMs, all address, data and control signals are synchronised or gated to a single system clock. All operations are synchronous to the master clock, thus simplifying design and memory system control. With SDRAMs, users realise a reduction in setup and hold times, as well as the elimination of time out delays typical in asynchronous design.

NEWS BRIEFS

- The China International Information Technology Application Exhibition ***CIITEX '94*** will be held at the Beijing Exhibition Centre from April 15-19, 1994.
- ***COMPUTER '94***, the 10th International Computer Expo, will be held in the Hong Kong Convention and Exhibition Centre from May 11-14, 1994. For more information about both these events, contact Business & Industrial Trade Fairs, 18/F First Pacific Bank Centre, 51 Gloucester Road, Wanchai, Hong Kong; phone (852) 865 2633, fax 866 1770.
- ***Fastron Technologies*** commenced trading on August 31, 1993, following a management buy-out of the business of Fastron Australia. Mr Michael Trubridge continues on as Managing Director and Mr Andrew Shaw as a Director and Sales/Marketing Manager. Business addresses and phone numbers remain the same.
- ***NSD Australia*** has added to its line-up of passive components Sprague tantalum capacitors and EMI/RFI through-hole filters. Sprague is part of the Vishay Group, which manufactures in the USA, Europe, Asia and Canada.
- ***MTL Instruments*** has set up a NSW branch office, following the acquisition of Control Devices. The branch will be managed by John Owens.
- ***Kenelec*** has moved to new modern offices in both Sydney and Melbourne. The new addresses are: Unit 1, 163-173 McEvoy Street, Alexandria 2015; phone (02) 550 5133, fax 550 1080; and 2 Apollo Court, Blackburn 3130; (03) 878 2700, fax 878 0824. ❖



ADAPTOR CONVERTS CD PLAYER TO VIDEO

A new breakthrough in video CD technology is claimed by a British company Nimbus, which has developed a decoder unit that, when linked to a standard audio CD player via a digital output, converts the signal from a 12cm video CD into a signal to be viewed on television.

The cost of the decoder unit, developed by Nimbus Technology & Engineering, a sister company of Nimbus Records, is a fraction of that of alternative CD video systems, and brings video entertainment within the reach of the millions who already own audio CD players with 'SPdif' digital outputs. It is said to overcome the reluctance of the public to invest in yet another specialist unit at great expense, and widens the use of players already in the household.

The company, the first to manufacture CDs in the UK, has independently developed its own CD mastering systems and remains at the forefront of CD technology. The initial reaction from video retailers is that Nimbus Video CD is the way forward for the domestic video market because it uses existing equipment. The system is easy to use and has all the standard features of a video cassette player such as play, skip and freeze frame.

In addition to its use as an add-on for the audio player, the circuitry involved could be incorporated within conventional audio CD players to convert them into audio and video players — the entertainment centres of the future.

Nimbus is not manufacturing the decoder itself and would welcome inquiries from potential licensees who should contact Nimbus Technology & Engineering, Wyastone Leys, Monmouth, Gwent, Wales NP5 3SR; telephone (44) 600 890682; fax (44) 600 890398. ❖

Filter Design Software:

OPFIL EDUCATIONAL

Opfil Educational is a low cost locally-developed software package for filter design, derived from a larger program called Opfil Professional. It's very user friendly and makes full use of a Windows-like graphical user interface.

by PETER PHILLIPS

OpFil Educational is essentially a cut-down version of OpFil Professional. This latter program sells for around $2000 and is aimed at the professional designer who wants full control over the design process (and who really understands the design of filters).

In contrast, OpFil Educational (which I'll now refer to as simply OpFil) is aimed at the educational market and the non-professional user. This software has been developed by staff from the University of NSW, and is marketed by Emona Enterprises for $349.00. It's therefore locally supported and a true Aussie product!

An overview

Filter design software is not new, and I can recall using my trusty Apple II many years ago to develop a filter for something I needed at the time. These days text-based software like that of the Apple II is almost gone, and OpFil uses a GUI (graphical user interface) to the full.

The program is for an IBM compatible (XT at least), and works best with a mouse. The display is in colour and runs happily with standard VGA. There are other display options available. A long list of printers is supported, selected from a pull-down menu.

OpFil can design lowpass, highpass, bandpass and bandstop filters. You specify the parameters like the filter order, allowable passband amplitude variation/ripple (dB), minimum stopband attenuation (dB), pass edge and stopband edge (in Hz or radians/s).

Once you've told OpFil what you want, you then select the filter response characteristic: Butterworth, Chebyshev, Inverse Chebyshev and Elliptic (Cauer). The latter has the greatest transition band attenuation slope for a given order and is the most difficult to calculate manually.

There are two choices for the filter circuit: active RC and passive LC. Active RC circuits are based around an op-amp with an assumed gain bandwidth product of 100MHz. OpFil can only realise classically-designed LC filters which means you don't have as much control over the design of LC filters as you do over RC filters. The designers are currently developing this section further to give it more features.

Program features

A strong feature of the program is its ability to produce graphs, which include frequency responses for amplitude, phase and delay. OpFil can also plot time responses for a step, pulse (variable width) and impulse input. For each graph, you can see the response for the whole filter, of an individual stage or a part of the circuit.

So what *doesn't* OpFil do? According to the manual, OpFil Educational won't realise and display filter parameters greater than order 10, or realise optimised RC circuit designs suitable for production.

It also won't automatically equalise delay and phase response for lowpass

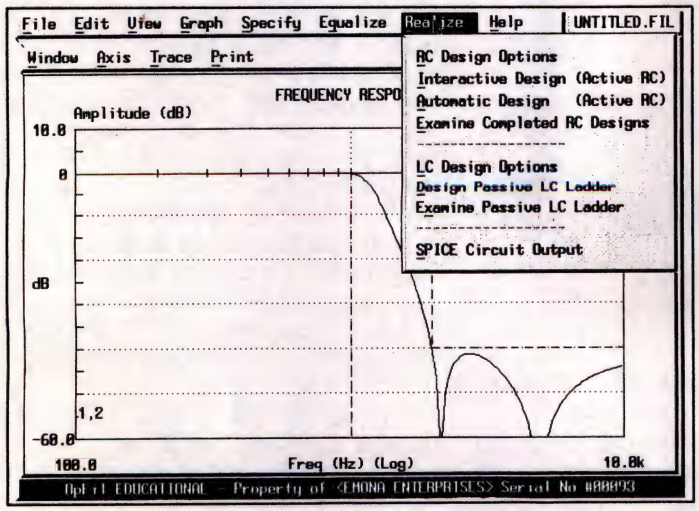


Fig.1: The frequency response of a lowpass Elliptic filter. The Realize menu is used to initiate the design process once paramaters are chosen.

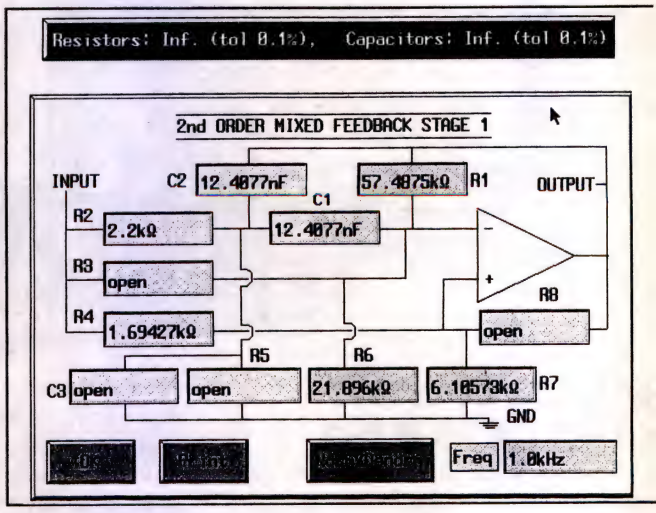
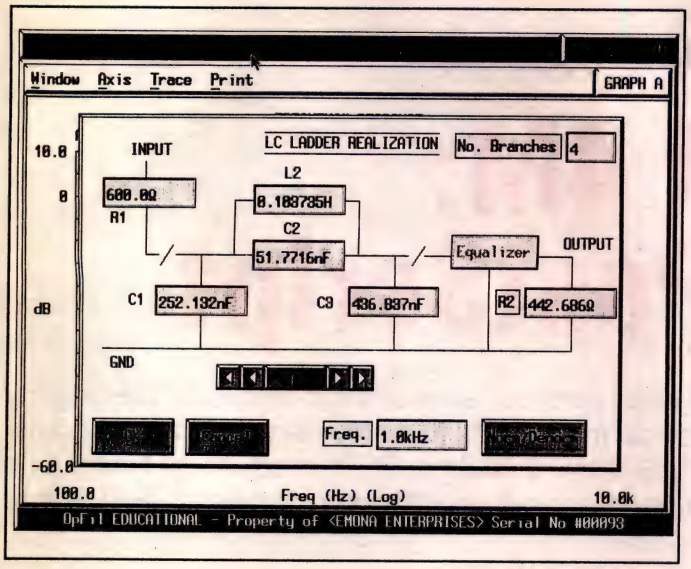


Fig.2: This is how OpFil shows stage 1 of the lowpass active RC filter circuit. Hitting the PRINT button gives a printout of the circuit.



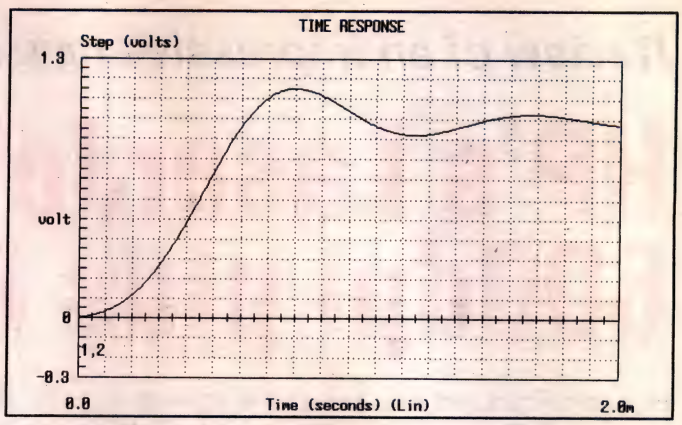


Fig.4 (above): The response of the filter to a step input. This is a direct printout from OpFil.
Fig.3 (left): The passive LC circuit for the lowpass filter circuit. The scroll bar is used to display branches not shown, as the program only shows three branches at a time.

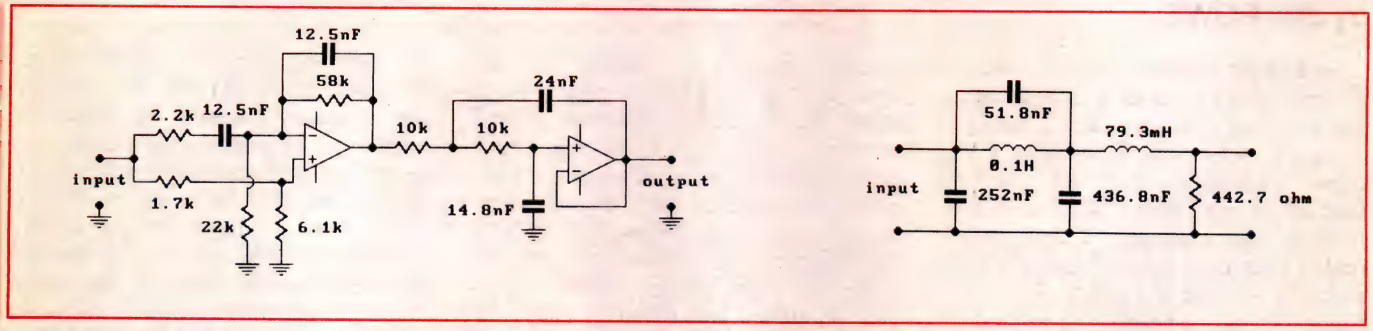


Fig.5 (left): This is the active PC circuit for the filter, redrawn in Protel Schematic. The component values have been rounded off. Fig.6 (right): The passive LC circuit that does much the same thing as the circuit in Fig.5. Again this circuit has been redrawn in Protel.

and bandpass filters. There's a few other things it won't do, but for most of us they're not things we'd miss.

Using OpFil

Like many people I distrust software that comes with a huge manual that you have to read to get anywhere. Fortunately OpFil is not one of these. In fact the program is very intuitive and easy to use.

The manual has 60 pages or so, and includes a lot of useful information about filter design. It's easy to read, despite the mathematical bent of the topic, and even those totally new to filter design should quickly end up with a circuit.

You can see some of the results from the various diagrams, which are for a low-pass elliptic filter with a passband of 1kHz, a stop band of 2kHz and a stop band attenuation of 40dB. The graph in Fig.1 shows the frequency response with the REALIZE menu dropped over it. You can read the co-ordinates at any point (Hz/dB) of the graph by moving the mouse cursor to any part of the graph.

The active RC circuit produced for this filter has two stages, and stage 1 is shown in Fig.2. This diagram is actually a screen dump, to show you how OpFil displays the circuit; but a printout of the circuit is rather similar.

The passive LC version of the same lowpass filter is shown in Fig.3. The Equalizer section is not available in the educational version and is greyed out. Pressing the Norm/Denorm button changes everything to rad/s, with corresponding changes to the component values.

The response of the circuit to a step input is shown in the graph of Fig.4. This is a printout directly from OpFil. The step size is the default value, which can be changed to suit.

Because the circuit diagrams produced by OpFil are rather difficult to read, I've redrawn them in Protel Schematic (shown in Figs.5 and 6) so you can see the final result. I've also rounded off the component values.

OpFil can also produce SPICE-compatible netlist files so that detailed analysis can be carried out on the circuit. This lets you see the effect of component tolerances or parasitic components.

Summary

OpFil is an easy program to use, but it has a great deal of sophistication. Filters are an exacting science and anyone who can make the topic palatable and even attractive has my acclaim. This program would therefore be ideal for anyone involved in designing audio equipment or even radio. I haven't tested OpFil's ability to produce RF filters, so I can't comment here.

It's also great for teachers who want to show the difference between the different types of filters, and the response curves they give. In fact, anyone with an interest in filter design will find this program useful.

Summing up, this is an attractive package with an easy to read manual. It requires a computer with a hard disk, and is supplied on a 3.5" disk or several 5.25" disks.

The review copy was supplied by Emona Instruments and my thanks to Emona for their assistance in preparing this review. For further information contact Emona on (02) 519 3933 at 86 Parramatta Road, Camperdown, Sydney. ❖

Review of an impressive new laser printer...

HP's LaserJet 4M: 600dpi plus PostScript

Hewlett-Packard has been the market leader in laser printers, ever since it released the original LaserJet. Recently the Company confirmed its position in the field with a range of new models, including the impressive LaserJet 4M — offering 600dpi resolution, HP's proprietary Resolution Enhancement Technology, PostScript Level 2 support as well as HP's own enhanced PCL5, and automatic emulation and port switching.

by JIM ROWE

Ever since Hewlett-Packard released its new 600dpi LaserJet 4 series printers, late last year, I've been keen to get hold of one to try it out. From what I had heard, the features of the new machines seemed to represent a significant step forward, and I wanted to compare the results with those from a familiar 300dpi machine — like the trusty TI MicroLaser 35's we've been using to produce *EA* for the last three years or so.

After quite a wait, my opportunity came a few weeks ago, when H-P Australia was finally able to spare a review machine for a couple of weeks. As soon as it arrived I set about hooking it up, and putting it through its paces. This review is the result.

In terms of its external appearance, the LaserJet 4M is virtually identical to its little brother the model 4; the only differences visible are a small 'diamond' shaped label with an 'm' symbol, and an AppleTalk/LocalTalk interface module plugged into a slot at the rear alongside the parallel and RS-232C serial inputs. All of the other differences between the two are inside.

Both models are based on a new print engine, designed from the ground up for a genuine 600dpi resolution in both directions (as opposed to some other machines, which 'push' a conventional 300dpi engine). The new engine uses special 'Microfine' toner powder, with particles 20-30% smaller than those typically used, and has an integrated toner/developer/optical photoconductor package for simplified maintenance. It has a rated printing speed of eight pages per minute.

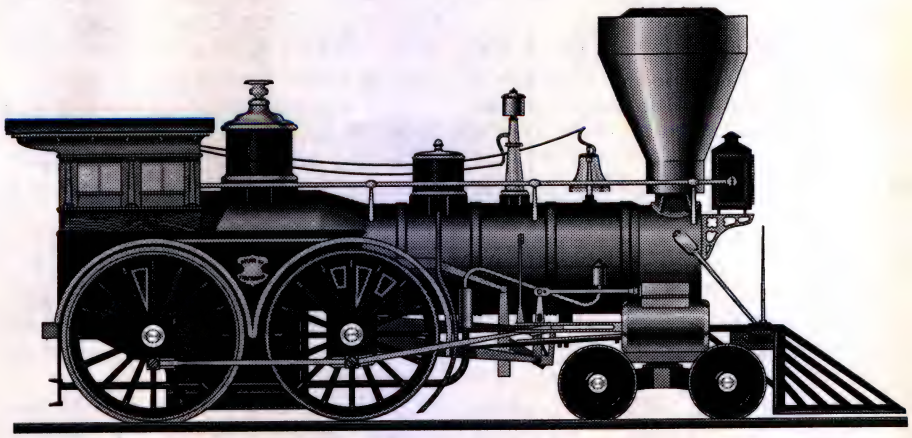
In the Model 4 machines, H-P has teamed the new engine with a fast controller, using the Intel 80960KA RISC processor running at 20MHz. This allows processing of 600dpi print jobs at speeds which compare well with 300dpi machines, even on complex mixed-text and graphics pages. In addition, the controller incorporates HP's own Resolution Enhancement Technology (RET) mentioned earlier, which adjusts the position and shape of the printed dots to give additional smoothing of edges — on both text and graphics.

The basic Model 4 machine provides both an RS-232C/RS-422A serial interface and an enhanced *fully bi-directional* version of the usual Centronics parallel interface, known as the Bi-Tronics interface. Although compatible with a standard Centronics port, the Bi-Tronics interface is capable of faster transfer rates — up to 156kBps, or around 10 times that of a standard Centronics interface. Of course to achieve this rate matching software (and possibly hardware) may be needed in the PC.

In addition to these two IBM-compatible interfaces, the Model 4M also features a factory-installed 'HP JetDirect' module, which provides an interface for the AppleTalk/LocalTalk serial communications used by Apple Macintosh machines. All of these interfaces are continuously active, with automatic switching between them as jobs arrive — so at least three different machines can be hooked up to the 4M very simply, by using one interface for each.

If desired, either model can be provided with other optional interfaces, using I/O modules which plug into the same rear slot used by the AppleTalk/LocalTalk module fitted in the 4M. Other modules available include interfaces for Novell NetWare/Thin Ethernet/10 Base, IBM LAN Server, AppleTalk/EtherTalk, Novell NetWare/Token Ring, HP-UX and SunOS.

The other main differences between the two models are in terms of



This well-known drawing was printed out on the H-P LaserJet 4M in PostScript, directly from Corel Draw. Because of its fairly heavy use of gradient fills, the same image tends to cause problems for the printer if you try printing it in HPGL.



This 85-line halftone image of the printer was produced by scanning a photo at 150dpi, sharpening it with Picture Publisher and printing it via the printer itself.

page/graphics description language capabilities, and memory. The Model 4 comes with the latest enhanced version of H-P's own printer control language, PCL5, which has been optimised for faster graphics performance and comes with no less than 45 scalable typefaces built in — including 35 Intellifont typefaces and 10 standard TrueType faces as used in Microsoft's *Windows 3.1*. Along with PCL5 comes the ability to handle H-P's printer job language PJL, and also graphics using the HPGL/2 'plotter type' graphics language.

To this already impressive capability the 4M machine adds PostScript Level 2 capabilities, with roughly four times the speed of Level 1 and a further 35 typefaces (those which have now become fairly standard for PostScript lasers). The 4M also provides automatic switching between PCL5 and PostScript, by recognition of print file headers — so files in either format can be printed quite transparently, without any user intervention. (Although there is one qualification, as I'll mention later.)

By the way, the PostScript capability can also be added to the Model 4, as a user-installable option. It comes as a set of ROMs on a single-inline memory module (SIMM).

The basic Model 4 printer comes with 2MB of memory as standard, while the 4M comes with 6MB. In both cases the memory can be expanded using SIMM modules, up to a total of 32MB in the case of the Model 4 and 22MB for the 4M. The reason for the smaller total with the 4M is that one of the four available SIMM sockets is already taken by the PostScript ROM module — so if the PostScript option is added to the Model 4, it too can only be expanded to 22MB.

Both printers are smaller than the previous H-P Model III machines, but still a little bulkier than some other machines. They measure 416mm wide by 297mm high by 403mm deep, and weigh some 16.8kg even without the toner/developer/drum cartridge. They draw a nominal 90 watts in standby mode, and a maximum of 660W when printing.

Status indication on both the Model 4 and 4M is via a vacuum fluorescent panel, which gives high readability in any normal office environment. The printers can be programmed to display their status messages in any one of 11 different languages (English, German, French, Spanish, Italian, Danish, Finnish, Swedish, Norwegian, Dutch and Portuguese!), while the section of the front panel which carries the control buttons also comes in 11 matching versions with the appropriate key legends. These printers are very definitely intended for the global marketplace!

An internal paper tray holding up to 250 sheets of A4 or similar paper is fitted as standard to both models, along with a swing-down front panel which becomes a 'multi-purpose tray' capable of holding either 100 sheets of alternative paper, or 10 envelopes. A nice feature of the main 250-sheet tray is that it has a built-in paper level indicator, showing how much paper remains available. The printers can be programmed to use paper from the 250-sheet tray by default, or alternatively from the multi-purpose tray if this contains paper.

Optional add-ons in the paper handling area include a second 500-sheet tray which attaches to the underside of the printer, below the main tray, and a power envelope feeder with a capacity of 75 envelopes.

With so many features built in, the Model 4 machines have little need for the plug-in cartridges used in most of H-P's earlier models. However they do provide one such slot, accessible via a small swing-in door in a recess at the lower front right of the case, just above the mains switch. Presumably its main use would be for adding extra TrueType, Intellifont or PostScript fonts, if they're needed.

Both models come with user manuals, of course, plus a set of matching software drivers for both *Windows* and *Macintosh* environments. In the case of the Model 4M you get both PCL5/HPGL and PostScript drivers for *Windows*, to ensure that you can get full 600dpi performance with either emulation. A package called *HP Explorer* is included to simplify printer setup, and there's also a set of *Windows* TrueType screen fonts to match those in the printers.

Trying one out

The 4M machine sent for review was slightly non-standard, being fitted with one of the Token Ring networking modules in the rear I/O slot, instead of the AppleTalk module. It was also fitted with a special 'showroom demo' ROM SIMM, capable of printing out various demo pages to display the printer's capabilities (which were very impressive, as you'd expect).

Having the Token Ring interface present but not connected to a network seemed to cause the machine's controller a certain amount of hassle, and I found it was easier to remove the module and leave it out for the rest of my testing. The printer then seemed quite happy. The demo ROM SIMM didn't cause any real problems, although it did make driving the printer's front panel a little trickier. This wouldn't be a problem with a 'normal' machine.

It didn't take long at all to hook the 4M up to the 33MHz 486 machine I use for DTP, CAD and other graphics-orientated work, and loading in the *Windows* drivers was also quite straightforward as

they come with their own INSTALL program. Then it was a matter of firing up various programs, such as *CorelDraw*, *Picture Publisher* and *Ventura Publisher*, and seeing how their output now looked in 600 x 600dpi resolution with RET.

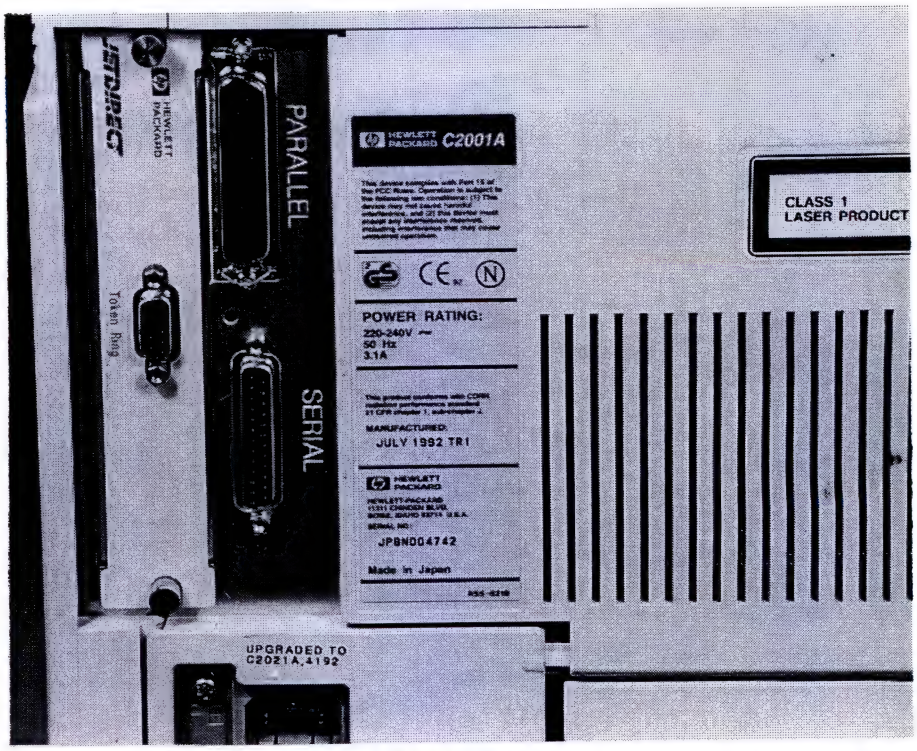
Frankly, the improvement over our existing 300dpi laser was quite dramatic. I really hadn't expected *such* an improvement, with only four times the printed pixels (twice as many each way). Presumably H-P's RET feature is responsible for at least some of this big improvement, along with the finer toner particles.

The printed text and other linework is very much sharper and smoother-edged than from a 300dpi machine, with the 'jaggies' now invisible with the naked eye and only *just* discernable under a magnifying glass. Similarly a grey-scale image printed in the 85-line (per inch) halftone screen we normally use for *EA*'s monochrome illustrations is now quite acceptable, and surprisingly close to the quality we get from either a 1200dpi Linotron or one of our parent Company's pro-quality direct digital scanners. Hopefully you can see this from the photo halftones reproduced in this review, which were printed out on the 4M using *Picture Publisher*, after scanning at 150dpi (grey-scale dots) on an AVR 8800 flat-bed scanner. (The half-tones used in November's Vintage Radio column were also produced in this way, incidentally.)

This sort of performance is very much better than I've ever been able to achieve using a 300dpi printer, emphasising that the output device plays a crucial role in final image quality.

By the way, although there didn't seem to be any special software drivers to suit *Ventura Publisher*, I tried printing out from it using the program's standard PostScript driver. This seemed reasonable, as PostScript is supposed to be output device independent, with each device interpreting the page description and producing an image of the best quality it's capable of. In this case the results were excellent — as you should be able to see from the text on these very pages, and also those of the Auto Electronics and Forum columns.

Apart from the dramatically improved resolution, the other thing that struck me about the 4M was its printing *speed*. With four times as many image pixels to rasterise as a 300dpi machine, I expected it to be at least a bit slower than our trusty TI MicroLaser. It was therefore quite a surprise to discover that in fact it was often noticeably *faster*.



Produced using the same technique as the previous halftone, this view shows the sample printer's rear panel with its serial, parallel and Token Ring interfaces.

Were there any unexpected hassles? Yes, there was one. Initially I kept on getting '20 MEM OVERFLOW' and '21 PRINT OVERRUN' error messages, plus incomplete images, when I tried to print out halftone images and even moderately complex graphics using the *Windows* PCL5 driver. This was puzzling, since the 4M is fitted with 6MB of RAM, which you'd think would be plenty even for rasterising a 600dpi image. Even more puzzling was the fact that the printer would generally print out the same files quite happily, using the PostScript driver!

After trying all the options I could think of, without success, I finally rang H-P's tech support people in Melbourne. A helpful chap by the name of Ano then asked me to check the version number of the PCL5 driver which had come with the review machine, and this turned out to be a superseded version with known bugs. When he kindly sent me the latest version (31V1.20) and I installed this instead, most of the problems disappeared.

There was still *one* small vestige of the problem, though, which is worth mentioning. Where an image such as a Corel drawing has a lot of 'gradient fills' (such as the well-known drawing of an old wood-burning steam locomotive), the printer tends to run out of memory even with the latest PCL5 driver. Apparently the HPGL graphics language is not too happy with gradient fills, due to its origins as a plotter language, and tends to need a *lot* of memory to rasterise them. It looks as if images of this type are best sent to the printer in PostScript — which is no problem with the 4M, of course, since it handles both.

That leads me to mention the small qualification I mentioned earlier, with regard to the 4M's automatic graphics language switching. I use the word 'complication' rather than 'problem', because it won't really cause any problems once you're aware of it.

There's no criticism about the printer's automatic switching as such — it swings back and forth in an entirely transparent fashion, so that generally a mixture of PCL5/HPGL and PostScript files can be printed out in any sequence, with no hassles whatever. Which is really great, of course.

But what if you are in the habit of downloading often-used additional PostScript fonts to the printer's memory, at the start of a session, to reduce the printing time for individual pages? At *EA* we tend to do this at the start of a DTP session with *Ventura*, for example, to load in our additional fonts like Optima and Futura ExtraBold Condensed...

The answer is that if you've downloaded these fonts in advance, they're lost if the printer needs to flip

over to PCL5/HPGL mode, to print a file in those languages. When it flips back again to print another PostScript file, those fonts are no longer in memory.

There are a number of ways around this, of course. If you're using the 4M with a single computer, you can simply make sure that you only print out files in PostScript until the downloaded fonts are no longer needed. If this isn't feasible, as it mightn't be with a machine shared by a number of computers, you can change over to downloading only the fonts needed for each file, with the file itself. Or you might be able to avoid downloading altogether, by swinging over to PCL5 and using the scalable typefaces already in the printer. These include CG Omega, which is very close to Optima; Univers and Univers Condensed, which are similar to Helvetica; Garamond; Times and Times New; and others such as Ariel, Albertus, Antique Olive, Clarendon Condensed, Coronet, Marigold and Letter Gothic.

In short, then, the fact that downloaded fonts 'evaporate' when the printer switches emulations needn't be a problem, once you're aware of it.

Summarising

On the whole, though, after putting the Hewlett-Packard 4M through its paces and despite the minor hassles caused by an obsolete printer driver, I have to say I'm *most* impressed.

The 600dpi resolution provided by the 4M is indeed a very significant improvement over 300dpi machines. I suspect this is not just because of the fourfold increase in pixels, but also to H-P's RET technology and the microfine toner. And this very worthwhile hike in image resolution certainly doesn't come at the expense of speed, because if anything that RISC processor makes the 4M faster than most 300dpi machines.

So if you need a printer capable of producing markedly better output than a 300dpi laser, and almost as good as a Linotron for many purposes, I can testify that the 4M is well worth considering. In fact having now tried out one for myself, there's no way I can ever be happy with 300dpi output again. I'm selling my 300dpi machine, so *I* can buy one too!

The current list price for the Model 4M is $3949 plus tax if applicable, but you may be able to do a little better than this if you shop around. Further information is available from H-P dealers, or from Hewlett-Packard Australia at 31-41 Joseph Street (PO Box 221), Blackburn 3130. The Company's customer information 'hotline' number is 131 347. ❖

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A Basic Guide to Colour
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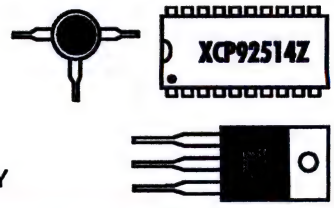
Two very popular series of articles, published in Electronics Australia in the late 1980's, have now been combined into a separate publication. Students, the home handyman, even the serviceman, will find that the latest publication from Electronics Australia gives a wide and comprehensive insight into the electronics involved in colour television and video cassette recording.

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Solid State Update



KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

High power UHF transistor

Motorola has released the MRF880 transistor. This device is designed for 26V UHF large signal, common emitter, class AB linear amplifier applications in industrial and commercial FM/AM equipment operating in the 800 - 960MHz range. Its features include output power of 90 watts; gain of 8.5dB minimum at 900MHz, class AB; efficiency of 35% minimum of 900MHz, 90W (PEP); and intermodulation distortion of -29dB max at 90W (PEP).

For further information circle 271 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

SAW filters for cordless phones

Siemens now has available two new surface acoustic wave filters for the digital cordless telephone of the new radio standard 'Digital European Cordless Telecommunication (DECT). The low insertion loss of typically only 3dB permits the operating time of the telephone to be extended.

The new intermediate-frequency filters B-4536 and 4537 belong to the low loss group. They have centre frequencies of 112.32 and 110.59MHz respectively and, in contrast to conventional versions, are surface mountable. The adjacent channel suppression of each type is more than 40dB. Improved adjacent channel selectivity results in a higher signal to noise ratio. Minimum bit error rates can be achieved due to the high selectivity and the small group delay ripple. The B-4537 filter operates in the extended temperature range from -30° to 85°C, the version B4536 from 0° to 40°C. Both filters are supplied in a surface mount ceramic package (14.2 x 0.2 x 2.7mm).

For further information circle 277 on the reader service coupon or contact Siemens Advanced Information Products, 544 Church Street, Richmond 3121; phone (03) 420 7716, fax 420 7275.



RF transistors in ultra-small package

Motorola has introduced its lowest noise small signal amplifier transistors in a miniature surface-mount package. The MRF947 and MRF957 small signal transistors are state of the art low noise NPN bipolar devices with the same die as Motorola's MRF941 and MRF951 transistors, mounted in the SC-70 surface mount package.

Applications include low noise front

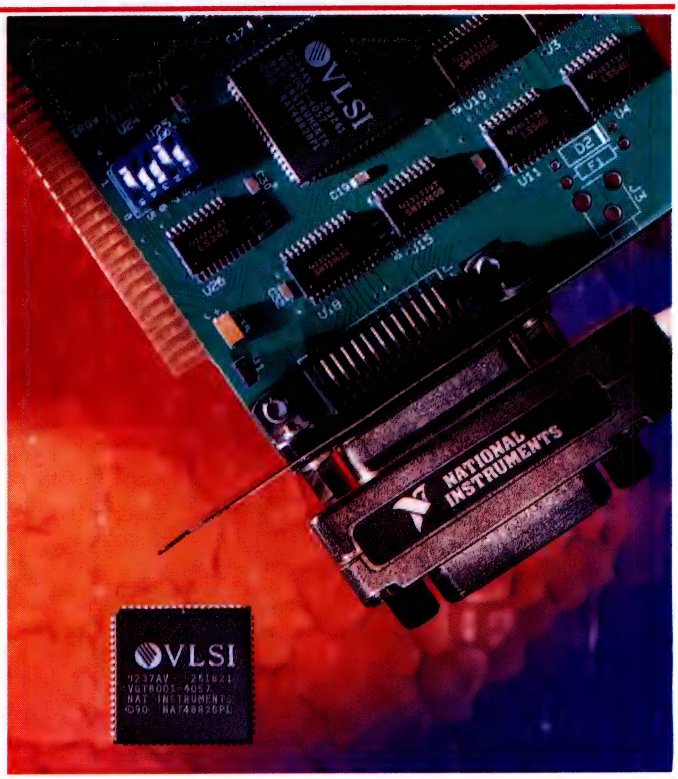
GPIB controller chip

National Instruments has announced the open market availability of its custom GPIB controller chip, the NAT4882, claimed to be the first IEEE 488.2 compatible controller chip. National Instruments has used it successfully since 1990 on its high performance GPIB interface products. These products include interfaces for the PC XT/AT, NuBus, SBus, MicroChannel, and TURBOchannel computers running a variety of operating systems. Target users of the NAT4882 include instrument and instrument controller manufacturers, as well as end users building custom instrumentation circuitry.

The NAT4882 is completely register compatible with both the popular NEC uPD7210 and the Texas Instruments TMS 9914A controller chips, yet can implement the capability specified by the IEEE 488.2 standard. Several added features include bus line control and monitoring of all GPIB handshake lines, a built-in timer to easily set bus timeout values, an increased set of interrupt conditions, and automatic last-byte handling for DMA reads and writes, which increases software throughput.

The chip does not transmit GPIB data or commands when there is no Listener. It conducts service requests according to the IEEE 488.2 preferred implementation, which prevents the loss of instrument service requests. Its clock rate is 20MHz, so DMA data transfers for reads and writes can attain rates of 7MBps. In addition, instrument developers can use the extra pins on the NAT4882 to connect GPIB status information to instrument displays.

For more information circle 275 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 879 9422.



ends in receivers and low power linear amplifiers, particularly where size, weight and low cost are prime design goals and the method of manufacture is automated surface mount assembly. Typical performance characteristics of both devices at 1.5GHz are gains of 10dB and noise figures of 2dB. The MRF947 transistor has a maximum current rating of 50mA, while the MRF957 has a maximum current rating of 100mA.

For further information circle 272 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03 887 0711.

Planar doped barrier diodes

Alpha Industries of Woodburn, Massachusetts, has recently released its range of planar doped barrier diodes to 60GHz for signal mixing and detection. Performance surpasses silicon and GaAs Schottky diodes. They are available in chip, beam lead and packaged forms.

The diodes feature high RF pulsed burnout; high ESD threshold; low 1/f noise; very good temperature stability, and voltage sensitivity and TSS; low noise figure at low local oscillator power level; and millimetre wave range operation.

For further information circle 273 on the reader service coupon or contact Electronic Development Sales, 2A/11-13 Orion Road, Lane Cove 2066; phone (02) 418 6999, fax 418 6550.

Fast TTL-compatible analog switch

Siliconix has released a TTL-compatible analog switch which breaks the 50ns barrier. Rated at 45ns maximum, the new DG601 series boasts a very fast switching time for a monolithic analog switch. In addition, it offers TTL-compatible 12V and 5V single-supply operation and +/-5V dual supply operation. Thus, the DG601 meets both the speed and logic compatibility requirements for high speed sampling in today's designs.

The DG601 is a quad single-pull, single-throw analog switch built on Siliconix POLYMOS process. The thin gate oxide and small feature size (5um) of this silicon-gate technology allow fast switching times (45ns max). This IC provides low charge injection (13pC typical), low on-resistance (35 ohms maximum), low thresholds (0.8V), and very rugged ESD (electrostatic discharge tolerance >+/-4000V).

The benefit of the DG601 is ease of design where speed, guaranteed single-supply operation and high reliability are required in applications such as data acquisition (sample/hold amplifier and gain ranging), instrumentation sample/hold amplifiers and signal routing), along with hard disk drives and tactical weapons.

For further information circle 278 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766, fax 647 1545.

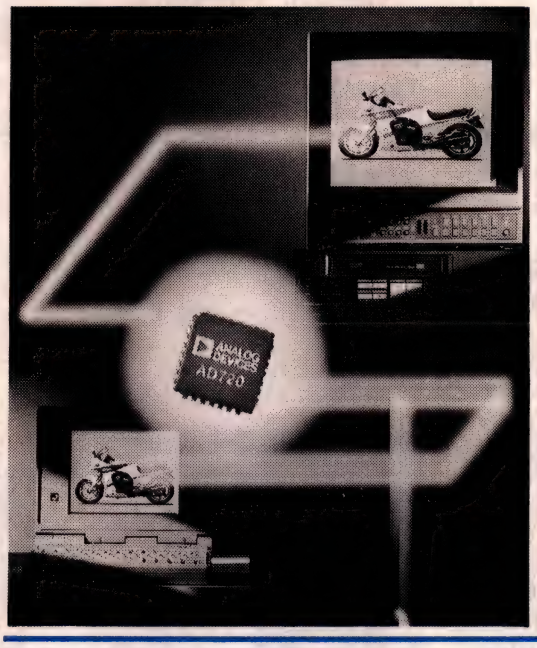
Encoder for RGB to NTSC/PAL

From Analog Devices, the AD720 is an analog RGB-to-NTSC/PAL encoder to provide video system designers with a high performance, fully calibrated, single IC solution — no discrete low pass filters or delay line are required. The AD720 features composite video output, differential gain of 0.1% and differential phase of 0.1°. This level of performance results in NTSC/PAL video outputs capable of generating 'smear-free' reverse type, as small as nine point, in applications such as PC video add-on cards, multimedia systems, CATV converter boxes and other video imaging systems.

The AD720 converts red, green and blue video signals into their corresponding luminance (baseband amplitude), chrominance (subcarrier chrominance) video signals. The superior picture quality generated by the AD720 is largely due to the use of thin film resistors in the RGB-to-YUV matrix, calibrated onboard low pass filters and delay line, and digitally generated quadrature signals. In addition, the chip uses multiple grounding and supply rail pins to lower interval package impedance and prevent cross-talk and signal feedthrough. These features result in a video encoder that provides superior picture quality without external adjustments.

Two four-pole filters bandlimit the U/V colour difference signals to 1.2MHz, prior to subcarrier (colour) quadrature modulation. A third three pole filter follows the modulator and limits the harmonic content of the user selected NTSC or PAL output. An onboard 170ns delay function provides pre-compensation for delays in the filters used to decode the NTSC or PAL signal in television receivers.

The separate luminance chrominance, and composite voltage outputs are DC coupled, providing S-Video output. The AD720 is capable of driving 75 ohm reverse terminated loads through the use of onboard gain-of-two output amplifiers, which amplify the output voltage's signal amplitudes to twice that of NTSC and PAL standards. The AD720 typically dissipates just 200mW (+/-5V supplies), and features a logic selectable power-down mode when the encoding function is not in use — resulting in less than 50mW of power consumption. All of the AD720's logic inputs are standard CMOS level compatible.



For further information circle 276 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

5A stepdown regulator

Maxim Integrated Products' LT1074 is a bipolar, pulse-width modulated (PWM), switch mode DC-DC regulator. Optimised for step-down applications, it produces 2.5V to 40V from input voltages in the 8V to 40V range (to 60V for the high voltage LT1074HV).

The LT1074 can also be configured as an inverter, negative boost converter, or flyback converter, with input voltages as low as 5V. The regulator requires few external components because the power switch, oscillator and control circuitry are all on chip. The oscillator is preset to 100kHz (adjustable to 200kHz) and the power switch current limit is preset to 6.5A.

For further information circle 274 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511. ❖

Special Feature:

New Products in Modems and Data Communications

'Smart' dumb devices

Black Box Catalog has introduced a new RS-485 device, the SmartNode, which can be used to add RS-232 dumb devices to a polled RS-485 network, extending up to 1524m. It can also be used to build a network.

The SmartNode enables all types of asynchronous RS-232 equipment such as dumb terminals, scales, printers, lathes, barcode readers, lab instruments, unable hitherto, to be addressed. Also, RS-232C devices can be added without modification to communication on an RS-485 multidrop network at speeds up to 38.4kbps. They are simply attached to the network as RS-485 devices.



For further information circle 201 on the reader service coupon or contact Black Box Catalog, 21-23 Maroondah Highway, Croydon 3136; phone (03) 879 7100.

Communications accelerator

Hayes Microcomputer Products has announced a single port, 16-bit ESP Communications Accelerator Version 2.0 which supports speeds up to 921.6kbps.

This half length card is an enhanced serial board for IBM PCs and compatibles that maximises data transmission speeds and prepares the way for high speed modems or ISDN applications. The board incorporates a dedicated communications co-processor with built-in automatic flow control. It ensures data integrity by eliminating buffer over-run errors experienced with even the 16550 UART at speeds of 115.2kbps or higher.

The Communications Accelerator comes with communications driver software for Windows 3.0, 3.1 and Windows for Workgroups, as well as a Windows-based installation and set-up program for easy configuration without the need for DIP switches.

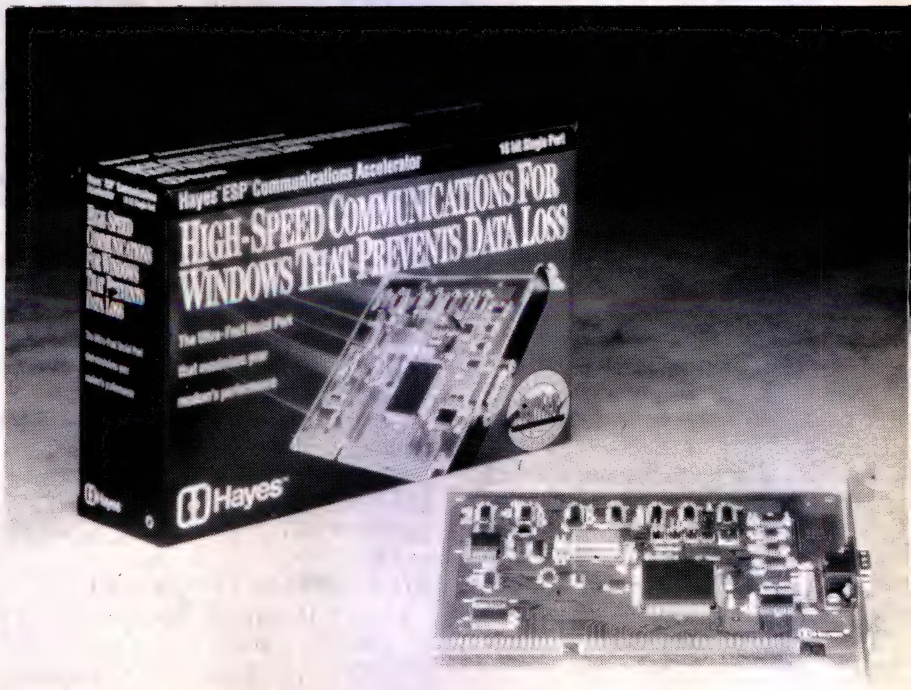
The Australian RRP (including tax) is quoted as $206.

For further information circle 207 on the reader service coupon or contact Merisel, 4 Sirius Road, Lane Cove 2066; phone (02) 882 8888. MPA International is another Hayes distributor; phone (03) 724 4444.

Interface for serial to IEEE

Industrial Computer Source has released the MICRO488/P and SERIAL488/P serial to IEEE 488 converters. Scarcely larger than a standard IEEE 488 connector, the MICRO488/P and SERIAL488/P are claimed to be the smallest serial to IEEE 488 controllers on the market.

The SERIAL488/P can control one IEEE 488 device, and operates at a baud rate of 9600. The MICRO488/P can control up to eight IEEE 488 devices and supports baud rates of 300, 1200, 2400, 4800, 9600 and 19,200. Both units operate in full duplex modem with



or without echo, support hardware and software handshaking CTS/RTS XON/XOFF, and required no external power supplies. The 'Serial' interface communicates with an IEEE 488 device set to address 05; while the 'Micro' supports controller subsets C1, C2, C3, C4 and C28, and has programmable terminator options. There is no need to modify existing software as these converters transparently convert RS-232 serial data from the host computer into the IEEE 488 protocol.

For further information circle 203 on the reader service coupon or contact Interworld Electronics and Computer Industries, 1000 Glenhuntly Road, Caulfield South 3162; phone (03) 563 5011.

Modular terminal server

MIS Managers, using UNIX-based hardware in medium to large private enterprise or government operations, can use Black Box's fully modular TCP/IP Terminal Server System, for flexible and cost-effective connection of data terminals, modems and printers. In effect, you can begin with one eight port unit and build progressively.

The first unit is linked to the Ethernet backbone via either AUI or 10Base2 connections and is immediately configurable and operational as a standalone package. It can then be expanded through the addition of further parallel or serial units, clipped together via a variety of user specified interfaces as RS-232C, DB25, RS-232C/RJ45, or RS-422C balanced interface. All serial modules provide V.24 modem support.

The system's maximum configuration is 32 ports and configuration is software addressable and modifiable. Driven by a 15MHz 286LX processor and with two RISC-based CD1400 UARTS for each eight port module, each service has throughtput capability in excess of 250kbps.

Individual RS-232C lines are able to drive devices at speeds up to 115,200bps — the maximum baud rate per port. Each unit can run up to four sessions simultaneously, with 'hotkey' access to one another.

Full TCP/IP implementation provides support for remote booting of systems software, gateways to other hosts and external networks and a 'ping' utility which tells a user whether or not a particular network host is accepting traffic.

For further information circle 205 on the reader service coupon or contact Black Box Catalog, 21-23 Maroondah Highway Croydon 3136; phone (03) 879 7100.

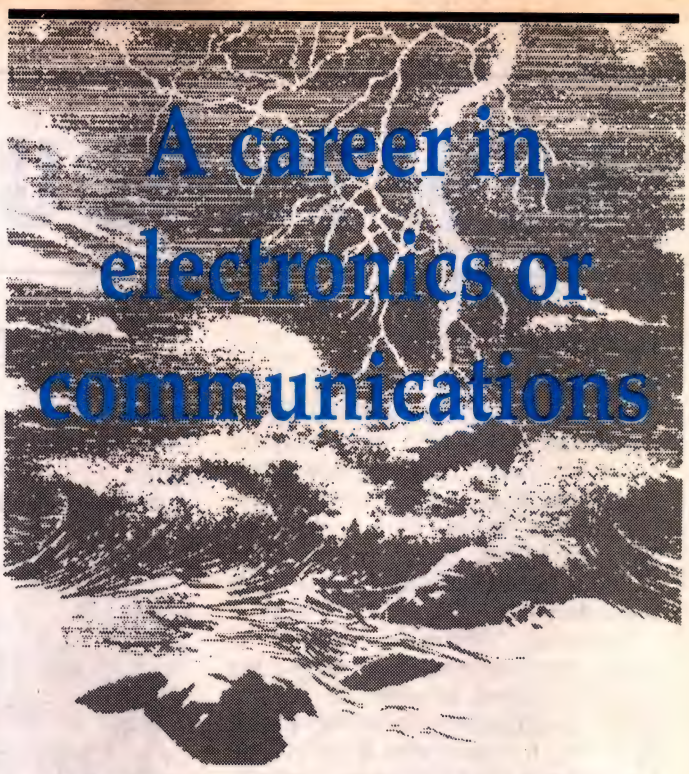
Peak performance from fast modems

Banksia Technology has introduced a high speed serial card, the SSerial Card, which allows fast modems to deliver peak performance. It overcomes the bottleneck caused by the AT standard 19,200bps serial port, which slows data communications significantly for many applications. The new card solves these problems by offering reliable communications speeds up to 57,600bps.

It can either replace an existing serial port, or can be used in an additional port. The SSerial Card, with an RRP of $88, is a standard AT-bus half-card size, which can be plugged in to become any port from COM1 through to COM4. It provides a standard DB25 socket.

Two software packages are available from Banksia to maximise the performance of SSerial Card: QModem, which is bundled with all Banksia modems, and QModemPRO, a commercial version with extra features.

For further information circle 202 on the reader service coupon or contact Banksia Technology, 83 Longueville Road, Lane Cove 2066; phone (02) 418 6033, fax 428 5460. ❖



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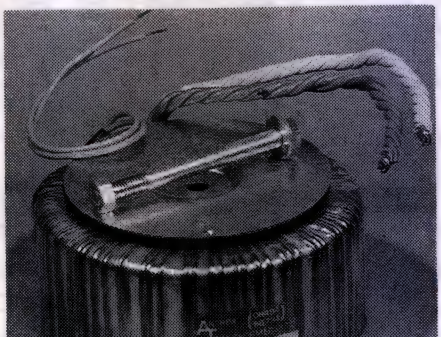
NEW PRODUCTS

High power 16.5V toroidal transformer

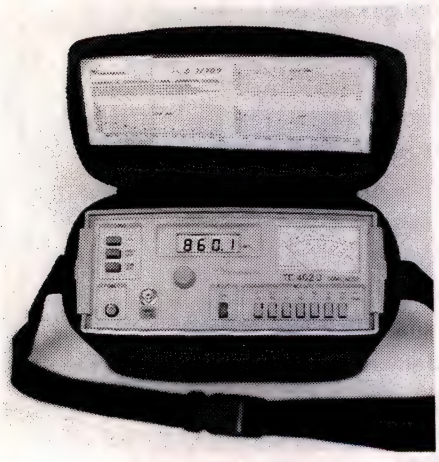
The Antrim ATT-96 toroidal power transformer is designed specifically for use in heavy-duty 13.8V DC power supplies, of the type used to operate amateur radio transceivers and similar equipment. Rated at 625VA, it can deliver up to 37.5A at 16.5V with a load regulation of better than 4%.

Measuring 135mm in diameter by 70mm high, the transformer weighs 5kg and is designed to meet all relevant safety specifications including a 4kV flash test. It comes with leads 200mm long and also a set of mounting hardware including a dished-centre 110mm steel clamp washer, two 110mm neoprene rubber insulating washers and a 90mm x 5/16" bolt with flat washer and nut.

Priced at $123.68 plus tax in one-off quantities, the ATT-96 is available direct from toroidal transformer specialists Harbuch Electronics, of 40 Leighton Place, Hornsby 2077; phone (02) 476 5854, fax 476 3231. Mail and credit card orders can be handled, and the transformer can be sent to most parts of Australia for an additional $7.00.



TV/FM signal meter



A new model TV/FM signal level meter from Sadelta has just been released, the TC402D. Important improvements to the model include the addition of peak detectors to minimise fluctuations in air readings, and a fourth digit to the frequency display. A personalised correction chart is also being supplied with each TC402D. The appearance has also been enhanced, and a zip-top cordura case included.

For more information circle 241 on the reader service coupon or contact Peter C. Lacey Services, 80 Dandenong Road, Frankston 3199; phone (03) 783 5767.

Digital logic scope

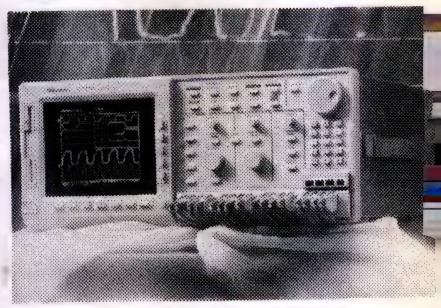
Tektronix has released the TLS 216 Logic Scope — a new type of instrument tailored to simplify the task of debugging digital hardware. The new logic scope combines the analog acquisition system of a high speed digital storage oscilloscope (DSO) with the triggering and display systems of a logic analyser, in a single instrument. The 500MHz, 2GSps TLS 216 meets a wide range of digital applications, and is ideal for engineers debugging higher performance digital hardware typical of computers.

The Logic Scope samples all 16 channels simultaneously, and has sophisticated time qualified triggering, high resolution colour display and integrated MS/DOS compatible 3.5" floppy disk drive.

The TLS 216 includes a set of 16 specially designed probes that have extremely low probe tip mass (1.5g) and input capacitance (≤2.5pF). Low probe tip mass ensures that connections made to surface mount and fine pitch ICs will be reliable.

The low input capacitance, combined with the 1M input resistance, decreases the effect of the probe on the DUT's operation, allowing very accurate measurements to be made with confidence.

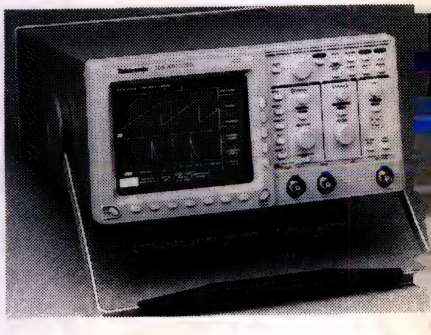
In addition to edge, pulse, glitch and



pattern triggering, the TLS 21 provides two new trigger resource which allow the instrument to trigg directly on common digital circuit b haviour. The instrument's time interval sequence trigger type monitors the tim between two events, allowing it to trigg easily on setup-time, or hold-time viol tions, or an unexpected propagatio delay. The powerful 'time out' trigg type can be used to capture incomplet handshake sequences or to trigger the i strument when the DUT 'hangs'. A quired data can be displayed as eith eight bit analog waveforms — like traditional DSO — or as dual threshol timing diagrams or BusForms, similar a logic analyser.

For further information circle 244 o the reader service coupon or conta Tektronix Australia, 80 Waterloo Roa North Ryde 2113; phone (02) 888 706 fax 888 0125.

Tek 100MHz DSO for rental



Tech-Rentals now has the recentl released Tektronix TDS 320 Dual cha nel 100MHz digital oscilloscope avai able for immediate hire.

Incorporating digitising technolog used in Tek's higher end models, t TDS 320 is able to provide real tim analysis up to 100MHz. Each chann

Programmable transformer tester

The Voltech AT3500 automatic transformer tester performs ne 110 key tests for reliability, performance and safety. These nay be programmed by PC or from the front panel, leaving the perator to perform simple go/no-go testing, with pass/fail ports generated from a compact front panel printer.

The tester has 20 test lead connection points, and plug-in fix- ures can be supplied for all outlines of transformers. Full safety nterlocks are provided, with the lid closing automatically efore test sequences begin.

The tests covered are winding and insulation resistance; turns tio and phasing; inductance; leakage inductance and current; agnetising current and open circuit voltage; inter-winding apacitance; inter-turn stress (watts loss); and high voltage test- g up to 5kV.

All test parameters can be programmed from the front panel hen programming is enabled at the keylock. Alternatively, up 16 testers can be connected to a standard PC acting as server r programming, backup and/or data capture.

For further information circle 242 on the reader service oupon or contact Westinghouse Industrial Products, 59 tephenson Street, Spotswood 3015; phone (03) 391 1222 or x 391 6607.



mples at the rate of 500MSps enabling ne oscilloscope to acquire high speed litches and transients.

This high level of oversampling liminates aliasing and ensures users of ccurate acquisition up to the full bandwidth, even for single shot events. Vertical resolution is eight bits, sensitivity is 2mV to 10V per division, and record length is 1K per channel. Edge and basic video triggering are standard features, as are 21 automatic measurements, ranging from period to volts RMS. For further information circle 246 on the reader service coupon or contact Tech Rentals, PO Box 621, Ringwood 3134; phone (03) 879 2266, fax 879 4310.

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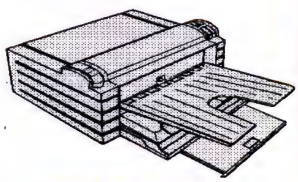
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READER INFO NO. 20

NEW PRODUCTS

High density DC/DC converters

Claimed to be the world's most advanced ultra high density, single and triple output DC-DC converters, the MicroVerter uV series from RO Associates deliver up to 250 watts at an impressive 58 watt/in^3 power density. The miniature converters are available in three input voltage versions, 28V and 48V DC suitable for the telecommunications industry, and 300V DC for distributed power applications.

Operating with constant frequency, the MicroVerter series can be connected in parallel with current sharing, and are fault tolerant with a true n+1 redundancy, offering a MTBF of over 1.1 million hours. The converters are packaged in the industry standard sizes of 13 x 61 x 177mm for the triple output version and 13 x 61 x 92mm for the single output version. As well as the single or triple voltage outputs, an 'output good' signal is provided and an optional 'sync' pin.

For further information circle 250 on the reader service coupon or contact Amtex Electronics, 13 Avon Road, North Ryde 2113; phone (02) 805 0844.

Surge diverters

The Critec MONTEC range of surge diverters offers transient protection against the dangers of multi-strike lighning.

Lightning impulses can be coupled onto power systems via the direct strike or more subtle mechanisms such as inductive and capacitive coupling.

The Movtec range offers very high energy protection with integral five segment status indication and remote alarm facility. This technology offers Multipulse protection against AS1768-1991 Category C power transients and above.

The multipulse surge diverters are specifically designed to cater for the additional energy associated with 75% of all lightning, where multiple restrokes follow the main discharge in the space of tens of milliseconds.

Unlike conventional MOV protection, which could rapidly accumulate heat and self destruct, MovTecs offer a high degree of redundancy through the use of matched protection arrays. In these, individual elements which have exceeded their thermal or energy ratings are sequentially disconnected from the primary circuit, leaving other segments active to maintain protection.

For further information circle 254 on the reader service coupon or contact Critec, Technopark, Dowsings Point, Hobart 7010; phone (002) 73 0066, fax 73 0399.

Handheld frequency counter

Florida-based Optoelectronics has released a new high performance, pocket sized addition to its line of Handi Counters, the Model M1.

The all new M1 includes 10 user-selectable sample measurement periods (gate times), ranging from 13ms to 10s with corresponding measurement resolution from 10kHz to 0.1Hz. This means that the M1 is capable of both ultra high speed measurement as well as very high resolution ten digit measurements.

The heart of the M1 is the OE10, a high speed ASIC (Application Specific Integrated Circuit) capable of 250MHz direct counting. An imbedded microcontroller provides digital filtering which greatly reduces the display of random noise and oscillation without any loss of sensitivity.

Digital auto capture (auto hold) locks the counter display on the first reading to pass the filter. An Arm/Store button send captured data into a three register stack that can be recalled later by the operator. These all new features make the M1 exceptionally useful for frequency finding, two way radio test, security, surveillance and law enforcement applications. A significant new feature found in the M1 is an asynchronous serial data port. The TTL data can be level shifted to RS-232C using the optional accessory Model CS12 interface.

Optoelectronics supplies its OptoLog data logging software with the CS12 which can be used with any PC to data log and time stamp frequency data. Also, a 16-segment relative signal strength bargraph is sensitive to low levels of RF, and can be used to verify transmitter output, or locate a stuck transmitter or an unauthorised source of RF.

The bargraph is very useful to indicate the presence of RF and is fully independent of the frequency measurement circuitry.

Despite its small size, the M1 is a full range counter with coverage from 10Hz up through 2.8GHz. It can be used with an oscilloscope probe for conventional test and measurement applications such as checking crystal oscillator test points. For portable operation, internal NiCad batteries provide 4 - 5 hours of operation from a 12 - 16 hour recharge period.

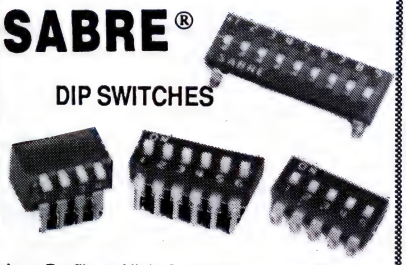
For further information contact Opto-Electronics, 5821 NE 14th Ave, Ft Lauderdale, Florida 33334, USA; phone (305) 771 2050, fax (305) 771 2052. ❖

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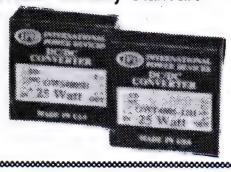
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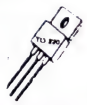
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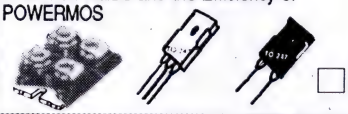


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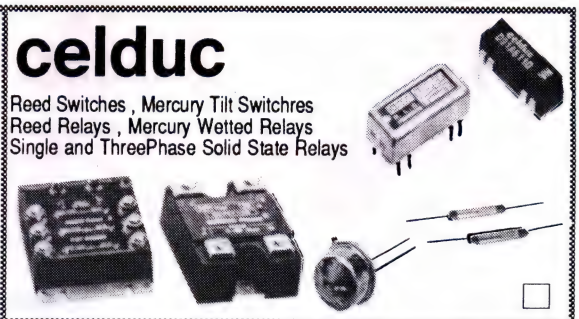
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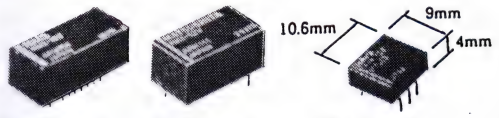
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READER INFO NO. 22

Silicon Valley NEWSLETTER



Task force for 'data super-highway'

Vice President Al Gore has released his government's proposals for overhauling the huge volume of laws governing the communications industries, in an effort to speed up the process for building a new communications infrastructure centred around a system of fibre-optics based data super-highways. As part of the proposal, Gore revealed the formation of the Information Infrastructure Task Force (IITF).

The White House report was very short on specifics. Instead the IITF, which is modelled after the health care reform task force headed by Mrs Clinton, will develop a specific plan for implementing the new data super-highway program.

The IITF's key objectives will be to promote competition among the industries that stand to benefit from the implementation of an information super-highway. Other issues the task force will address is to ensure there will be universal access to the network, that privacy is guaranteed, that unnecessary regulatory and legal barriers which could delay or prevent the building of the super-highway are removed or prevented from being put in place, and to help create an environment that will encourage development of new products and services.

The task force will include representatives from the government, the computer, telecommunications and entertainment industries, academia, labour, and even the public which will be counted on to accept and use the system.

Consortium wants to build prototype...

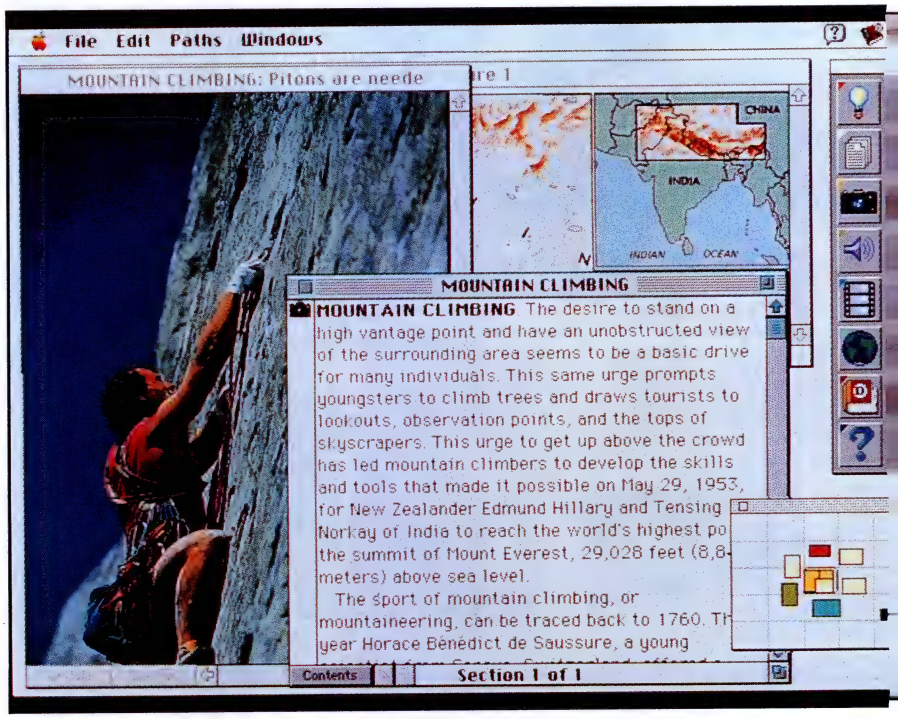
Already a consortium of 16 leading US high-tech companies has announced plans to build a data super-highway to enable scientists around the United States to work 'side-by-side' on a common research project.

The group, to be known as the National Information Infrastructure Testbed (NIIT), said it will build a prototype of the network which may one day be adopted nationally in the US and carry both scientific and business computer data, as well as entertainment and telecommunications information.

Among the companies supporting the consortium are Hewlett-Packard, AT&T, Sandia National Laboratories, Novell, Sun Microsystems and SynOptics. The founding members have contributed more than US$50 million to get the project underway.

NIIT is wasting little time. As early as this November, the group planned to conduct its first test in which environmental research facilities at the University of Berkeley, Oregon State, and New Hampshire would share data and collaborate on such problems as ozone depletion deforestation ion, and ocean pollution.

"The goal is really to prove that we can use networks so that remote facilities can collaborate on solving scientific problems" said Raymond Kline, a computer scientist at Sandia National Laboratories.



1993 has seen a dramatic increase in the market for CD-ROM drives and softwa — Apple Computer alone expects to have sold between one and 1-1/2 millio drives just in the US market, before the end of the year. A large range of CD-RO software is now available for both the Macintosh and IBM-compatible environments. This screen shot is from Compton's interactive encyclopaedia.

In a second test which may be co ducted early next year, NIIT will set up network for computerised hospit patient record keeping databases, whic will enable doctors in remote areas to a cess patient files.

The NIIT announcement was time carefully to coincide with the a nouncement by the Clinton Administr tion, just hours earlier, that calls for th overhaul of most of the US con munications laws in order to more quick ly implement the national dat super-highway infrastructure.

GPS based system passes FAA test

The US Federal Aviation Administra tion (FAA) has completed a successfu test of a breakthrough satellite navigatio system for the commercial aviation sec tor. Using signals emitted from fou satellites, a global positioning syste (GPS) aboard an airplane kept th

aircraft on a near perfect course, from just after lift off to a few seconds before landing. The new system will enable pilots to plot routes and land aircraft without having to rely on any ground based navigational aids.

As part of the test, a commercial jet flew two 12 mile round trips following the winding contours of the Potomac River. The only time the pilot had his hands on the controls was during take off (up to 135 feet in the air) and 30 seconds before landing. The rest of the way, the aircraft adjusted its pre-plotted course against data analysed by the on-board GPS system.

FAA officials said the satellite based navigation system will save the government hundreds of millions of dollars. Currently, airports maintain radio beacons worth US$1 million at the beginning and end of every runway. By comparison, each satellite transmitter costs only US$100,000. The GPS receiver system will cost about US$15,000 per aircraft and requires very little additional training for pilots.

Apple opens office in China

If personal computers were to reach a market penetration of only 5% in the People's Republic of China, it would double the number of personal computers in use around the world. Apple Computer does not want to be left out of a market with such vast potential, and recently its chief executive officer Michael Spindler travelled to Beijing, to underscore the importance with which Apple views the opening of its first corporate office in the PRC.

As part of the move, Apple also signed a deal with China's top computer distributor. Spindler told Chinese government and industry officials his company also plans to set up manufacturing operations in the PRC within the next two years. To date, there are about 10,000 Macintosh computers in use in the PRC, made available through Apple's distributor in Hong Kong.

"The Chinese market holds an enormous amount of potential for us," Spindler said.

In the near term, 'potential' is all China will mean to Apple and a host of other PC manufacturers which are eyeing the market there. At an average annual income of US$330, few Chinese will be able to afford even the least expensive personal computer.

But that may soon change, many market watchers believe. China is trying to move towards a market driven economy, while maintaining the current political power structure. That means tens of thousands of new businesses will form during the coming years. As they grow, many are likely to start buying personal computers to run their business.

Most PC sales to China are IBM-compatible systems, which are far less expensive than most Apple machines.

Three cities want flat panel consortium

Cities in at least three states are battling to be awarded what may one day prove to be one of the most lucrative high-tech economic development projects. San Jose in California, Austin in Texas and the entire state of Michigan are lobbying to be chosen as the headquarters for the US Display Consortium, a federally-funded effort to help create a US flat panel display industry.

Although the consortium currently consists of an office of only five people, it is expected to grow into a full scale research facility which would be at the heart of a huge manufacturing operation, to produce flat panel displays for member companies.

The USDC currently has 33 member companies and has secured a US$20 million grant from the Pentagon's Advanced Research Projects Agency (ARPA) to get started.

San Jose is the early favourite in the bidding. For one, it is close to Mountain View where the Semiconductor Equipment & Materials Institute is located. SEMI is coordinating the efforts between the consortium's members and US chip equipment companies, who want to develop production equipment for the display industry.

Also, California is long overdue to win a federally supported high-tech project, having lost Sematech, the MCC consortium, and the super-collider programs to Texas. Political realities almost demand that the Clinton Administration put pressure on the Pentagon to put the display program in California.

For its part, Austin can boast of the success it has had with Sematech and MCC. And Michigan already has one federally funded flat panel program going, with Optical Imaging Systems which has received a US$50 million subsidy to build a flat panel plant to make displays for the defence and aerospace industries.

Apple launches first IBM hardware

Apple Computer has introduced its first hardware product designed exclusively for the IBM-PC market: a CD-ROM drive package which will enable PC users to access up to 660 megabytes of multimedia based data.

The US$600-700 package includes the 660MB drive, a 16-bit sound card from Media Vision, and a pair of powered stereo speakers designed by Apple.

In making the announcement, Apple officials said the company expects to sell between one and 1.5 million CD-ROM drives in 1993.

The move into the IBM PC market appears to be aimed at leveraging the company's lead in CD applications into the PC market. In turn, Apple hopes software developers will see the effort as all the more reason to speed up development of new CD-ROM applications, as the market for such products is growing rapidly.

Analysts said the new IBM drive is also evidence of a new movement within the company to diversify beyond its proprietary Macintosh line. Apple has had considerable success selling Claris software programs such as the Filemaker database program into the IBM market.

Intel, Pac Bell link on PC-ISDN

Intel has joined the growing high-tech industrial movement towards the next generation of integrated computing and communication technologies, by forming an alliance with Pacific Bell, the largest of the 'Baby Bells'.

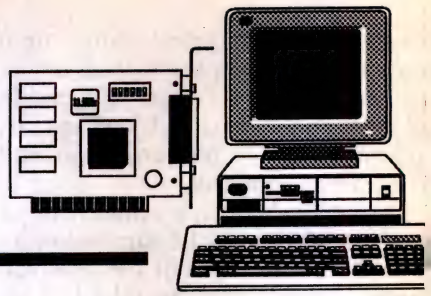
The first objective of the cooperative effort will be to develop ISDN products which will enable PC users in different locations to work on the same electronic document while talking to each other on the telephone. In a second phase, different parties working together would also be able to see each other on televideo displays in a window on their computer display.

As part of the effort, Intel will design new PC-ISDN circuit boards which will make such connections possible. Pac Bell, meanwhile, will use its research operations to develop the means to enable more people to take advantage of ISDN services. Currently more than 7.5 million of Pacific Bell's 14 million telephone lines in California have access to ISDN services. But the response has been dismal, with only 8000 lines actively being used for ISDN.

"We would like to encourage Pacific Bell to get people to install ISDN, because we need a bigger pipeline to the PC desktop," said Intel senior vice president Frank Gill.

One of the things Intel and Pac Bell will be working on is to ensure that all software, hardware, and transmission equipment works together in ways that are easy for customers. ❖

Computer News and New Products



Improved 15" multisync monitor

NEC Home Electronics Australia has released details of its new 15" MultiSync monitor, the 4FGe, with higher bandwidth for flicker free performance. According to NEC, the 4FGe updates its family of six MultiSync monitors, designed for business and professional users, which range in size from 15" to 21", with advanced performance and ergonomic features.

The NEC MultiSync 4FGe updates the MultiSync 4FG, and is the latest in the new series of ergonomically affordable monitors, incorporating the 3FGe and 5FGe released earlier this year. The Multisync 4FGe is a digitally controlled multiple frequency colour monitor, which is now also compatible with the new IBM XGA-2 standard and Macintosh computer platforms. According to NEC, the higher bandwidth of 80MHz and horizontal frequency of 62Hz allows the 4FGe to exceed the VESA standard and provide an extra high refresh rate of 76Hz at 1024 x 768 non-interlaced. At this rate, flicker is undetectable by the vast majority of users.

For Macintosh users the 4FGe is available with an optional adaptor, converting the monitor from PC, VGA mode to Macintosh video mode supporting resolutions of 640 x 480 or 832 x 624. The 4FGe is available with the matching NEC MacFG 24Xp interface card for Macintosh NuBUS accelerated video up to 832 x 624.

The NEC 4FGe has an RRP of $1575, including tax.

For further information circle 163 on the reader service coupon or contact NEC Home Electronics, 244 Beecroft Road, Epping 2121; phone (02) 86 1811, fax 869 1112.

Data terminal for hazardous areas

Data handling in hazardous areas achieved simply and successfully t Measurement Technology's handhe data terminal, the MTL 611 — a powe ful unit capable of sophisticated da collection and configuration as we as more basic notebook and dia type functions.

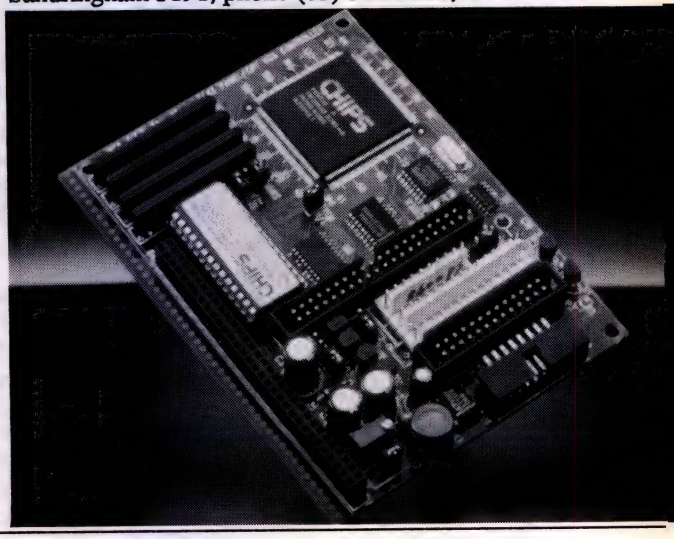
Its universal nature has been enhanc by the development of a comprehensi range of slot-in interfaces. These allo such functions as configuration ar communication with HART smart tran mitters; local 5V logic RS-232C cor munication for linking to IS station e.g., data loggers; and a long distan link to the safe area via an IS interfa

PC flat-panel & CRT module

The new PCA-6443 flat-panel/CRT VGA Piggyback module plugs directly into the 64-pin connector of the Advantech range of Industrial all-in-one PC-based CPU cards, to provide a complete IBM compatible system. The module supports a wide range of LCD, EL and gas plasma flat-panel displays and traditional analog CRT monitors in high-resolution display modes, while maintaining complete register, gate and BIOS compatibility with the IBM VGA. It supports use of both a flat-panel display and a CRT VGA display at the same time.

The onboard Chips 65530 IC provides a variety of programmable features to optimise display quality. This includes vertical and horizontal compensation, text enhancement, RGB-colour-greyscale reduction, and a polynomial FRC greyscale algorithm to reduce flicker on fast-response 'mouse quick' displays, without increasing the panel's vertical refresh rate. In addition to the general purpose 40-pin connector, three special onboard connectors are provided for easy installation of the most popular 640 x 480 TFT LCD, mono LCD and EL panels.

For further information circle 162 on the reader servic coupon or contact Priority Electronics, 23-25 Melrose Stree Sandringham 3191; phone (03) 521 0266, fax 521 0356.



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module. Collected data can be downloaded via a serial link to a safe area computer or, for greater flexibility, be stored locally in IS datapaks for download and analysis when convenient. A bar code reader accessory simplifies data entry in the form of a 'swipe' application — eliminating errors and maximising efficiency — and is ideal for batch data entry, product traceability and equipment site inspection.

For further information circle 164 on the reader service coupon or contact Measurement Technology; phone (09) 455 2994.

New Hypertech 486

Users of portable IBM PS/2 model P70 computers can now benefit from 486DX processing power, following the release of the Hyperace 486DX P70 processor upgrade/accelerator board. It speeds up the 386 DX-based P70 machine by up to 5.78 times, according to Landmark *Speed* V2.0, while floating point performance in Whetstones is improved by 5770 times.

Hyperace 486DX P70 incorporates an 80486DX processor running at 33MHz, with an internal 8KB cache and built-in maths co-processor. The model is designed to lift productivity for users running demanding software applications, such as large spreadsheets, databases or graphics applications.

The Hyperace 486DX/33 P70 retails at $1400, excluding tax. For further information circle 170 on the reader service coupon or contact Hypertex, 112-118 Talavera Road, North Ryde 2113; phone (02) 805 0111.

Barcode printer

Superb quality bar codes are possible with the Astech range of Thermal Transfer Bar Code and text printers, which are suitable for records management, medical and library inventory control and warehouse and point-of-sale applications. The systems have been designed and manufactured in Australia.

All models are intended for online use, and the Model 2104T is also useable off-line, featuring its own keyboard control. A wide selection of print formats are available, and labels can be produced horizontally or vertically, on two label widths.

For further information circle 165 on the reader service coupon or contact Databar, PO Box 300, Brookvale 2100; phone (02) 938 4994, fax 938 5730.

32-bit video accelerator card

Actix Systems has begun shipping its ProStar VL Series, to join its mid to high end line of Windows Accelerators based on the S-3 chip. At a price less than the basic GE32 model for ISA, ProStar is a true 32-bit bus design for VESA Local Bus.

The board supports 1024 x 768 non-interlaced resolution and delivers sharp, stable images to VGA, SVGA, and multisync colour monitors, making it ideal for Windows users with a 14" or 15" monitor. The ProStar VL also supports 16.8 million colours and up to 90Hz refresh rate.

In addition to high refresh rates, ProStar VL displays the full range of colour depths (from 256 x 16.8 million colours) and supports high resolutions (up to 1280 x 1024), allowing the most exacting graphics work possible. It features the Cirrus Logic graphic drawing engine, CL-GD5428, which is an enhanced VGA chip, to accelerate graphics in Windows, CAD and other environments. The ProStar VL is designed for the VESA Local Bus at a maximum processor speed of 66MHz, with 32-bit data and I/O transfer widths. The adaptor also includes VESA BIOS and feature connector, and D subminiature 15-pin (VGA standard) video connector. All Actix Windows accelerator boards are primarily designed to speed up Microsoft Windows, but will also speed up the on-screen graphics performance of CAD/CAM, illustration software, desktop publishing and multimedia applications. ProStar VL retails for A$299, ex tax.

For further information circle 176 on the reader service coupon or contact Sprinter Products, 15 West Street, Brookvale 2100; phone (02) 938 3388, fax 938 3288.

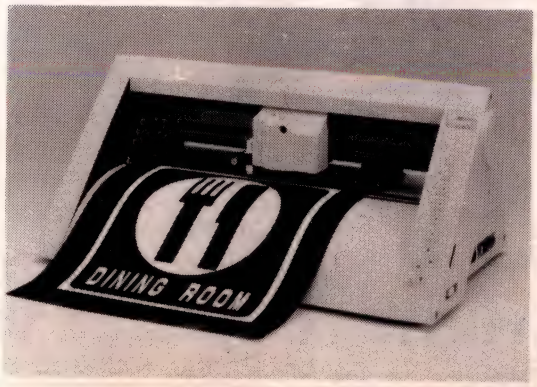
Sign maker

Roland's PNC-900 lets you create custom vinyl signs and banners instantly — right from your computer. Simply design your sign in a lettering or graphics program and output the file to your PNC-900. Roland's open-architecture technology allows you to use a PC, and the software of your choice.

The PNC-900 offers an advanced smoothing feature for 'flawless' arcs and curves. Its quick swivel blade operation ensures clean, accurate cornering routines, even on the most intricate cuts. It can cut lettering as small as 3mm through to banners 30mm wide by 25m long. You can also produce vehicle graphics, exhibit displays and other large format signs quickly and easily.

In addition to the more than 200 colours and styles of vinyl available, the PNC-900 performs with a range of graphic arts materials, including rubylith and amberlith film used for screen printing. It even cuts sandblast stencil, reflective vinyls, frisket and other materials for a wide range of applications.

For further information circle 161 on the reader service coupon or contact Roland Digital Group. 573 Church Street, Richmond 3121; phone (03) 428 1088.



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Several new products are scheduled for release by Binary using both Microsoft Visual BASIC, C Software and Windows products. These include enhanced GPIB Control Software designed for use with Binary's GPIB Smart Cable, and Binary's TM2 Software for use with its SMT-2000 Automatic PCB Test System.

For further information circle 166 on the reader service coupon or contact Binary Engineering International, 102/658 Pittwater Road, Brookvale 2100; phone (03) 938 5344, fax 938 5875.

IBM 5250 emulators for PCs

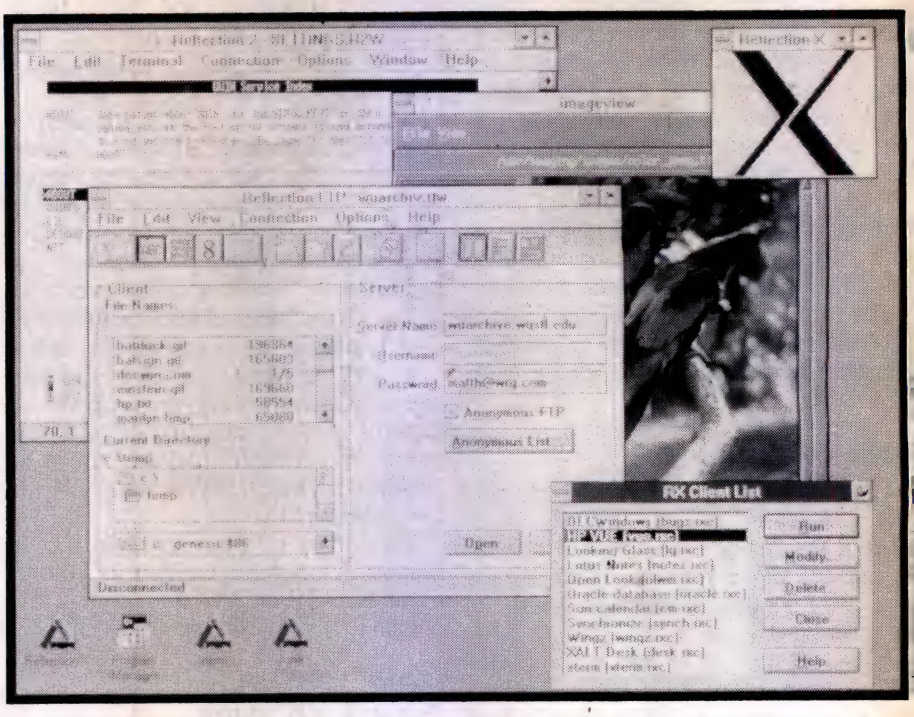
Intelligent Technologies has announced a new low price for its IT 8251 series of IBM 5250 emulation cards, making the IT 8251 a cost effective way to connect a PC to an IBM AS/400 or System 3X midrange computer.

The 8251 supports a total of seven concurrent sessions, using a minimum memory of only 63K, plus 15K per active printer session. Sessions can run under Windows in a DOS partition, and switching between active host and PC/DOS sessions is via a hot-key.

It provides a wide variety of printer emulation support for most industry standards, and it is possible to have up to five printer sessions running simultaneously with either serial or parallel printers.

The IT 8251 series features two models, the 'E' version for AT bus PCs at a recommended retail price of $495 and the 'ME' for Microchannel (MCA) bus computers at $575 (including tax).

For further information circle 180 on the reader service coupon or contact Intelligent Technologies, 21 Cowpe Street, Parramatta 2150; phone (02) 891 6010. ❖



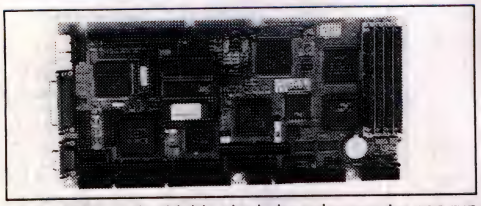
Windows terminal emulator

A terminal emulator that allows PC users to run both X Windows and Microsoft Windows platforms on the one computer has been released in Australia by Megatec. 'Reflection X', a PC X server software package developed in the United States, provides Windows users with fast and accurate graphical access to X applications running on any host on a network.

The X Window System provides end users with a standard windowing interface to network applications on DEC HP and IBM hosts, which shields users from differences between the systems. Management gains an open standard which enables the flexibility and easy hardware upgrades in the future. Also, it allows Windows users to tap their organisation's information resources which, until now, could only be reached on a dedicated X terminal.

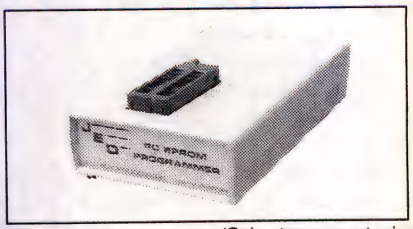
For further information circle 171 on the reader service coupon or contact Megatec, 2 Brunswick Road, Mitcham 3132; phone (03) 874 3633, fax 873 5667.

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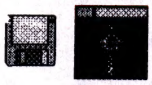
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1N5404 (PK.100)	$14.00	1N5408 (PK.100)	$16.00

BRIDGES

W04 (PK.10)	$5.00	BR64 (PK.1)	$2.00
BR104 (PK.1)	$2.50	BR354 (PK.1)	$4.50

LED's

3mm RED (PK.100)	$12.00	5mm RED (PK.100)	$12.00
3mm GRN (PK.100)	$15.00	5mm GRN (PK.100)	$18.00
3mm YLW (PK.100)	$15.00	5mm YLW (PK.100)	$18.00

TRANSISTORS

BC547/8/9 (PK.100)	$8.50	BC557/8/9 (PK.100)	$8.50
BD139 (PK.10)	$6.00	BD140 (PK.10)	$6.00
MJ2955 (PK.1)	$2.00	2N3055 (PK.1)	$1.50

IC's

324 (PK.10)	$9.00	339 (PK.10)	$8.50
555 (PK.10)	$5.50	741 (PK.10)	$5.00

NULL MODEM LAPLINK CABLE

- IF YOU NEED TO TRANSFER LARGE FILES BETWEEN TWO COMPUTERS, THEN IT'S ALOT QUICKER TO SEND THEM SERIALLY, RATHER THAN USE DISKETTES. MS-DOS 6 INCLUDE INTERLNK.EXE JUST FOR THIS PURPOSE.
- DB25 PLUG TO DB25 SOCKET.
- 1.8m LENGTH.

WE HAVE SEEN SOME OF OUR COMPETITORS ADVERTISING THESE FOR $25.00 OR MORE!!

OUR PRICE $17.50

HARD DRIVES

- RELIABLE TOP NAME BRANDS.
- WESTERN DIGITAL, MAXTOR, OR CONNER PERIPHERALS.
- FULL 2 YEAR MANUFACTURERS WARRANTY.

80M	***$309.00***
120M	***$345.00***
170M	***$359.00***
200M	***$385.00***
250M	***$450.00***
340M	***$575.00***
500M	***$1225.00***

15CD LED

YES THAT'S RIGHT!! INCREDIBLE 15 CANDELA!! APPROXIMATELY 1000 TIMES BRIGHTER THAN ORDINARY LED.

13mm RED ***$34.00***

MATH COPROCESSORS

$\Sigma+$ $\cos(\Phi)$ $\delta x/\delta t$

INCREASE THE PERFORMANCE OF YOUR MATH INTENSIVE APPLICATIONS SUCH AS SPREADSHEET, DATABASE AND CAD PROGRAMS.

IIT BRAND

387SX-33	$135.00
387DX-40	$150.00

IEC MAINS LEAD

- WE HAVE BULK PURCHASED THESE HANDY LEADS WITH IEC SOCKET ON ONE END AND BARE LEADS ON THE OTHER.
- USED BY MANY COMPUTER EQUIPMENT.
- IDEAL FOR REPLACEMENT.

NORMALLY $3.95
SALE PRICE $1.95

YES FOLKS! IT'S THAT TIME OF THE YEAR AGAIN. CHRISTMAS IS ONLY A FEW WEEKS AWAY.

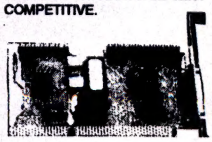
IF YOU HAVEN'T DECIDED ON A GIFT FOR YOUR TECHNICALLY-MINDED FRIEND OR RELATIVE, THEN LET US MAKE A FEW SUGGESTIONS.

ROLL OF PVC TAPE	$1.50	NEON TEST S/DRIVER	$1.95
SOLDERWICK	$3.50	ALIGNMENT TOOL SET	$4.50
JEWELLER S/DRVR SET	$4.50	3HR VHS TAPE	$4.95
3.5" DISK STORAGE BOX	$4.95	SOLDERING AID TOOL	$6.95
JUMPER LEAD SET	$6.95	MOUSE MAT	$7.50
PCB HOLDER STAND	$9.95	DESOLDERING TOOL	$11.95
S/IRON STAND	$12.95	4WAY POWER BOARD	$12.95
MINI BENCH VICE	$13.50	.71 500g SOLDER	$14.95
840 HOLE B/BOARD	$15.95	25W SOLDERING IRON	$17.95
ANALOG MULTIMETER	$19.50	NIBBLING TOOL	$19.95
WIRE STRIPPER	$20.95	12V MINI DRILL	$21.50
NEEDLE FILE SET	$24.30	SERIAL MOUSE	$27.50
48WAY PARTS CASE	$28.95	2WAY DATA SWITCH P	$29.95
2WAY DATA SWITCH S	$29.95	101 KEYBOARD	$37.50
GAS SOLDERING IRON	$38.95	WELLER SP25D	$39.95
LOGIC PROBE	$43.95	TOOL KIT 16 PIECE SET	$49.95
VIDEO SENDER	$69.50	ARLEC SUPERTOOL	$79.95
TEL. ANS. MACHINE	$95.00	WELLER WTCPS	$149.00
200W INVERTER	$169.00	AVIATION HEADSET	$189.00
ULTRASONIC CLEANER	$229.00	CAR ALARM	$249.00
INT. FAX/MODEM	$289.00	FLUKE 77	$349.00
14" SVGA MONITOR	$389.00	CD-ROM DRIVE	$395.00

Merry Christmas and a happy New Year!!

PERIPHERAL CARDS

-WHETHER YOU'RE REPLACING A FAULTY CARD OR INSTALLING AN ADDITIONAL CARD, WE CAN OFFER YOU THE RIGHT CHOICE.
-COMPARE OUR PRICES WITH OTHER DEALERS. YOU'LL FIND OUR PRICES TO BE VERY COMPETITIVE.



XT CLOCK	$22.50
XT/AT SERIAL (1 POP.) ..	$19.50
XT/AT PARALLEL	$19.50
XT/AT GAMES	$19.50
AT MULTI I/O (2S,1P,1G)	$25.00
AT IDE/FDD	$22.50
AT IDE/FDD MULTI I/O	$39.00
MONO/CGA GRAPHICS ..	$45.00
512K TRIDENT VGA	$75.00
1M CIRRUS VGA	$109.00

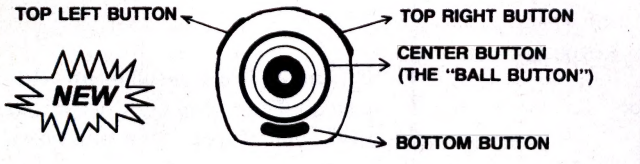
VESA LOCAL BUS CARDS

1M CIRRUS VGA	$175.00
IDE I/O CONTROLLER ..	$99.00

1 YEAR WARRANTY!!

HANDY MOUSE TRACKBALL

- THIS IS A UNIQUE AND INGENIOUS DEVICE WHICH ALLOWS SINGLE HANDED OPERATION WITH MUCH GREATER EASE THAN CONVENTIONAL TRACKBALL.
- IDEAL FOR LAPTOP USERS AND THOSE PEOPLE WHOSE DESK TOP RESEMBLES AN AFTERMATH OF AN ATOMIC EXPLOSION.
- SPECIALLY DESIGNED TO SUIT BOTH LEFT-HANDED AND RIGHT-HANDED USERS.
- THE MOST SIGNIFICANT FEATURE OF THIS DEVICE IS THE **"BALL BUTTON"** WHICH ACTS AS THE LEFT BUTTON ON A STANDARD 2 BUTTON MOUSE.
- MICROSOFT MOUSE COMPATIBLE.



INTRODUCTORY PRICE OF $49.50

EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
Altronics	WA	●	●	●	●	●	●	●
Companion Computers	VIC		●					
Dick Smith Electronics	ALL	●	●	●	●	●	●	●
Emona Instruments	NSW						●	
Geoff Wood Electronics	NSW	●	●	●	●	●	●	
Jaycar Electronics	Eastern	●	●	●	●	●	●	●
Kalex	VIC			●				
Macservice	VIC						●	
RCS Radio	NSW			●				
Rod Irving Electronics	VIC	●	●	●	●	●	●	●
Scientific Devices	VIC						●	
TECS	VIC	●	●	●	●	●	●	●
Wagner Electronics	NSW		●		●	●	●	

KEY TO CODING:
A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Co, PO Box 199, Alexandria 2015; phone (02) 353 9992.
BACK ISSUES: Available only until stocks are exhausted. Price A$7.50 which includes postage within Australia only. **OVERSEAS READERS SHOULD ADD A FURTHER A$2.50 FOR EVERY BACK ISSUE REQUIRED.**
PHOTOSTAT COPIES: When back issues are exhausted, photocopies of articles can be supplied. Price $7.50 per project or $15 where a project spreads over several issues.
PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, $10 for larger boards. Please specify negatives or positives.
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.
OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.
PAYMENT: Must be negotiable in Australia and payable to 'Electronics Australia'. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).
ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria, NSW 2015; phone (02) 353 0620.
PLEASE NOTE THAT WE ARE UNABLE TO SUPPLY BACK ISSUES, PHOTOCOPIES OR PCB ARTWORK OVER THE COUNTER.

METHOD OF PAYMENT: (Please circle correct method).

Credit Card: Mastercard / American Express / Visa / Bankcard
Cheque:
Money Order:
Expiry Date:.....

Name:.....
Address:.....
.....Postcode:.....
Back Issues:.....
.....
.....
Photostat Copies:.....
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No.of issues required:.....$7.50=.....
No.of copies required:.....$5.00=.....
No.of copies required:...$15.00=.....
Total Payment Enclosed $ =========

Signature:.....
(Unsigned orders cannot be accepted).

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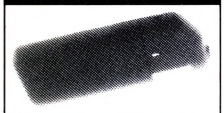
This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

FM TRANSMITTER MK1 KIT

This unit has most of the features of our previously advertised FMTXMK2 transmitter, but is much, much smaller. The complete transmitter PCB (Miniature microphone included) is the size of a "AA" battery, and it is powered by a single "AA" battery. We use a two "AA" battery holder (provided) for the case, and a battery clip (Switch) for the switch. Estimated battery life is over 500 hours!! SAME PRICE AS OUR FMTXMK2:

$11 ea or 3 for $30

LASER POINTER



When this magazine goes to print we will have in stock a very small 5mW-670nM laser diode based pointer. This pointer actually uses a 5mW laser diode: Very bright! Do not be misled by advertisements that advertise pointers with a power output of 5mW maximum, as these could have a power output of as little as 1mW. The SPECIAL introductory price for our pointer is an all time low:

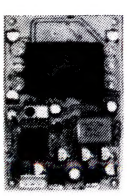
$139

APC VISIBLE LASER DIODE KIT

Our best visible laser diode kit ever! This one is supplied with a 5mW-670nM diode and the lens already mounted in a small brass assembly, which has the three connecting wires attached. The lens used is the most efficient we have seen, and its focus can be adjusted. We also provide a PCB and all onboard components kit for a driver kit that features Automatic Power Control (APC). Head has a diameter of 11mm and is 22mm long, APC driver PCB is 20 x 23mm, 4.5-12V operation at approx 80mA.

$85

MINIATURE CCD CAMERA



A monochrome CCD Camera that is totally assembled on a small PCB and includes an Auto Iris lens: Overall dimensions of camera are 24 X 54 X 120mm. The camera can work with as little as 0.1 lux illumination, and it is IR responsive! The six IR leds that are included on the PC.B. are useful for producing good images in a totally dark room! Available in EIA or CCIR standards.

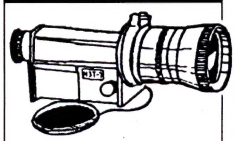
$199

VOICE RECORDING MODULES

These "State of the art" solid state voice recording modules can record and play back messages up to 20 seconds long. They are very small and produce good quality sound. Include PCB assembly, microphone, speaker and a battery holder. INCREDIBLE PRODUCT AT ONLY:

$25

PASSIVE NIGHT VIEWER



This is a completed commercial monocular hand held night viewer, that employs an image intensifier tube: Luminous gain of 12500! The viewer is of a USSR military standard, and will produce useful images in as little as starlight illumination. Has adjustable low light objective lens, adjustable eyepiece, and is supplied with a carry case. Limited supplies at an incredible price of:

$799

PRECISION STEPPER MOTOR



This precision 4 wire Japanese stepper motor has 1.8 degree steps: That is 200 steps per revolution! 56mm diameter, 40mm high, drive shaft has a diameter of 6mm and is 20mm long, 7.2V-0.6A DC. We have a good, but LIMITED supply of these brand new motors:

$20

9" AMBER MONITOR

These are non enclosed composite monitors that can be powered from a 12V D.C. supply.

$60

IR LASER DIODE SPECIAL

If you have never experimented with laser diodes, don't miss out on this SPECIAL. We supply a brand new 780nM LASER DIODE (Barely visible) with small plastic COLLIMATING LENS to suit, a HEATSINK for the diode, a PCB and components kit for a suitable CONTANT CURRENT DRIVER, a suitable PIN DIODE that can serve as a detector, plus some INSTRUCTIONS. Suitable for medical use, perimeter protection, data transmission, IR illumination, etc. Experimenters delight at a SPECIAL PRICE OF ONLY:

$30

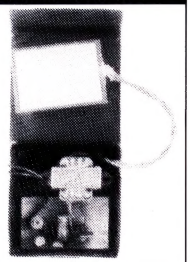
UNINTERRUPTABLE POWER SUPPLY (UPS)

THESE ARE VERY COMPACT, HIGH QUALITY, UPS's. They feature a 300W-450W **SINE WAVE INVERTER.** The inverter is powered by two series 12V-6.5AHr. (24V). batteries that are built into the unit. **There is only one catch:** Because these NEW units have been in storage for a while, we cannot guarantee the two batteries for any period of time, but we will guarantee that the batteries will perform in the UPS's when these are supplied. We will provide a three month warranty on the UPS's, but not on the batteries. A circuit will also be provided. **PRICED AT FRACTION OF THEIR REAL VALUE: BE QUICK!**

$239

We may also have some similar 600 Watt UPS's available: Similar story. New 6.5 AHr. batteries: $35 ea. Freight charge: $15 per UPS.

BACKLIGHTING INVERTER KIT



This kit inverter can power all the Fluorescent screens that are supplied as an option with many LCD displays. 5-12V operation with adjustable output power for different screen powers — brightness. A 60 X 45mm fluorescent screen and a plastic case will be supplied for FREE with each kit. When powered by the inverter this screen will light a brilliant white whilst the inverter only draws 100mA from the battery: Very efficient small fluorescent light! Experimenters delight at only:

$12

For the inverter kit and one screen. Additional screens $3 ea.

PLASMA BALL KIT

This kit will produce a fascinating colourful changing high voltage discharge in a standard domestic light bulb. The EHT circuit is powered from a 12V supply and draws a low 0.7A. We provide a solder masked and screened PCB, all the onboard components (Flyback transformer included), and the instructions at a SPECIAL introductory price of:

$29

We do not supply the standard light bulb or any casing. The prototype supply was housed in a large Coffee jar, with the lamp mounted on the lid: A very attractive low cost housing!! Diagrams included.

IR VIEWER "TANK SET"



ON SPECIAL is a set of components that can be used to make a complete first generation Infra Red night viewer. These matching lenses tubes and eyepieces were removed from working tank viewers, and we also supply a suitable EHT power supply for the particular tube supplied. This power supply may be ready made or in kit form: Basic instructions provided. The resultant viewer requires IR illumination.

$150-$200

12V OPERATED LASER



This combination includes one used 3mW SIEMENS visible red laser tube and one 12V Universal Laser power supply MKIII kit. The inverter is easy to construct since it is supplied with a prewound transformer, and solder masked and screened PCB.

$89

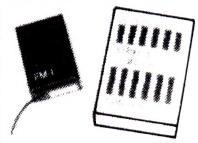
INDUCTIVE PROXIMITY SWITCHES



These industrial quality detectors will detect ferrous and non-ferrous metals at close proximity. Some are DC powered (10-30V), some are mains AC powered, and all will switch loads directly. All have three wires for connecting into circuitry: Two for the supply, and one for switching the load. These also make excellent sensors for rotating shafts etc. LIMITED SUPPLIES. ON SPECIAL AT:

$22 ea. or 6 for $100

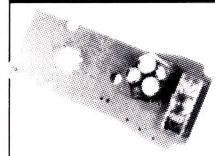
MINIATURE FM TRANSMITTER



Not a kit, but a very small ready made self contained FM transmitter enclosed in a small black metal case. It is powered by a single small 1.5V silver oxide battery, and has an inbuilt electret microphone. SPECIFICATIONS: Tuning range: 88-108MHz, Antenna: Wire antenna-attached, Microphone: Electret condenser, Battery: One 1.5V silver oxide LR44/G13, Battery life: 60 hours, Weight: 15g, Dimensions: 1.3" X 0.9" X 0.4". Some would call this a miniature "BUG" and sell it for much more than our price:

$32

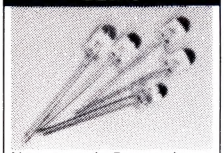
LIGHT MOTION DETECTORS



Small PC.B. Assembly based on a ULN2232 IC. This device has a built in light detector, filters, timer, narrow angle lens, and even a siren driver circuit that can drive an external speaker. Will detect humans crossing a narrow corridor at distances up to 3 metres. Much higher ranges are possible if the detector is illuminated by a remote visible or IR light source. Can be used at very low light levels, and even in total darkness: With IR LED. Full information provided. The IC only, is worth $16! OUR PRICE FOR THE ASSEMBLY IS:

$7 ea. or 5 for $30

HIGH INTENSITY LED's



Narrow angle 5mm red LED's in a clear housing. Have a luminous power output of 550-1000mCD @ 20mA: That's about 1000 times brighter than normal red LED's. **SPECIAL UNBELIEVABLE INTRODUCTORY PRICE:**

60c ea. or 10 for $5

ATTENTION ALL MOTOROLA MICRO-PROCESSOR PROGRAMMERS

We have advanced information about two new STATE OF THE ART microprocessors to be released by Motorola: 68C705K1 and 68HC705J1. The chips are fully functional micros containing EPROM/OTPROM and RAM. Some of the features of these new LOW COST chips include:

- **16 pin DIL for the 68HC705K1 chip**
- **20 pin DIL for the 68HC705J1 chip**
- **10 fully programmable bi-directional I/O lines**
- **EPROM and RAM on chip**
- **Fully static operation with over 4MHz operating speed.**

These two chips should become very popular. We have put together a SPECIAL PACKAGE that includes a number of components that enable "playing" with the abovementioned new chips, and also some of the older chips.

IN THIS PACKAGE YOU WILL GET:

- **One very large (330 X 220mm) PCB for the Computer/Trainer published in EA Sept. 93, one 16X2 LCD character display to suit, and one adaptor PCB to suit the 68HC705C8.**
- **One small adaptor PCB that mates the programmer in EA Mar. 93 to the "J" chip, plus circuit.**
- **One stand alone programmer PCB for programming the "K" chip plus the circuit and a special transformer to suit.**

THE TOTAL COST OF THE ABOVE PACKAGE IS ON SPECIAL AT A RIDICULOUS PRICE OF:

$99

Note that the four PCB's supplied are all silk screened and solder masked, and have plated through holes. Their value alone would be in excess of $200!! A demonstration disc for the COMPUTER/TRAINER is available for $10. No additional software is currently available. Previous purchasers of the COMPUTER/TRAINER PCB can get a special credit towards the purchase of the rest of the above package.

OATLEY ELECTRONICS

PO Box 89, Oatley, NSW 2223

Telephone: (02) 579 4985 Fax: (02) 570 7910

MAJOR CARDS ACCEPTED WITH PHONE AND FAX ORDERS

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FOR MOST MIXED ORDERS: $2.50-$10

Now meet our new family member: an 8.5 GHz Spectrum Analyzer designed for testing Digital Cellular Radios.



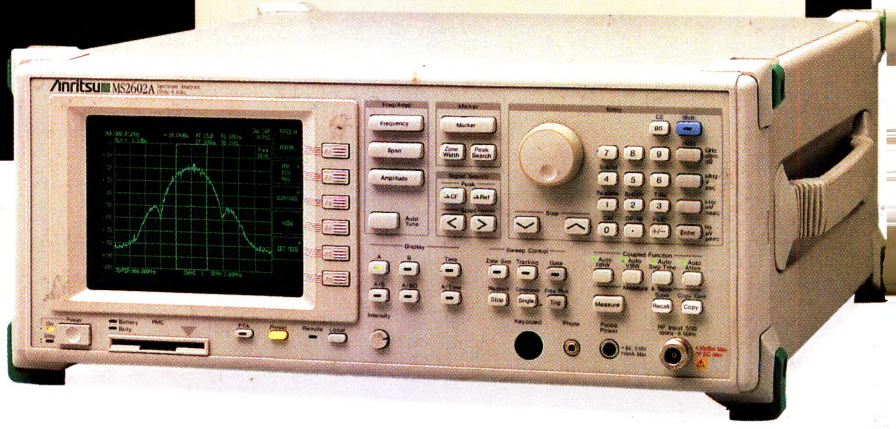
If you're testing Digital Cellular Radios, Anritsu has a message you'll want to hear: take a close look at our new MS2602A Spectrum Analyzer.

Our new Spectrum Analyzer gives you performance the competition simply can't match. Performance like the greatest frequency coverage in its class: up to 8.5 GHz. Plus, greater dynamic range with unbelievably low distortion. All topped off with superior level accuracy of ± 1.1 dB! In short, it's ideal for R&D and Production testing, installation and maintenance applications as well.

Here are some other features that deserve a closer look:

- Simultaneous Frequency and Time domain display
- Adjacent channel leakage power
- Occupied frequency bandwidth
- Zone sweep capabilities and up to 10 markers

When you're ready for a Spectrum Analyzer that answers all your digital cellular radio testing needs, there's only one name to call–Anritsu. Contact us for detailed literature or a demo.



Anritsu

MELBOURNE - 58 QUEENSBRIDGE STREET
SOUTH MELBOURNE, VICTORIA 3205
TELEPHONE : (03) 694-6666
FAX : (03) 694-6667

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AUSTRALIA