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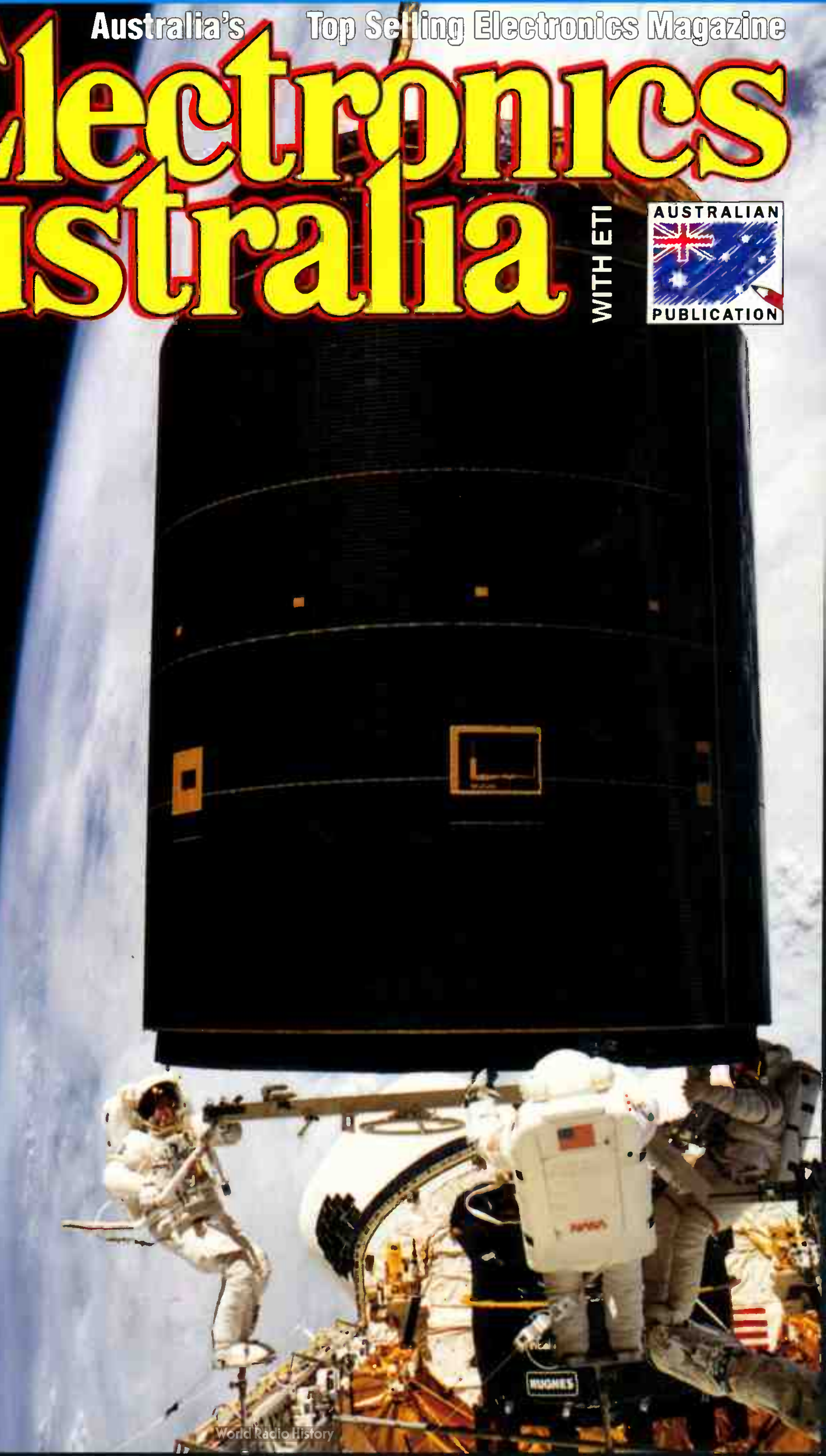

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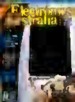

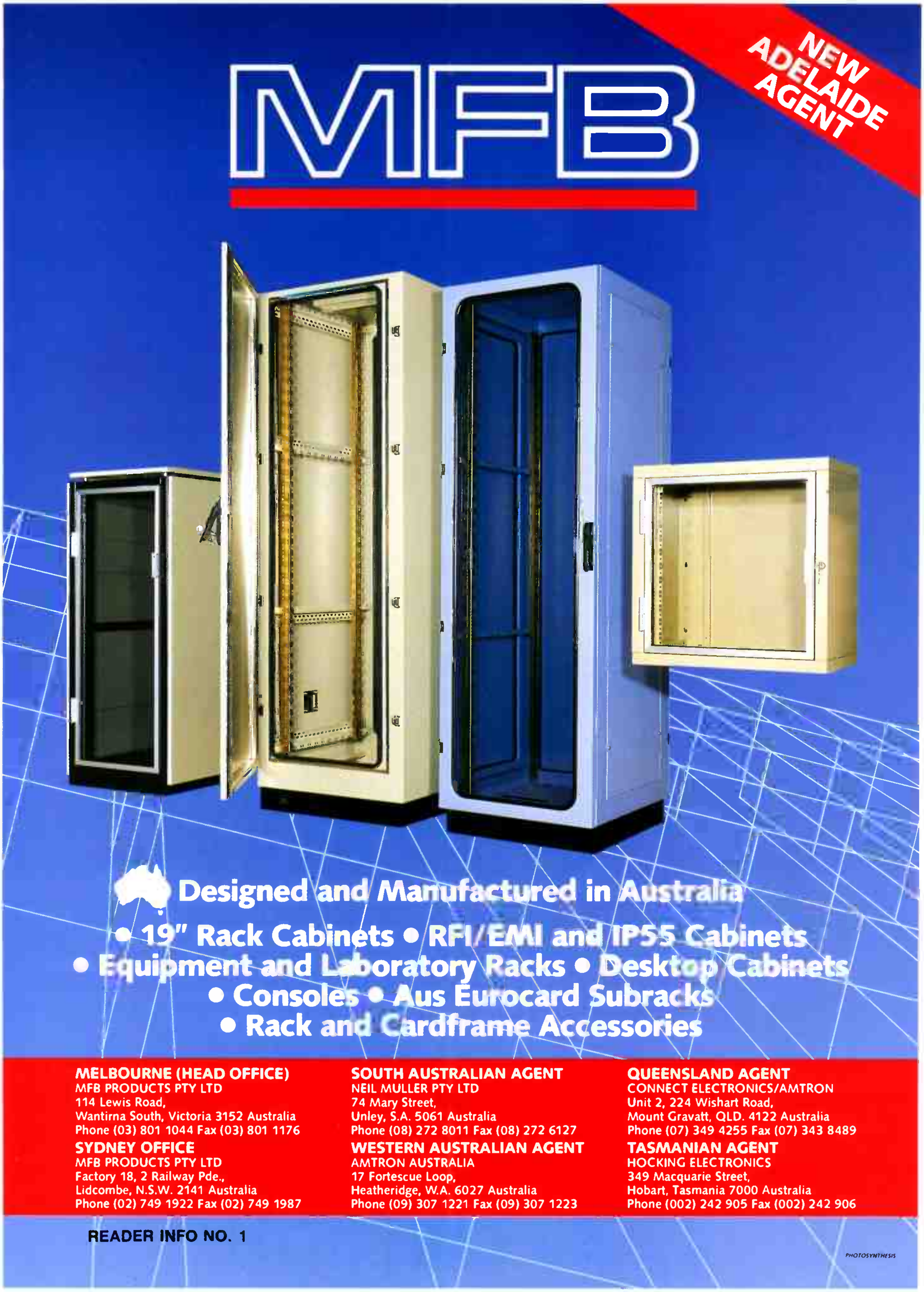
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Volume 54, No.8

Electronics Australia

WITH eti

August 1992

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Weird, but it really works:

In his third and final article on weather satellite reception, Tom Moffat explains how to build a Lindenblad antenna. Held here by his daughter Fiona, Tom describes the antenna as 'ugly'—but an excellent performer when it comes to receiving the weak signals from orbiting weather satellites. You'll find his story starting on page 32...

Continuous forms laser

The new Facit D7160 laser printer has a throughput of 16 pages/minute, and also accepts continuous form stationery. You'll find more information on it in the Computer News section, on page 151.

On the cover

The moment of truth, when NASA's astronauts Pierre Thuot, Rick Hieb and Tom Akers had grasped the errant INTELSAT VI F-3 satellite in their gloved hands and were tethering it to the capture bar. See Kate Doolan's cover story, starting on page 18. (Picture courtesy NASA)

Video and Audio

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Projects and Technical

Professional Electronics

Columns and Comments

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MANAGING EDITOR
Jamieson Rowe, B.A., B.SC., SMIREE, VK2ZLO
FEATURES EDITOR
Peter Murtagh, B.SC, Dip.Ed.
TECHNICAL EDITOR
Rob Evans, CET (RMIT)
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Peter Phillips, B.Ed., Dip Ed., ECC
CONTRIBUTORS
Neville Williams, FIREE, VK2XV
Jim Lawler, MTETIA
Arthur Cushen, MBE
Tom Moffat, VK7TM
Peter Lankshear
SECRETARY
Ana Maria Zamora
PRODUCTION EDITOR
Milli Godden
DRAFTING
Karen Rowlands
COVER DESIGNER
Clive Davis
PRODUCTION
Patrice Wohlnick, Mal Burgess
ADVERTISING PRODUCTION
Anthony Macarounas
CIRCULATION MANAGER
Michael Prior
PUBLISHER
Michael Hannan
ADVERTISING MANAGER
Selwyn Sayers (02) 693 9734
HEAD OFFICE - EDITORIAL
180 Bourke Road, Alexandria, NSW 2015
P.O. Box 199, Alexandria, NSW 2015
Fax number: (02) 693 6613
READER SERVICES: 693 6620
SUBSCRIPTIONS ENQUIRIES: phone (02) 693 9751
BOOK SHOP ENQUIRIES: phone (02) 693 9751
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MELBOURNE: 504 Princes Highway, Noble Park, Vic 3174. Phone (03) 795 3666.
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BRISBANE: 26 Chermside Street, Newstead, Qld 4006. Phone: (07) 854 1119.
Fax: (07) 252 3692, Bernie Summers
ADELAIDE: 98 Jervois Street, Torrensville, SA 5031. Phone: (08) 352 8666,
Fax: (08) 352 6033, Mike Mullins
PERTH: Allen & Associates, 54 Havelock Street, West Perth, WA 6005. Phone: (09) 321 2998,
Fax: (09) 321 2940, Tony Allen
NEW ZEALAND: 67 View Road, Glenfield, Auckland, 10, New Zealand. Phone: (09) 443 0250,
Fax: (09) 443 0249, Advertising Coordinator
UNITED KINGDOM: John Fairfax & Sons (Aust), 12 Norwich Street, London, EC4A 1BH.
Phone: (71) 353 9321, Fax: (71) 583 0348
ASIA: Headway Media Services Ltd, Room 2101, Causeway Bay Centre, 15-23 Sugar Street, Hong Kong. Phone: 516 8002,
Fax: (862) 890 4811, Adrian Batten
ELECTRONICS AUSTRALIA is published by Federal Publishing Company, which is owned by General Newspapers Pty Ltd.
A.C.N. 000 117 322
Double Bay Newspapers Pty Ltd.
A.C.N. 000 237 598
and Brehmer Fairfax Pty Ltd.
A.C.N. 008 629 767
180 Bourke Road, Alexandria, NSW 2015

Typeset and printed by Hannanprint, 140 Bourke Road, Alexandria, NSW for Federal Publishing Company.
Distributed by Newsagents Direction Distribution Pty Ltd, 150 Bourke Road, Alexandria NSW 2015. Phone: (02) 693 4141.
The Australian Publication emblem on the front cover of this magazine is there to proudly signify that the editorial content in this publication is largely produced and edited in Australia, and that most of the advertisements herein are the products and services available within Australia.
ISSN 1036-0212
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LETTERS TO THE EDITOR

Who wins the prizes?

I would like to ask you a question about the prizes which you can win when you start a new subscription or extend your subscription to *Electronics Australia* magazine. I have seen a lot of good prizes offered, but never a winner — at least not printed in this magazine.

I hope that you clear this up for us so we know who the winners are.

Herman Rozier,
Mareeba, Qld.

Comment: We always publish the names of the winners in the News Highlights section, Herman. Often there's a picture of them, as well. You must have missed them!

And one writes in...

As winner of the HP54600 oscilloscope, I would like to thank both HP and *EA* for a great prize. I am still exploring its many functions, but the function I am taken with at present is that, at the press of a button the waveform is analysed and the results are digitally displayed at the bottom of the screen — so there's no problems with interpreting the display.

Being involved in electronics in both employment and as a hobby, I have often wished for test equipment of this calibre for use at home, but had to set my sights a little lower. After winning this prize, my enthusiasm to attempt more adventurous projects has been rekindled, so I should be able to put this prize to good use.

Again thanks to all concerned for making this prize possible.

G.W. Beutel,
Mt Waverley, Vic.

A fan, though bemused

I always enjoy reading Moffat's Madhouse, as Tom's stories are both interesting and educational. His experience with electronics and industry has provided him with some great stories.

His column over the last few months has allowed the reader more than an insight into what Tom thinks about the world. His article about 'Windows' showed us Tom's disgust with the manipulation of the user by big business.

His last article in the June edition showed us Tom in the social scene. No one could say that Tom is only interested in electronics, because his description of a female patron at the hotel was from a man with an eye for detail.

Tom didn't just tell us that an attractive lady got up and danced. He said, "A group of women arrived obviously celebrating someone's birthday or something. They took a table right at the front, opposite ours. One of them had magnificent legs, encased in sheer stockings with black spiders embroidered onto them. She wore a tiny leather mini-skirt and a black leather vest, and she drove certain male members of the audience quite mad."

I still haven't figured out what this paragraph is doing in an electronics magazine, but it is definitely a pleasant relief from 'hardcore' electronics. All I can say is keep those stories coming Tom, and don't forget the pictures next time.

Dennis Clare,
North Melbourne, Vic.

Phodis record player

In the May 1992 issue, the Serviceman commented on a Phodis record player. He may not be aware that it was a locally produced unit, manufactured in the northern Sydney suburb of Artarmon. He can rest assured that it had nothing to do with a chemist's shop!

Phodis Pty Ltd was a small operation that went into receivership in the early 1980's. The Serviceman was right, however, in that it would probably be impossible nowadays, to procure a circuit diagram. The chances are that he'll never be faced with another one.

Keep up the good work.

Ian A.Nye,
Ascot, Qld.

Comment: We gather that the Serviceman guessed that it was locally made, but didn't know where or when. Thanks for the information.

Bouquet and brickbat

I enjoyed Peter Jensen's article entitled 'Atomic Radiation in your Home' in *EA*, April 1992, and I found the section on the geiger counter so clear that we have made a copy for training medical Radiation Technologists (i.e., Radiographers in the 'old' nomenclature).

I think the article went astray however, when it quoted a story which blamed a number of electronic faults on someone

[illegible]

having had a 'radioactive barium meal' (sic). There is no such thing. The person concerned may have had a barium meal, in which the patient drinks some (non-radioactive) radio-opaque barium salt, which acts as a contrast. Hence when the patient is X-rayed, the outline of the inside of the stomach is shown in silhouette. As you would know X-ray studies such as this do not cause any radioactivity, so the patient could not have later exposed anything to radioactivity.

Perhaps your patient had a study in which the patient drinks some radioactivity, usually to measure gastric emptying time. It is possible that one of these may have been described to the patient loosely as 'similar to a barium meal'. The radionucleide most commonly used for such studies is ^{99m}Technetium, emitting 140keV gamma photons. The patient is slightly radioactive for a few hours after one of these tests, as they are after other nuclear medicine scans.

If the radiation from these patients were of sufficient energy and/or amount to cause problems with electronic devices, I am sure that medical radiation technologists and others preparing doses, injecting and positioning millions of patients yearly around the world would have noticed it.

We mostly wear digital watches, often have sophisticated portable calculators in our pockets, and also use ordinary PC's close to equipment used for counting radioactive samples.

Therefore on theoretical grounds, I doubt that radioactivity or exposure to X-rays caused the electronic problems reported. I agree that there is the theoretical risk that one high energy photon may hit a critical junction in a RAM or ROM, but for that patient to have had enough to zap a number of devices, they should have been dead before being able to tell the story.

Next, what about the electronic symptoms? Digital watches do die prematurely at times — was it a flat battery, or bad contacts? The computer network symptoms sound too organised to be the result of one or more bad bits in memory. Faulty bits in memory usually reveal themselves in much more subtle ways than setting off to print a document over a network. If gamma radiation (or other form of radiation) was the cause of the problem, there would then have been permanent damage to the RAM or ROM, which would be detected by software diagnostics. Was there in that case?

K.P. Smidt,
Director, Nuclear Medicine,
Palmerston North Hospital,
Palmerston North, NZ.

EDITORIAL VIEWPOINT

A close shave, and superb sound on a limited budget

I'm really glad that we're able to bring you this month's cover story on NASA's rescue and repair of the INTELSAT VI F-3 satellite. But I'm also very relieved, because the article almost didn't make it.

Space writer Kate Doolan was very keen to write another story on the mission, to follow on from her 'preview' in the April issue. She had arranged with her contacts at NASA to send over all of the necessary information, as soon as possible after *Endeavour* had touched down. The moment the first parcel arrived, she contacted me and asked if we could reserve space for the story in this issue. Needless to say I was delighted to do so, because the mission had turned out to be such a cliff-hanger, with a lot of technical interest.

This agreed, Kate sprang into action and began a marathon research session. This involved phone calls, faxes and listening to hours and hours of cassettes dubbed from the flight message logs, so she could piece the story together in the correct order. Then she had to boil it all down, and use her existing background knowledge to produce a story which would satisfy our readers.

Although time was pretty limited, Kate still managed to finish the article itself comfortably ahead of deadline. But then the *real* panic began — because a parcel of pictures, which NASA had despatched only four days after *Endeavour* landed, still hadn't arrived. We had an article, but still no pictures to illustrate it or go on our cover!

Luckily, just as we had resigned ourselves to swinging in a replacement feature and a substitute cover, Kate rang jubilantly to say "They've finally arrived — and they're great!". I had them next morning, with one day to spare before the issue was to go to the printers. Whew!

My thanks to Kate, our friends at NASA, and our own production editor Milli Godden for putting so much effort into making the article happen. I'm sure you'll find it as fascinating as I did.

On a different topic, one of the other things in this issue that I'm really proud to commend to you is our article on the new *Seas-EA* 'Hobart' speaker system kit, presented by technical editor Rob Evans.

This is no ordinary kit for a hifi loudspeaker system; both Rob and I have been lucky enough to spend many pleasant hours at our homes, listening at length to sample Hobart systems during the development phase, and we've both been *very* impressed. Despite their compact size they really are outstanding, with firm extended bass, transparent highs and excellent stereo imaging — which stays remarkably stable over a wide listening area. In short, they're the equal of up-market systems costing well over $2000, yet *you* can build them for less than $1000.

The main reason they *are* so good is that they've been designed by Ralph Walters, designer of the famous Richter speaker systems. Ralph is highly experienced in hifi speaker system design, and he's also an absolute perfectionist. He even arranged in this case for world-acknowledged manufacturer Seas to produce a very special 'phase plug' bass driver, especially and exclusively for the new system.

So if you're in the market for a compact system, but don't want to compromise on quality, I can really recommend this one.

Jim Rowe

What's New in VIDEO and AUDIO

DCC launch before Christmas

Philips has announced that the Australian launch of its new Digital Compact Cassette (DCC) system will be later this year, and definitely before Christmas. The local release will follow after the system is launched in the USA, Japan and Europe in September.

The first hardware product is to be the DCC 900 player/recorder deck, which connects to any home stereo system to provide full digital recording and playback, with music quality described as 'comparable to compact disc'.

Apparently 'several hundred' pre-recorded DCC tape titles are planned for release at the same time as the DCC 900, from PolyGram and other distributors. The titles will cover a broad range of musical tastes, described as 'ranging from Bryan Adams and U2 to Pavarotti'.

The DCC 900 machine has direct track access, and can display track title and artist information on its fluorescent display. The machine will also play back conventional analog compact cassettes. Pricing is not fully finalised as yet, but the unit is expected to retail for around $1300.

Philips claims that more than 60 audio equipment manufacturers and music recording companies throughout the world have declared their intention to market DCC products in 1993. This includes firms in Europe, the USA and Japan. Apparently nine other cassette manufacturers and recording companies, apart from PolyGram, have announced that they will be producing software on the DCC format.

Philips apparently plans to follow the DCC 900 with additional hifi decks, personal stereo portables, stereo radio/cassette combinations and car players using the DCC system.

More on Sony's Mini Disc

Meanwhile, Sony has also released further information on its Mini Disc (MD) system, seen by many as a competitor for DCC. The first MD products are expected to be released in Australia in early 1993.

Like DCC, MD is a digital audio recording and replay system which takes advantage of recently-developed digital compression technology, to achieve much higher information packing density than conventional CD's or DAT. Sony's system uses the ATRAC (adaptive transform acoustic coding) compression system, which operates in a roughly similar way to the PASC (precision adaptive sub-band coding) system used by Philips. This allows Sony to fit up to 74 minutes of recording time (virtually the same as a standard CD) on a disc only 64mm in diameter — around half that of a conventional CD.

MD uses actually uses two different, but compatible recording technologies. Pre-recorded music MD's use conventional CD technology, and are played by the MD player in the usual way. However the MD system also allows for discs to be recorded by the user, and these discs use a *magneto-optical* recording system.

The recordable mini discs incorporate a special magnetic layer, made from a sputtered amorphous mixture of terbium, lead and cobalt. During recording, this layer is subjected to both a high-powered, focused laser beam, and also a vertical magnetic field which is modulated with the digital data to be recorded.

The laser beam causes brief localised melting of the magnetic layer, which rapidly solidifies again — but with a digital magnetic recording effectively 'locked in'. This varying magnetic recording interacts with a modified reflective layer to vary the latter's reflectivity, when played back with a standard replay laser beam. In effect, the varying magnetic record replaces the 'pits' of a conventional CD or the pre-recorded MD's.

As with conventional CD's, both kinds of MD offer virtually instantaneous random track access. While DCC also offers programmable track accessing, like DAT, it is inevitably somewhat slower due to the serial nature of any tape format.

Sony has announced that the first MD products are planned for release in Japan by early November, and by Christmas in the USA. Target prices in Japan are around 80,000 Yen (about $800) for a portable recorder/player, and 60,000 Yen (about $600) for a player.

To date, Sony claims that some 22 hardware manufacturers, eight software-related firms and 10 blank-media makers have signed licensing agreements for MD technology. Hardware licensees include Aiwa, Alpine, Casio, Hitachi, Kenwood, Mitsubishi, Pioneer, Sanyo, Sharp, Teac, JVC — and Philips, which is of course co-licensor of the conventional CD system.

Pre-recorded MD software licensees include Toshiba/EMI, SKC, JVC, Nippon Columbia and Philips/PolyGram — plus of course Sony Music Entertainment. Blank media licensees include Hitachi/Maxell, Seiko Epson, SKC, TDK, JVC, Philips and Hoechst.

Sony itself was to begin manufacturing blank recordable MD's in July, with an initial monthly production of 300,000 discs at the company's Sendai Technology Centre.

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Asian distributor for ME amplifiers

Australian-made ME hifi amplifiers have gained a world-wide reputation, and not surprisingly there have been many requests from firms in Asian countries wishing to become dealers or distributors for these products. However ME's co-owner and chief designer Peter Stein made no decisions until he could visit the various countries, and assess interested firms for their suitability.

Following this visit, Singapore firm Auvi Private Ltd has been appointed as ME distributor for both Singapore and Malaysia. Auvi is also the regional distributor for Australia's Duntech loudspeaker systems, and Peter believes this combination to be a synergetic one. The firm has already taken delivery of an initial $100,000 consignment of ME amplifiers.

Auvi can be contacted at 24 New Industrial Road #04-01, Pei-Fu Industrial Building, Singapore 1953, or at its showroom, located at 1 Coleman Street #04-06/07, The Adelphi, Singapore 0617. In Malaysia the firm is known as Auvi Sendiran Berhad, and is located at No.6 Jalan 16/36, 46300 Petaling Jaya, Selangor.

Eight-channel DAT recorder

Yamaha's DRU8 Audio Recorder is a rack-mounting, eight-channel machine suited to professional applications in studio and location recording, broadcast and film/video post production.

The DRU8 is a stationary head recorder using a convenient cassette format, giving 22 minutes of continuous 20-bit recording at 44.1kHz sampling frequency. The unit boasts a frequency response of 20Hz to 20kHz (at 44.1kHz and 48kHz sampling frequencies), a dynamic range of over 120dB and immeasurable wow and flutter. All common operating modes are accessible with a single keystroke on the DRU8's front panel or on the optional RC8 and RC24 Remote Controllers.

In addition to the unit's eight PCM audio tracks, the DRU8 features a separate timecode track, a servo control track and two analog tracks for sync codes or click tracks — leaving all eight channels free for audio program material, unlike conventional analog systems where one, or even two tracks must be reserved for timecode. An inbuilt 8 x 2 digital mixer with panning is providing for monitoring. Headphone monitoring is provided for track pairs and the mix output.

Digital inputs and outputs are provided in AES/EBU, DAT/SPDIF and Yamaha formats. The DRU8 supports all the standard digital sampling frequencies (32kHz, 44.1kHz and 48kHz), all with +/- 10% varispeed, for digital transfers to and from other professional equipment. Yamaha offer a range of A/D and D/A converters, a digital format converter and an eight channel microphone preamplifier for interface to the analog domain. Using Yamaha's DMC1000 Digital Mixing Console together with the DRU8 provides a complete digital audio mixing and recording system.

For further information circle 181 on the reader service card or contact Yamaha Pro Digital Group; phone (03) 699 2388.

Mini system has surround sound

Inside Akai's new MX-100 mini component systems is a conservative 30-watt (RMS) MX100A surround sound amplifier with seven band LCD spectrum analyser. Designed as Akai's 'flagship' mini system, the unit also incorporates such features as a motorised volume control. The MX-100 also incorporates many karaoke features, including mic mixing and a mic level control that enables singers to accompany the music from either CD, cassette or tuner.

Measuring only 265mm wide x 240mm deep, the MX-100 is designed to be stacked, with speakers being detachable to suit room or individual listening requirements.

The CD section uses a 16-bit twice oversampling digital filter and offers a dynamic range of over 92dB. Up to 16 tracks can be programmed in any order, while a musical calendar indicates programming order.

The radio tuner is a two band AM/FM stereo synthesised unit that offers 19 preset stations. A large LCD display indicates station frequency, tuner mode and memory location. The double cassette deck offers 'feather touch' logic control operation, Dolby B noise reduction and an auto tape selector that adjusts for Normal and High position tapes. The speakers use a bass reflect three way design that offers a frequency response of 40Hz to 16kHz.

The MX-100 has an RRP of $899 and is covered by a 12 months parts and labour warranty. It is available at selected Akai dealers and department stores.

New 8mm video tapes from TDK

TDK has released a new line-up of video tapes in both the 8mm and Hi-8 formats. All new tapes produce higher output and superior specifications than any other previous formulations, according to TDK.

The 8mm format offers two grades, new HS (High Standard) and new E-HG (Extra-High Grade). Both grades employ TDK's proprietary 'Super Finavinx' pure iron particles.

In Hi-8 TDK's new Hi8MP formulation is designed to faithfully reproduce over 400 lines of horizontal resolution. In addition to greater packing density and improved dispersion of the magnetic particles, the new Hi8MP uses newly developed high precision calendering technology which is claimed to produce the highest degree of smoothness of any particle coated tape.

The new Hi8ME formulation is the flagship of the Hi8 line-up and uses a two layer vacuum-evaporated metallox magnetic layer as the storage medium.

This process offers the highest magnetic properties of any of the Hi8 and 8mm formulations. This ultimately translates into Hi8ME being ideal for all mastering and editing applications. ❖

Another approach to curing the video shakes

A few months ago we ran a story from Barrie Smith on the image stabilising system in Mitsubishi's camcorders. Since then another manufacturer, Panasonic, has released a model which attacks the 'shakes' from another direction. We thought we'd set the record straight by giving details of this system as well.

by BARRIE SMITH

The electronics industry predicts at least 160,000 camcorders will be sold in Australia by the end of this year. In spite of the tight times, the figure may be higher than last year's.

Of this high number the fastest growing sector is the 'palmcorder' — the compact camera of the video world. Newcomers to the video scene often home into these attractively miniaturised marvels: they're lightweight, small enough to go into many jackets, the controls are usually few in number (or hived off into viewfinder menus) and operationally simple.

But many people are misled (mostly by their own ignorance) into thinking the little videos can be used just like a 'point and shoot' compact still camera.

The chilling truth only comes on the first replay of the novice's early shooting forays. Aside from the frenetic panning and waving that goes on in early amateur videos, the biggest shock to be swallowed is the problem of shake, jitter and wobble.

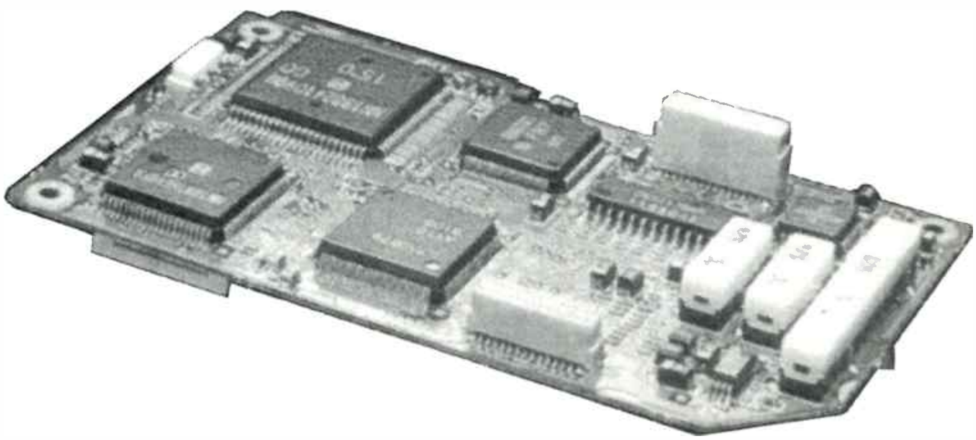
Inherent drawback

The Japanese industry has recognised the attractive marketing territory that is occupied by the small palmcorders, and virtually all have at least one model in their lineups that conforms to the design philosophy.

Fundamental to a small camcorder is light weight and small size — most are under 800g with battery and tape, and little larger than an outstretched hand. But with light weight comes camera shake, and as manufacturers explore the gold mine that is the palmcorder some are attacking the shake problem with electronic image stabilisers.

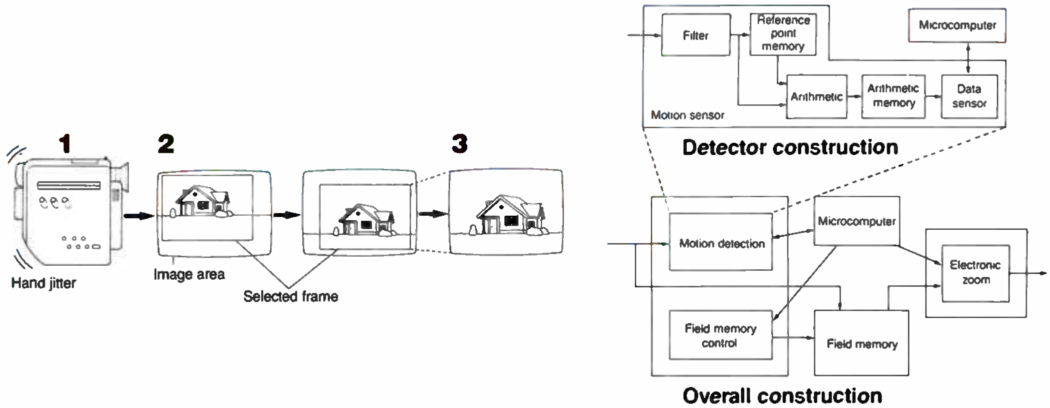
In a previous issue we described the Mitsubishi approach to steadying the video image, in their CX4 and CX7 models. Actually at the time it had been 12 months since the concept of electronic image stabilisation had first surfaced, in the guise of Panasonic's S1 palmcorder. The latter machine's

Panasonic's second image stabiliser camcorder, with an improved stabiliser system — the NV-S5A.



The stabiliser circuitry in Panasonic's new S5 palmcorder involves a number of digital IC's.

Another approach to curing the [illegible]



1	2	3
Detects the displacement vector in the signal picked up.	Signals to be picked up are recalled for stable picture reproduction.	Enlarges the selected picture to fit the TV frame.

•Detects and digitally compensates for hand jitter to produce consistently stable images.

Diagram of how Panasonic's stabiliser circuitry operates. Note that in Panasonic's approach the actual image is assessed and connected for stability, in contrast with the Mitsubishi system which detects physical camera movement.

designers had perceived hand jitter as being mostly a vertical phenomenon, so introduced circuitry which dealt with this area.

But late in 1991 the new model S5 arrived, with a 'Mark 2' stabiliser that worked very much in the same fashion as the first — with one important difference: shaking motion in the horizontal direction was also sensed and corrected.

Different systems

Mitsubishi and Panasonic's image stabilising systems operate on quite different principles, but are intended to do the same job.

Mitsubishi's approach to stabilisation is based more on hardware than software — sensing actual movement of the camcorder, rather than perceived movement in the image.

The Twin Gyro Image Stabiliser system involves two gyroscopic devices which detect vertical and horizontal movement of the camcorder body. Compensation for this shake is achieved by adjusting the output timing of the CCD, theoretically producing a system which responds only to actual camcorder body movement — not just movement in the image.

Panasonic's solution is the Digital Image Stabilisation system. During processing of the image by the CCD, the DIS circuitry divides the image into four quadrants, each containing 30 representative points; each point is a pixel in dimension. The data from these points is stored in a memory area.

When camera instability causes the image on the CCD to move, the displacement vector, which shows the movement of each representative point, is quickly determined and analysed by comparing with the signal in the frame store.

Based on this assessment, the signals en route to the record head to produce a stable picture are recalled from the field store. The 'trimmed' image (essentially smaller in area than the total CCD) is electronically enlarged to full screen size, yielding a stable picture.

A pre-processor is used to remove unwanted noise from the signal, so the necessary accuracy can be achieved with only 30 points per quadrant. The DIS for that noisy area is switched off until the image disturbance comes back into line with that of the other quadrants.

Comparing the two

So how do the two systems shape up?

Without wishing to find myself jammed between the northbound daylight express (Mitsubishi) and the southbound freight train (Panasonic) I can at least give some personal observations. This is because I've had the chance to use both units since the first article appeared.

Mitsubishi:

The company claims that there is virtually no image degradation with the stabilising mode switched in — which is quite correct. It is very hard to see, on an ordinary-sized set, any image quality drop. However, the amount of correction to a shaky image is also correspondingly less. In use, while walking, there seems to be little help from the gyro device.

The designers also opted to scan more of the CCD area, relying on the fact that most TV's overscan.

The problem is that many sets — including, in the writer's tests, both a new model and a 15 year old 'veteran', both displayed a black border varying between 5 and 10mm around the steadied Mitsubishi image.

Panasonic:

The main objection to this company's system is the quality loss when the circuit is switched into operation. Quantified as 15% image degradation, it certainly affects the resolution of fine details. However, the stabiliser certainly does *stabilise*. You can walk and hold the camcorder unsteadily — and the DIS does its stuff.

Many people think that the stabilising systems discussed are the ultimate godsend to poorly-shot amateur video, and will transform a novice's nervous wobbles into 'Hollywood class' material. 'Fraid not. Not yet, at least.

But if Mitsubishi decide to use a 1/2" CCD instead of the current 1/3" they could be on a winner, enjoying little image degradation yet with the ability to indulge in a higher degree of correction.

And if Panasonic do the same, they could enjoy the same success.

But, at the end of the day, we are still left with excessively lightweight machines that are used by a majority of people unused to holding a $20 telescope steady — let alone a $2,000 camcorder!

The truth is that technology has not yet replaced the tripod. ❖

Other CD Players spin the disc in mid-air.

Most CD players clamp an area of the disc not much larger than a 20 cent piece.

Unfortunately, this leaves the rest of the disc free to vibrate as it spins in mid-air, which is not a good idea.

Seeing as the laser in a CD player has to follow a path ten times narrower than a human hair.

Which is why Pioneer invented the Stable Platter CD mechanism. This supports the entire CD on a turntable, totally eliminating the vibration that plagues conventional CD players.

And because the stable platter mechanism has a greater rotating mass than conventional CD players, speed fluctuations and mechanical noise are virtually non-existent.

As is the problem of dust. It can't build up on the laser

and lenses for the simple reason they now face downwards.

All of which results in more natural, lifelike sound, that faithfully captures even the most subtle musical nuances.

In fact, the Pioneer Stable Platter CD will play exactly what was recorded.

Unlike other CD players that seem content merely to play Frisbee. **READER INFO NO. 2**

PIONEER
The Art of Entertainment

THE JAMO 'ORIEL' LOUDSPEAKER SYSTEM

What kind of domestic speaker system do you get for $17,000? We thought readers would be interested to find out, so we asked Louis Challis to run both his instruments and experienced ears over the new top-of-the-line Jamo system. Here's what he found...

The 'Holy Grail' of virtually every speaker designer has been to design the 'best loudspeaker that money could buy'. The catch has always been that even if management had been willing to let them have their way, it's just not that easy to design loudspeakers that produce sound that is bordering on the perfect.

My first introduction to the Jamo 'Oriel' speakers was at the Mirage Hotel in Las Vegas, last January. As it happened I had just finished a somewhat hurried visit to the High End display room and was getting ready to leave Las Vegas, when I was waylaid by an unusually friendly sales rep.He eyed me up and down, squinted at my name badge, and then disarmingly suggested I should come across the floor so that I could admire a new Jamo product which they had only just received by air from Denmark that morning.

I was a trifle bemused as he nonchalantly waved his hand towards the back of what I had mistakenly thought were a pair of decorative columns. By the time I had re-interpreted his southern drawl, I came to the conclusion that these shiny grey columns weren't what I had initially mistaken them for.

Yes, you guessed it — they were loudspeakers. But quite honestly, viewed from the rear and considering their position on the floor, I think I could be forgiven for making such a mistake.

"Could you play some music through them, so that I can gauge their performance?", I asked brightly.

"Sorry, I can't", he gently responded. "We are having a little difficulty in connecting them up, and as we have only just received them this morning and don't yet have any information on them, I really can't do it!"

As I was impatient to leave the hotel and was within an hour of departing Las Vegas, I didn't push the point. I gave him my CES data card and told him I really would like to review these unusual speakers when they finally reached Australia (which I guessed would be in a year or so).

THE JAMO 'ORBIT' LOUDSPEAKER SYSTEM

Deja vu

Well of course I gave no further thought to those speakers, until some three months later when *EA*'s editor rang to ask me if I'd like to review the new Jamo 'Oriels'. I had to think hard for a few seconds; then the penny dropped, and of course I said 'Yes!'.

After I'd hung up, I had visions of the tall grey columns from the Mirage Hotel, and I winced momentarily. So I rang back with the request that all the moving and handling of the speakers had to be arranged by the Jamo agents — otherwise the deal was off. I knew how tall the speakers were, and guessed that they were equally heavy; and as it happened I was right.

It's very lucky that I asked for that assistance. For as it transpired, if I hadn't, I now know how much trouble I would have been in!

When I reviewed the Jamo Concert 5's two years ago, I was very impressed by their wide range performance — and particularly by their bass response. The Concert 5's main claim to fame was their innovative use of a coaxial double vented woofer, in what I considered to be an attractive cabinet, to which few intending purchasers could reasonably take offence.

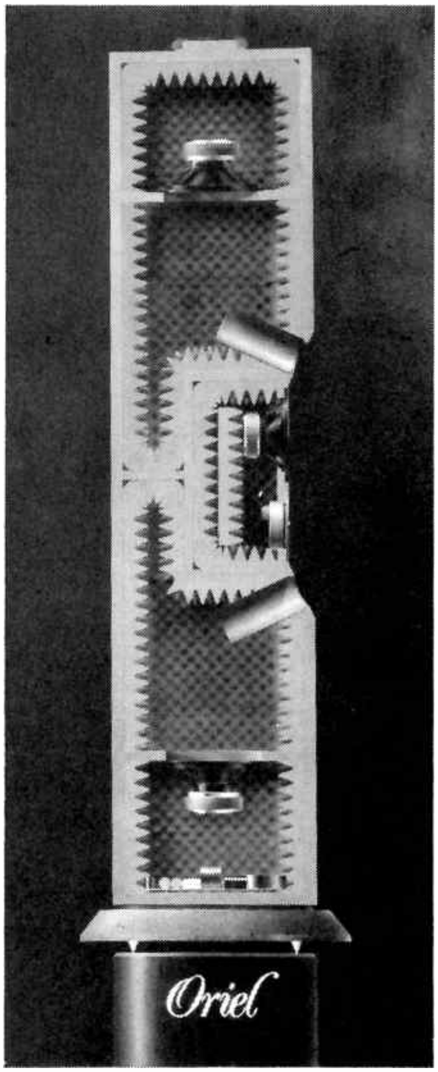
When I briefly examined the Oriels in Las Vegas, I guessed that what I was looking at was a double stacked Concert 5 configuration, but with only a single midrange and a single tweeter stuck in between them at mid height. That design concept is reasonably well conceived, and has been adopted by the larger Duntech speakers and a number of other notable speaker designers over the last few years. It offers the possibility of a rollicking bass response with optimal stereo imaging — particularly if the treble speakers set at a height which nicely conforms to a seated listener's head height.

Tall and slim

The one obvious catch is, that by double stacking two speaker cabinets so that one is inverted on top of the other, the total height becomes greater than your own. The aspect ratio of the composite system is unusually tall and slim, and also potentially unstable.

The Oriel's designers faced a number of difficult problems. One was whether they should choose a circular, rectangular or oval plan configuration, as each has differing merits. As you will note from the pictures, they chose an oval plan form as it offers markedly superior stiffness, significantly better sound dispersion for the sound radiation, and almost completely avoids the difficult problems of achieving visually attractive junctions between intersecting sections of the cabinet covers.

Like other contemporary expensive Japanese as well as American loudspeakers, they chose a soft grey lacquer finish, whose junctions were dressed up with expensive cherry wood trimmed black glass. Whilst the Jamo designers may think this is smart and what the market will really like, I am not convinced that they were correct.



A cut away view of an Oriel enclosure. In the centre is the sealed mid range enclosure, which houses the tweeter as well.

In the middle of the front panel the designers have carefully contoured the face to incorporate the upper and lower bass speaker venting ports, between which they set the mid range driver immediately above the new wide range tweeter.

The tweeter is a 28mm soft dome driver of advanced design. It incorporates a massive magnet assembly with a weight of over 1kg, which provides the tweeter with an extremely high energy to weight ratio and the ability to handle peak pulse inputs of up to 1kW. The design of this tweeter is in my opinion outstanding, and it offers a performance which is both objectively and aurally superb.

The mid-range driver is a 180mm dynamic driver with a roll surround, whose diaphragm is a composite honeycomb construction — one layer of which apparently uses Kevlar cloth. Although this driver is very well constructed, I am not yet convinced that it achieves the level of performance which the manufacturers concede may be Utopian, and which dominates the most critical aspect of the Oriel's performance.

The mid-range driver is self-ventilated at the rear of its very large magnet assembly, and its performance is linear. The tweeter and the mid-range driver are flexibly supported to decouple structural resonances, and the implementation of this detail appears to be reasonably successful. The external face of the enclosure around each of the two central drivers has been covered by rubber to provide enhanced damping, and to minimise spurious sound reflections from that surface.

Bass enclosures

Each Oriel speaker cabinet incorporates two woofers, which are respectively mounted in the upper and lower sections of the enclosure. The natural resonant frequency of these drivers is way down the frequency spectrum at 20Hz, whilst the mounted resonances are at 40Hz and 75Hz, with a true bandpass response. This can be clearly seen in the frequency response measurements recorded at 50mm from the venting ports.

Unlike the Concert 5's, the designers have adopted a sealed rear cavity structure whose resonant frequency is 75Hz, and a tuned front ported cavity whose resonant frequency is approximately 40Hz to achieve a very smooth and sophisticated bass response.

The cabinet is solidly made from segmentally cut timber pieces, which are individually glued and then both internally and externally braced by solid baffles and by the external stressed laminated skin. The internal sound absorption is a continuous layer of polyurethane foam, with a profiled surface to increase its effective absorption.

The crossover circuit is conventional and it is mounted in the concrete-filled base, so that access can only be gained through the base. The circuit design and the major components used appear to be primarily five air-cored coils, two coils with low loss iron powder cores, and a number of high voltage foil capacitors and resistors. There is no sign of a protective circuit — which is unusual, particularly with a speaker system costing this much.

Whilst it must be acknowledged that the components have unusually high peak power ratings, this does not automatically guarantee protection against the unusual nor the unexpected — both of which in

my experience happen with unusual regularity. In point of fact, my own amplifier misbehaved rather badly only a week before the Oriels arrived, and while so doing subjected one of my reference speakers to a peak voltage transient which must have been well in excess of 200 volts.

Although my reference speakers are adequately protected against such transients (with an excellent self-powered protection circuit), I would be hesitant in applying or considering the application of such a transient to the Oriels. The handbook makes no reference to installing protective fuses, which would in such circumstances appear to be worthy of consideration.

The gold-plated terminals at the base of the unit allow you to biamp or triamp the speakers if required, as well as to adjust the level output between the mid range and the tweeter.

One area where the speakers are more than adequately protected is immediately in front of the mid-range and tweeters. The designers have chosen to install a gently curved perforated metal facing with a fine black cloth cover, which sits neatly over the central section of each of the speakers' curved fronts.

The position of the cover and shape of the curve in relation to the tweeter is most unusual, and although the manufacturer advises on the desirability of removing this cover for the 'most critical listening', I did not appreciate the full significance of this caution until I subsequently initiated my objective testing.

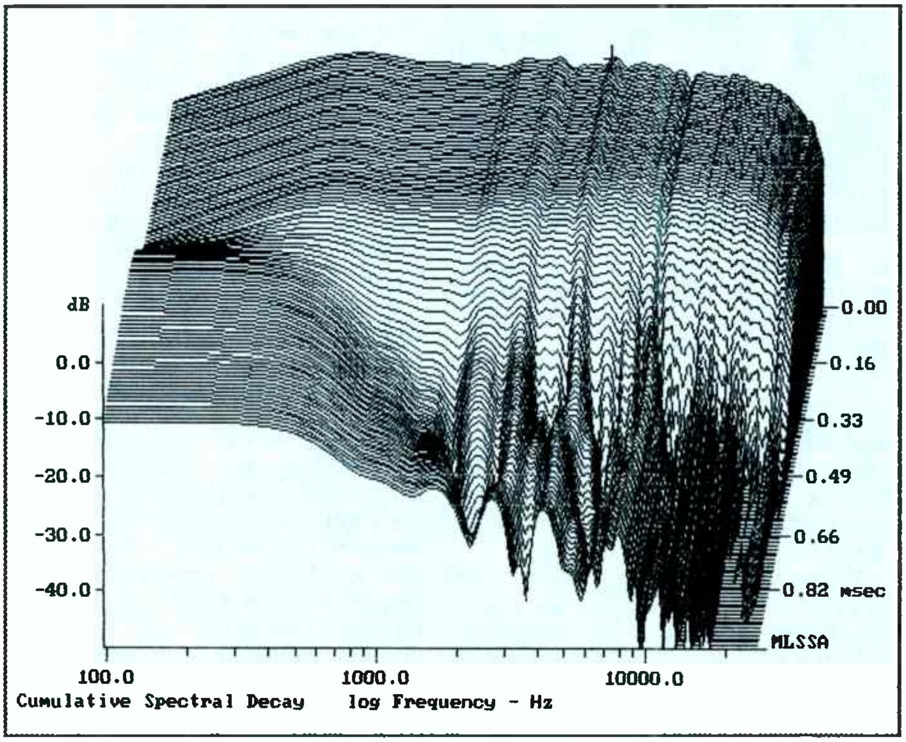
The base of each speaker is a concrete material which appears to be loaded with higher mass material, and which feels like lead even though it may not be. This extremely heavy base improves the stability of what would otherwise prove to be a relatively unstable configuration. Each base is drilled and tapped to accept four rather massive spikes, which the designers recommend you use when the speakers are standing on wooden floors.

I baulked at fitting these spikes, as the speakers would only be at my home for a few weeks and my domestic bliss would most surely have been sorely tested had I suggested to my wife that I was going to 'nail the speakers to the floor'.

Fortunately, Jamo's local representative neatly solved my problem, by providing me with some special purpose adaptors which Jamo provide when required, (in situations like this).

Measured Performance of Jamo Oriel Loudspeaker System Serial No. 219

Frequency Response	34Hz to 20kHz =+/-4dB			
Crossover Frequencies	80Hz & 2kHz			
Sensitivity (for 96dB average at 1m)	8.8VRMS = 12.9 Watts (nominal into six ohms)			
Harmonic Distortion (for indicated level at 1m)		**90dB 100Hz**	**96dB 1kHz**	**90dB 6.3kHz**
	2nd	38.9	63.6	41.5dB
	3rd	44.4	51.7	58.2dB
	4th	59.4	71.9	65.4dB
	5th	61.9	66.0	-
	THD	1.3%	0.27%	0.85%
Input Impedance	100Hz 4.8 ohms			
	1kHz 21.0 ohms			
	6.3kHz 13.8 ohms			
	Minimum at 8Hz 3.8 ohms			



The cumulative spectral decay or 'waterfall' response plot for the Jamo Oriel. The designers have been very successful in obviating most of the defects which are characteristic of many lesser systems.

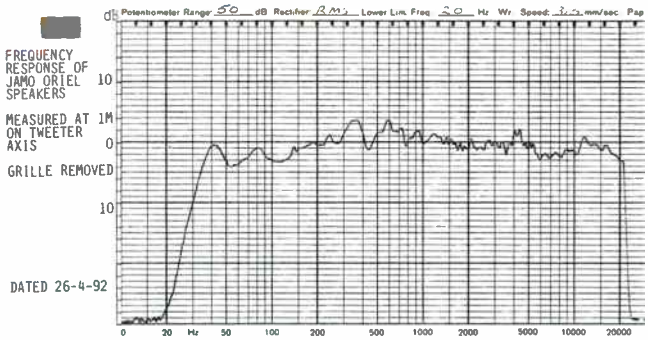
Objective testing

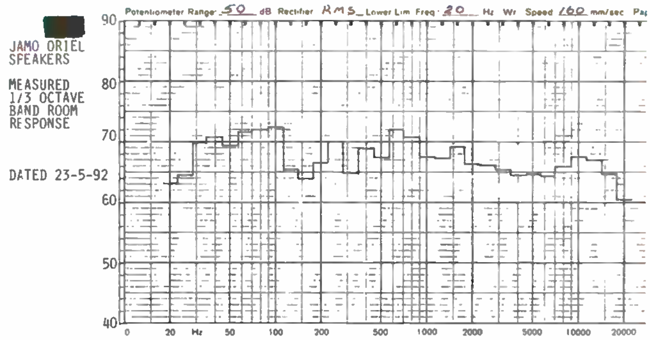
With a product as new and as expensive as the Jamo Oriels and in the absence of comprehensive test data from the manufacturer, the measured objective performance of the speakers is obviously of critical importance. To make those measurements, we arranged for the importers to deliver one of the speakers straight into our anechoic room, and place it straight on top of our Bruel & Kjaer turntable. It took three men to carry the speakers into the anechoic room, and although I don't doubt that two *strong* men could handle them, these are amongst the heaviest speakers we have tested to date.

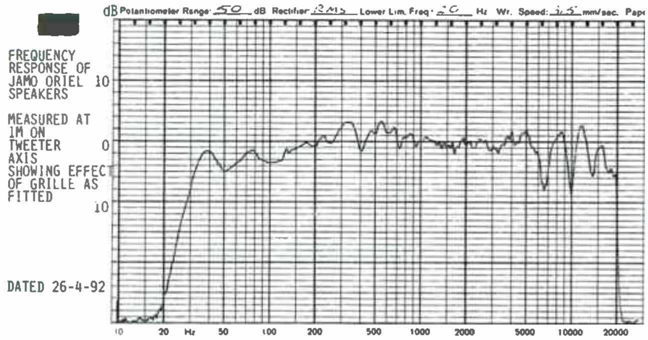
It was in the anechoic room that I experienced my first hurdle — which was to find the speaker terminals!

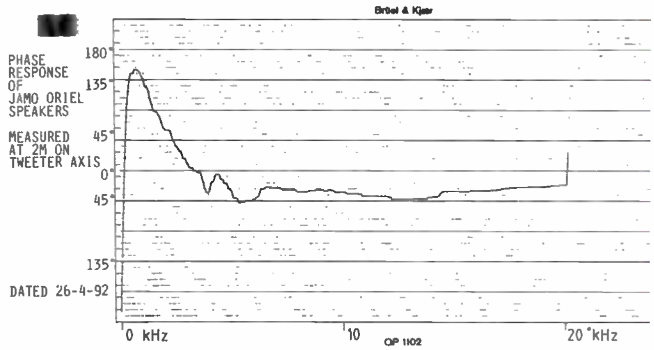
As it happens, the terminals are on the bottom of the speaker base, in what I believe to be a most unusual, and rather impractical location; one where it certainly took longer to find them than I care to admit.

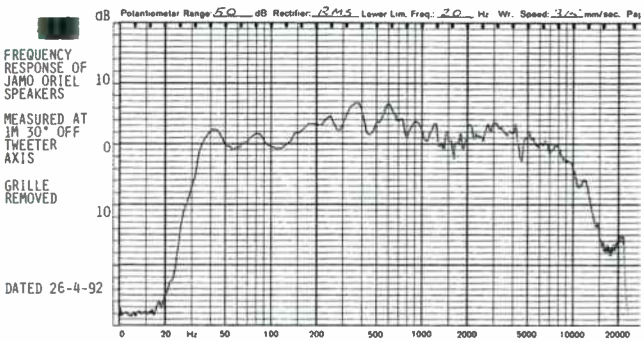
In fact it was only after I found the terminals that I recalled my conversation with the sales rep in Las Vegas. His reluctance

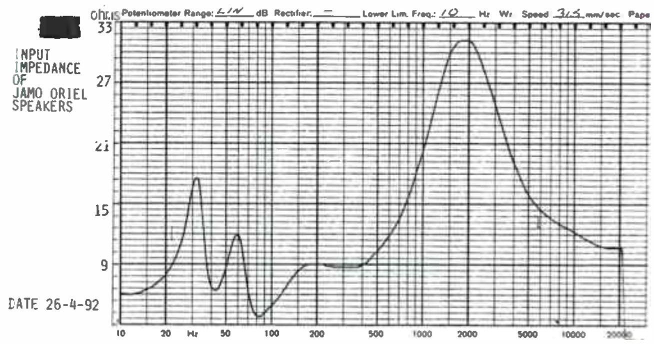


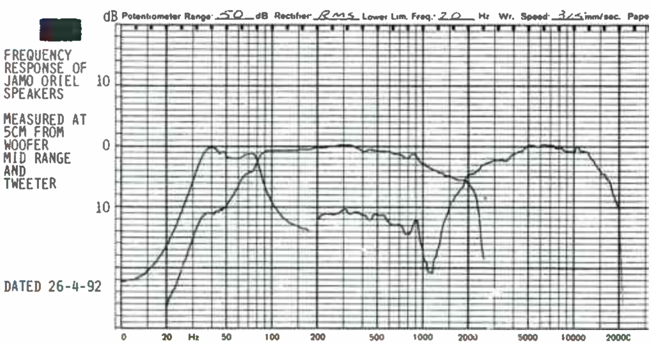












Here are the main response plots for the Jamo Oriel system. At top left is the overall response at 1m on the tweeter axis, with the grille removed; Below this is the same response with the grille fitted, for comparison; then follow the response at 30 degrees off axis and the individual responses of the various drivers. At top right is the one third octave band room response, with the phase response and input impedance plots underneath.

(or inability) to connect up the speakers and demonstrate them came to mind. After my own difficulty in finding where the speaker terminals were, it is now apparent that he must have been having the same problem!

Having resolved that problem, we connected up the speaker, and systematically put it through its paces. The effort was most certainly worth it, and the first on-axis free field speaker response confirmed that the designers had really achieved a particularly flat frequency response (with the speaker grille removed). As it happens the flatness of the graph was the equal of any speaker system I had ever measured.

For the heck of it, I decided to measure the frequency response of the speaker with its fancy perforated metal grille and cloth cover re-attached. You can appreciate my surprise as I watched the response recording roll out with the most unsightly high frequency perturbations I have ever seen any protective grille produce!

It only required a few seconds of contemplation to work out what was happening. The curved metal protective facing, although perforated and almost acoustically transparent at low and medium frequencies, is nonetheless unusually reflective at higher frequencies. At certain frequencies the curved focal length of the path from the dome tweeter to the inner curved surface of the perforated metal generates destructive standing waves. These destructive notches result in a 6 - 8dB loss in sensitivity, over a range of frequencies which extends over almost 1kHz in bandwidth at three points in the frequency range: at

The Challis Report

6.5kHz, 10kHz, 14kHz and again between 17-20kHz.

The lower end of the frequency response is smooth and although there are a few ripples in the overall frequency response, the frequency performance displayed is most credible.

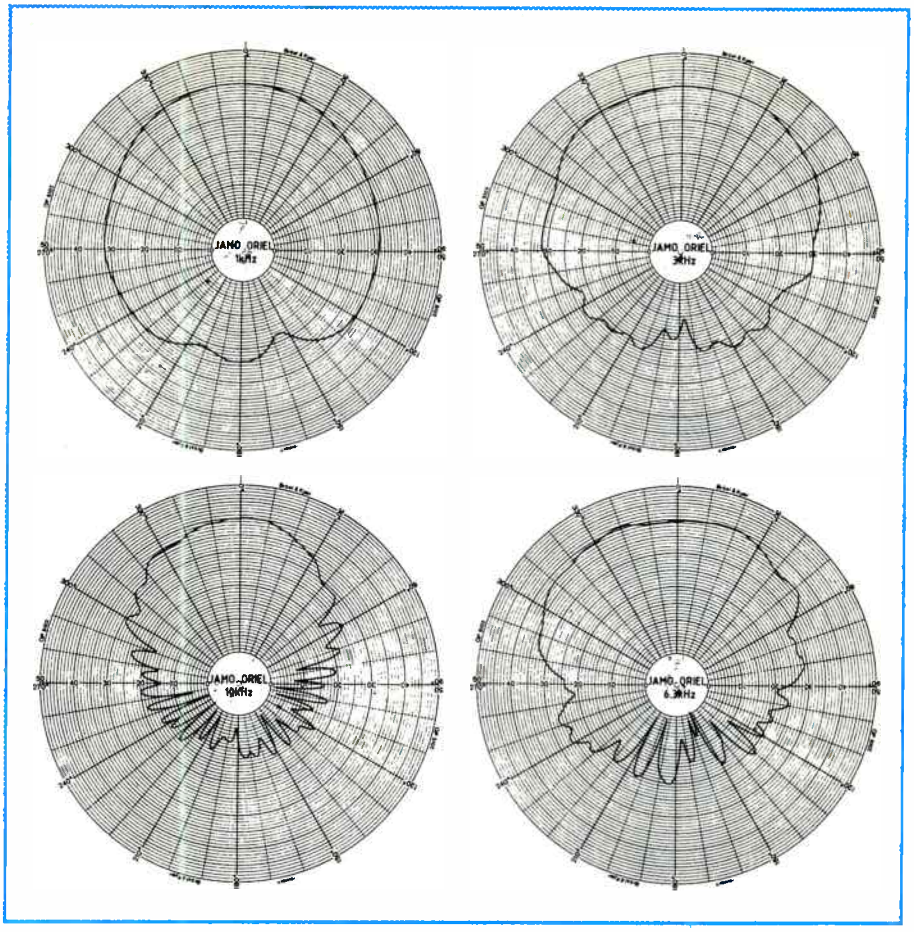
The frequency response at 30° off axis is excellent up to 10kHz, but really drops its bundle once you get past 10kHz. An examination of the polar plots reveals how smooth the performance of this speaker system is up to 10kHz. But above that frequency, you really have to be sitting in the right position to correctly hear its top end.

The phase response of the Oriels is particularly smooth. It is apparent that the designers have taken considerable trouble to ensure that the phase linearity of this system, particularly in the critical crossover regions, is as close to perfect as you could ask for.

The tone-burst testing reveals that the impulse response at low frequencies is normal and acceptable, but that at high frequencies there is some tendency to ringing. The decay response spectra reveals a performance which is exceptionally smooth at the start of the decay, but which exhibits significant ringing resonances at 2kHz and 4kHz, both of which are evident in the measured frequency response. There is also a trace of a low level resonance at 7kHz, and some very low resonances at high frequencies which are inconsequential.

From an objective test standpoint, the decay response spectra confirms that the designers have been very successful in controlling the common and garden variety of defects which many if not most lesser speaker systems display.

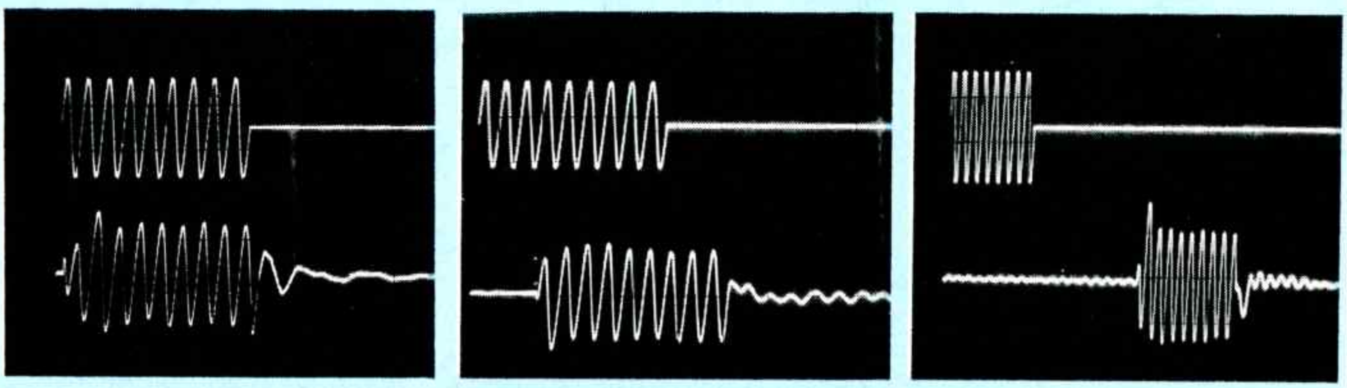
The measured one-third-octave band room response, evaluated with pink noise, displays a trifle more non-uniformity and audible colouration than I would have expected — although the room response is nonetheless reasonab-



The Oriel's polar response plots. Shown clockwise from top left are: 1kHz, 3kHz, 6.3kHz and 10kHz. The response at 30 degrees off axis is excellent up to 10kHz, but dies away rapidly thereafter.

Tone Burst Response of Jamo Oriel Loudspeaker System
(for 90dB Steady State SPL at 1m on axis)
Upper trace is electrical — lower trace is louodspeaker output

100Hz (20ms/div) | **1kHz (2ms/div)** | **6.3kHz (0.5ms/div)**

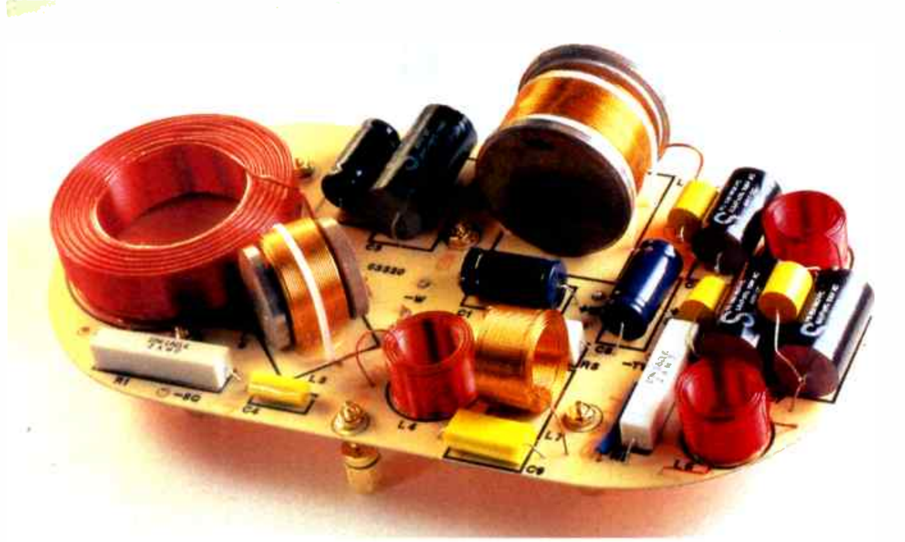


The tone burst response. There is a small tendency towards ringing at high frequencies — particularly at 2kHz, 4kHz and to a lesser extent, at 7kHz.

ly smooth, and generally superior to that offered by most other speakers which I have recently tested.

The distortion characteristics of the speaker system are excellent over the frequency range 40Hz to 80Hz, and generally good over most of the mid-frequency and high frequency range. Regrettably the 100Hz frequency at which we have routinely recorded our lower frequency distortion, conforms to the lower band edge of the mid-frequency driver and is beyond the upper edge of the double ported woofers, so that the level of distortion is significantly higher than that which would be generated elsewhere in the frequency range.

Taken over all, the objective testing of the Jamo Oriels provides performance parameters which are outstanding.



The crossover networks are of the first-order type, but incorporate various impedance linearising components. Expensive French Solen capacitors are used in critical signal path, and the system also features gold plated terminals.

Listening tests

I was pleased that I had arranged for technical assistance from the Jamo agent to move the two speakers from the laboratory to my home, because frankly I would have baulked at doing it myself. I must admit that the support that the agents provided was excellent, and I soon had the pair of Oriels installed in my living room (sitting free on my parquetry floor and without spikes).

Because the Oriels cost so much and because I was able to keep them for some weeks, I arranged for a number of musicians as well as some critical audiophiles to assist me in the review process. The discs which we used for this review process included the Chesky Records 'Jazz Sampler & Audiophile Test Compact Disc Volume 1' (Chesky JD37). This is a very suitable disc for initiating such evaluations. It contains listening and technical tests which revealed that the Oriels display a superb breadth of acoustic sound staging, and stereo imaging.

This disc also provides some wonderful music from Luiz Bonfa, David Chesky, Phil Woods and Ana Caram, each of whom features on one or more Chesky discs. Their music is modern and exciting, and the Oriels provided a clean and exciting stereo image in which I and my group of listeners were able to precisely identify the positions of the individual musicians on the broad sound stage that the speakers generated.

The percussion instruments, snare drum and other complex high frequency sounds within the music were delightfully realistic, and by shutting one's eyes you were immediately enveloped by the realism of the sound.

We proceeded to a fine new disc from Sony Classical, with Emanuelax and YoYo Ma playing *Cello Sonatas from Rachmaninov and Prokofiev* (Sony Classical SK 46486). This is a superb disc, beautifully recorded with some wonderful music. Neither the review committee nor I could fault the speakers, which produced realistic and cleanly defined sound — which was as close to perfection as we could reasonably ask or expect. The Rachmaninov pieces in particular evoked a strong commendation from each member of the listening group.

We progressed to Eileen Farrell in *This Time It's Love*, (Reference Recordings RR-42CD), which contains some beautiful old-time and contemporary songs, particularly well recorded and most suitable for assessing the human voice reproduction capabilities of the speakers. Here for the first time, the Oriels did not perform as well as I would have expected, and introduced vocal qualities into Eileen Farrell's voice which were clearly additive components.

Our assessment reinforced my prior observation, derived during the pink noise room response testing, that there is a degree of mid-range and upper frequency colouration, which is predominantly in the frequency range between 2kHz and 7kHz, and which detracts from the otherwise excellent performance of these speakers.

The last formal assessment disc that we used was a Sony Classical disc with Fumiaki Miyamoto playing the *Mozart Oboe Concertos*, with the English Chamber Orchestra and Jose Luis Garcia (Sony Classical SK48302).

This particular disc incorporates some truly fine sonic recording characteristics and is at the top of the league when it comes to providing wood wind instrument reference material. The oboe's sound spectrum basically covers the same fundamental frequency range as the human voice, and consequently provides appropriate reference material for evaluating speakers.

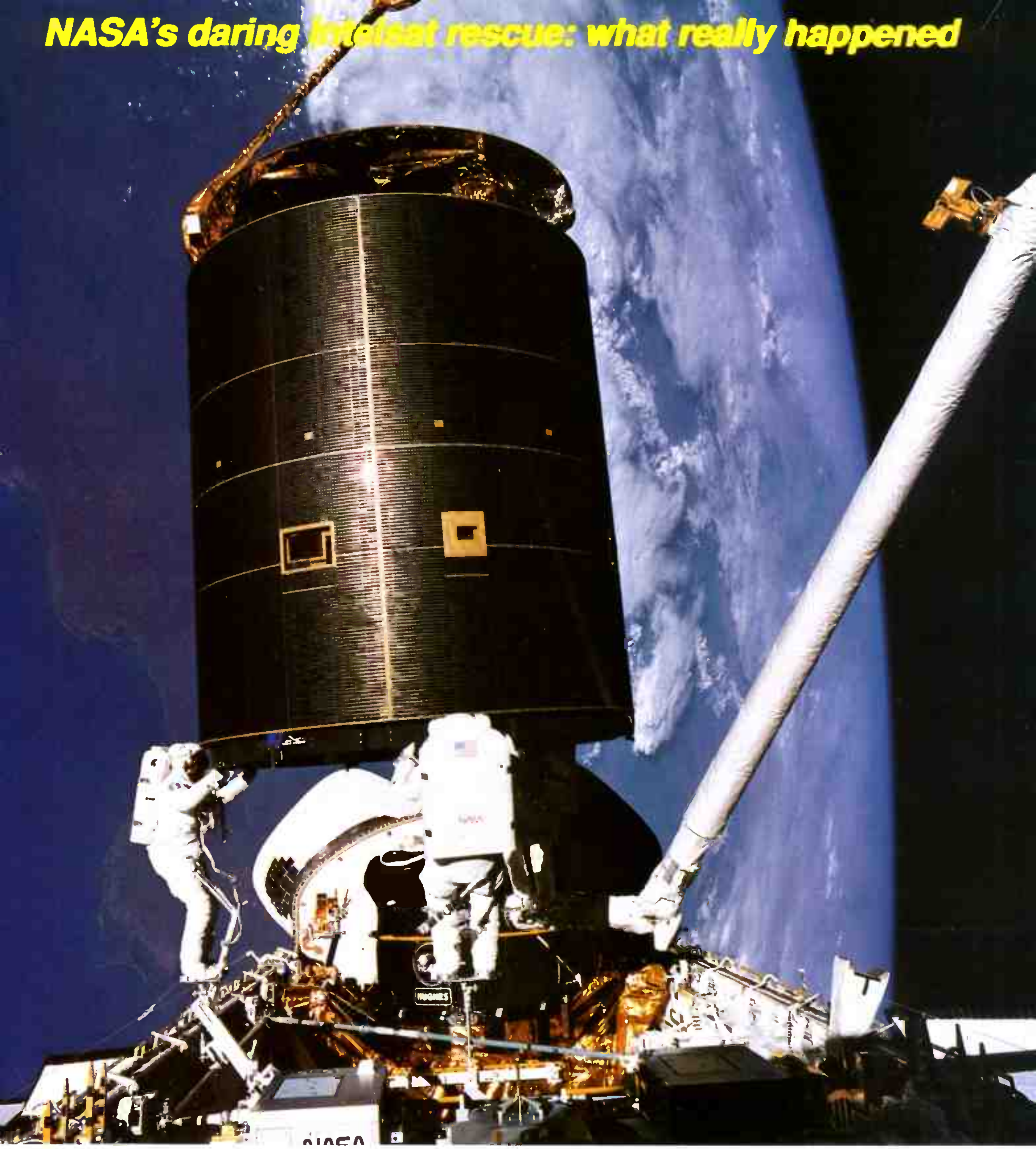
When Fumiaki Miyamoto played, both my supporting listeners and I were able to detect audible nuances and detect additive colouration of the reproduced sound. It was apparent to each of us that the midrange speakers, although undoubtedly well designed, have some detectable peaks in their frequency response as well as generating some pronounced decay resonances which are audible. This phenomena may well be traceable to the method of mounting the speakers, or to the design of the sub-enclosure, which would have the potential to give rise to spurious decay resonances.

Whilst I would not normally comment so critically with a speaker system which costs a few hundred dollars or even a few thousand dollars, when a speaker system sells for $17,000 I must of necessity relate the audible performance of the speakers to their cost, as the quality of that performance should directly relate to that cost.

I listened to dozens of other discs, and excluding the Oriels' reproduction of the human voice and the oboe, I could not really fault these speakers. Whilst the designers have undoubtedly achieved meritorious results, I have nonetheless formed the opinion that a little more work is required before they can truly claim that their 'search for the Holy Grail' has been successful.

The Oriel enclosures are 400mm wide, 295mm deep and 1780mm high, and each weigh 72kg. As noted earlier, the system is priced at $17,000. Further information is available from the Australian agents for Jamo, Scan Audio Pty Ltd, of 52 Crown Street, Richmond 3121; phone (03) 429 2199. ❖

NASA's daring Intelsat rescue: what really happened



"HOUSTON, I THINK WE'VE GOT A SATELLITE"

In our April issue, you may recall, we ran a story on NASA's planned rescue of the ailing INTELSAT VI F-3 satellite — described as 'one of the most daring space missions ever planned'. As you may have seen from the TV coverage, the mission turned out to be even more daring and exciting than NASA had planned. Here's the inside story on what really happened — how fast re-planning, persistence and bravery was able to turn repeated failures into a dramatic success.

by KATE DOOLAN

One of the major arguments against having people in space is that their roles can be carried out by robot spacecraft, which are usually safer and cheaper. This argument has been going on for the previous 31 years, since people first flew in space.

However, the debate may have lost some of its sting with the recent debut flight of NASA's space shuttle *Endeavour*. In a nine-day mission, the crew of six men and one woman conducted what was probably the most spectacular human spaceflight ever.

Over the duration of the flight, four Extra Vehicular Activities (EVA) or 'spacewalks' took place. Three of them were to rescue the ailing INTELSAT VI F-3 communications satellite, while the fourth was to demonstrate construction techniques for the upcoming space station.

However, it was undoubtedly the third spacewalk that captured the imagination of the world. In a brillant display of improvisation and for the first time in space history, three astronauts completed an unplanned spacewalk in record time to capture and repair the satellite.

Initial delays

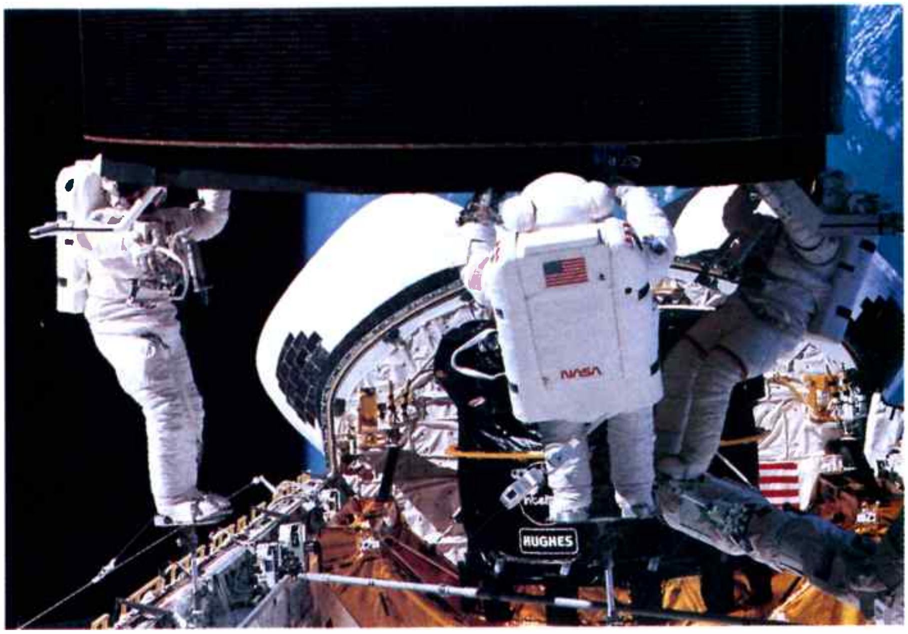
The shuttle *Endeavour* was originally scheduled to launch in the first week of April. Delays in the processing of the orbiter caused the mission to be put forward to May. On April 6, the main engines of the shuttle underwent a test firing. (A test firing is required before each new space shuttle orbiter is launched.) The firing was delayed by a blown fuse in the launch platform, but eventually the engines were fired for 22 seconds.

At first Kennedy Space Center officials announced that the test was successful, but a closer examination of the engines showed that several irregularities had turned up in two of the engines. It was decided to remove and replace the three engines, as their installation would have no impact on launch preparations.

After a Flight Readiness Review in late April, it was decided to launch *Endeavour* at 8:56pm (Florida time) on May 5.

This was changed to a launch window between 7:06pm and 7:55pm on May 7, on the suggestion of former astronuat John Young. Young suggested the change because *Endeavour* was a new orbiter, and a proper photographic record should be made of the launch and if the shuttle launched at night, this would be difficult to do so. There was also the possibility that if the new shuttle

At Launch Pad 39B, the newest Space Shuttle 'Endeavour', undergoes a 22-second firing of its three main engines. A successful firing is required before launch on NASA's mission STS-49.



The successful capture of the Intelsat VI satellite by astraunts (from left to right) Richard Hieb, Thomas Akers and Pierre Thuot, is recorded in this picture.

was in a *Challenger*-type accident, it would be impossible to use photographs taken at night to determine the cause of the accident.

The day before the launch, the Kennedy Space Centre was swept by thunderstorms and it was doubtful that the launch would proceed. Officials of the National Aeronautics and Space Administration (NASA) rated the chances of launch at only 40%.

The following day saw the weather clear and at 7:40pm on May 7, *Endeavour* was successfully launched from Launch Complex 39B at the KSC. On board were the STS 49 crew commanded by Dan Brandenstein and pilot Kevin ('Chilli') Chilton, with mission specialists Tom Akers, Rick Hieb, Bruce Melnick, Kathy Thornton and Pierre Thuot.

The first three days of the flight were comparatively relaxed, as the shuttle was basically 'catching up' to the INTELSAT VI F-3 communications satellite. The crew particpated in a series of onboard experiments, including a protein crystal growing experiment and the tracking of *Endeavour* by a US Air Force electro-optical facility in Hawaii.

The facility tracks the orbiter to record signatures from thruster firings, water dumpings and the phenomenon of 'shuttle glow' — which is a glowing effect around the orbiter caused by the interaction of atomic oxygen with the spacecraft. Other activities included Earth photography and the checkout of spacesuits that would be needed for the upcoming spacewalks.

Before the *Endeavour* could rendezvous with the INTELSAT satellite, several complicated manoeuvres had to be made by ground controllers. The satellite had to be in a 'control box' mode by 46 hours into the shuttle flight.

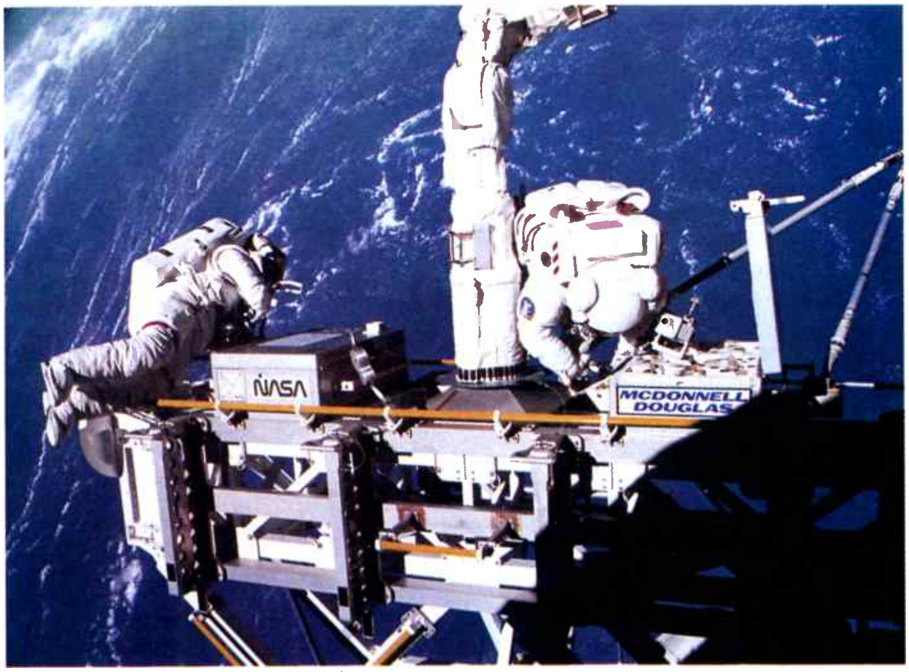
The 'control box' was a volume extending over 6° of arc, in a 380 to 390-kilometre orbit with an inclination of 28.5°. Six hours before the rendezvous, the satellite's spin rate was slowed down to less than 0.25 revolutions per minute.

In the first four days of the flight, astronauts Brandenstein and Chilton precisely guided the shuttle and used less propellant fuel than was allocated for that period of the flight. This would turn out to have been crucial, in the latter part of the mission.

Another significant feature of the upcoming satellite retrieval and repair was the use of hand-held laser tracking devices, as the orbiter's radar system was inoperable within 130 metres of the satellite. The laser tracking system was developed by the US Army, and was used with great success in the Panamanian invasion in 1989 and the Gulf War of 1991. Inside the shuttle, astronauts Akers and Thornton would use the devices to show the distance and separation of the satellite from the orbiter.

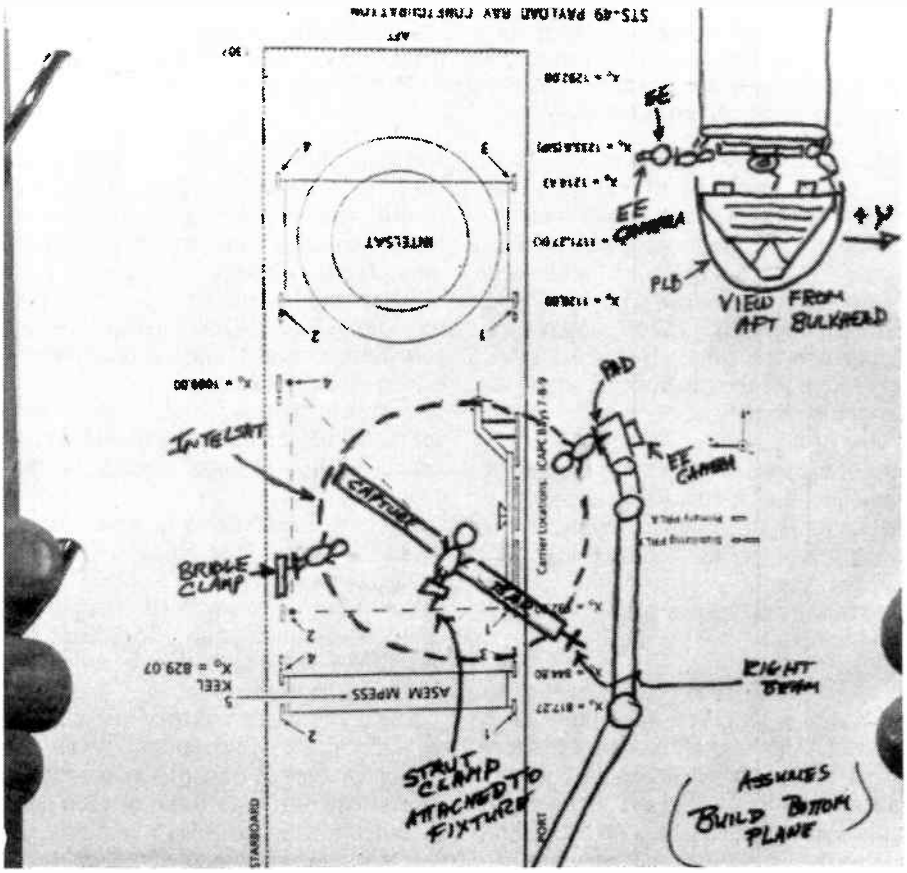
First attempts

The first rendezvous between *Endeavour* and the satellite began on flight day four, when astronaut Brandenstein



Here we see astronauts Kathryn Thornton (lef) and Thomas Akers at work with the components of the Assembly of Station by EVA Methods evaluation. he Ulti-purpose Support Structure (MPESS) is held aloft by Endeavour's remote manipulator system.

On the second day of the mission, astronaut Pierre Thuot made an unsuccessful attempt to affix the grapple bar to the communications satellite, as seen here, from inside Endeavour's cabin.



This close up picture is a detailed hand sketch on a crew member's payload bay schematic showing the astronaut's proposed plan for capturing the errant Intelsat VIF-3 communications satellite.

moved the shuttle to within 11 metres of the satellite. Pierre Thuot and Rick Hieb suited up and entered the payload bay, where Thuot positioned himself on a foot restraint, at the end of the Remote Manipulator System (RMS) arm.

As the *Endeavour* flew in close formation with the satellite, Bruce Melnick operated the arm and carefully moved Thuot towards the satellite. Once Thuot was in reaching distance of the satellite, he attempted to catch it with the specially designed capture bar.

On reaching the satellite, Thuot attempted to push the capture bar into the base of it. However on making contact, the satellite became unstable and started to spin out of control.

At the controls of *Endeavour*, Brandenstein maintained formation for another orbit so Thuot could try to catch the satellite again. But each time he touched it, the INTELSAT moved into a different tumble, yaw or spinning motion. There were concerns that the satellite would hit the orbiter; at one stage on viewing television footage, it appeared that INTELSAT only just missed hitting the *Endeavour*'s wings.

After three and a half hours in the payload bay, Thuot and Hieb returned inside the orbiter.

As the satellite moved away from the space shuttle, ground controllers at the INTELSAT control centre in Washington DC attempted to gain control of the satellite. They succeeded two hours after separation from the shuttle.

After talking to *Endeavour*'s crew, Mission Control at the Johnson Space Centre in Houston, Texas determined that the satellite's sensitivity to contact by the capture bar, as well as Thuot's body position, had led to the failure of the spacewalk.

Another problem mentioned frequently by Thuot was that NASA's ground-based simulators had not adequately duplicated the conditions of working in a zero-gravity vacuum.

The following day, Thuot and Hieb went out into the payload bay again to attempt another capture of the satellite. Before starting the capture attempt, Thuot practised a satellite capture by bumping the capture bar against the payload bay.

Again flying in close formation, Brandenstein manoeuvred the *Endeavour* to within 11 metres of INTELSAT. Thuot managed to make contact with the satellite four times, and on one try actually latched onto it for several moments — but was still unable to capture it. After a 5-1/2 hour spacewalk, the two astronauts returned into the orbiter once more.

"Houston, I Think We've got a Satellite"

The repeated contacts with the satellite had sent it into a flat spin, which was more difficult to recover from compared to the previous day's spin. However INTELSAT ground controllers were again able to stabilise the satellite.

Emergency re-think

Following the failure of the second spacewalk, desperate NASA and INTELSAT officials began emergency planning for a third and final spacewalk — one last try, to catch the recalcitrant satellite.

In conversations with the ground, Dan Brandenstein suggested an unprecedented move: sending out three astronauts to catch the satellite by hand. At the time, his request was overruled until further study of the plan could take place.

An enormous effort involving personnel from NASA, INTELSAT and the Hughes Aircraft Company (manufacturers of the satellite) began to determine whether three astronauts could make a spacewalk.

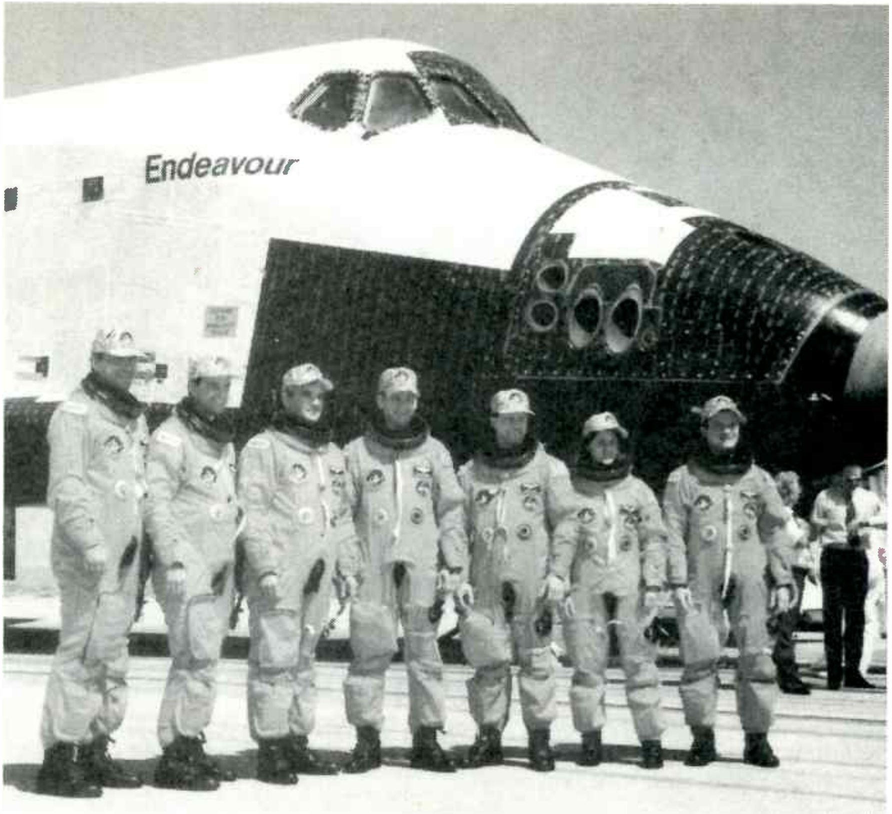
At the Johnson Space Centre, astronauts Story Musgrave, Jim Voss and Rich Clifford suited up to determine whether the three astronauts could fit and suit up in the shuttle airlock. The astronauts also used the Weightless Environmental Training Facility (WET-F), which is a large swimming pool used for spacewalk simulations.

Another two astronauts, Joe Engle and John Casper, flew approaches in the shuttle simulator to determine how to approach the shuttle. At Hughes' headquarters in Los Angeles, engineers calculated where the astronauts could grapple the satellite using their hands, and whether they would catch their gloves on any sharp edges.

Newly-appointed NASA Administrator Dr Dan Goldin appointed a team of engineers and former astronauts with spacewalking experience to oversee the operation and provide advice. In a radio broadcast the night before the spacewalk, Goldin wished the astronauts luck and reminded them that 'crew safety is the first objective'.

It should be pointed out that INTELSAT's satellite was not originally designed for servicing by astronauts, and as such did not have any handrails for the astronauts to use.

Chosen to assist Thuot and Hieb in the spacewalk was Tom Akers, who had originally trained to backup Thuot. Another reason for choosing Akers instead of Kathy Thornton was that Akers was taller, which would make it easier for him to help the other two astronauts.



The seven crew members of Mission STS-49 getting their feet on terra firma after nine days in Earth orbit. Left to right are astronauts Richard Hieb, Kevin Chilton (pilot), Daniel Brandenstein (mission commander), Thomas Akers, Pierre Thuot, Kathryn Thornton and Bruce Melnick.

The plan for the capture was to position each astronaut at 120° intervals around the *Endeavour*'s payload bay. Brandenstein and Chilton would then manoeuvre the shuttle under the satellite, where the three astronauts would attempt to grab it.

One of the items essential for the success of the spacewalk was the amount of propellant used by the *Endeavour* during the flight. By their careful flying, Brandenstein and Chilton had used less fuel, and therefore there was plenty left for the critical rendezvous phase of the upcoming rescue.

The fateful day

On flight day seven, Mission Control ordered Akers to enter the airlock before Thuot and Hieb, so he could cool his spacesuit with one of the two service umbilical units. Thuot and Hieb then cooled their suits also, and suited up.

The start of the spacewalk was delayed by 90 minutes, as there were problems with the rendezvous software which had failed to operate properly. An improper software configuration was the culprit, and the rendezvous phase was completed using data generated from the ground rather than the spacecraft.

After the astronauts entered the payload bay, Tom Akers used hardware scheduled for the later 'space station demonstration techniques' exercise to construct a bridge-like truss across the payload bay, to provide somewhere for him to stand during the the capture attempt.

With the *Endeavour* passing over Australia, Brandenstein and Chilton again approached the INTELSAT. Outside, Pierre Thuot was stationed on the shuttle's manipulator arm, Rick Hieb on the sill of the payload bay and Tom Akers on the truss.

Brandenstein then moved the shuttle up under the satellite, and the two were flying in formation only two metres apart. The three astronauts then observed the satellite for 15 minutes, to determine what course of action they should take to snare it.

After a false start, the astronauts finally reached up and with their gloved

hands grabbed the satellite. Thunderous applause rocked Mission Control, as Brandenstein radioed "Houston, I think we've got a satellite".

But on hearing the applause, he reminded them that "It ain't over yet, guys!". The astronauts then held onto the satellite for 45 minutes, so Hieb could place the capture bar on the satellite.

With the capture bar attached, Bruce Melnick inside *Endeavour* grabbed the satellite with the manipulator arm and placed it on its new Perigee Kick Motor (PKM).

Thuot and Hieb then clamped and latched the INTELSAT, to secure it to the PKM. The capture bar was then released from the satellite and attached to the kick motor, where it would be jettisoned once the satellite reached the proper altitude.

Once the connections were completed, Thuot and Hieb activated four springs that would be used to eject the satellite from the payload bay.

The astronauts also activated two timing devices for the deployment. Following that, all three astronauts returned inside. Their spacewalk of eight hours and 29 minutes had set a new record, for the longest spacewalk in space history.

The previous record of seven hours and 37 minutes was held by Gene Cernan and Jack Schmitt, who walked on the Moon in December 1972.

Final snag

But problems with the INTELSAT VI F-3 continued right up to the very end. When Kathy Thornton flipped the switches to deploy the satellite, nothing happened.

Switching to the backup systems achieved the same result, so ground controllers reconfigured the electronics systems of the satellite. Fifteen minutes later, the satellite was finally on its way to the correct geosynchronous orbit, 36,000 kilometres above the Atlantic Ocean.

The following day, another spacewalk took place. Tom Akers and Kathy Thornton spent seven hours, demonstrating construction techniques for the upcoming space station *Freedom*. As well as building several trusses, the astronauts tested several self-rescue devices. It is essential that these devices are tested, because when the space station is under construction or operational, it will be impossible to sent the shuttle after a stranded astronaut who has lost his or her 'tether' — the line that connects them to the space station.

The main chute is fully deployed on Space Shuttle Endeavour's first landing, following a successful nine-day mission in Earth orbit. The landing was the first use of the Shuttle's drag chute system.

Another record

After the spacewalk was completed, Kathy Thornton was informed that she had broken the record for the longest spacewalk by a woman. This had previously been held by Soviet cosmonaut Svetlana Savitskaya.

The following day was given over to the crew, for a well-earned rest day. The traditional in-flight press conference was held, and in it, the spacewalking astronauts expressed the opinions that the training they had received on Earth did not prepare them for the rigours of spacewalking — pointing out that there was no way to train for zero gravity on Earth. The astronauts also suggested that NASA needs to hold spacewalks on a more frequent basis, to train for the space station and also for satellite servicing of spacecraft such as the Hubble Space Telescope.

In response to media queries and outside criticism, NASA Administrator Dan Goldin decided to establish a committee headed by aerospace engineer Eugene Covert and former astronaut Tom Stafford, to determine when NASA should undertake satellite rescues and what they should charge.

There were some eyebrows raised when it was revealed that the INTELSAT retrieval and rescue had cost NASA some US$350 million, yet INTELSAT had only been charged US$93 million. But eventually a profit of US$1 billion will be made, from the operation of the rescued satellite. The report was due to reach Dr Goldin by August 1.

Successful touchdown

The *Endeavour* successfully landed at the Edwards Air Force in California at 3:40pm (Houston time) on May 16, after a flight duration of eight days, 21 hours and 17 minutes. A new feature of the landing was the deployment of a drag chute, immediately after the nose gear touched down on the runway.

Shortly after the landing, the crew climbed out of the orbiter and preparations were made to fly the *Endeavour* back to the Kennedy Space Centre for its next mission — scheduled for launch in early September.

The first flight of the *Endeavour* does indeed prove that there is a role to be played by humans in space. The flight also showed that the best-laid plans often go wrong, and in the end, it is the human mind rather than a robot which has the ability to develop quickly plans that can turn a failure into a resounding success.

The author would like to thank Kay Grinter, of the Kennedy Space Center; and Steve Nesbitt, Dianne Ormsbee and Lisa Vazquez of the Johnson Space Center, for their assistance in the completion of this article. All photographs used in the article are courtesy of NASA and the Johnson Space Center. ❖

NEW BOOKS

Construction guide

ELECTRONICS ASSEMBLY POCKET BOOK, edited by Keith Brindley. Published by Butterworth-Heinemann, 1991. Hard covers, 200 x 95mm, 298 pages. ISBN 0-7506-0222-8. Recommended retail price $38.95.

This is one of a series of Newnes Pocketbooks which are intended as concise guides to designated subject areas. The present volume covers electronic equipment assembly. Without being too simplistic, topics are covered to a sufficient depth to give readers a basic, but quite thorough grounding.

Glancing at the index reveals the large number of topics covered — there are 92 entries. Starting with safety and first aid, it proceeds to cover areas like specifications, electronic symbols, component types, logic principles and circuits, types of cables, printed circuit boards, etc.

The book serves two very useful purposes. It is a mine of theoretical electronic information, which can be used either to introduce new knowledge, or to revise once-familiar but now half forgotten information. And in addition, it also present many hints for practical implementation: e.g., how to solder, wire-wrapping, etching PCBs and using an oscilloscope.

I feel that the book achieves its aim: it covers a huge field, with enough information on each topic to make it a very useful reference.

The review copy came from Butterworths, 271-273 Lane Cove Road, North Ryde 2113. It is available from technical bookshops. (P.M.)

TV antenna manual

HILLS ANTENNA INSTALLATION MANUAL 1991, compiled by R.F.W. Castle. Published by Hills Industries Ltd. Soft covers, 280 x 215mm, 96 pages. Price $25.00 plus sales tax ($5.00) and postage ($2.50) where applicable.

Some months ago, our Serviceman commented in his column about the scarcity of sound practical information on the correct installation of TV and FM antennas, and recalled a very useful publication that had been produced back in the 1950's by one of the TV antenna manufacturers. Wouldn't it be great, he mused, if there was an up-to-date version of the same kind of manual, which also covered things like UHF, masthead amps, splitters and diplexers?

As it happens, there is. Hills Industries produced this new manual only last year, and their Victorian sales manager sent us a copy for review, on reading the Serviceman's comments.

Basically it provides just what the Serviceman asked for: virtually all of the basic theory and practical information necessary in order to install a variety of TV antenna and distribution systems. There's everything from how to design a home-unit distribution setup, with amplifier and splitter configurations, down to details like fitting the various common types of co-ax connector, and running cable around skirting boards.

For those in difficult signal areas, there's even a guide to working out the delayed path length corresponding to a ghost on the screen, and ways to improve directivity in order to improve the direct/reflected signal ratio.

In short, it's both comprehensive and practical. And everything is presented in concise, down to earth language, so that it should be of value not only to would-be professional installers, but home handypersons and well.

My only gripe is that it uses a non-SI contraction for megahertz: 'Mhz', rather than the correct 'MHz'.

Copies of the book are available for the price shown, from Hills Industries Ltd., PO Box 78, Edwardstown 5039. (J.R.)

Practical projects

HOME REMOTE-CONTROL & AUTOMATION PROJECTS, by Delton T. Horn. Published by TAB Books (a division of McGraw-Hill), 1991. Soft covers, 235 x 185mm, 301 pages. ISBN 0-8306-2197-0. Recommended retail price $31.95.

This book assumes that electronic experimenters enjoy building projects for various remote control and automation applications, and that they find such projects fascinating, educational, practical and economical. To spur them on, the author offers 77 such projects. Of course with so many projects, only the basic circuit is given, without detailed explanations of how they work. Each project takes up, on average, about one page.

Though the main emphasis of the book is practical, the first two chapters give some general information on remote control and automation theory. Chapter 11 also outlines the operation of timing chips like the 555. Some of the other chapters contain explanations and relevant theory, as well.

The groups of projects are dealt with in chapters 3-10 and 12. For most of the projects it is assumed that the 'remote control' connects to the central unit via wires, but there are also circuits for a fibre-optic transmitter and receiver, as well as an AM radio transmitter.

Ch.3 deals with light switching; Ch.4 with controlling doors and windows; Chs.5-8 cover temperature, liquid, stereo/TV and telephone circuits. Ch.9 deals with motor control, Ch.10 with electronic switching and Ch.12 with wireless control.

The variety of circuits and applications should stimulate any experimenter to try out, modify and adapt many of these projects. In short, the book is a great source of ideas.

The review copy came from McGraw-Hill, 4 Barcoo Street, Roseville East 2069. It is available from technical bookshops (P.M.) ❖

NEW BOOKS

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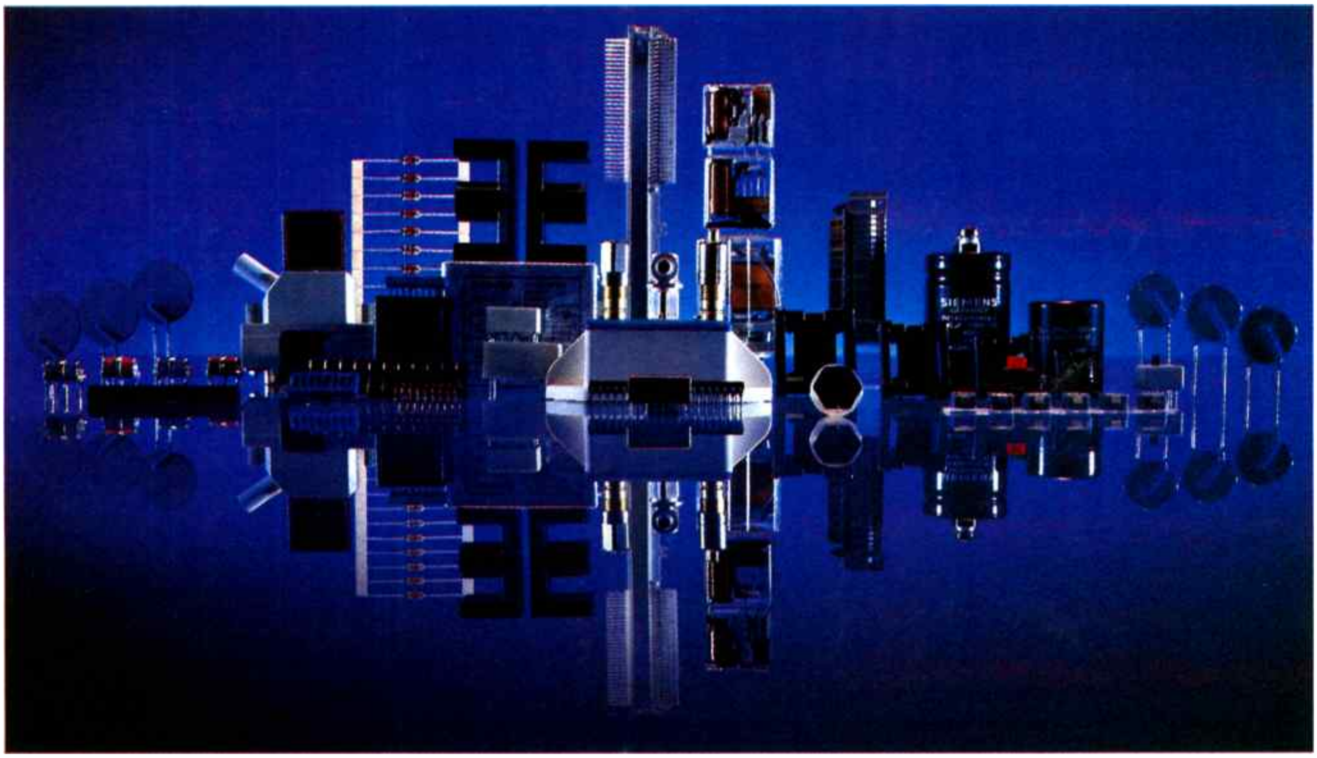

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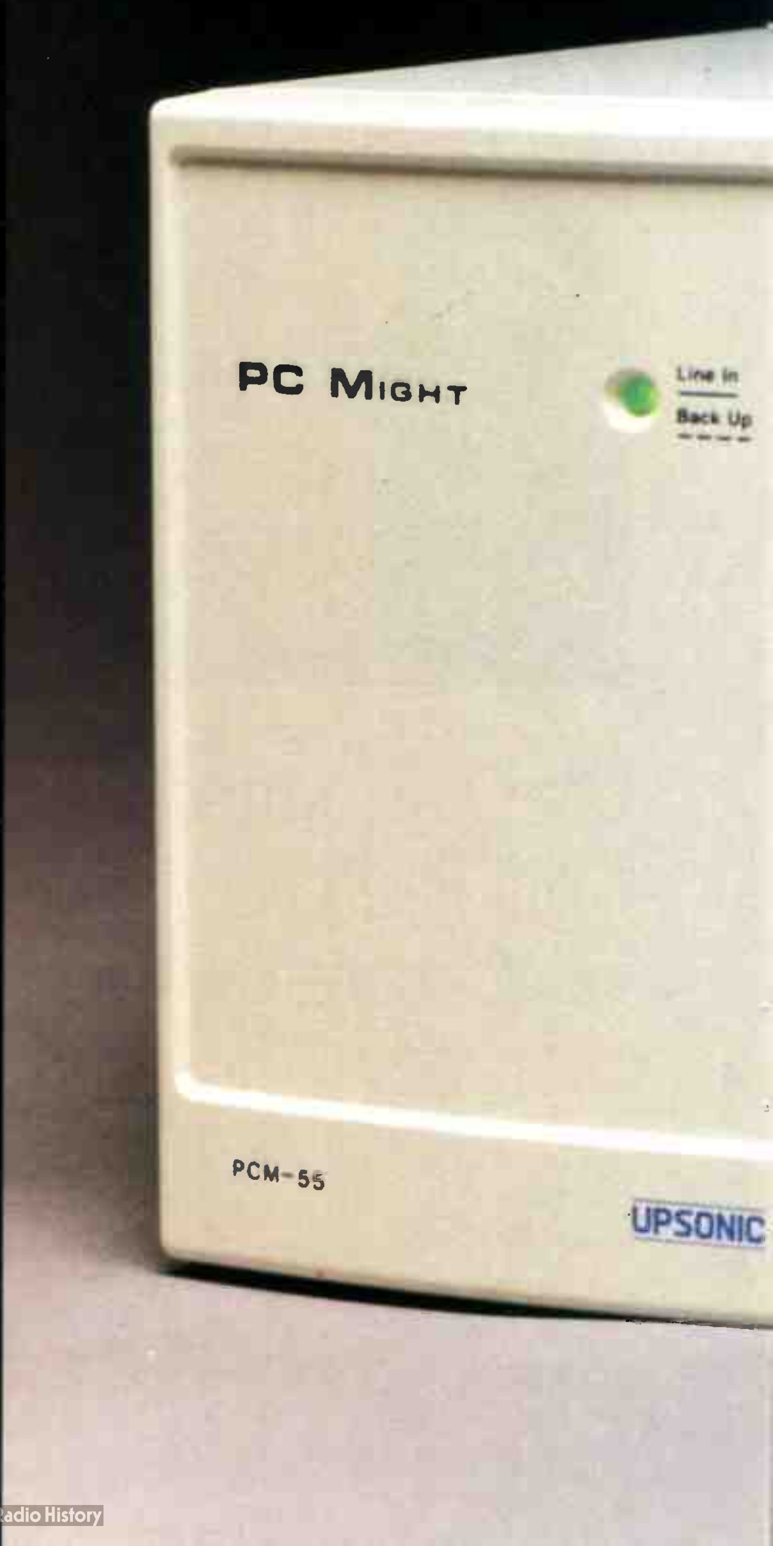

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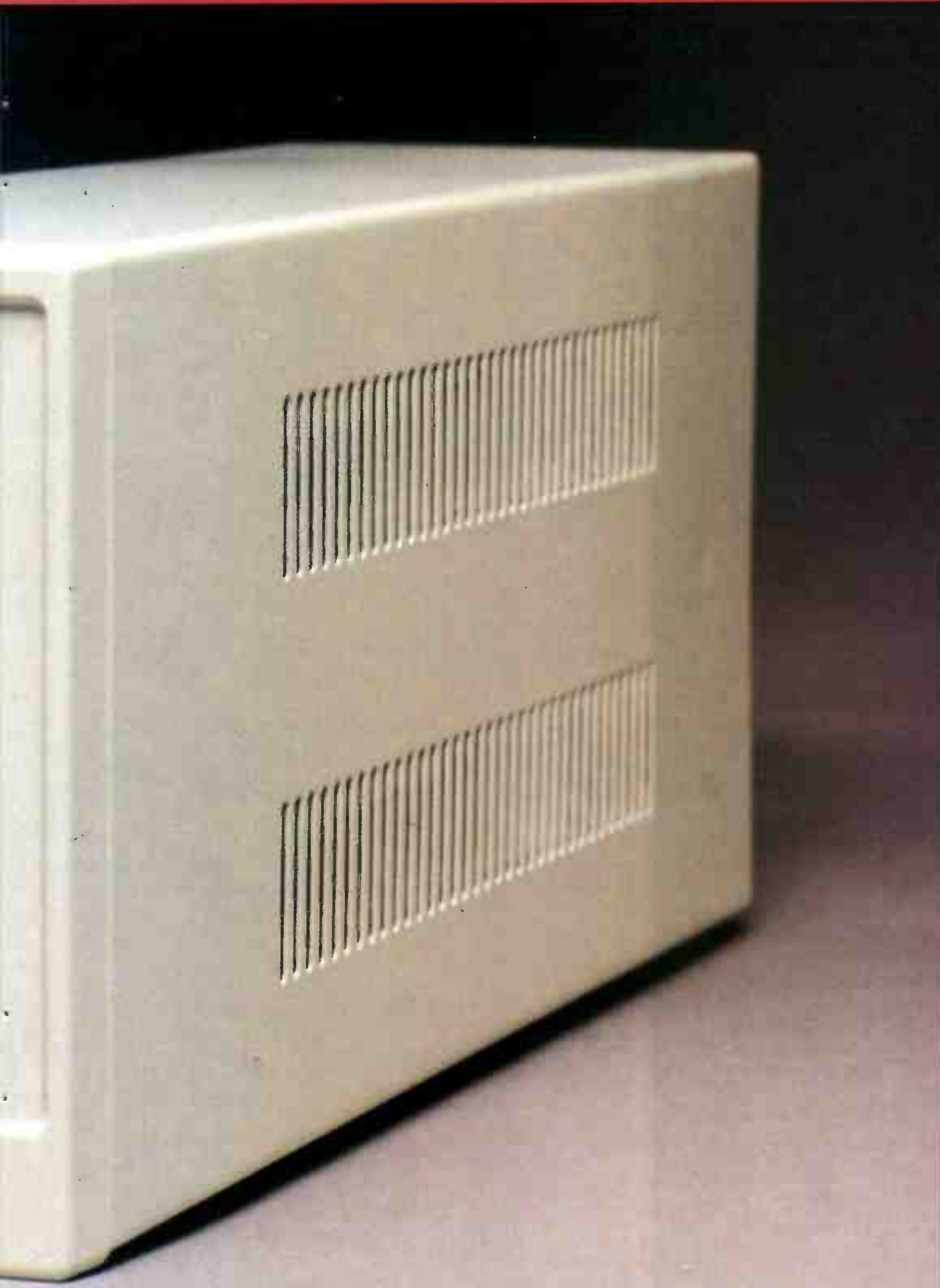

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Inside the PLL FM demodulator

Continuing from our last episode on the Phase Locked Loop or PLL, here we look inside the PLL itself to find out just how it operates as a demodulator of FM signals.

You may recall from the last episode on the phase locked loop (PLL) FM demodulator that the phase comparator has two inputs, f(in) and f(vco), as in Fig.1(a). The signal f(in) is the receiver intermediate frequency (IF), commonly 10.7MHz.

This signal rises above and falls below the nominal IF centre frequency slightly, with the frequency modulation. The second signal, f(vco) is the square wave output from the PLL's voltage controlled oscillator or VCO.

How these two signals mix within the phase comparator is the crux of the FM demodulating action, and the secret of the circuit's ability to reject AM, noise and interference.

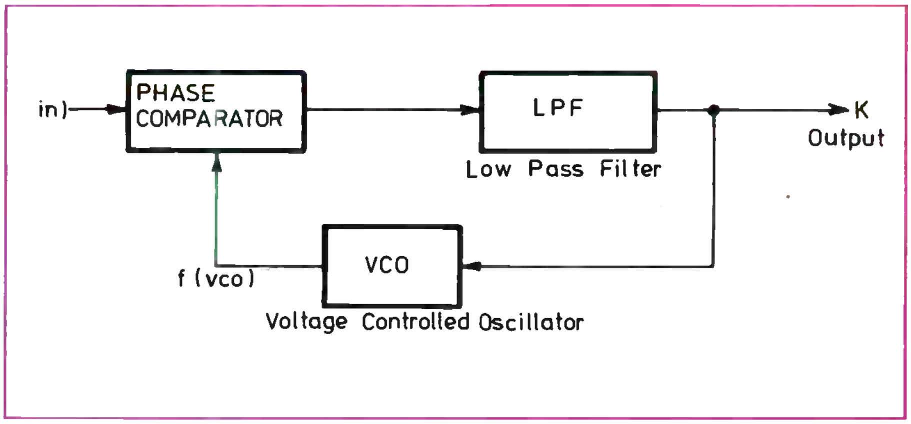

Fig.1(a): The basic phase-locked loop (PLL) FM demodulator. The FM IF signal f(in) is compared in the comparator with f(vco), the output of the voltage controlled oscillator.

Switched amplifier

The phase comparator (or phase detector as it is sometimes called) could be likened to a switched amplifier. In this analogy, shown in Fig.1(b), the signal f(in) is amplified by a linear amplifier A whose operation is simply switched on and off at T by the square wave signal f(vco).

In Fig.2, only those parts of the input sinewave f(in) which occur while f(vco) is switched on will appear in the output signal D. That is, point D in Fig.1(b) only sees the sinewave f(in) between times a and b; c and d; e and f; etc.

Now let us observe in Fig.2 that when f(vco) lags exactly 90° behind f(in), as shown, the switched signal at D has exactly equal areas above and below the zero line. Therefore its average DC level is nil.

Remembering that the signal at D is a high frequency, (commonly 10.7MHz) when we pass it through the low pass filter LPF, only its DC level remains at K. But as the signal at D in Fig.2 averages to zero, there is accordingly zero output at K when f(vco) lags 90° behind f(in). Enthusiastic readers who love scribbling waveforms all over the place are invited to show for themselves that when f(vco) *leads* f(in) by exactly 90°, the output at K will also be zero.

That's not very difficult. But someone is sure to object that there are many other phase angles between +90° and -90°. How true!

Other phase angles

Look at what happens in Fig.3(a), when f(vco) is not 90° out of phase with f(in), but lagging by some small angle.

Now the output at D has much more signal above the zero line than below. Therefore signal D has a positive average value.

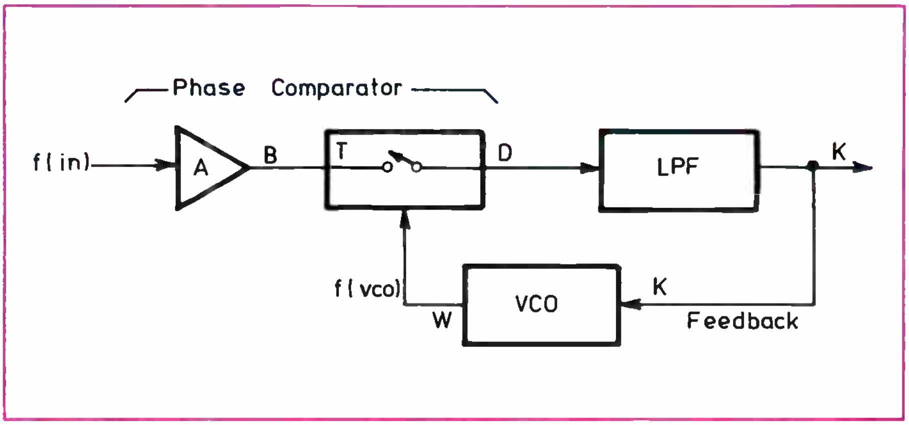

Fig.1(b): A functional representation of the PLL system. The signal f(vco) switches the output of amplifier A on and off. The feedback from the low pass filter (LPF) at K controls the frequency of f(vco).

[illegible]

[illegible]

[illegible]

That is, after passing through the low pass filter only that positive DC level remains at K.

Conversely when f(vco) is lagging behind f(in) by *more* than 90°, as in Fig.3(b), we see that the signal at D has much more signal below the zero line than above. Therefore D has a negative average level. In this condition the output from the low pass filter is a negative DC voltage. Thus the polarity of the DC signal at point K depends on the phase relation between f(in) and f(vco).

The abbreviated internal circuit of the phase comparator is shown in Fig.4, where the 'long tail pair' amplifier Q1A/Q1B is switched on and off by switch transistors Q3A/Q3B and Q4A/Q4B, depending on whether the square wave f(vco) rises or falls.

The circuit is akin to a dual cascode amplifier with a switching function added to the upper pair.

Controlling the VCO

The output DC level at K is connected via the feedback loop to the input of the voltage controlled oscillator (VCO). Over a restricted range, the frequency of the switching signal f(vco) so generated is directly proportional to the DC level output from the low pass filter LPF at K.

The essence of the VCO which performs this function is shown in Fig.5. Q1 is an operational amplifier with capacitor C in the feedback path, thus forming an inverting linear integrator. (The input current of Q1 must be very small).

Q5 is an inverting linear amplifier, used simply to add a constant bias voltage to signal K.

The sum of K and some positive bias appears at M, which feeds the inverting terminal of the integrator via R2. This positive composite signal is integrated by Q1 to form a falling straight line ramp signal at J, which feeds the inverting terminal of Schmitt trigger Q2.

Negative bias -Vb is applied to the non-inverting input terminal of Q2 via Rb and the divider R4, R5. This holds the output P of Q2 down near the -6V level until the falling ramp signal at J falls lower than -Vb. This occurs at time t2. Once that happens the dominant negative potential on the inverting input of Q2 sends its output P up to the positive rail potential.

This voltage change, through voltage follower Q4 and R6, switches transistor Q3 into full conduction (saturation), quickly discharging the integration capacitor C. As a result the output of Q1 returns to near ground potential at time t3. Immediately Q2 switches back to negative output at P, Q3 switches off and the integration cycle starts again.

Integrating down from time t3 to time t4, the cycle repeats indefinitely. The output of the Schmitt trigger Q2 at P, as shown in Fig.5, is a pulse waveform which is at -6 volts most of the time (t1 to t2), and up at +6 volts for the very short time from t2 to t3. This short time t2-t3 is made just long enough for Q3 to fully discharge capacitor C.

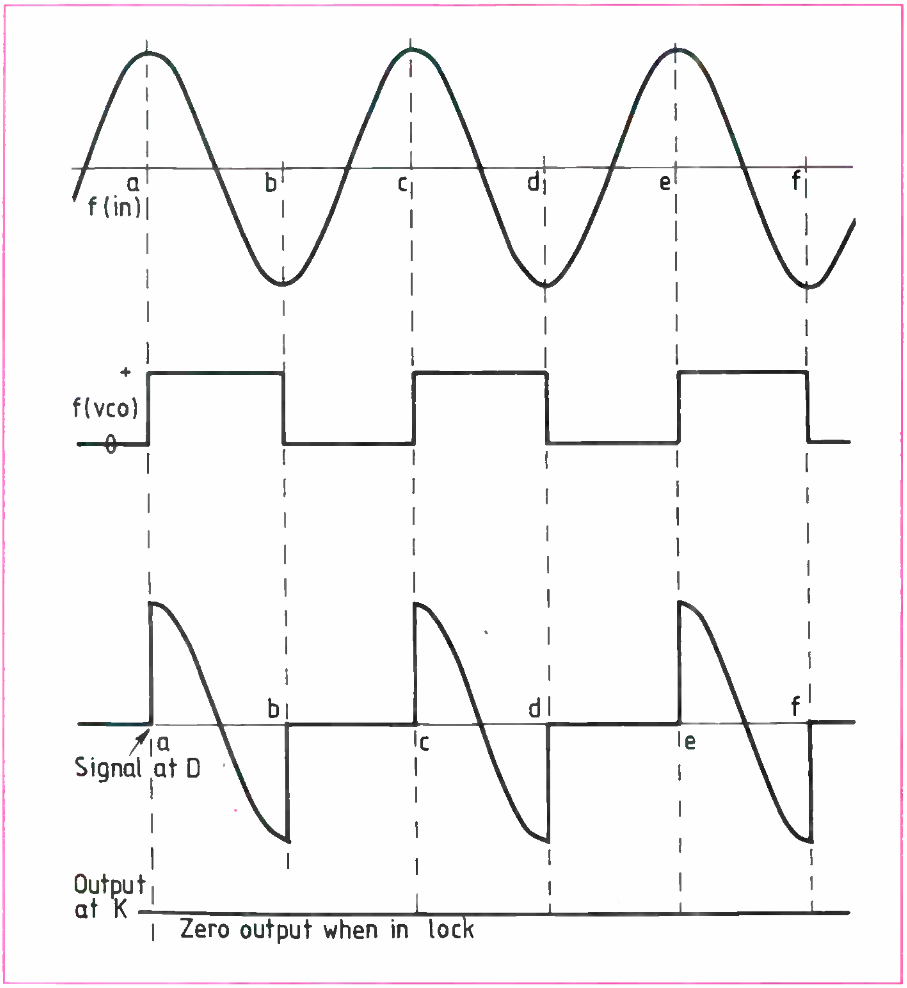

Fig.2: The condition 'in lock', when f(vco) is 90 degrees displaced from f(in). The sinewave signal f(in) is switched on by f(vco) at time a, then switched off at time b. Similarly for c and d, e and f, etc. So only those parts of the sinewave (a-b), (c-d), (e-f) and so on are present at D. Since this waveform has equal areas above and below the baseline, the average output at K after filtering is zero. The feedback holds this condition until modulation next changes the frequency of f(in).

VCO linearity

We all like distortionless hi-fi music to emanate from our FM radios, do we not? That ardently desired result is dependent on the frequency f(vco) of the VCO being directly proportional to the feedback voltage K.

At first glance that would seem easy to satisfy, because Q1 is a linear integrator — i.e., its output waveform is a straight line slope. This is because a constant voltage at M causes a constant current through R2 to charge capacitor C. Thus the voltage on C increases by equal amounts in equal times. (If you like equations, $dV(c)/dt = i/C$, so the rate of change of $V(c) = dV(c)/dt =$ a constant.)

Naturally we all remember that the virtual earth at the inputs of an operational amplifier means there is almost zero volts at point X (even though the voltage on C builds up), so the charging current is always V(M)/R2.

So a constant voltage V(M) causes a constant current, which can charge capacitor C at a constant rate. Thus the output at J is a linear ramp.

If you are hazy on the vital nature of the virtual earth in operational amplifiers, you could try reading the relevant pages (p6 and pp43/44) of the author's book *Op Amps Explained* (the 2nd Edition of which is still available from *EA* — sorry for the commercial).

Thus if we doubled the voltage at M, the ramp signal at J would run down

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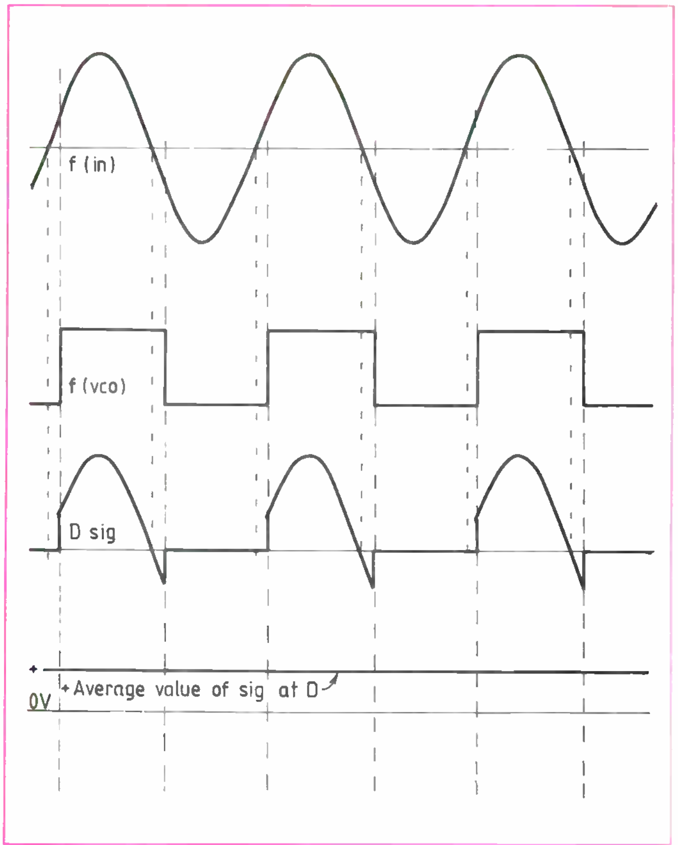

Fig.3(a): The capture state, approaching lock. When f(vco) lags f(in) by some angle less than 90 degrees, the signal at D from the phase comparator has a positive average value.

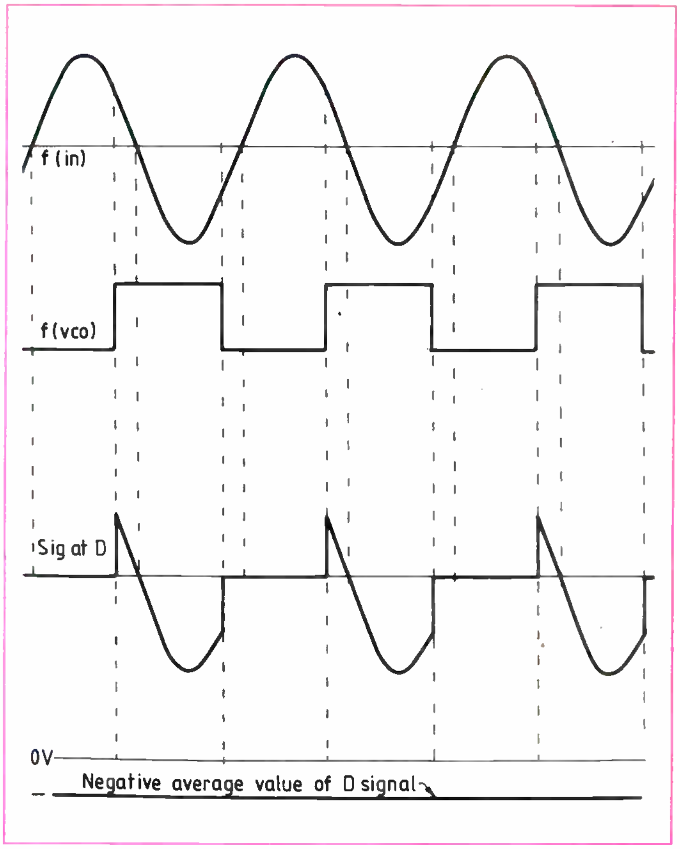

Fig.3(b): When f(vco) lags f(in) by some angle more than 90 degrees, the signal at D from the phase comparator has a negative average value.

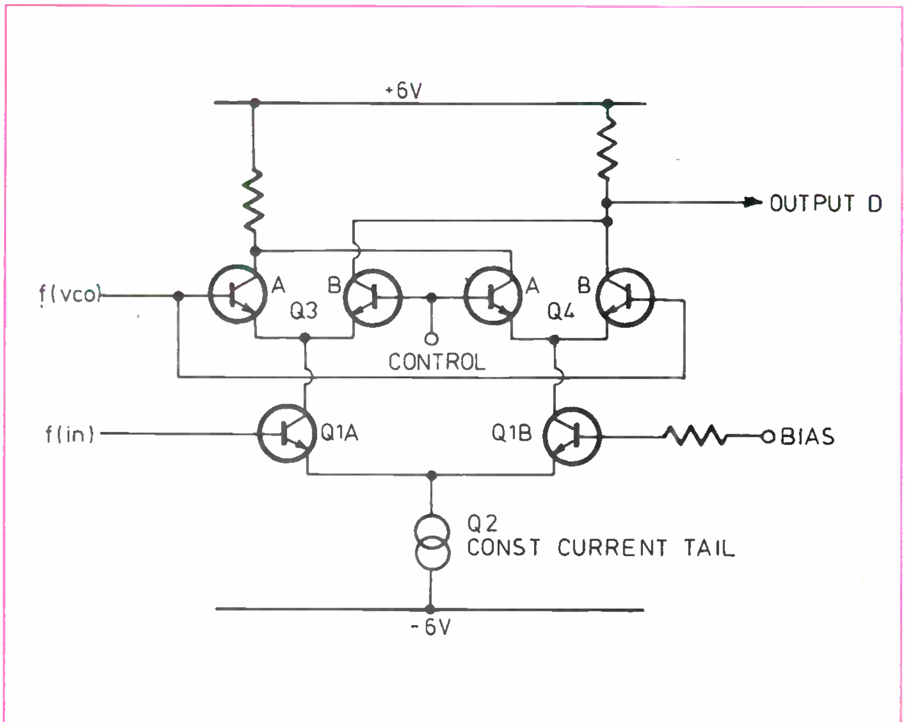

Fig.4: An abbreviated circuit for the phase comparator. The transistors Q1A, Q1B carrying the signal f(in) are dwitched on and off by the signal f(vco) in the upper transistors Q3 and Q4. The output is at D.

twice as fast — i.e., time (t1-t2) would be halved.

You would think that would ensure linearity, by making f(vco) twice as high a frequency; but alas not quite! For there is also the uncontrolled time (t2-t3), the time which must be allowed for capacitor C to discharge.

Charge/discharge ratio

Therefore we discharge C as fast as possible! This means we use a good transistor like the 2N2222A, a nice fast (f_T = 300MHz) semiconductor capable of peak currents as high as 500mA. Also the leakage of a 2N2222A is very small (I_{CBO}<10nA) during the capacitor charge time, so that it doesn't disturb the charging.

Then as long as the charge time is long compared to the discharge time, (t2-t3 insignificant compared to t1-t2), we will have reasonable linearity. That statement forms the limit to the frequency of operation of the VCO.

VCO output waveform

Fig.5 shows the waveform at P to be a pulse wave of very short mark/space

ratio. But Fig.2 implies that a 1:1 mark/space would be more suitable for f(vco), to achieve best PLL operation.

That little hiccup is easily fixed, by running the basic VCO circuit of Fig.5 at about 21.4MHz and feeding the output P of Q2 through a divide-by-2 flipflop, toggling on each rising edge of waveform P. The divider output at W is thus a true square wave of equal mark/space ratio (i.e., 50% duty cycle), in the desired 10.7MHz frequency range.

Three PLL states

Recall from the last episode of this saga that the PLL exists in one of three possible states:

1. Free running (i.e., no FM signal present);
2. Capture (i.e., the VCO is changing frequency, attempting to align f(vco) to the same frequency as f(in); or
3. Locked or tracking (i.e., f(vco) at the same frequency as f(in) and 90° different in phase).

Once locked, if the receiver's local oscillator or the transmitter's carrier oscillator (or both) should drift, the PLL will simply follow in frequency and remain in lock. In this aspect the PLL is by far the best FM demodulator, especially for hand-held battery driven transmitter/receivers of imperfect frequency stability. The feedback action will just not 'let go' of the received signal! Unless the frequency drift goes outside the range of the circuit, of course.

PLL operation

To observe that the PLL has indeed locked onto the received carrier, we can display f(in) (the IF signal) and f(vco) simultaneously on a dual-trace oscilloscope. The 90° or quarter-cycle phase difference of these signals tells us that lock has been achieved.

So far we have called signal K a constant voltage, which it is when the received carrier signal is unmodulated. *But as the carrier is modulated, its frequency and phase shifts back and forth. For an instant f(in) and f(vco) are not at 90°*, so some voltage appears at K. This is fed via the feedback loop to the VCO, so changing the frequency f(vco) — which quickly re-establishes the 90° locked relationship. As modulation continues to shift the frequency and phase of the received signal f(in), the voltage at K therefore swings positive and negative, 'chasing' it.

Now you see why the signal at K is a copy of the modulation, and is of course the desired audio output signal of our FM radio receiver. From K follow the usual audio amplifier stages, volume and tone controls and loudspeaker.

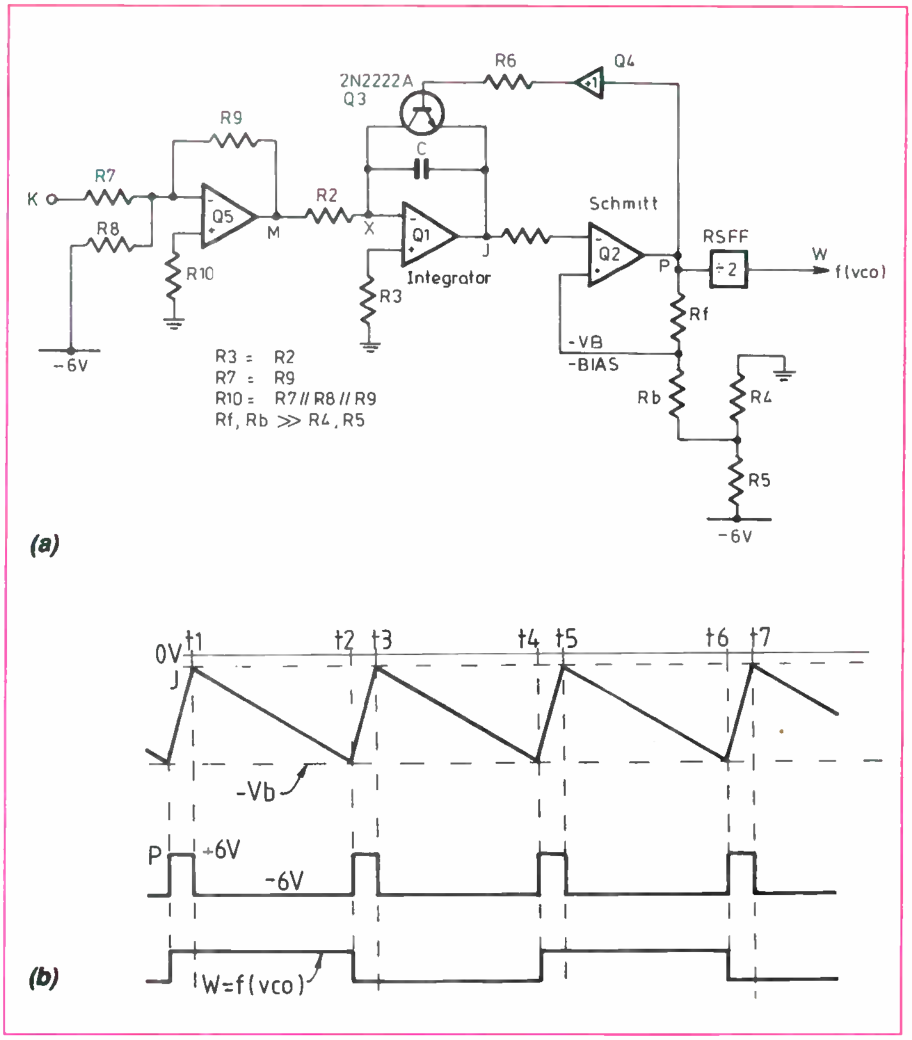

Fig.5: Abbrieviated circuit for a voltage-controlled oscillator (VCO). Q1 is the switched integrator, turned on and off by Schemitt trigger Q2 driving the switch Q3 through Q4. As a result of the linear integration and switching action, the output frequency is proportional to control voltage.

We have described the PLL in detail, as if it were constructed of discrete components. Indeed you could do that if you really wanted to. But the easiest way is to buy an LM565 or NE565 or 4046, etc., over the counter for a few dollars.

The 565 is a complex integrated circuit containing on one chip the phase comparator, low pass filter, amplifier and voltage controlled oscillator. This complete PLL on a chip has revolu-tionised the communications world.

More terms

To close this discussion of the use of a PLL for FM demodulation, let us define two more terms:

Threshold sensitivity: The feedback loop action of a PLL requires some minimum amplitude of signal f(in) for the loop action to succeed. This amplitude is called the *threshold sensitivity*. For the LM565 this sensitivity is expressed as typically 60mV peak to peak, for a 1.5 normalised lock range. For maximum phase error less than 1 radian, lock can occur (1 radian = 57.3°).

De-emphasis function: As high audio frequencies are 'pre-emphasized' at the radio station before FM transmission, to return to normal frequency response we must *de-emphasize* the audio output from the PLL. This is accomplished by using the standard 75-microsecond time constant low pass filter (LPF).

Other PLL uses

For phase errors less than one radian, the PLL is substantially a linear control system. So next time we will look at the other fascinating PLL applications — frequency synthesizers, and clever FMFB and frequency feedback systems which made space communications possible.

Bye for now. ❖

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Receiving weather satellite images with your PC:

LISTENING POST WESAT STATION - 3

So far in this series we've discussed weather satellite lore and described the equipment needed to transform an audio signal into a nice 'space' picture on the screen of a computer. This month we will look at ways to capture the signal from space in the first place.

by TOM MOFFAT, VK7TM

The thrust of this entire project is to allow reception of satellite photographs — normally a process requiring hundreds or thousands of dollars worth of equipment — using an existing computer, a $99 interface kit, and an existing receiver. The receiver can be a simple scanner, or even perhaps a modified FM broadcast set. But it must be able to produce a noise-free signal from a five-watt transmitter hurtling through space, 3000km away.

Since we have backed away on the performance requirement on the receiver, we must pick it up again in the antenna or preamplifier, or both. Antennas for space reception come in two general flavors: in NASA parlance, *high-gain* and *omni*. High-gain antennas must be pointed in the direction the signal is coming from. Fine for something like a TV station, but if the signal source is moving, as does a polar-orbiting satellite, the antenna must be 'tracked' to follow the satellite. This can be a messy and complicated business.

Polar-orbiting satellites are specifically designed to allow the use of omni antennas, and several omni antennas have been designed for use with polar-orbiting satellites. An omni antenna for space use must be omnidirectional in three dimensions — up and down as well as round and round.

'If such an antenna can receive equally well from anywhere, then it doesn't need to be tracked. You can just set it up in one position and forget it.

The first omni antenna that comes to mind is the familiar 'ground plane'. This antenna works all right in all directions out toward the horizon, but it's hopeless at higher angles. As a satellite flies over a ground plane, the signal will get stronger and stronger as the satellite comes closer. But at some point the signal will begin to drop away again, and when the satellite is directly overhead its signal will be zero — since the signal is coming in from the end of the antenna's only element.

Some experimenters have tried to get rid of this 'hole' in the top of the ground plane's reception pattern by tilting the antenna away from the vertical.

But all this does is point the hole somewhere else. The satellite will still fade out going past it. A simple ground plane antenna will get you started in satellite reception, but you will soon want to graduate to something better.

Around the twist

Satellite transmitting antennas use what's called 'circular polarization' to reduce fading to a minimum as the spacecraft makes its way across the sky. To explain, imagine a jail with a round window which is filled in with vertical bars. Imagine you are standing on one side of the window, and a friend is on the other. Each of you is holding the end of a rope.

If you and your friend shake the rope up and down between the bars it will move easily, as if the bars weren't there. The wave motion of the rope is said to be 'vertically polarised'. If, however, you try to shake the rope sideways, you can't do it because the rope hits the bars. The wave motion of the rope is now 'horizontally polarised', but the window is still arranged to allow only vertical wave motion. The performance of horizontal rope-shaking is very poor.

Now remove the bars from the window altogether. It is now possible to shake the rope up and down or sideways, with no impediment from the window. In fact you can spin the rope round and round, jump-rope style, with no problem. If the window were an antenna it would now be said to be 'circular polarised'. It can accept waves going up and down, sideways, or round and round.

If satellites used vertically polarised antennas you would be expected to use a vertically polarised antenna to receive them. But when the satellite twists and turns in space, it could end up with its antenna horizontal with respect to your vertical antenna, and the result would be an almost total loss of signal. Weather satellites transmit through circularly polarised antennas so much of the fading problem is removed. But if you are also receiving with a circular antenna, performance will be at its optimum.

If you are trying to spin the rope to the right and your friend is trying to spin the rope to the left, the rope won't spin at all. There is a disagreement in the SENSE of the circular polarisation. Same goes with satellites — if the spacecraft is spinning the signals to the right and your antenna expects them to be spinning to the left, reception will be terrible.

All weather satellites we're interested in use right-hand circular polarisation, so any antennas we consider from now on must match: right-hand circular.

Common antennas

There are two major ways of producing circular polarised antennas. One method involves a main antenna element wound as a helix, or coil. A coil of a few turns, with a reflector at one end, becomes a circularly polarised antenna with its major reception 'lobe' along the axis of the coil. The more turns in the helix, the more directional the antenna.

You see helical antennas in use a lot

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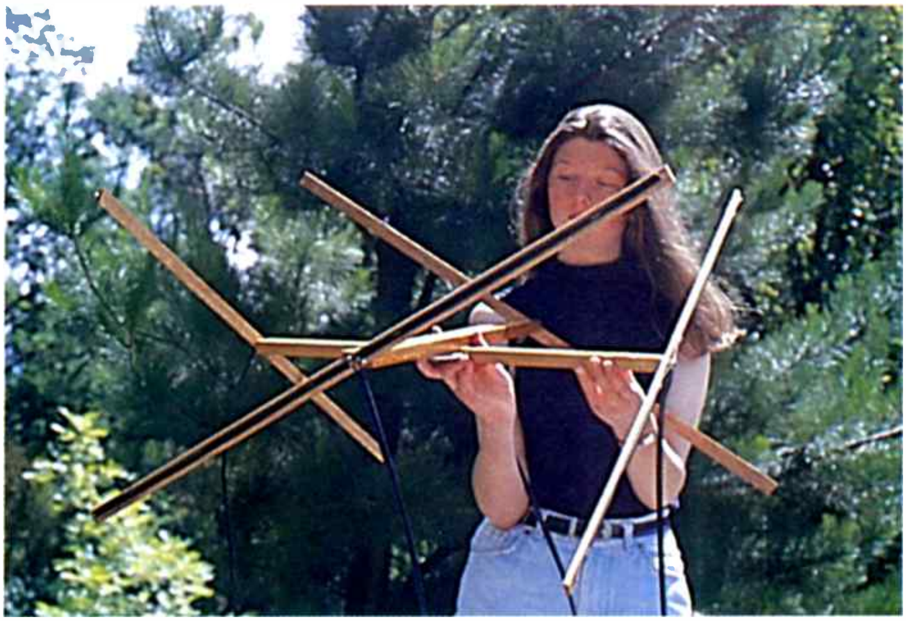

Photo 1: Tom's daughter Fiona is seen here holding the prototype of his Lindenblad antenna for the 137.4MHz weather satellite band. Note that each of the four elements slopes upwards to the right at 30 degrees, as viewed from the outside.

on missile tracking ranges, usually with an operator to manually point them at the missile being tracked. It seems unlikely one could make an omni-directional or even wide-angle helix, although it would be interesting to experiment with a one-turn coil to see what happens. Helix antennas are hard to construct, and hard to match correctly to a feedline.

An easier way to achieve circular polarisation is to use two normal half-wave dipoles and cross them at their centres. An extra length of coaxial cable is inserted between the two dipoles, so that the signal feeding the second one is 90° out of phase with the first dipole. If there are the two dipoles and nothing else, the arrangement is called a 'turnstile' antenna. It is substantially omni-directional.

A dipole antenna with a reflector, or perhaps a reflector and some directors, is known as a Yagi antenna. If you cross two Yagis, like in the turnstile above, you have (would you believe) crossed yagis — a nice high-gain circularly polarised antenna. This is a favorite among radio amateurs using amateur communications satellites. But crossed Yagis must be tracked, and there are some pretty snazzy motor-drive schemes and computer programs to do this automatically. But it's too complicated for simple weather-satellite applications.

If you mount a turnstile antenna near a reflector, it will be come a half-omnidirectional antenna, with its sensitivity forced toward one direction. If you then lay the structure down so it's resting on the screen with the turnstile above it, you then have the most popular weather satellite antenna, called a 'TR' or turnstile/ reflector antenna. Photo 3 shows an example of a TR antenna, installed on a science building at Hobart College.

This antenna is a good performer, but it's difficult to build and mount. The screen is quite heavy, the structure presents a lot of surface to the wind, and keeping it in the air is a dicey business. However the TR would be well worth looking at if you have a house with a flat roof you could lay it on. With a metal roof you might be able to forget about the reflector and use the roof as the reflector. The turnstile is usually spaced 5/8 of a wavelength away from the reflector.

Another idea is to replace the screen with crossed reflector elements, so that the result is two crossed Yagi antennas spaced 5/8 wavelength between driven elements and reflectors, and pointed straight up. I am told by those who've tried it that weather satellite results with this arrangement are excellent.

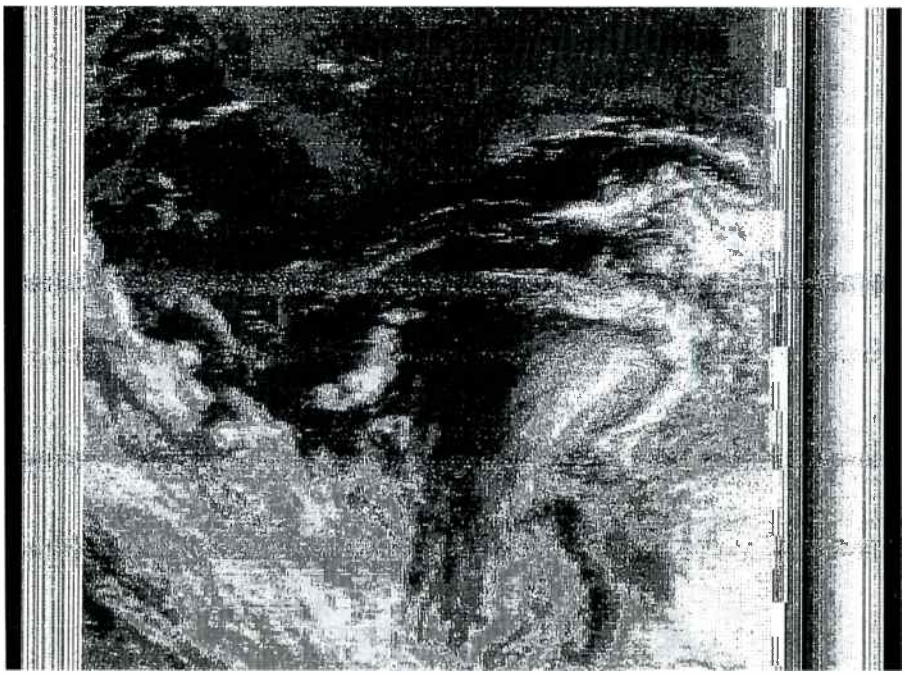

Photo 2: A picture from a meteor satellite passing over Western Australia, received in Tasmania using Tom's Lindenblad antenna.

The Lindenblad

A truly great antenna, as compared to a good antenna, usually has two distinctive characteristics: (a) it has LOTS of wire in it, and (b) it's ugly. Here we will present construction details for a satellite receiving antenna that meets both of these criteria.

The Lindenblad designed for the 137MHz satellite band has something like eight metres of television twin-lead in it, or 16m of wire. As for its looks, don't be surprised when you hear those immortal words "You're not going to put THAT thing above *my* house are you?" Well, be brave, do it. You'll find the antenna's performance startling, at an all-up cost of around $12.

Most people have never heard of this

antenna, even though the original design came out in the late 1930's. It seems Mr Lindenblad was in charge of antenna design for New York's earliest experimental TV station, which transmitted from the top of the Empire State Building. So when you see that classic film scene of King Kong gripping the girl in one hand and the top of the Empire State Building with the other and shaking his fist at the attacking airplanes, remember that it was a Lindenblad antenna he was hanging onto...

My own involvement with Lindenblads was on a missile test range in Nevada in the 1960's. Several of these fine antennas were mounted atop the telemetry building, to receive signals from shooting rockets and falling bombs as they twisted and turned every which way — at any angle and any elevation from the antenna. The incoming telemetry signals never faltered, until the object being studied either crashed into the ground or exploded.

Like the turnstile antenna, the Lindenblad is circularly polarised and it can 'see' equally well in all directions. But unlike the turnstile, the Lindenblad has its best sensitivity (gain) toward the horizon, with the gain decreasing as the satellite moves to higher elevations. This is a convenient arrangement, because the satellite becomes closer as it moves higher in the sky, and its signal becomes stronger.

So the Lindenblad is most sensitive when the satellite is furthest away, and less sensitive when it is closer. This tends to even out variations in signal strength during a satellite pass, with the receiving system working hardest where it's most needed, at great distances.

Figs.1 and 2 are graphs of signal strength at the input of an Icom R7100 receiver, plotted over a period of 20 minutes. The graphs were made with the Icom/Yaesu computer control interface from February 1992's *EA*, and a computer program written in the C language. The microvolt readings shown are artificially large because of the influence of a preamplifier.

Fig.1 was made during a pass of a Russian Meteor satellite, which reached an elevation of 55°. The recording was started as the signal rose out of the noise, which was at around the 10uV level because of the preamp. The signal rose steadily, but not dramatically, because as the elevation was increasing and the distance decreasing, the antenna gain was dropping off. Averaging out the

Photo 3: The lower wooden cross piece of the Lindenblad is fitted with a 'U' bolt as shown, for mast mounting.

small bumps and fades, the signal remained pretty steady until it sloped downward again — to fade into the noise at about 18-1/2 minutes. There was a substantial fade at 12 minutes, for reasons which remain unexplained. You get these sometimes.

Fig.2 is a graph from a NOAA satellite pass, with a maximum elevation of 64°. The recording was started as the satellite made its first appearance. The signal strength started to rise properly about 30 seconds into the chart, and then continued to rise to peak at seven minutes. It then fell away again, to disappear completely at 14 minutes.

In general Meteor satellite passes last longer than NOAA passes, because Meteors fly at a higher altitude — 900km instead of 600km. But the ultimate signal strength from NOAA's is greater than from Meteors, because they come closer to the antenna (both use five-watt transmitters). NOAA's also show a greater signal strength peak, somewhat overcompensating for the gain variations of the Lindenblad.

In theory the Lindenblad would have a reception null straight up. In practice this is true, but the null is not very deep. The signal strength does fall away considerably if the satellite goes straight over the top, but by then it is quite near so its signal is fairly strong. In noisy areas you may get a fade during 90° passes, but passes that rise to around 75° or less show almost no signal decrease.

It is worth accepting a small null at highest elevations; in return you get the ability to receive good pictures from a five watt transmitter over 3000km away. From Tasmania we can receive pictures from well east of New Zealand, over Western Australia, over Antarctica, and north to Cape York Peninsula.

Photo 2 is a picture from a Meteor satellite as it cruised northward from the Southern Ocean and directly over Kalgoorlie in Western Australia. Its closest approach to the Lindenblad receiving antenna in Tasmania was 2698km.

Building one

Our version of the Lindenblad is made of sticks of wood and bits of twin-lead wire. This method of construction is cheap, but not nasty. If the wooden parts are painted with marine varnish, they should last for years. The main antenna crossarms are made of 25 x 50mm (1" x 2") stock, and the element supports are of very light 5 x 20mm D-molding. The thing looks like it could blow apart with the first puff of wind, but the prototype

Photo 4: A turnstile/reflector or TR antenna for weather satellite reception, installed on a science building at Hobart college.

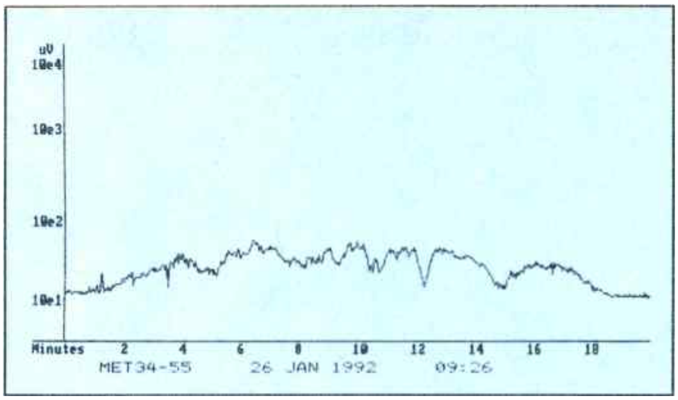

Fig.1: A plot of the signal strength of a Russian Meteor satellite, as received at the input of an Icom R7100 receiver — using the Lindenblad antenna.

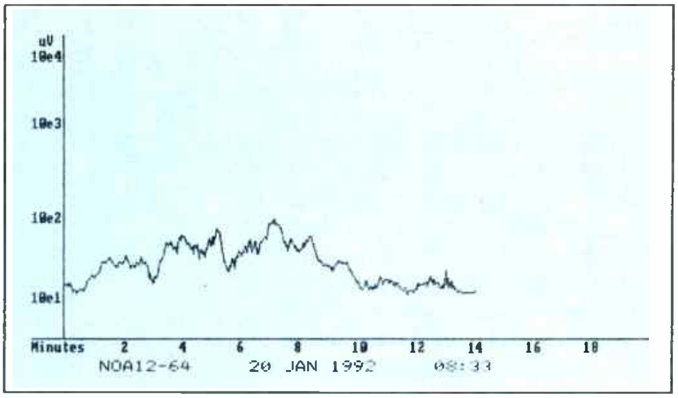

Fig.2: A similar plot from an NOAA satellite. As can be seen, the signal strength is relatively constant apart from a few unexplained dips.

has survived a measured 84-knot storm with barely a quiver.

Electrically the Lindenblad consists of four half-wave folded dipoles mounted every 90° around a circle. So when it's up in the air, one dipole is facing north (more or less), one is facing east, one is facing south, and one is facing west. The actual directions are not important.

To achieve circular polarisation, each dipole is tilted exactly 30° from the horizontal. Which way the dipoles tilt, up or down, determines whether the antenna will be right-hand or left-hand circular.

For weather satellite work the antenna must be *right-hand* circular, so the elements must be higher on the RIGHT-hand end when viewed from OUTSIDE the antenna. Photo 1 illustrates this. Fiona's right hand is holding the Lindenblad at its centre, at the place where it will attach to the mast.

The element closest to the camera is low on its left end and high on its right end. If Fiona rotated the antenna by 90°, so that the element near her other hand now faced the camera, it would also be low on the left and high on the right. And so it goes, right around the four elements.

This is the way you must put your own Lindenblad antenna together. If you somehow get the elements tilted the wrong way, the antenna will be left-hand circularly polarised and it will carefully discriminate *against* weather satellites. Its performance will be lousy.

Perhaps the best place to start is to make up the four half-wave folded dipoles in the traditional manner. Begin by cutting *eight* lengths of 300 ohm twin-lead exactly 910mm long — a touch longer than an electrical half-wave-length.

To make one dipole, strip enough insulation from each end of one piece of twin-lead so that the wires at each end can be soldered together.

We now have a length of twin-lead, one-half wavelength long, shorted at each end.

Next cut ONE of the wires at the exact centre of the dipole, and strip enough insulation away so that each exposed piece of wire can have another wire attached to it. Now strip some insulation from a second length of twin-lead, but from only one end for now.

Finally solder the two wires from the second piece of twin-lead to the exposed wires in the center of the first piece, so the whole structure takes on a T-configuration. You now have a half- wave folded dipole, complete with a half-wavelength long feedline. Repeat this process for the other three dipoles.

Before beginning the woodwork you'll need a 30-60-90° set square, the bigger the better, available from any office supply store. For the cross pieces

Photo 5: The 300 ohm ribbon used to make up the Lindenblad elements is attached to the wooden supports using the 'office' stapler, as shown here.

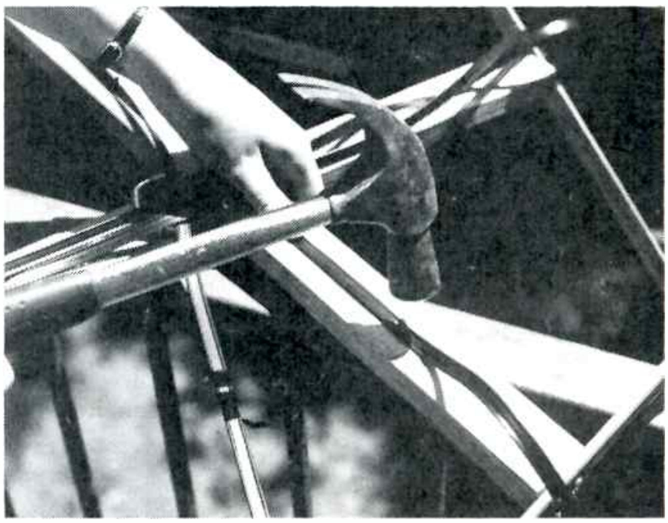

Photo 6: The feeder ribbons are attached to the centre supports using small tacks. Take care not to smash into the ribbon with your hammer!

cut two lengths of 1 x 2, 610mm long. Before joining them you should prepare one piece to take a U-bolt which will hold the antenna to the top of a mast. Photo 4 gives the idea. Then fasten the two cross pieces together with wood glue and screws, getting them centred in relation to each other and with an angle of as close to 90° as possible. Use the 90° angle of the set square to set this.

Now cut four lengths of D-molding 920mm long — just a whisker longer than the element lengths of the folded dipoles. These pieces must now be attached to the ends of the cross pieces, with screws and glue so that they slope upward to the right at a 30° angle. First drill and insert one screw, and then carefully set the 30° angle before installing the second screw. We used a set square to measure the angle.

When the framework is complete you should give it a couple of coats of marine varnish. The wood will look quite nice once this is done, and it should survive the lashings of the elements with ease.

Now it's time to attach the twin-lead dipoles to the framework. You'll find the easiest way to fasten the dipole sections to the D-molding is with a common office stapler. The molding is soft, and it's thin enough so the stapler will fit around it. See Photo 5.

Next the feeders from the dipoles can be fastened to the cross pieces with some larger wire staples or tacks, hammered in. Leave small loops of twin-lead where the feeders attach to the dipoles, and DON'T smash the feeders with the hammer! See Photo 6.

All four feeders must now be connected in parallel, and in phase. This means all four 'left-hand ends' must be connected together, as must all four 'right-hand ends'. Trace the wires carefully; if you get any of them reversed the antenna will be worthless.

Finally you can 'gloop' all the exposed antenna connections with Silastic to water- proof them. You can also use the stuff as a glue to hold down any bits of twin lead that may flop about on their supports.

The four 300-ohm dipoles connected in parallel result in a 75-ohm feed impedance (300/4 = 75). This is a good match for 75-ohm coaxial cable, but it is still 'balanced'.

For best performance and noise rejection you should now construct a balanced-to-unbalanced transformer (balun) having a 1 to 1 impedance ratio.

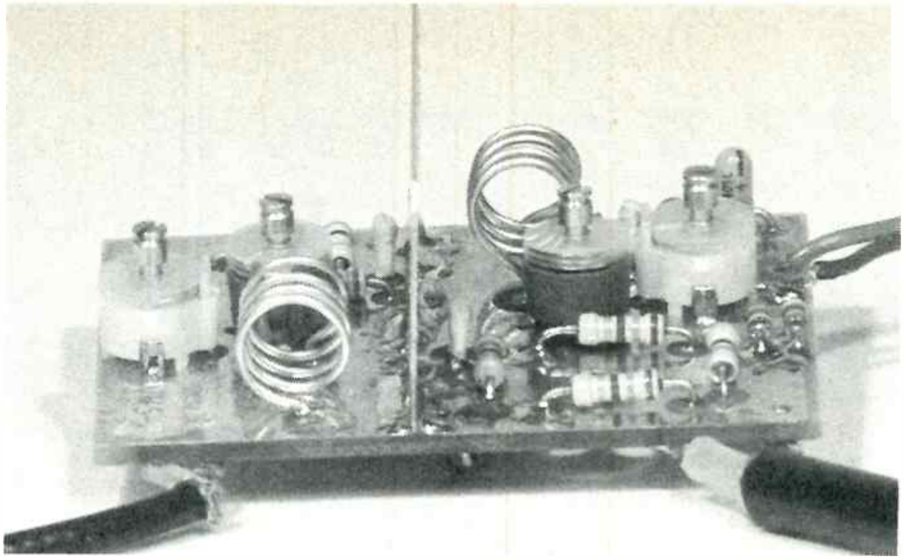

Photo 7: One of the VK5 preamps, shown here a little larger than actual size. It uses a low noise GaAsFET device, and provides very stable amplification for the weak weather satellite signals. The text explains where the kits can be obtained.

Such a device is shown in Fig.3, wound on a common 'VHF balun core'.

Even though the signals are coming from space, the Lindenblad should be mounted as high as possible. Its performance will be hindered by objects such as other antennas that may get in its field of view. Also keep in mind that since the Lindenblad's highest gain is toward the horizon, it can see down as well as up.

This is somewhat troublesome if the Lindenblad is to be used above a flat metal roof, because signals will bounce up into it from the roof, as well as arriving from above. This causes phase cancellation and severe signal fading. The higher the antenna is mounted above the roof, the less severe the effect.

Possibly the better choice on a flat metal roof would be a Turnstile/Reflector-type antenna. But if the metal roof is pitched, signals should be reflected away from, instead of into, the antenna, so there should be no problem with a Lindenblad.

Preamplifier

If you are going to use an 'off-the-shelf' VHF receiver or scanner, it will most likely need a preamplifier to enable it to receive the weak satellite signals. A preamp officially designed for the two-metre amateur band (144 - 148MHz) can be easily tuned down to 137MHz. These can be bought ready-made, or built.

In my early experiments I used a ready made GaAsFET two-metre preamp from Dick Smith Electronics. This preamp works pretty well, although it's hard to keep it stable when you begin to fiddle with the tuning. A more recent discovery is a kit put out by the South Australian Division of the Wireless Institute of Australia. The full version of this kit includes a couple of relays and some other

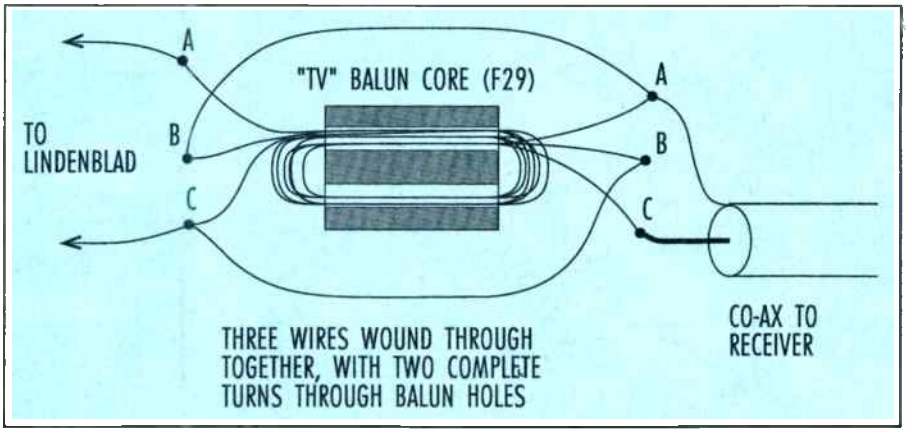

Fig.3: How to make a 75 ohm 1:1 balun to match the Lindenblad antenna to standard 75 ohm coax. It uses a 'TV' ferrite core (F29 material), with 3 windings that are wound together in trifilar fashion.

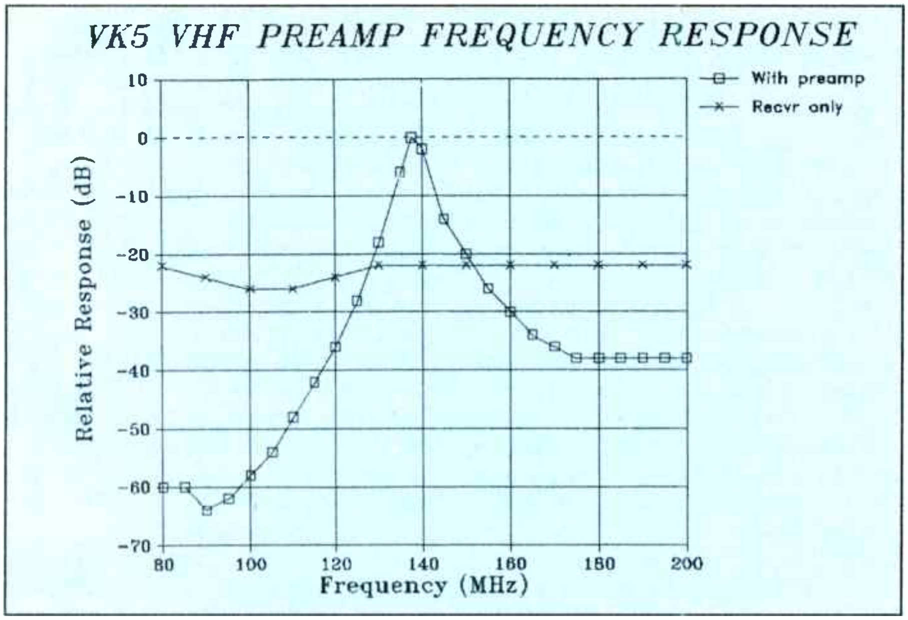

Fig.4: The measured response of one of the VK5 preamps, when it's tuned to 137.4MHz. As well as providing around 20dB of gain, it also helps filter out interfering signals from nearby FM and radio transmitters.

components so that the preamp can be switched out of the antenna line while using a transmitter.

For non-members of the WIA, the kit costs $35.00 posted. Another version can be purchased without the relays, for receiving only, for $23.00 posted.

I had hoped to design a nice preamp as part of the Listening Post Wesat project, but when I saw what the WIA had on offer I decided there was no sense in re-inventing the wheel.

Their kit contains excellent quality parts, it is fairly easy to build, and when properly tuned it is very stable. Gain is 20dB, and this can be adjusted downward if necessary. The preamp can be mounted right at the antenna for best performance, and the 12 volt power for it can be fed up the co-ax.

No matter where you mount it, the preamp must be housed in a proper metal enclosure to prevent RF from things such as TV transmitters leaking into the receiver via the preamp output circuitry.

You must also be sure to use a shield between the input and output sections, as shown in the kit's instructions, to prevent instability. The shield should be big enough to fill the whole cross-section of the box.

The standard kit can be built as a low-band or high-band version, making it usable on any slice of spectrum between 50 and 200MHz. I've just ordered a second kit, to be built for 76MHz where the Tasmania Police and other emergency services are active. You can order the 'VK5 VHF Preamp kit' from the Equipment Supplies Committee, PO Box 392, Marden, SA 5070. Cheques should be made out to 'WIA S.A. Division'.

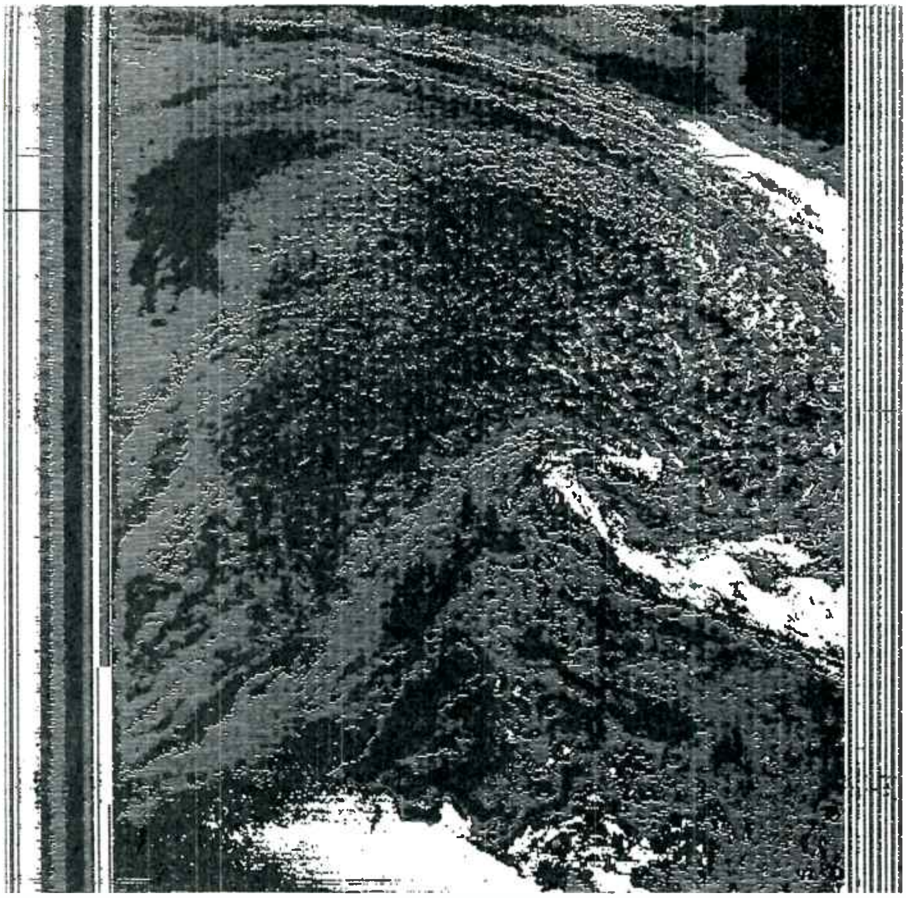

Fig.5: A VGA printout of the 'blast from Antarctica' satellite image which was shown in the first of these articles.

Hints for success

One thing that must always be kept in mind: good satellite pictures don't just fall out of the sky. You must nurture them, massage them, talk nicely to them — and hopefully you'll get a top quality tape recording of the 'tick-tock' or 'goose' sounds of a passing weather satellite.

Assuming all your equipment is correct, the biggest hazard when receiving weather satellites is man-made interference. In country areas this should be no problem, except for ignition noise and/or noise from electric fences. It might not sound like much, but over Easter at our beach shack I continuously had pictures wiped out by the combined efforts of a chainsaw, a motorbike being ridden around in circles, a petrol-driven tractor, an outboard motor, and an electric fence.

Since this kind of interference is coming in directly on the desired frequency, you can't filter it out. You can only hope it goes away, possibly with the kind help of the person owning or using the interfering device ("Turn that bloody thing off!").

My biggest problem was the Easter holiday; during other times things are

Wesat Station - 3

much quieter and satellite reception is fantastic. In the cities, interference is most likely to come from sources transmitting on frequencies other than the satellite frequency, such as TV and FM stations. These appear both above and below the 137MHz satellite band. Here you can remove the interference by filtering.

By its very nature, a scanner is a wide-coverage receiver, and as such it's susceptible to overload from nearby strong transmitters. If you try to listen for a weather satellite from the suburbs of Sydney, you probably won't hear more than bits of music and buzzing from VHF broadcast transmitters. But by tailoring the frequency response of the system, we can overcome most of the interference problems.

The first line of defence is the preamplifier. Because it is designed to respond to only a narrow band of frequencies, it acts as a filter against all others. Fig.4 shows the measured frequency response of the VK5 VHF preamp when it's tuned to 137.4MHz. The flatter trace is the response of the receiver alone, without the preamp.

Only between the frequencies of 130 and 150MHz is the preamp a preamp; beyond this range it's really a filter (providing it's properly housed in a metal box). The preamp response is at least 55dB down on FM broadcast frequencies, and 38dB down for high-band TV.

The Lindenblad antenna shows useful selectivity as well. Experiments indicate that its response is more than 20dB down on TV and FM frequencies, compared with its design frequency of 137MHz. Other purpose-built satellite antennas should be similar. Both the preamp and the antenna should work together to give you good interference-free reception from weather satellites.

As for picture quality, Russian Meteor satellites almost always deliver fine photographs no matter how poor the 'lighting'. They seem to have some kind of automatic exposure system.

But you may find the visible part of NOAA pictures either very dim or non-existant, less than two hours past sunrise or less than two hours before sunset. This is because NOAA satellites are actually measuring earth reflection, instead of merely taking pretty pictures. Nice pictures only result when there is heaps of light.

As this is being written, in early winter, NOAA's 9, 10 and 12 are just about useless for visible pictures because their passes all seem to be before 8:00am or after 6:00pm. MET 3/4 is putting out lovely pictures in early to mid morning, while NOAA 11 is churning them out in mid-afternoon.

By the time you read this the days will be getting longer, and all the satellites will start putting out good visible pictures again. In the meantime the NOAA's are still providing interesting infrared images.

Getting the kit

The Listening Post WESAT project kit is now in full production, available only by mail order from High-Tech Tasmania, 39 Pillinger Drive, Fern Tree, Tasmania 7054. The cost is $99 for the kit and the software, posted in Australia and New Zealand. (Cheques or money orders only, please.) Be sure to specify which version and the disk size required.

The IBM-PC kit comes with three software versions, for VGA, CGA, and LCD graphics. VGA provides the full gray-scale and false-colour high resolution graphics you've seen in these articles. CGA is restricted to 300 x 200 pixels in four colours, but it allows picture reception with older computers that would otherwise miss out. The LCD version is the CGA standard optimized for use on laptops, allowing reception of satellite pictures aboard yachts.

Note that the software will NOT run on the earliest PC's with a 4.77MHz clock. These machines are just not fast enough to do 1200 software analog-to-digital conversions every second. But the software runs fine on 'turbo' XT computers, AT's and other faster machines.

All versions are capable of printing pictures onto an Epson-compatible printer, using a simulated gray-scale made up of dot patterns. Fig.5 is a VGA printout of the 'blast from Antarctica' satellite picture from part 1 of this series.

A WESAT version is also available for the Commodore Amiga, using a 600 x 400 eight colour high-res screen. The same hardware kit can be used on both IBM and Amiga, connected to the printer port. For owners of both computers, High-Tech can supply the second set of software for an additional $49 posted. The software is not available separately.

And that completes this series on weather satellite reception, at least for now. In the future we might come up with some more antenna projects, or articles about how weather satellites are being used in the scientific community. In the meantime, there's plenty to see up there, from your very own 'eye in the sky'. ❖

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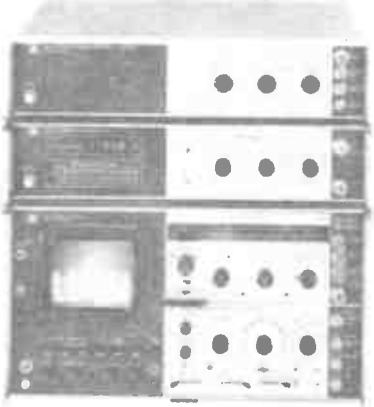

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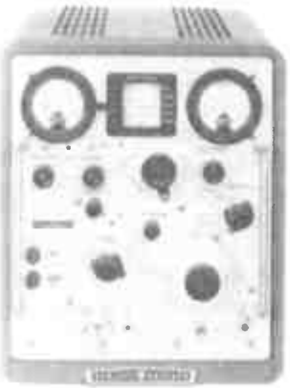

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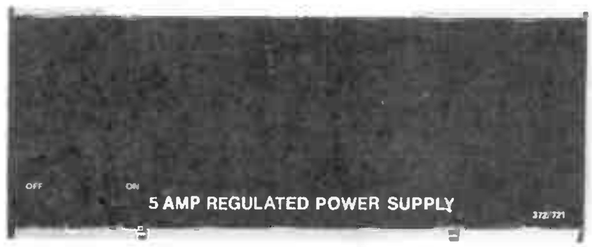

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READER INFO NO. 4

When I Think Back...

by Neville Williams

Aeronautical radio navigation beams — from civil airliners to wartime bombers!

Researching historical articles is rather like turning over proverbial stones: you're never quite sure what you'll uncover! My recent articles on the pioneering flights of Sir Charles Kingsford-Smith proved no exception. Even before they appeared in print, I found myself with photostats of two supplementary historical articles which were sufficiently relevant to warrant mention by way of a follow up.

As readers may recall, the original subject was suggested to me by Aub Topp VK2AYT, librarian for the NSW Division of the Wireless Institute of Australia. Planning a series of Sunday morning WIA broadcasts, Aub had been researching the supportive role of amateur radio operators in providing wireless communication for the *Southern Cross*, particularly for the first trans-Pacific crossing in 1928.

Once having become involved in the subject, however, I ended up by recounting Smithy's overall career and developing the theme that — over and above their spontaneous contribution in 1928 — the amateur radio fraternity had also exposed the urgent need for an official aeronautical communications system.

Just as regional governments had done for shipping during the preceding decade, the authorities would clearly have to set up permanent radio networks to meet the needs of the airlines which would inevitably exploit the routes being pioneered by Smithy and other enterprising aviators.

In pursuing this theme, reference was made to historic IRE engineering papers presented in Sydney in 1938 — one whole decade later — which clearly indicated that, while Australians had been prominent in opening up the airways, we were lagging well behind Europe and the USA in terms of back-up aeronautical radio communication and guidance facilities.

The validity of this latter observation was borne out by an article that Editor Jim Rowe subsequently came across in *Wireless Weekly* for June 7, 1935. Entitled 'Flying Blind on a Radio Beam', it had been written by none other than John Stannage — a man who was better qualified than most to comment on the situation.

John Stannage had been a crew member on the plane that found the *Southern Cross* when it was stranded in the desert near Wyndham — mainly because of inadequate radio facilities.

He had also been radio operator aboard the same plane in its historic crossing of the Atlantic in 1930 and, as an experienced marine radio operator, deserved much of the credit for guiding Smithy to a safe landing at Harbour Grace in Newfoundland.

He subsequently flew with Smithy across the USA to the west coast, to complete the world's first ever round-the-world flight.

Back in the USA in 1935, the year of Smithy's tragic death, Stannage had had the opportunity to take a close look at the mail/passenger service that had been set up by United Airlines in the Los Angeles — San Francisco area.

Relying heavily on available radio techniques for communications and guidance, UA were said to have earned a reputation for extraordinary efficiency.

Stannage knew only too well that it had been the lack of just such radio facilities that had led to the loss of the *Southern Cloud* in 1931, with all aboard — triggering the demise of Smithy and Ulm's Australian National Airways. (See panel).

Airliners in 1935

United had based its Pacific coast operation on the new American Boeing 247D transport, which Stannage described in the article as a 'beautiful Ship'. As pictured in Fig.1, it bore a superficial resemblance to the Douglas DC2 and DC3/Dakota which became a familar sight in Australia from 1936 onwards.

A sleek all-metal, low-wing monoplane with a conventional tailwheel undercarriage, the 247D had occommodation for two pilots and 10 passengers — the same complement as for ANA's Fokker-based Avro 10's. However, with its clean lines and twin 575hp Wasp radial engines, the 247D had a normal cruising speed of 185mph — more than twice that of the older Fokker design.

According to Stannage, the glass-enclosed flight deck was well equipped, but still noisy enough to warrant the pilots wearing headphones for both on-board intercom and radio communication. The passenger cabin, however, was sufficiently well soundproofed to permit normal conversation.

Ian Debenham, curator for aviation at Sydney's Power House Museum, confirmed that, appearance notwithstanding, the Boeing 247D was considerably smaller than the Douglas DC2, which had 'just appeared when John Stannage wrote his article, and which he referred to as 'huge'.

According to Ian Debenham, the success of the 247D had been such that they were in strong demand by other airlines.

Boeing put them off, however, on the grounds that their total production would be absorbed by United for the forseeable future. Boeing's rebuff presented a golden opportunity to Douglas, which came up with its DC2 — using a similar design philosophy, but larger and with a greater payload capacity.

In the 247D, the main wing spar intruded into the cabin floor space, complicating passenger seating and movement. In the DC2, the cabin was uncluttered, well insulated and roomy enough to accommodate at least twice as many passengers. In fact, the hugely successful DC3, developed from the DC2, could accommodate up to 33 passengers.

(In his book *Smithy — the True Story* referred to in earlier issues, Ward McNally notes that Smithy expressed a preference for the Douglas 'DC' series in 1935, when seeking the Australia/New Zealand mail contract. He claimed later that the British Government had let it be known that it would be inappropiate for the two colonial governments to endorse an American rather than a British plane for such a service).

On-board radio gear

Getting back to the 247D, Stannage says that he was granted free access to one of the planes on the ground, which gave him opportunity to study the nature and layout of the controls and 'the maze of instruments' which faced the pilots.

The plane was fitted with two main radio systems. One, based on a special medium-wave receiver, gave the pilot ready access to radio guidance, weather and flight information being provided at the time by the Aeronautical branch of the US Department of Commerce.

The relevant aerial was a wire 'V' running from the nose of the plane to a pillar atop the pilots' cabin and thence back to anchor horns atop either side, about midway along the fuselage. As such, the aerial was stable, with minimal drag and fairly safe from possibledamage.

In addition, the planes carried a two-channel shortwave receiver and transmitter, for independent communication with each other and with the company's own ground facilites.

A separate shortwave V-aerial ran from a spike under the nose cone to rear supports near each of the engine nacelles,

The radio equipment was housed in the nose of the fuselage, with a direct connection to the respective aerials. No tuning or adjustments were required of the pilots, all units being crystal-locked and operated by mode selector switches.

United had its main maintenance base at the Oakland Airport, Stannage was told, and each time one of the planes landed there after a long flight, a radio service engineer would open the cowling, release two clips and a supply plug and take the equipment to a service bench for a performance check. Every 200 hours it would be subjected to an extensive strip-and-check overhaul.

The radio equipment was powered by a motor-generator, running from the plane's central 12-volt battery supply — which floated across an engine-driven generator. An hydraulically operated shelf gave ground engineers ready access to the large battery for regular checks and made it an easy matter to substitute a replacement if necessary.

Info and guidance

To John Stannage's delight, he was invited to occupy the second pilot's seat on a typical Los Angeles to San Francisco flight, during which he was able to experience 1935 technology in practical, everyday use.

The takeoff from UA's sealed runway, he said, was so smooth that it was literally impossible to tell exactly when the plane became airborne.

Chief pilot Sullivan took it to 1000 feet (305m), placed it on course and, pressing the intercom button behind the left side of his control wheel, invited Stannage through his headphones to take over. Stannage found the plane to be inherently stable, apart from a slight tendency to yaw, but so easy to control that his attention soon reverted to the radio facilities.

Flying at 5000 feet (1525m), they were well clear of the mountains below, which were themselves hidden beneath an endless sea of white cloud. But the plane was exactly on course for an intermediate stop at Bakersfield, as evidenced by an unbroken sequence of dashes in the phones from the beacon at their destination. UA had opted for aural rather then visual monitoring of the guidance beam, on the grounds that an off-course deviation would be more readily noticed.

At this stage, chief pilot Sullivan pressed the right hand buttom on his control wheel and reported in on the company system:

"Hello Bakersfield. Ship 27, ship two-seven reporting."

Back came the acknowledgment, without a trace of ignition or other interference, along with information about the amount of mail and freight to be picked up at Bakersfield and the number of passengers to alight and board. Then followed the weather information that he would need:

THE SOUTHERN CLOUD.

HOPE PRACTICALLY ABANDONED.

Did Liner Crash Into the Ocean?

Five days' desperate searching by air and land has failed to provide a clue to the whereabouts of the air liner Southern Cloud, which has been missing since Saturday afternoon.

All the territory in which it is considered possible that the liner could have descended has been thoroughly searched from the air.

Hope that the two pilots and six passengers are still alive has practically been abandoned.

The possibility that the liner crashed into the sea is being investigated.

Headlines like this one from the Sydney Morning Herald for Friday March 27, 1931 dealt a body blow to the fledgling Australian National Airways, whose planes initiated a service without any radio backup whatever. Onboard two-way radio could at least have alerted the pilot of the ill-fated Southern Cloud to treacherous storms ahead, or ground stations to the plane's position.

"Ceiling 8000 feet (2420m) rain squalls, barometer three oh oh four, temperature six eight, visibility one mile (1.6km) clouds breaking at Newman...", etc.

On receipt of the information, and after calculating that they would be nearing Newman and well clear of the mountains, Sullivan headed down through the dense cloud — guided by the beam and confident that, even without a break in the clouds, he could count on 800 feet of visibility above ground.

In fact, they were able to spiral down through a break above Newman and head for Bakersfield 'skimming along' at 200mph-odd at around 800 feet, which Stannage found quite fascinating. Sullivan took the opportunity to demonstrate the beam by veering to the left, to demonstrate how the dashes changed into a letter 'A' (dot-dash) and to an 'N' (dash-dot) when he veered right.

Assured of clear weather ahead, they proceeded without incident to Bakersfield. Then to Fresno, Mills Field at San Francisco and on to the UA base at Oakland Airport, covering 350 miles (560km) in an elapsed time of just under three hours. The regular scheduled non-stop flight over the same distance would have taken just over two hours.

Stannage added that, with Smithy in the Lockheed Altair, they had covered the distance in one hour and 35 minutes, just failing to break the then record by three minutes.

Summing up his reactions to the visit he said, and I quote:

I was rather amazed by the amount of confidence placed by the pilots in their directional radio gear. They tell me that the transcontinental pilots barge right into the bad stuff en route, without the slightest fear that they may be off their course.

These days, such situations are routine. Back in 1968 I was a passenger in a Air Lingus 707 that headed across the Atlantic from Shannon in Ireland, and deliberately took its place in a 'stack' adjacent to Kennedy Airport — flying through and into violent thunderheads.

This, the pilot explained, rather than be diverted with a plane load of passengers to "God knows where" in the middle of the night. Despite the darkness, the lightning, the wind and the driving rain, we landed smoothly at Kennedy — as did as many other planes stacked up over nearby La Guardia!

But Stannage's tribute was directed in early 1935 to systems that, by then, had been installed, tested and accepted across the USA.

Another three years were to pass before our radio engineers, in conference at Sydney University, were to be briefed on aeronautical guidance and communication facilities that were only then being installed in Australia.

Beams & bombers

Amongst the photostats made available to me by Aub Topp was a copy of an article from the UK magazine *Ham Radio* for June 1989, entitled 'The Battle of the Beams' and written by D.V. Pritchard G4GV0. It had apparently been reprinted by arrangement from *Practical Wireless* for January 1988. The article had little direct relevance to the Kingsford-Smith story but, along with the foregoing Stannage report, provided a distinctly different insight into the evolution of aeronautical guidance beams.

Pritchard makes the point that the German Lorenz beam system, along with other rival technologies, had been promoted throughout Europe during the 1930's, although with a rather different emphasis to elsewhere. In America, as in Australia, cities and airports were dispersed over a wide area, with the operational range of navigation and communication equipment emerging as a prime consideration.

In Europe, with its many cities and airports in relatively close proximity — and its often inclement weather — it was more important that navigation beams be able to guide planes during their approach procedure to a safe touch-down, under conditions of very limited visibility. The different emphasis was evident in the Erben/Lorenz presentation to the IRE in Sydney during 1938. (See last issue).

According to Pritchard, Dr.E. Kramer had commenced work on the basic Lorenz guidance system in 1932, based on carrier frequencies in the range 30 - 33.5MHz, tone modulated at 1150Hz. His concept was to radiate two overlapping guidance beams from the same MCW (modulated continuous wave) transmitter, one 'keyed' with a continuous sequence of Morse code dashes, the other with a suitably synchronised

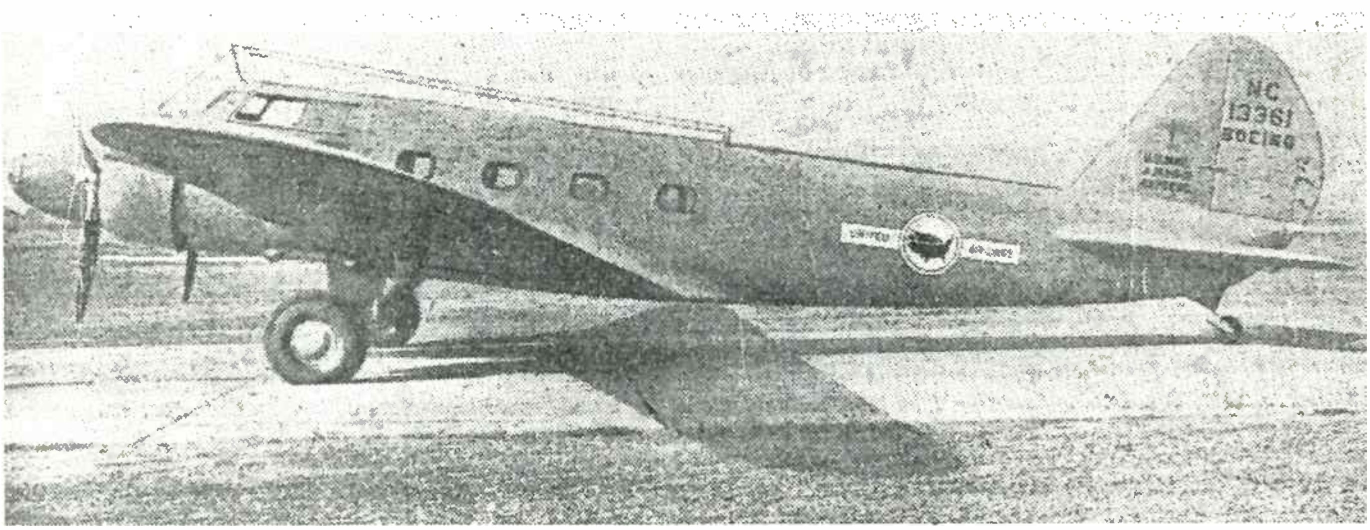

Fig.1: From Wireless Weekly June 7, 1935, a Boeing 247D with onboard radio communications and guidance facilities — which Stannage says had won for United Airlines a reputation for 'extraordinary efficiency'.

train of dots. If an approaching aircraft encountered only dashes, the pilot would know that he was to the right of the optimum approach path. Dots only would indicate the reverse. In the central overlap or 'equi-signal' region, where the receiver sensed both beams, it would merge the two modulation components to produce a subjectively continuous 'on course' tone.

(An alternative approach, referred to in the Stannage story, involved using the Morse characters for 'A' and 'N', so timed that, when overlapped, the dots would be masked, leaving only a succession of dashes).

'Keying' separate lobes

To achieve the distinctive modulation of the respective beams, Kramer installed a vertical dipole at the far end of the runway, along with two separate parasitic elements — so placed that they could distort the dipole's normal field pattern into two overlapping lobes, displaced symmetrically to either side of the correct approach path.

Both parasitic elements, however, had a gap in the centre; each gap was bridged by relay contacts, such that they could only function as reflectors when the relevant contacts were closed. By energising the relays separately as appropriate, it was possible to arrange for the respective lobes to be activated, as if 'keyed' with dots or dashes, suitably synchronised.

(Since the right and left signals were both sourced from the one tone modulated carrier, possible problems of frequency or phase discrepancy were avoided).

By way of supplementary information, an 'S' (signal strength) meter offered the pilot a broad indication of his proximity to the source antenna. But a separate vertically-orientated approach beacon on 38MHz gave him a blip of distinctively different modulation, to indicate that he was 3000 metres from the start of the runway. A second approach beacon signified 300 metres to go.

As the Lorenz technology evolved during the 1930's, it was licensed to other countries and evaluated, from time to time, by the various major airlines and air defence forces. However, with the outbreak of war in 1939 its possible role had to be re-appraised, both as a domestic navigation aid and as yet another radio transmission that might conceivably serve to guide marauding aircraft to strategic targets.

Aware that this and other emerging technology could have a profound effect on the outcome of modern-day war, Britain moved to strengthen that aspect of the Military Intelligence Service (M16). What turned out to be a particularly fortuitous step, according to D.V. Pritchard, was the appointment in 1939 of a relatively young physicist, R.V. Jones, as Scientific Officer to M16.

Born in 1911, Jones had rounded off his formal education with an Open Exhibition in 1929 to Wadham College, Oxford. There he worked in the Clarendon Laboratory under Professor Lindmann, who later became Lord Cherwell and Scientfic Adviser to Winston Churchill.

Fortuitous hunch

In early 1940, Jones had a premonition that the Germans could be developing a radio navigation system to increase the effectiveness of their night bombing raids. Apart from the technical logic of such an idea, examination of documents from crashed German aircraft turned up the code name 'Knickebein' — meaning 'crooked leg'.

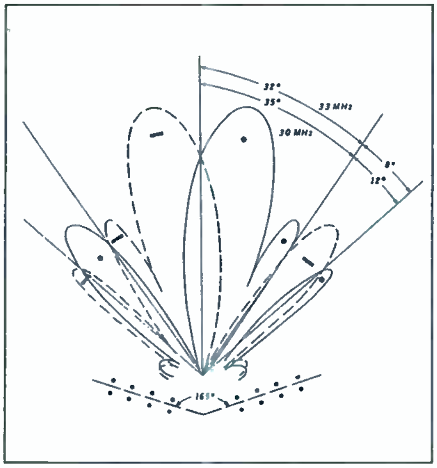

Fig.2: Reprinted from Ham Radio for June 1989, this diagram shows the radiation pattern from a typical wartime Knickebein array. It extended the range by using twin phased arrays, suitably angled to concentrate the energy into two slightly overlapping forward lobes.

From its sense and context, M16 and Jones concluded that it might well signify a radio beam of some kind.

The speculation was heightened when two prisoners were overheard discussing 'X-gerat' ('secret apparatus'), being evidently something used in German aircraft and involving radio pulses. Could it relate in some way to Knickebein?

That such could indeed be the case was indicated by the navigator's notes from a downed Heinkel, which read:

Navigational aid: Radio beacons working to Beacon Plan A. Additionally from 0600hr Beacon Duhnen. Light Beacon after dark. Knickebein from 0600hr on 315 degrees.

Shortly afterwards, an ostensibly 'co-operative' prisoner made the mistake of 'confiding' to the British what he wrongly assumed that they already knew: that Knickebein was a beam so narrow that two of them could pinpoint a target with an accuracy of less than a kilometre. It was related to 'X-gerat'.

Having by this time broken the German 'Enigma' code, M16 operators were able to identify further fragments of the jigsaw from other documents recovered from crashed enemy aircraft. One carried a German aircrew report of having received a beam a few miles south of Redford in Nottinghamshire, which had originated in Kleve — on the nearest German soil to England.

Other papers captured a few days later identified a second (or marker) beam being radiated from Bredstedt in Schleswig-Holstein. Jones' hunch had seemingly been authenticated, but it triggered time-wasting argument between the military buffs who were privy to what Jones was on about...

Technical conundrum

They were aware that the Lorenz system, as deployed in Europe, had a range of 10 miles at best (16km), with relatively broad lobes that were adequate as landing aids only because the focal point was co-sited with the home runway. It seemed unlikely that the Germans had been able to upgrade the concept sufficiently to sharpen the lobes to less than a kilometre wide at 300km or more from their point of origin. But who could be sure that they hadn't?

On the other hand, sharply defined beams might suggest transmissions at a centimetric wavelength — yet it was unlikely that available valves could deliver sufficient power in this portion of the spectrum. Yes, but German engineers had been quietly experimenting since around 1930, with radar techniques on 50cm; they might just have overcome the valve problem!

That aside, because of the quasi-optical nature of very high-frequency transmissions, others contended that the signals would not conform to the curvature of the earth anyway, but follow a straight path rising above the altitude limits of contemporary bombers.

It was left to an amateur, Rowley Scott-Farnie G5FI, then a signals officer in RAF Intelligence, to alert Jones to a report by T.L. Eckersley — Britain's foremost propagation expert. If Eckerley's calculations were correct, a 20cm wavelength beam originating in

the Hartz mountains would indeed exhibit sufficient curvature to be detected by a plane flying over England at 20,000 feet (6,100m).

With Eckersley's article in hand, Jones was able to convince Professor Lindmann — Churchill's technical adviser — that guidance beams were at least technically feasible.

The big problem was that M16 had never been able to find anything in crashed German planes even vaguely resembling a centimetric wave receiver. The nearest thing was a seemingly ordinary E BL-1, a blind landing receiver that could as easily have come from a British plane.

Interrogation of German fliers yielded nothing new, but one was overheard to say in casual conversation that, no matter how hard the British looked for the equipment, they would never identify it. Jones interpreted this to mean that it was right there under their noses, and they simply hadn't recognised it.

Unwitting challenge

With this possibility in mind, Jones quizzed the technicians at Farnborough who had evaluated the German E BL-1 receiver. Was there anything unusual about it?

"No", they said, then adding as an afterthought, except that it was "many times more sensitive than they would ever need for blind landing". Could that hold the key to the situation? Was the E BL-1 fulfilling a double role?

As Rowley, G5FI commented to Jones, it was entirely feasible that the Germans had sought to disguise the beam system by operating it on accepted Lorenz frequencies (say) 30, 31.5 and 33.3MHz. This would check, what's more, with further recovered German flight documents, including mention of another Knickebein installation, this time at Stollberg.

Unfortunately, three Anson bombers fitted with standard Lorenz equipment and flown by Lorenz-trained pilots failed to discover any trace of alien guidance signals, over areas that were conceivably being targetted.

The impasse led to a top-level meeting between Churchill and a number of Service Chiefs, seeking to resolve the question as to whether the Knickebeins posed a tangible threat and/or whether the diversion of further time and trained personnel to their investigation was justified.

Jones, who had been invited to attend, quickly realised that much of the opposition came from men who had been inadequately briefed in a predominantly technical subject; so he sought and was granted an opportunity to recount and explain his convictions from start to finish. Twenty minutes later, his listeners were better informed but still far from unanimous.

Fig.3: The site of the second Marconi transmitter near Harbour Grace, which replaced the first one — destroyed by a cyclone shortly after its erection. The building on the right houses a model of the installation. Adjacent to it is a memorial obelisk and, to the far left, a viewing platform. (Photo by 'Blue' Easterling).

Whatever errors of judgment may have been laid at Churchill's door in other situations, he came up with the right decision on this occasion — tearing strips off the Air Ministry for their tardiness and obduracy and ordering them to get up there and 'find those beams once and for all'.

But, even so, Jones' troubles weren't over. Some still argued doggedly that beams or no beams, German pilots would continue to find their targets, just as RAF pilots were able to do over Germany. Ansons had consistently failed to find Knickerbein signals in the past — why should they be any more successful now?

They and their crews could be better employed on other assignments. Under pressure, even Eckersley was equivocal about his earlier pronouncement: yes, he *could* possibly have missed something in his maths!

Success at last

But the Ansons did go up, and one of them — fitted with a sensitive Hallicrafters receiver — did find a narrow alien beam, 400 - 500 yards (or metres) wide just south of Spalding, on 31.5MHz, with Lorenz dash/dot modulation.

They had flown along the equi-signal path, plotting it as they progressed, duly encountering an intercepting marker beam at a point near Beeston. The designated target was clearly Derby, the site of a Rolls-Royce factory producing engines for the RAF.

It was the kind of evidence that could not easily be ignored. With doubts abruptly dispelled, attention turned urgently to unravelling the technology and to possible counter-measures.

How had the Germans transformed a local, blind landing aid into a sharply defined, long-range beam? The answer: by the same basic techniques that amateurs had exploited during the same decade to extend their local 'rag-chews' across states, continents and oceans — by replacing unpretentious antennas with high gain beam arrays and upping the input power level for extra measure.

It turned out that, back in 1938, with war clearly in the offing, Dr Lohmann of Telefunken had discreetly devised a huge new array, conforming to the Lorenz frequency parameters.

Involving metal girders 30m high, spaced out over a distance of 90m, it was shaped like a shallow 'V', with an angle of 165°, and overlooked the runway, as did the original Lorenz antenna.

Mounted on a circular track, however, with a 50-watt transmitter at its centre, it could be rotated to project the beam in any desired direction. While able to double as a landing aid in conjunction with normal Lorenz receivers, it had another, more sinister potential role in view.

The actual antenna, supported by the

framework, comprised a total of 16 vertical dipoles and the same number of reflectors — eight of each per side — forming huge, twin, phased arrays, with lobes broadly similar to those illustrated in Fig.2.

Because of its supposedly 'broken necked' appearance, or 'geknickten' in German, it was given the codename of 'Knickebein' — which proved sufficiently transparent to attract Jones' attention.

Pritchard says that the precise details of Knickebein antennas, transmitters and receivers appear to have been lost, but Dr Lohmann's original array was followed by smaller and less conspicuous structures comprising half as many elements — four dipoles and reflectors in each leg — constructed of large diameter tubing to achieve a bandwidth covering the range 30 - 33MHz. The centre, equi-signal zone was +/-0.6° wide, as compared with +/-0.3°, but the range was much the same.

Ten such arrays had been set up by 1940. Lorenz/Knickebein receivers were also progressively installed in all German multi-engine combat aircraft.

Early model receivers were TRF types, which proved to be unduly susceptible to jamming.

In response, Dr W. Kloepler of Lorenz came up with a superhet alternative, switchable to 34 channels in the range 30 - 33.3MHz. Physically, it was a more or less direct replacement from the earlier model and carried the type number EBL-3H, presumably to support the masquerade as simply a new and improved landing aid.

British countermeasures

Once convinced that Knickebein posed a major threat, the development of countermeasures was accorded the highest priority under Wing-Commander E.B. Addison of No.80 Wing at Radlett and Dr.Robert Cockburn of the Telecommunications Research Establishment at Worth Matravers.

Manned receivers were placed in dizzy 'crow's nests' atop selected Home RDF (radar) towers, to keep watch for the beams which some had argued would never be heard over Britain at less than 20,000 feet.

But they certainly were heard and, when they were switched on around dusk, reports from the towers were correlated to indicate their likely orientation. Ansons were then sent aloft to track and plot them accurately.

Meanwhile, medical diathermy equipment and industrial RF generators were requisitioned from available sources and 'fiddled' to concentrate their noise output on the Knickebein frequencies. Installed in police stations, they were switched on and off at the discretion of No.80 Wing.

As a further measure, all available Lorenz equipment was modified and strategically located to operate as 'Meacons', or mock beacons, to confuse the pilots trying to follow the Knickebeins. Or, again, by placing a false marker short of the target area, German aircrews could hopefully be induced to drop their bombs in the countryside short of the target.

But the most effective countermeasure, according to Pritchard, was Cockburn's so-called 'Aspirins', which had been specially designed to cure the 'headache' presented by the Knickebeins.

Immensely powerful transmitters, they could flood the Knickebein route with false dashes, causing the pilots to fly 'in circles' searching for the companion dots. Or they might still hear dashes when they were actually in the equi-signal zone.

Contrary to some statements, the German Knickebein beams were never actually 'bent' by the British countermeasures — but the level of confusion was such that they may just as well have been!

After a few weeks of this, Luftwaffe aircrews realised that their beams had been completely neutralised. Ironically, however, it reportedly took several months before anyone had the courage to tell Luftwaffe chief Hermann Goering that his Knickebeins had become totally useless.

Had it been otherwise, according to the article, the system at its best would have been able to direct a bomber force to drop bombs every 17 metres across a designated target area! Who knows, asks Pritchard, how much more destructive the bombing might have been but for the perception and persistence of a young physicist who refused to be silenced by the 'experts'?

Mind you, how many residents in Britain's cities have even heard of Professor R.V. Jones — or his amateur friend G5FI?

Newfoundland in 1901

Rounding off the avionics theme, earlier mention of Newfoundland and Harbour Grace reminded me that, if radio guided the *Southern Cross* to a safe landing at Harbour Grace in 1930, it was only in 1901 that Marconi and Vyvyan, using crude brute-force spark equipment, had managed to launch the first-ever radio transmission across the Atlantic to that same remote spot.

The background to that historic transmission was detailed, you may recall, in a letter from W.A. ('Blue') Easterling featured in this column on pages 42-45 of the May 1991 issue.

That, in turn, reminded me that 'Blue' (Wal) Easterling had come across another photo that he had taken of the lonely, windblown site at Cape Cod, where they had erected a second antenna array to replace the one blown down a few days after it was erected.

If you do turn back to the story, as above, note that Walfleet should read Welfleet and the reference to arc supply volts should read 20,000/200 rather than 2000/200. In anybody's language, that's a lot of volts to be keying!

Thinking back over his own training in the spark era, Blue says that enormous RF voltages were developed on arc transmitter antennas, especially if the L/C ratio of the system was too high.

'Brushing' or corona effects would be evident across the insulators, or to any nearby metal object. All that remains now of Marconi's historic radio station are a few footings on the sandspit, that has been savagely eroded over the intervening years by recurrent Atlantic gales.

As I wrote the caption for Blue Easterling's picture, I called to mind Erben's preamble to his lecture to the IRE in 1938.

Although he was about to describe state-of-the-art navigational equipment for aircraft, he warned his listeners that it was the product of 'our two youngest technologies', both of which were still undergoing rapid development. How dramatic those developments have been — all within the lifespan of a single generation. (My own mother is only days away from her 99th birthday!)

In 1901, wireless telegraphy was still a primitive by-product of electrical engineering. Heavier-than-air flying machines were about to enter the manned glider stage. By 1931, more functional but still primitive wireless equipment was able to guide a practical aeroplane to a safe landing in Newfoundland.

Today, the world is being criss-crossed by hundreds of lavishly appointed jumbo jets and supersonic airliners. Space ships and satellites orbit the earth, all of them guided and/or controlled by modern high-tech radio.

I wonder whether Erben imagined, even in his wildest dreams, that people in his audience would live to see the day when satellite technology would be able to pinpoint the location of ships, aircraft, land vehicles and even individuals, within metres of any point on or above the earth? ❖

Moffat's Madhouse...

by TOM MOFFAT

Seriously, it's a taxing matter

Most months I try to keep this column somewhat lighthearted — a sort of friendly oasis, in a land of intense technology. But this month we've got to get serious. I want to discuss with you something that's been bugging me for a long time; something that has the potential to bug you too, especially if you run a small business. The subject is consumption tax, or GST.

As we all know, there is a plan afoot to introduce a 'goods and services tax' on just about every financial transaction we make in life. This plan is conditional on a particular political party gaining office; in other words it is an election promise. I don't for the life of me see how anyone can expect to get elected when their main pledge is for a new tax, but if they can get the voters to believe the new tax isn't *really* a new tax, then maybe they'll pull it off.

I should state at the outset that I am not a party political person. I have voted for many candidates, from many political parties, or for no party at all. I have even been known to vote for opposing parties in the same election, if each of their candidates have policies I find attractive. I would have to be the classic 'swinging voter', so I'm not here to plug one party against another. But this consumption tax idea must be resisted.

If you are a wage earner or a public servant or someone on a nice, steady, pay-as-you-earn weekly pay package, then perhaps you won't feel the sting of the consumption tax so much. You'll pay more, but you'll soon get used to it. If, however, you make your living from a small business — or worse still, if you're 'self-employed', then it appears that a consumption tax as envisaged by Hewson could change your life for the worse — forever.

The problem isn't that costs of things will go up. The problem is that you, as a small businessman or self-employed person, will become a tax-collector for the government. Keating mentioned this once when he said that every shopkeeper in the land would spend Sunday afternoons filling out the week's consumption tax returns.

It isn't often that I believe what Keating says, or what any politician says for that matter, but this time I feel he's hit the nail on the head. Trouble is, it was just a passing remark, and I don't think many shopkeepers or other small businessmen have yet got the message.

I have a particular interest in this matter because I am a self-employed shopkeeper, of sorts. People don't come through the door to buy stuff; I send it out through the post. But the fact remains, I have LOTS of customers and I make LOTS of financial transactions every week. I buy stuff in, I sell stuff out. I will be in the 'goods' part of the goods and services tax. I'm sure many *EA* readers will be in a similar situation.

As for services, how many readers are involved with some version of 'Joe's Friendly TV and Video Service'? Well, YOU will be in the 'services' part of the goods and services tax. From now on, all of us will have to record the finest details of every business transaction and dutifully report them to the government.

Under our current sales tax system, larger 'small' businesses buy their raw materials sales-tax-free, but they must then charge sales tax on the finished products as they sell them to the end user. Sales tax returns must then be submitted to the tax office on a regular basis.

But one-person operations like *Joe's TV Repairs*, if they're small enough, simply pay the sales tax on what they buy and build the expense into the charges to the end customer. There is no direct involvement with the government.

I am told by the Sales Tax Office that a business must have a turnover of at least $50,000 a year to come under the wholesale sales tax system. This would most likely exclude a large proportion of *EA* readers who earn a simple and satisfying living doing electronic servicing or a similar activity.

I know I would feel very fortunate indeed if my one-man electronic business turned over $50,000 a year.

However under the GST system it looks like we will *all* become tax collectors. One-person businesses and self-employed people will have to pay consumption tax on the goods they buy; in my case on the parts purchased to produce the kits. This will in theory reduce the tax paid at purchase from the normal 20% to 15% — BUT we will then have to charge another 15% consumption tax on our finished products.

Promoters of the GST say businesses can then claim back the tax they paid on the goods they purchased. But the only way to do this will be to fill in a complicated government form, detailing every sale made and the GST collected for the government, while at the same time trying to claim back the GST you have PAID for the things you have bought. Until this form is completed, everything you make will have been taxed twice — once coming in the door, and once going out the door.

However it is anticipated that this double-tax period will be very short, because the forms will have to be completed regularly — perhaps weekly. Like every Sunday afternoon.

Now I don't suppose the fat cats in their ivory towers realize it, but most of us self-employed folk already work seven days a week. (*Editor's interjection: some of the rest of us have to do so, as well!*). This column is being written on a Sunday afternoon. Maybe we can do our consumption tax forms on Sunday nights...

The tax forms will contain lots of information useful to a government. For instance, they will know, perhaps week by week, what goods we bought from which supplier, how much we paid, who we sold our finished products to, and how much they paid.

Their computers will know which businesses did well that week and which businesses did badly. They will know

[illegible]

exactly how our economy is running; which businesses coributed, which businesses didn't contribute. Perhaps if they could get rid of the businesses that didn't contribute so much, our economy would improve...

But how could the government rid itself of businesses that don't contribute what the government thinks they should contribute? Simple. License them. No licence, you can't run your business. If a business hits bad times, pull their licence! Have the business painlessly destroyed.

Don't laugh. In many parts of the world you already need to have a licence to run a business. Politicians love it — grease my palm, the licence is yours. Offend me — you're gone!

Never happen in Australia? Don't believe it. In some places licenses to do business take the form of 'building permits' — the licence to conduct the business of undertaking a construction project is awarded after careful political, and sometimes financial consideration.

Or say you want to start up a radio station. You must have a licence from the government to do so. To be sure, a large part of the licence requirement is to ensure that your station doesn't cause interference to other radio spectrum users. But the government must also approve the type of material you intend to put to air; the content of your broadcasts. There's certainly nothing to stop some future government from using the licensing system to prevent the broadcasting of 'incorrect' thoughts.

But one part of broadcast licensing the public doesn't hear much about is the government's deep investigation into a potential broadcaster's financial status. If the government doesn't deem the licence applicant to be financially suitable, then no licence is issued.

What business is it of theirs, anyway? If somebody starts up a radio station and then goes broke, then the station simply goes off the air again. There's no skin off anybody's nose other than the station owner's.

Why then is the applicant's financial status such a big thing? One suspects a lot of it has to do with the government wanting to know for sure who the licensee's backers are.

Another possibility is licences for newspapers. It would then be a simple matter to silence some ratbag commentator who said embarrassing things about the government. You wouldn't have to cancel a paper's licence — you would just have to remind the paper of the existence of the licence and of who issues it.

If the paper wanted to remain in business it would have to muzzle the commentator, or sack him. If the paper didn't cooperate, it could be found to be 'financially unviable'.

No way, you say — licences for newspapers will never come. But perhaps they are already here. The government has a strong ability to determine who will control newspapers, by specifying which person or group can own what percentage of a given paper.

Much of this is based on foreign ownership rules, but the lack or presence of a foreign investor has a direct influence on which Australian investors are allowed to own which newspapers.

Maybe the government won't force businesses to have licences to exist. Not this time around. But 20 years on, with the GST data bank firmly in place, perhaps some future government won't be able to resist the temptation of total control of the community's finances.

Remember a few years ago the government tried to float the 'Australia Card' as a way to keep a file on each and every loyal citizen. The community knocked that one on the head, in grand style. But now we have the tax file number system, which is still a file on each and every loyal citizen but without the physical plastic card.

Now it is proposed to introduce what is essentially an Australia Card for every business in Australia, from the smallest cottage industry to BHP. These files, of course, could be quickly linked with the existing tax file number system so each business's file will then include not only its current trading results, but pointers to files on every person connected with the running of the business. Are we ready for that, in this 'free' country?

What can we do about it? Here you might be expecting me to say "don't vote for the Liberal Party". But that wouldn't solve anything; maybe it would mean throwing out a perfectly good policy package just because of one bad apple in it.

Whether the Libs' other policies are good or bad, or Labour's policies are good or bad, is not the point of discussion here. It's simply the GST and its threat to the whole structure of small business.

If Australia goes into the election with its eyes open, I don't think the Liberals can win with their GST. They have already taken a significant thrashing in the recent Wills by-election.

Lots of voters hate Keating, though, blaming him for the pain of the recession, and maybe the Libs are banking on a protest vote. But wouldn't their chances be much better if they got rid of this silly GST idea?

Perhaps small business people and the self-employed should word up a few Liberal politicians and remind them that there are going to be a lot of angry people when they feel the yoke of the GST around their necks. The Libs might squeak in this time, but next time, watch out! ❖

FORUM

Conducted by Jim Rowe

Personal computer 'user interfaces': DOS diehards versus the GUI lovers

I had a feeling that Tom Moffat's critical comments about GUI's (graphical user interfaces), in his April column, would stir up a bit of controversy — and there has certainly been a strong response, both for and against Tom's position. I also have an interesting item about vintage radio, although one that might bring tears to a few collectors' eyes...

Reader surveys have suggested that over 75% of *EA* readers are owners and/or users of personal computers, so I guess most people reading this column will be well aware that there are basically two kinds of 'user interfaces' on today's PC's: the text-driven 'command line interface' or *CLI*, and the 'point and click' mouse-driven 'graphical user interface' or *GUI*.

For those who aren't quite so familiar with PC operation, I should perhaps give a bit of background. With most of the early computers — mainframes and mini's — the only real way of communicating with the machine's operating system was by typing in simple text 'commands'. Usually these would be the name of the program you wished to run, or a brief and often cryptic one-, two- or three-word statement to achieve things like file copying, printing etc.

The early PC's used the same kind of system, which has become known as the *command line interface*. And this kind of 'user interface' is generally still available on most modern PC's — especially those of the IBM-compatible type.

For example with this kind of computer, if you want to do some word processing using say *Wordstar*, you simply type:

WORDSTAR

on the DOS command line, and then press the 'Enter' or 'Return' key. The DOS operating system will then load *Wordstar* from your hard or floppy disk, and transfer control to it. When you've finished with word processing, you can exit from *Wordstar* and return to DOS — after which you can run some other program, simply by typing its name instead.

With this system DOS also communicates with you, the user, in simple (and often *very* cryptic) text messages — either to tell you that you've done something wrong, or that it has/hasn't done something you asked it to do.

Now this CLI system is actually quite easy to use once you get used to it, especially if you have a bit of technical or scientific background. And it is fairly undemanding in terms of both computer hardware and software; it can run on machines that are quite modest in terms of speed, 'crunch power' and memory capacity, and the DOS program itself tends to be quite small in size — typically around 50-60 kilobytes.

But the PC revolution brought computers well down in price, and made them accessible to many other people besides we technical types. And non-technical people have tended to find the DOS/CLI system a bit arcane and off-putting. As a result, computer firms cast around for a way to provide their machines with a user interface that would be more 'friendly' and intuitive for non-technical users.

Happily this came about at much the same time that chip technology made it possible to provide even low-cost PC's with quite respectable video graphics capabilities. And research establishments like that run by Xerox at Palo Alto, in California, had also been able to take advantage of early computer graphics systems to develop the *graphical user interface* or GUI — where the computer presents a series of little images or 'icons' on the screen, along with various 'pull down' or 'pop up' menues which present all of the available options. The user can then select what's to be done by manipulating a small pointer 'cursor', using a device such as a 'mouse' or 'trackball', and simply pressing a button.

This GUI approach turns out to be very much easier for non-technical users to grasp, due to its more intuitive nature. Many technical people find it convenient, too — especially where quite complex software systems have to be used.

The main complication with the GUI approach is that it is much more demanding in terms of computer hardware and software. Because relatively complex images have to be drawn on the screen and changed repeatly, quite a lot of computing speed and 'horsepower' are required; and the operating system and/or its GUI 'environment overlay' has to be much more complex, so that it tends to grow many times larger than a simple DOS/CLI operating system. Typically it grows to a few megabytes, so that the computer now needs much more memory and disk capacity — even to run the DOS/GUI system, let alone your application programs!

Still, memory chips are getting cheaper all the time, in real-money terms, and so are hard disk drives. So you can argue that the cost of adopting a GUI system is getting cheaper by the day...

The first personal computers to feature a GUI were of course the Apple Macintosh series — or strictly, their immediate and ill-fated big sister, the *Lisa*. Somewhat later, various firms began to provide similar GUI 'facades' for the DOS in IBM-compatible machines; the most notable of these being Microsoft's *Windows*, which is now used quite extensively.

So that's the general background to this debate. And the debate itself arises because some people (Tom Moffat included) have resisted the trend towards GUI's — arguing that any benefits they offer are far outweighed by the need for faster processors, much larger memories and bigger disk drives. Others, of course, argue that this kind of attitude is reactionary — and akin to the 'Luddites' who tried to resist the industrial revolution...

FORUM

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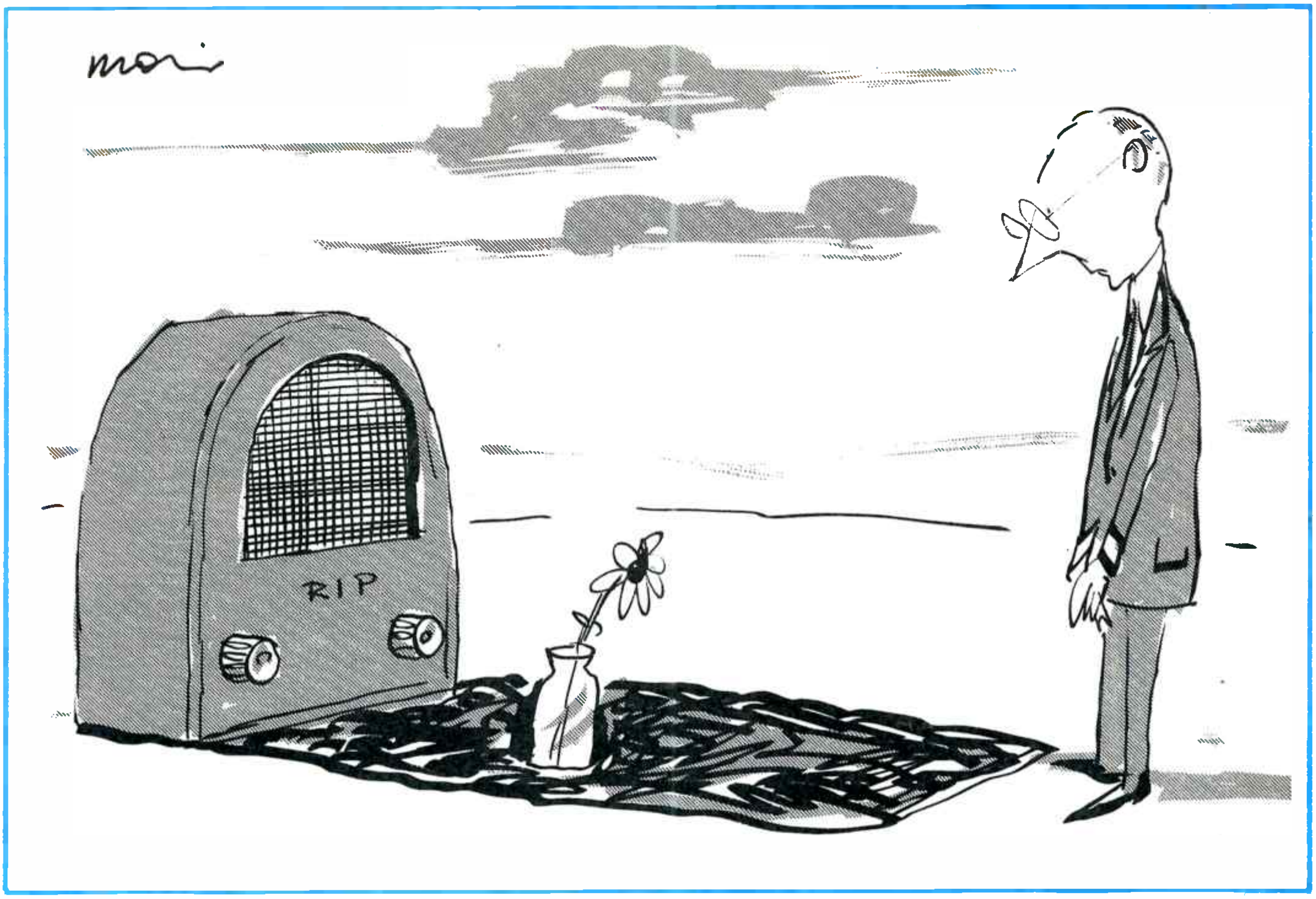

With everyone hopefully in the picture, then, let's look at the kind of responses that were evoked by Tom Moffat's April column. I won't try to present a lot of different letters, because they basically fell into two broad camps: those who wanted to congratulate Tom for having the courage to speak out against GUI's, and those who thought he was a reactionary old fogey. This being the case, it seems best to select one good letter from each group, and let these represent the rest.

The pro-Moffat side...

Representing the pro-Moffat side, then, in the anti-GUI corner, here is the letter that came from Mr John Donaldson, of Sandringham in Victoria. Mr Sandringham titles his letter 'The Emperor has no Clothes', and proceeds thus:

I would like to write and congratulate Tom Moffat on his article 'GUI — Phooey', in the April issue. I think that Mr Moffat has dared to say what maybe a lot of people are feeling — that while there have been some wondrous developments in programs and hardware, the programs have expanded in 'Parkinson' mode to fit the hardware, and vice-versa.

I am old enough to have built a Twin-10 Watt valve Playmaster, and my first computer was a Sorcerer with a 'whopping 48K of memory', courtesy of Dick Smith (his words, not mine). 'Megs' were not invented, or maybe things that were associated with resistance.

The Sorcerer started off with an 8K BASIC ROM pack, and then MDOS and CP/M, which were each about 3K. I still have the Sorcerer — in fact two of them, both looking for something useful to do. Their life was extended by membership of an active user group, and my steam-driven machines ended up with 700K RAM disks and other goodies. The Melbourne Sorcerer User Group were enthusiasts and pioneers.

My IBM clone, a 286 NEAT, is strictly DOS using a lovely little program called 'LeMenu' as the menu CLI — and with its co-processor and lots of 'megs', gives excellent service.

My son's 386 D-33 is even better (he uses the Windows 3 GUI and I don't). I have dabbled with GUI's, which leads me to comment and agree with Mr Moffat.

I use Microsoft 'Word 5.0', a good word processor with far more features than I will ever need, and which uses about 2 megs of my hard disk. If I purchased a copy of the new Microsoft 'Word for Windows 2', it would need something like 15 megs to install! Add this to Windows 3, which needs another 5-6 megs or so, then 50% of my hard disk space is used.

Sure 'Word for Windows 2' has a lot more bells and whistles than 'Word 5.0', but it is nearly 10 times as big, needing of course the more powerful machine.

I recently carried out a test, running 'Word 5.0' under Windows on the 386, and also using the same program on the same machine but under straight 'DR DOS 6'. Using Word's screen preview command for simple word processor text, the reduction in speed to write the screen — running under Windows 3 — was most significant (like about 50% slower). And obviously in graphics mode, even with a fast machine, the overhead in processor time and memory usage was significant. I wasn't multitasking, just making a simple comparison.

To be fair, no doubt Windows programs run best under Windows, and 'Windows 3.1' is apparently more efficient. But it does make the point that some of these calls on the system, in terms of processor time, RAM and disk storage do make you wonder just where it is all going to end. Of course it never will, whilst Messrs Intel, Motorola and

Co keep coming up with faster chips, and people keep buying them.

So I thing that Mr Moffat has a valid point, in seriously questioning that the call for 'bigger is better' really means 'grander', but maybe 'less efficient'. By querying the direction of the industry, he is saying that 'the Emperor has no clothes'.

I hope that in fact, progress may mean more efficient AND elegant — better use of the power of modern computers, rather than the large and sometimes brute force techniques which seem to be more prevalent than they should. I also get very tired of looking at that hour glass!

Thank you for your comments, Mr Donaldson. I think many of us who have lived through and been involved in the development of either computers as a whole, or even just PC's, will share with you the feeling that at least some of the GUI-based software is pretty inefficient. Now that memory chips, more powerful processors and high-capacity disk drives have become relatively cheap, it does seem that programmers are losing their former motivation to produce tight, efficient and compact code.

In fact many of the new programs seem to offer very little over their earlier predecessors, apart from needing a faster machine and a great deal more memory/disk space. No wonder people like Tom Moffat have expressed the thought that perhaps the computer hardware manufacturers are encouraging programmers to write ever-bigger and more complex programs, so they can have a continuing market for their newer and fancier machines...

And those agin'

But let's turn now to the opposite corner, ladies and gentlemen, where the pro-GUI side is impatiently waiting to present their case. Representing the pro-GUI team is Fred Stratford, currently of Kedron in Queensland, who you may recall recently contributed a pair of articles describing a program which emulates the operation of a basic CPU. Fred has been using computers for many years too, but he takes a somewhat different view to that of Tom Moffat and John Donaldson:

Firstly I wish to point out that I am not one of those trendy computer types with pot plants nearby and 'slinky black women' swanning around — not that I have any objection to slinky women of any colour, or even pot plants for that matter. (I must however join Jim Rowe in his dislike of thongs!) And I am not 'buzzing around' like a hornet, ready to defend GUI to the death.

I also regard the computer as a tool. However I object fundamentally to the assertion that a computer is not useful unless it is connected to a 'process' like a radio, etc. I assure Mr Moffat that computers doing functions like financial, materials or maintenance management are as much tools as those controlling some industrial process. I wish also to draw out some of the inconsistencies and errors behind his article.

Let's take interfaces for a start. Interfaces are not the clear-cut classes that Mr Moffat implies. Interfaces cover the complete continuum from CLI's through techniques such as function keys and menues of various types (pull down, pop up, etc) through GUI techniques and on to the futuristic ones such as pen based, voice controlled etc.

Now Mr Moffat implies that all of his favourite programs are CLI based. What he actually means is that they START from the DOS command line (which is a CLI system), and then proceed to use whatever interface technology they use internally — which is very unlikely to be CLI. I am sure the video display editor Mr Moffat uses does not provide a prompt line at which he types commands — it will almost certainly use a combination of function keys and menues, and the arrow keys to move around the screen.

If Mr Moffat likes command lines so much, he already owns a great little command line editor that came with even the first versions of DOS — EDLIN. I take it Mr Moffat is not so masochistic?

From personal experience, I know that the PCB layout program Mr Moffat refers to isn't quite command-line driven, either. I seem to recall that it uses a combination of pull-down menues, function keys and arrow keys, plus a mouse if you wish. In fact it even displays the PCB on the screen, so it can be seen. The cursor is steered directly, so that its movement can be seen. None of this 'move the cursor right six times' stuff, typed in at a command line prompt...

In fact VERY FEW applications employ CLI technology, because it requires memorising a fair number of sometimes quite obscure commands. One of the few exceptions was the dBase series from Ashton-Tate (now Borland). This provided one mode where a 'dot prompt' appeared and the user had to type in the appropriate commands. It was great for users who were prepared to put in the time and learn the package in depth, but for more casual users it was not so good. As the series has developed, the dot prompt has been retained to support the experienced user, but other modes have been added — such as 'Assist' and the report writer, to make the package accessible to casual and non-programmer users.

The only other package which comes to mind that uses a CLI to any extent is DEBUG, which is also a DOS freebie.

The point about man-machine interfaces can be taken one step further yet. As a case in point, I use four programs regularly. These are WordPerfect 5.1 for word processing and some elementary desktop publishing; a pair of good shareware packages for a spreadsheet (ASEASYAS) and drafting (DRAFTCHOICE); and finally Borland's TURBO PASCAL 3.0 (yes, 3.0!), when I feel the urge to cut a line or two of code. All of these except the last are 'mouse aware', but are not Windows 3 packages.

No consistency

Now none of these packages is consistent. Help in WordPerfect is obtained by pressing the F3 key, but the more usual (and de-facto standard) F1 key is used with ASEASYAS and DRAFTCHOICE, while TURBO PASCAL 3.0 doesn't recognise the need for help at all and I have allocated F1 to exit the edit mode. I could make a similar point for all of the functions performed by each package. Any consistency is purely accidental.

I must make another point before leaving this area. I certainly prefer mouse-aware packages. Marking text for moving or deleting is certainly more natural, as well as faster with the mouse. I still feel that moving to TURBO PASCAL 6.0 on these grounds is not quite justi-

[illegible]

A picture sent in by reader Colin MacKinnon, after he saw Peter Lankshear's book 'Discovering Vintage Radio' in his local bookstore. We couldn't resist publishing it, for reasons explained in the text — but if you're a vintage radio enthusiast, you may not be too happy about what you read...

fied, as I do too little programming these days, but the temptation is there (besides the extra features of TURBO 6, of course).

Now this might not worry Mr Moffat, who is constantly using a few packages, but I can assure him that it annoys the blazes out of any poor casual user who must remember a raft of different commands and functions, each time they use a package. And it's not only annoying but costly, because more time is lost or training is spent on the package, instead of using it to improve the quality of the product or the service of the company in question.

Another point which seems to be on Mr Moffat's mind is 'not fixing things which ain't broke'. Now being an ex-maintenance person I can relate to this. The problem is the definition of 'broke'.

DOS is an old package now. It really grew out of CP/M, for the older 8-bit machines — not a direct lineage, to be sure, but quite recognisable. It was designed to run on the 8088/8086 series, which was really an upgraded 8085. This was a good strategy at the time, as the old 8080/8085/Z80 software could be adapted to run readily, giving an instant source of software. Remember Wordstar and Visicalc? The new DOS allowed access to the 1 megabyte of the 8088 system, and some very reasonable decisions about giving the user a 'massive 640K' were made. This was 10 times what anyone had been used to, and seemed more than adequate at the time.

However technology marches on, and so do expectations. Packages have become larger and more functional. People expect things not even dreamt-of a few short years ago. The 64K pages and 640K limit of the 8088/DOS system make for multilpy-overlaid and generally disk-bound programs. All this could be fixed only if the 'protected' mode of the advanced processors (80286, and particularly the 80386, 80486 etc) could be used. But no, DOS stands in the way, and the 80386 plods along as a fast 8088.

To me this makes DOS unquestionably 'broke', as Mr Moffat would put it, and requiring 'fixin'. The problem is how, as there is a wealth of software out there which requires DOS and which will not be thrown away.

WINDOWS is an attempt to alleviate this; OS/2 is another. WINDOWS lays down standards, about how an application should look to a user. Techniques used in one application will work to some extent in another, even if they are from different areas. WINDOWS can also extend the machine beyond the 640K limit, even if this is only a partial extension.

There is no doubt that WINDOWS is slow, though, and that a machine with a good deal of horsepower is required. I seem to recall this type of criticism about earlier versions of DOS though, probably because too much code was written in higher-level languages such as C. This was addressed with critical areas being re-written in assembler.

In summary, I think Mr Moffat needs to take a good look at his attitude to change in general. Sure it may not be good for him personally, in that his machine could be made obsolete. But surely this cannot be the first time he changed software? I am sure he has an old CP/M machine lurking somewhere, with a whole 64K of memory, and a couple of really good applications such as an assembler and an editor. I too have such a machine, but it is a FLEX-based 6800/6809.

It is certainly true that the GUI may not be for everybody. It may even be a by-way on the overall technological road, but progress will come even if it is convoluted in its arrival. Man-machine interfaces are a difficult problem,and will remain so for some time, I suspect.

To conclude, then, I hope Mr Moffat is no Luddite. To use one of the analogies he likes so much, I hope that if he had lived just after the turn of the century and heard about the coming of the motor car, he would not have gone out and bought shares in a company making buggy whips — just because he believed his horse would never become obsolete.

Thanks for your comments too, Mr Stratford. You have summarised the pro-GUI and pro-standardisation case very well, I think — although I suspect that people like Tom Moffat and John Donaldson are not likely to find them persuasive.

Perhaps I shouldn't have admitted to not liking thongs, because presumably that means I'm not a true-blue Aussie — thongs seem to be almost a part of our national dress!

By the way, I too don't have any objection at all to having attractive women around computers. But I haven't noticed too many of the 'slinky' kind, in any colour; in just about all of the pictures I've ever been sent by computer companies, to show off their latest model, there's a severely-groomed blonde — of the icy, ultra-aloof variety, rather than 'slinky'. This has been happening for about the last 30 years, for reasons I have never been able to fathom. Perhaps the computer firms think that this gives their systems an 'up market' image; I suspect all it has done is reinforce the average person's idea of computers as remote and unfriendly, by implication.

Less friendly

I guess I have to agree with Fred Stratford's point about CLI-type interfaces as less friendly, and requiring the user to memorise a huge raft of commands. Even though I've been using computers for almost 20 years, I still find it hard to remember the commands for all of the software I have to drive, and often find myself cursing while I have to

dive back into the manuals, to look up some command that I don't need very often. It's a real pain, and I'm really glad that many of the new packages have a more friendly interface with on-line help, etc.

In fact I hesitate to think what it would be like if our CAD packages, desktop publishing package, circuit simulation and other fancy software was all still based on a CLI-type interface. It would be horrendous — I don't think I'd ever remember how to drive them.

Standard environment

As Fred Stratford says, the other important advantage of a GUI interface like *Windows* is that it provides a standardised environment — both in terms of the user interface itself, and in terms of interfacing to things like video display controllers, printers and other peripherals. So that not only do your applications programs all tend to behave and respond in the same broad way, but they can all 'talk' to the various parts of your hardware, with equal ease...

It's true that at present, as Fred Stratford admits and Tom Moffat and John Donaldson have pointed out, *Windows* and similar GUI interface/environments seem to slow everything up significantly. I remember trying out the first *Windows* version of *Ventura Publisher*, and discovering it went at only about half the speed of our Gem version — an enormous disappointment. (I gather the latest version is somewhat faster, but I haven't tried it yet.)

I've also had reports that the *Windows* version of our favourite Protel PCB design package *Autotrax* is rather slower than the DOS version, too, although here again I haven't actually had the opportunity to try it.

It's also true that *Windows* and its GUI-based applications packages seem to gobble up memory and disk space, at a rate that seems a bit alarming to old hands like Tom Moffat, myself and John Donaldson. When you've lived through the era when even 4K of memory and 100K of floppy disk capacity seemed plenty, it takes a bit of adjustment to get used to system environments that need a couple of megabytes, and applications that need three to five times that figure!

But as I have to keep reminding *myself*, memory chips and magnetic disks *are* getting cheaper all the time — so the real cost of providing ourselves with more friendly, intuitive and easier to drive computers is actually *falling*, not rising. And the software people are not dills; they know that if their packages are slow and frustrating — or conversely, only run satisfactorily on the fanciest and most expensive machines — they won't sell as many. So they do have a vested interest to keep improving their products, and making them faster and more efficient.

The main problem in all of this is that we seem to have to keep upgrading our hardware and software all the time. But I guess this is inevitable; if we want the benefits of computers as tools, we probably have to accept it. I'm not sure what Fred Stratford means by 'progress', but whatever it is, it grinds on — and it seems pretty foolish to try resisting it.

That said, there are of course still a great many useful things you can do with an 'obsolete' computer, and with older software that will run quite happily on one. Tom Moffat has shown us how to do this on more than one occasion, and I'm sure he'll keep the good ideas coming in the future.

When it comes to sticking with CLI and resisting the trend towards GUI-based systems, he's of course entitled to his opinion — and he's obviously not alone. But all the same, I think he's backing the wrong horse. Ultimately I think all of us want to be able to use computers with the absolute minimum of hassle, memory strain and/or reference to manuals. The GUI approach seems to be the way to achieve this goal, or at least make worthwhile progress towards it. Don't you agree?

Vintage horror!

To end off this month's column, I have something that is likely to bring tears to the eyes of our Vintage Radio columnist Peter Lankshear, and many of his devoted readers. It came in the form of a letter from radio amateur Colin MacKinnon, with an enclosed photo — which I'm reproducing as well. And as Colin explains, he was prompted to send in both letter and photo after seeing our new book *Discovering Vintage Radio*, based on many of Peter's earlier articles.

What does the photo show — an exciting find of old radios, which Colin was lucky enough to rescue from the local tip? No, not exactly. Here's the story, in his own words:

I have just seen the new book 'Discovering Vintage Radio' by Peter Lankshear, and was intriqued at the interest in collecting old radios.

Enclosed is a photo of what I do with them — use them for land fill! The pile was actually about one metre deep, with the old wooden cases from AWA Radiolas, Colmavoxes and Attwater Kents underneath. I seem to remember there were a couple of sealed sets in there, too.

Well, there you are. You'll notice that I haven't revealed where Colin lives, or even given his callsign — just in case some of the more fanatical vintage radio enthusiasts might be tempted to pay him a clandestine visit, and either dig up his backyard or inflict some horrible punishment upon him.

Life does have its ironies, doesn't it? Here's Peter Lankshear and all of the other vintage radio enthusiasts busily trying to rescue and refurbish as many of the old classics as they can, while at the same time people like Colin MacKinnon can cheerfully chuck them into a hole in their backyard, as land fill...

Sorry if the prospect gives Peter and his mates nightmares, but I just couldn't resist publishing Colin's picture. Not because I'm against restoring old radios; on a personal level I am quite keen of the idea, as it happens (I even have a few items of my own). But we all know that a lot of old radios have been chucked out in the past, and are no doubt still being thrown out by people who aren't too concerned about their preservation. It's just unusual for us to be sent a picture of this being done, and that's what makes it of interest.

Don't bother to write and ask me for Colin's address or phone number, though — I don't want to be responsible for him receiving any harassment.

Hopefully you'll join me again here next month — even the vintage radio enthusiasts! ❖

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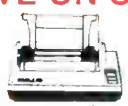

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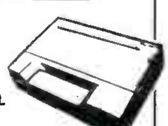

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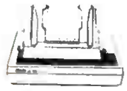

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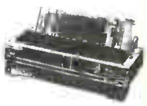

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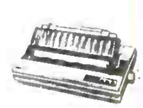

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80386-40 CPU 64K CACHE ON BOARD
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65 Mhz LANDMARK SPEED TEST
40 MEG HARD DISK 12ms ACCESS TIME
1.2M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
MINI CASE & 200W POWER SUPPLY
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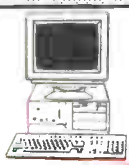
RITRON EXECUTIVE 486-75



80486SX-20 CPU
1 MEG RAM EXP TO 32 MEG
75Mhz LANDMARK SPEED TEST
40 MEG HARD DISK
1.2M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
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WITH 200 MEG DRIVE
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$1,999 TAX EX.

RITRON EXECUTIVE 486-157

80486-33 CPU
256K ON BOARD CACHE. 1 MEG OF RAM
157Mhz LANDMARK SPEED TEST
40 MEG HARD DISK
1.2M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
SERIAL, PARALLEL, GAMES PORTS
512K VGA CARD. IBM* COMPATIBLE
SVGA COLOUR MONITOR (1024 x 768 Resolution) 0.28"DP
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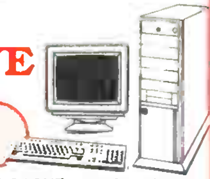
WITH 200 MEG DRIVE
$2,874 TAX INC
$2,399 TAX EX

RITRON EXECUTIVE 486-157



80486-33 CPU 256K ON BOARD CACHE. 4 MEG OF RAM
157Mhz LANDMARK SPEED TEST
200 MEG HARD DISK 12ms ACCESS TIME
1.2M JAPANESE BRAND F.D.D
3.5" 1.44M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
SERIAL, PARALLEL, GAMES PORTS
1 MEG VGA CARD. IBM* COMPATIBLE
TOWER CASE & 220W POWER SUPPLY
SUPA VGA COLOUR MONITOR (1024 x 768 Res) 0.28" DP
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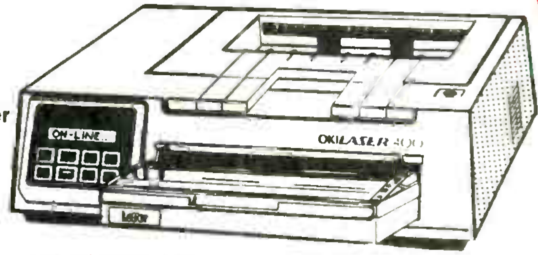
Only $1095 Tax Ex.



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5 year warranty on LED system head.

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DR DOS 6.0

NOW ONLY $89.95

The most advanced, fully DOS-compatible operating system available today. It's everything you need to run your DOS, Windows, and networking applications faster.
Maximize hard disk performance, keep your system and Data secure, and make your PC easier to use.
DISKMAX: Improves your PC's overall performance so you can get more work done in less time. Its optional automatic file compression feature potentially doubles your hard disk storage space.
MEMORYMAX: moves DR DOS buffers, drivers, TSRs and networking software outside the 640K memory area, leaving more memory for your DOS, Network and Windows applications.
THIS MONTHS PRICE IS THE LOWEST YET!...... **$89.95**

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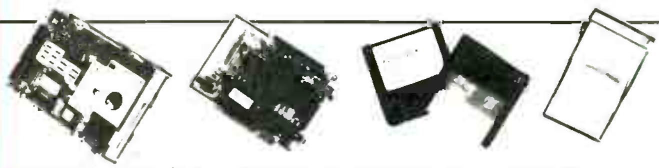
SHAREWARE NOW AVAILABLE AT NORTHCOTE, OAKLEIGH, SYDNEY & BLUESTAR COMPUTERS ONLY $3 95 FOR 5 1/4" DISK! 1300 TITLES AVAILABLE



INSITE 1325VM 20MB FLOPTICAL DRIVE

At last a floppy drive that is truly multi-purpose.
You now can load and save all the 3.45" format software you are used to and in the same drive backup at 20 Mega bytes per disc. This truly remarkable drive is a GIANT leap forward in removable technology.
Features:
Comes with a "Grassroots" SCSI host adaptor card.
Has an on board BIOS, so no drivers are required.
Will BOOT MS-DOS using either 20MB, or 1.44MB or 720 KB disketts
DOS compatible with MS-DOS 3.3, 4.01 and 5.00
BIOS compatible with PHOENIX 286 and 386 ver 3.10
AWARD 286 and 386 ver 3.02
20MB Diskettes can be bought pre-low-level formatted
Low-level formatting can be done with LFMT program supplied or using DEBUG "G=CD80:6"
The unit can BOOT the system as drive "A:" or "B:" in either 720K, 1.44MB or 20MB format .... Drive $849.00
20 M Discs to Suit...................... $39.00 Each.

4 PORT SERIAL CARD

(Software Output Cables included)
The PE-514 has 4 port serial ports for asvnchronous communication. These ports can bve used to connect your PC with a serial printer, MODEM, Serial mouse or serial devices which use an RS232C interface. The interface is a DTE type with a male DB25P for 4 serial port output. It supports DOS & XENIX.

X18155.................................... $199.00

ULTRA 15C 16MB CACHING IDE CONTROLLER CARD

TURNS A 20mS ACCESS TIME HARD DRIVE INTO EFFECTIVLY A 0.2mS DRIVE.
The ULTRA 15C provides intelligent caching up to 16 MBytes of cache memory to make the drive "invisible" when a cache hit is achieved providing multiple increases in I/O performance. It is AT register & BIOS compatible. It supports two high transfer IDE drives. It supports the largest selection of hard drives in the market today. The ULTRA 15C also supports any mix (5.25" and 3.5") of up to three floppy disk drives or floppytapes. In addition to the special support to break the support to break the 1024 cylinder and the 528MB partition limits of DOS and OS/2, the ULTRA family of caching controllers will also co-reside with any other controller to support dual channels and/or duplexing/mirroring in popular network operating systems. $649.00

RITRON NOTEBOOK 80386SX-20 CPU

60M Hard Drive 2.5 hour Battery Life
Backlit Paper White LCD
The 945/20 achieves new levels of excellence in portable PC design without compromising size or weight.

The Ritron 945/20 takes up less space than your old desktop when you're working and can be stored in the drawer of your desk when your finished.

MICROPROSSOR
- CPU 80386SX-20

BIOS
- 128KB ROM Pheonix BIOS

MEMORY
- Fitted with 2MB Exp to 8MEG

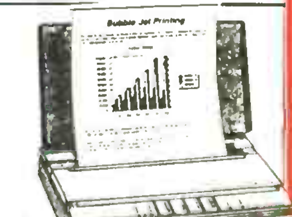
STORAGE DEVICES
- One 1.44MB 3.5" Floppy disk drive
- One 60M B 2.5" Hard Disk Drive

Display
- VGA compatible display
- 640 x 480 pixel resolution
- 32 grey scales
- Backlit Paper White LCD

RETAIL $2395
TAX EX $1995

Bubble Jet Printer BJ-10ex

The bubble jet printing system prints characters and graphics by firing ink drops at the paper form thin nozzles producing bubbles that quickly expand and eject the ink. The heat is generated by applying electrical pulses to the heating elements builtin each nozzel.
The printing mechanism is more durable and smaller. Printing quality is higher because of greater nozzel density. Quiet, non-impact operation. The Bubble jet printer can be used for a much wider range of applications than other printers.



C22240................ $589.00

CANON NICAD BATTERYPACK NB-150
To suit BJ-10ex printer C22242.................... $95.00

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CHECK OUT OUR NEW RANGE OF MIXERS

FIVE CHANNEL SPECIAL EFFECTS MIXER

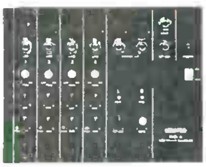
At last! A console or freestanding mixer with eight inbuilt special efffects. Allows sounds and effects to be mixed into existing soundtracks without the aid of additional external sound generators.
As the MM6 is designed for both DJ and studio use, the following inputs are provided: • 2 x turntables • 4 x line inputs • 2 x low impendance 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, headphone (cue) monitoring, CH1 to CH2 cross fader, microphone talkover switch, master volume level control and left and right LED

A12013............$299.00

FOUR CHANNEL MICROPHONE MIXER

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...............................$69.95



MM-4 4-CHANNEL BALANCED MIXER

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 that so the output is balanced. And it does not choose a space because of the compact size. The MM-4 is a mixer designed by musician's request.
FEATURES: • CHANNEL INPUTS •TRIM control • EFFECT Level control • PAN control • PEAK LEAD Indicator • POWER SWITCH • CHANNEL VOLUME control • MASTER INPUT • EFFECT SEND • EFFECT RETURN • OUTPUT PEAK LED switch • EFFECT RETURN control • ECT RETURN control • EFFECT SEND control • MASTER VOLUME L& R control A12017..........$299.00

VIDEOCAM / VCR AUDIO MIXER

A professional audio mixer designed for the serious home video movie maker though 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 sound tracks.
Ideal for weddings, family , aporting and other recordings.

- Input for a video camera, VCR, CD, tape, tuner, auxillary and turntable.
- Magnetic/ceramic turntable inputs
- Microphone left and right panpot
- Optionally available AC power pack
- Dual output monitoring VU meters
- Linier sliding level fader controls
- Mono/stereo microphone input
- Video camera or VCA output
- Headphone monitoring
- Battery opertated 9 volt
- Battery testing facility
- Mono/stereo switch

IDEAL FOR HOME MOVIE MAKERS

A12004 ....$169.00

INDOOR SPIRAL ANTENNA

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

L15040........$9.95

FOUR CHANNEL STEREO AUDIO MIXER

- Compact portable desk mount or panel mounting stereo mixer with 5 band equalizer and twin LED display UV meters.
- 3 x stereo magnetic tunable inputs switchable
- Headphone monitoring on all channels
- 18 dB talk over switch
- Output sockets for both the amplifier and tape deck .

A12012...$399.95

AUDIO/VIDEO

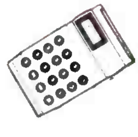
VHS VIDEO HEAD CLEANERS

New "wet, dry, wet" system cleans and dries all parts which come into contact with the magnetic tape. Fluid is applied directly on to cloth cleaning tape prior to use. It uses clean tape for each cleaning operation. Low drag for use is sensitive mechanisms

A11456.....$16.95

VIDEO/AUDIO TRANSMITTER

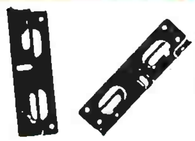
A small compact unit that allows transmission of video & audio signals (RF) to any TV or set VCR within range of 30 meters. Ideal for watching videos in the bedroom or kitchen without having to move the entire VCR or having long extension leads running through the house. Can also be used as a transmitter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



ONE INRFA RED REMOTE CONTROL FOR YOUR VCR, TV, CD, HIFI & Aux!

This unit will replace all your existing remotes & is programmable to replace future ones. Has liquid crystal display, clock, alarm, and countdown timer $67.95

COMPUTER ACCESSORIES



3 1/2" HARD DRIVE MOUNTING KIT

2 Universal brackets with screws to mount 3 1/2" hard drives into computer cases.

X19971 ....$9.95

DUST COVER

Keep your computer and accessories free of dust and grime while not in use.
XT* Cover Set
C21066............$14.95
AT* Cover Set
C21068........$16.95

HEAD CLEANER DISKS

It takes only a minute amount of dust, dirt, or magnetic oxide particles on your drive heads to cause problems, errors downtime or expensive service call. Regular use of a head cleaner will keep your drive free of trouble causing dirt and help keep your system up and running. These disk cleaners are simple to use and include cleaning solution and instructions.
• 3 1/2"
C12560..........$6.95
• 5 1/4"
C12555..........$4.95

MOUSE COVER

Be the first in your office to have a mouse that every one will want use. This cute little mouse cover puts a bit of fun and colour onto your desk while keeping your mouse free of dust!
C21069...........$7.95

MOUSE CLEANING KIT

Keep dust and dirt from damaging your mouse with this handy mouse cleaning kit. This special rounded tool will find its way into all the hard to get at places. The kit also comes with cleaning fluid and 5 soft cloths to keep your mouse spotless!
C21071 ....$9.95

MOUSE KIT

Everything you need to keep your mouse happy! You get a mouse pad, a mouse holder, a cleaning kit (previously described) and a cute little mouse cover.
C21072.............$16.95

MOUSE GIFT SET

Here it is! The ultimate mouse kit. You get the cute little mouse cover to protect it from dust, the mouse cleaning kit with the rounded tool & 5 cloths, the mouse house and mouse pad all in a handy black case.
C21074.............$19.95

COMPUTER CLEANING KIT

To gain optimum performance and prevent damage to valuable disks, this cleaning kit has all you need to keep your computer in top notch performance. Anti-static cleaning pads, cleaning swabs, cleaning solution, 5 1/4" & 3 1/2" cleaning diskettes.
C21077.............$19.95

SPEAKERS

8" DOPED PAPER CONE

- High compliance rubber surround.
- 45 watts RMS
- Dark grey cone
- Black dust cap
- Black round frame

C10233.........$44.95

10" HIGH POWER WOOFER

- With ribbed black paper cone. • 40 watts
- Black dust cap
- Cloth edge
- Rubber mounting seal

C10228.........$49.95

10" DOPED PAPER CONE

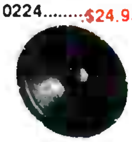
- High compliance rubber surround.
- 60 watts RMS
- Dark grey cone
- Black dust cap
- Black round frame

C10238 ....$59.95

8" FULLRANGE

- Twin cone speaker with white paper cone ideal for public address column speakers.
- 30 watts RMS
- Foam edge
- Whizzer cone

C10224.........$24.95



12" HIGH POWER WOOFER

- With ribbed black paper cone • 50 watts
- Black dust cap
- Cloth edge
- Rubber mounting seal

C10229..........$64.95

6" HORN & LINE X'FORMER

- Weatherproof plastic horn with 100 volt line transformer
- 15 watts RMS
- Adjustable metal bracket

C10218.........$74.95

New 1992 Mailorder catalogue Out Now!

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PIEZO SOUNDERS

Piezo Sounders PCB Mounting

A piezo electric sounder for direct mounting on pcb's. Two 1mm dia. holes are required 10mm apart.

Resonant frequency: 4kHz±500Hz
Resonant resistance: 300Ω max
Electrostatic capacitance: 17nF±30%
Max input voltage: 30Vp-p
Nominal drive voltage: 95dB@ 30cm
Size: 24mm dia 5.5mm thick

	1-9	10+
S15238	...$3.95	$3.50

Low profile PCB mounting buzzer

A miniature solid state PCB mounting buzzer having a loud but pleasant 75dB tone and operating from a 12V DC supply. It is only 7mm high when mounted on the PCB. It will work with supply voltages ranging from 3 to 24V DC. Supply polarity is marked on the bottom of the case as an aid to installation. Two 2 mm dia. holes are required 18mm apart. The case is finished in a cream colour.

Resonant frequency: 3.5Hz
Operating Voltage: 3 to 24V DC
Current consumption at 12V: 5mA
Sound Output at 12V DC: 75dB at 30cm
Temperature range: -20 to 70°
Diameter: 23mm
Height: (without leads): 7mm
Lead length: 8mm

	1-9	10+
S15260	...$3.95	$3.50

Wire-Ended Piezo Sounder

A piezo electric sounder ideal for use in applications where space is at a premium owing to its small size.

Resonant frequency: 4.6kHz
Electrostatic capacitance: 20nF
Normal drive voltage: 3-30V p-p
Output at 10v p-p: 80dB@30cm
Size: 31mm dia. x 8mm thick
Fixing centres: 35mm x 8BA

	1-9	10+
S15250	......$3.95	$3.50

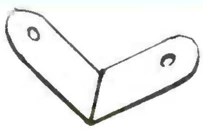
Very Low Profile Piezo Sounder

A piezo electric sounder which can supply levels of over 100dB at a distance of 30cm, yet is only 4mm high. It can therefore be used wherever space is at an absolute premium. It requires an external driver which should operate on, or as near as possible to, the buzzer's resonant frequency of 5500 Hz. This source should present a maximum drive voltage of 30V peak-to-peak to the buzzer. 100mm lead-out wires with tinned ends are provided. Mounting lugs with 2.5mm holes are moulded into the buzzer's cream-coloured case.

Resonant frequency: 5500Hz± 500Hz
Resonant resistance: 300Ω max
Electrostatic capacitance: 12000pF (±30%)
Sound output at 30cm: 103dB max
Height: 4mm
Diameter: 23mm
Length (lug tip to tip): 35mm
Fixing centres: 29mm x 8BA

1-9 10+

NEW HARDWARE



L-SHAPED CORNER BRACKETS

60 x 18mm
Pack of 4
H11860..................$4.95

BONDED HEATSINKS IDEAL FOR HOT IC'S

Length 32mm Width 13mm
Height 5mm
H10668........................$2.95
Length 19mm Width 6mm
Height 5mm
H10670........................$2.50

RIBBON CABLE

Colour: Multi. Reel size: 100m
12 conductor flat rainbow cable. Each 1.2mm diameter core is colour coded and can be easily separated.
Conductors 12 x 7 strands/0.12mm
PVC: Each with 1.2mm dia.
..............$1.95 per metre

CB MIC HOLDER

Designed for CB and other communication microphones.
- Screw mounting
- Mounting slot allows mic to be quickly removed or reheld.

...............................$1.95

CRIMP CONNECTORS - NYLON

Ideal for joining wires and cables together
- 12 amp · Size: 0.5-1.5mm · Gauge: 22-16

100Pcs
..........................$14.95

- 20 amp · Size: 1.5-2.5mm · Gauge: 16-14

100Pcs.............$15.45

- 50 amp · Size" 2.5-6.0mm · Gauge: 12-10

100Pcs.............$15.95

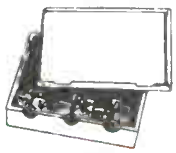
INSULATED STAPLES

For speaker cable and other figure eight cable.
- Takes cable with a maximum width of 5 mm.

Pack of
100.........................$4.50

MOUNTING HARDWARE

Set of 50 hexagonal nuts designed for securing inline chassis computer "D" connectors. Fits most standard size hardware supplied with 9, 15, 19, 23 and 25 "D" type male and female computer connectors.
Pack of
50..........................$7.95



75 OHM 3 WAY SPLITTER

Splits UHF/VHF/FM signals.
- Input: 1 x 75 ohm screw terminals.
- Output: 2 x 75 ohm screw terminals (4dB)
1 x 75 ohm with AC power pass (8dB)
- Bandwidth: 5-890MHz

..............................$7.95

DYNAMIC MIC WITH FLEXIBLE GOOSENECK

Versatile microphone ideal for use with amplifiers, mixing consoles etc. The base of the gooseneck has a standard 5/8" female screw thread for mounting the mic directly onto mixers or other desk mounting stands. The high quality rubber mounted dynamic insert is protected by a metal mesh grille and removable metal slotted shroud. The microphone has both an on/off switch and flexible gooseneck.

SPECS:
Type: Unidirectional
Impedance: 600ohm
3 metre cord
A10114.......................$69.95

LET US REMIND YOU ABOUT MEMORY.

EXPANDED DYNAMIC RAM RANGE

	Speed (ns)	No. of pins	1-9	10+	100+	1000+
4164-10	100	(64K x 1)	$4 95	$4.50	$2 90	$2 25
4464-08	80	(4 x 64K)	$6.95	$5 95	$3 50	$2 95
41256-08	80	(256K x 1)	$2.95	$2 75	$2 50	$1.95
44256-07	70	(256K x 4)	$8.95	$8.50	$7.95	$6.95
1M-10	100	(1M x 1)	$10 95	$9.95	$7 95	$7.50
1M-08	80	(1M x 1)	$12 95	$10 95	$8 95	$7.50

SIMMS

	Speed (ns)	1-9	10+	100+	500+
256K x 9	80	$21.00	$19 00	$18.00	$16 00
1M x 9	80	$79 00	$75.00	$69 00	$59 00
1M x 9	70	$65.00	$59.00	$55.00	$48 00
		1-9	10+	25+	
4M x 9	80	$295.00	$275.00	$250 00	

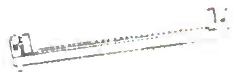
SIPPS

	Speed (ns)	1-9	10+	100+	500+
256 x 9	80	$21.00	$19.00	$18.00	$16 00
1M x 9	80	$79.00	$69 00	$59 00	$55 00
1M x 9	70	$79.00	$75.00	$69.00	$59 00

IC MEMORY - EPROMS

EPROM Cat No.	Type	Price	CMOS EPROM Cat. No.	Type	Price
U20550	2716	......$11.75	U20591	27C32	....$14.95
U20560	2732	......$9.00	U20592	27C64	....$5.50
U20590	2764	......$6.95	U20593	27C128	..$7.50
U20540	27128	....$7.50	U20594	27C256	..$9.00
U20542	27256	....$9.00	U20595	27C512	..$11.50
U20544	27512	....$12.50	U20546	27C010	..$22.50

SIMM SOCKETS



SINGLE
P10536.....$5.95

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P10538............$6.95

These are good quality SIMM sockets with metal clips at the ends and not the plastic ones which tend to break.

INTEL CO-PROCCESSORS

Cat No.	Type	Price
U21841	287XL	$210.00
U21851	387DX	$459.00
U21854	387SX-16	$310.00
U21855	387SX-25	$335.00

NEW TRANSISTORS

SWITCHING TRANSISTORS

		VCBO V	VCEO V	Ic a	hFE	Package
2SC2625	NPN	450	400	10	10	TO3P

1-9: $10.95 10+: $9.95
Above Transistor will replace 2SC2555, 2SC3306, 2SC4138 etc.

		VCBO V	VCEO V	Ic a	hFE	Package
2SC4242	NPN	450	400	7	10	TO3P

1-9: $7.95 10+: $6.95
Above Transistor will replace 2SC3039, MJE1007, MJE1008, etc.

DRIVER TRANSISTORS

		VCBO V	VCEO V	Ic a	hFE	Package
2SC945	NPN	60	50	0.1	20-400	TO92

1-9 $0.35 10+: $0.30
Above Transistor will replace 2SC1815, 2SC2320, etc.

TDA2002
8 WATT CAR RADIO AUDIO AMPLIFIER 1-9 $2.95 10+ $2.50

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Computer sales: Ph 639 1640.
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OAKLEIGH: 240C Huntingdale Rd, Ph: (03) 562 8939
SYDNEY: 74 Paramatta Rd. Stanmore. N.S.W.
Ph: (02) 519 3134
MAIL ORDER: 56 Renver Rd, Clayton Vic, 3168.
Ph: (03) 543 7877
Mail Order Hotline: Ph: 008 33 5757.
DEALERS: BLUESTAR COMPUTERS
(Computer Products only)
MELBOURNE: 217 Maroondah Hwy, Ringwood. Ph: (03) 870 1800
SYDNEY: 115-117 Parramatta Rd, Concord. Ph: (02) 744 5526
MAIL ORDER & CORRESPONDENCE
P.O BOX 620, CLAYTON, VICTORIA, 3168.

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THE SERVICEMAN

An elusive power supply fault, and a set that was gradually disappearing!

I'm feeling a bit out-numbered this month. We have two contributions from readers, and only one from my own bench. Still, there are some months when you don't have jobs that are interesting enough to write about — just 'run of the mill' ones that go towards paying the bills! Luckily our readers' stories are more than sufficient to fill the breach...

I'll give one of our readers first bite of the cherry, with an interesting story of power supply troubles in a Sharp colour television.

The reader is W.N., of Blackwater in Queensland. W.N. is new to these pages and his first story bodes well for his future success, both as a serviceman and a contributor:

The set was a Sharp colour TV, model CX1464, which came into the workshop with the complaint that it had no sound and no picture. To me, this sounded very much like a power supply failure and I wasn't wrong.

This model has a stand-alone power supply which, after a 'kick start' at switch-on, is driven by a pulse from the line output transformer.

It took no time at all to find that the power regulator (an STR4090) had gone short circuit. I quickly replaced the power IC (along with the other related components that often fail along with it) and the set came to life with no further signs of trouble.

After patting myself on the back for doing such a routine job in record time, I put the covers back on and left the set running while I prepared the bill. However, as I went to disconnect the set from the mains, it suddenly went dead again.

I once again replaced the power regulator and associated components, but I was reluctant to power it up until I had gone over the supply board again. There had to be something there to kill the new chip.

After going over all the components on the board, I was left scratching my head because I could find no reason for it to fail. Whatever it was had to be very obscure.

I then decided to power the set from an independent power supply, a modified HMV power supply board. Needless to say, the set ran perfectly for two days. With renewed faith, I reconnected its own power supply and switched on — with my fingers crossed.

After several hours the set was still running, so I decided to replace the cover. It ran OK for the rest of that day, and the customer collected it the following day. I put the second failure down to Murphy's Law — if there was going to be a bad chip in a batch, then I had to be the one to get it.

Three weeks later the set was back!

The customer was not very happy and after reminding me of the charge so recently paid, demanded a further repair under warranty. I reassured her that if it was indeed our fault, the set would be repaired free of charge.

She then told me that this time, it was whilst changing channels that the set had failed. I could see no relevance to the problem, but this was obviously not the time to mention it.

I put the set on the bench once more and went through the process of replacing the components in the power supply board. I then ran the set from my bench supply for several days, frequently monitoring the supply rails while changing channels. But, you might have guessed it, the set ran perfectly.

Next, I decided to use a variable DC supply to power the set's own supply board. After several days on full power, it had never missed a beat. I was genuinely at a loss to know why it was so hard on power chips. The manual is very vague as to the operation of the power supply, concentrating mainly on areas that never seem to fail.

During my tests, I did find that on 'no load' this power supply unit will tend to fail. So I soldered all the connecting rails to the plug sockets and left the set running. It ran for about five minutes before destroying the power regulator again. I had by this time replaced just about every component on the board, including the chopper transformer.

I decided to study the circuit in detail, in the hope that I might see the reason for intermittent failure of the unit. After searching the print for several days, on and off, I reasoned that it had something to do with the pulse clipper circuit.

This comprises a diode, coil, and a capacitive and resistive circuit across the chopper transformer (T701). All the components checked OK with a meter while in circuit.

I then disconnected C712 (33nF 630V mylar) associated with this stage to check it for capacity and leakage while out of circuit. It too checked OK.

But on an impulse, I connected it across 240 volts straight from the mains and in series with my meter. A

high voltage capacitor in good condition will show a low deflection when tested this way.

I didn't expect any reaction from the meter, so I was really surprised when the needle started to fluctuate. The capacitor was obviously breaking down when a high voltage pulse was passing through it, and this was as good a reason as any for the repeated destruction of the power chips.

I replaced the capacitor and the set has been running now for several months — and hasn't killed any more power regulators.

I cannot justify charging the customer again and in fact didn't even tell her about the time and money her set had cost me. After all, isn't that what servicemen are there for?

Thanks, W.N. Your cautionary tale is a lesson for all of us. Whenever a power transistor or IC shows a history of breakdown, careful inspection of every component around the breakdown is called for.

Your method of testing the capacitor across the mains is ingenious, to say the least, but needs to be accompanied by some words of caution. The method can only be used with caps having a voltage rating higher than the peak voltage of the mains (say 350V). Some critical power supply capacitors can be quite low voltage types, even though they are working in high voltage circuits.

The other aspect that should be considered, of course, is safety — both yours, and your meter's. Needless to say, extreme care must be taken when using the mains as a source of test voltage; if you come into contact with the 'active' line yourself, and you happen to be earthed, the result could be lethal. I'd recommend the use of a special test rig, with say two 47k 1W resistors in series with both the active and neutral leads (i.e., four resistors in all). Everything should be safely covered apart from the test terminals, to prevent accidental contact. The total series resistance of around 200k will limit the maximum current to around 1.7mA, which should minimise the risk of a lethal shock — and also protect your meter if a capacitor turns out to develop a short.

With those reservations, W.N.'s capacitor test is one that can be used with benefit by all who have to service mains power supplies.

Thanks again, W.N., and I hope that your fee for this story goes some way to compensating you for the loss you made on the job.

Now, I'll give myself a go.

'Sounds easy...'

I don't often work for nothing, but sometimes my good-heartedness gets me involved with long, convoluted jobs for pensioner customers. Commonsense tells me that I should never accept this kind of job in the first place, but I'm a sucker for a hard luck story.

Needless to say, this philosophising came about after I promised an elderly customer that his job sounded like a simple one, and that it shouldn't cost more than the parts involved.

This was a genuine charity job for the head of a family who, while not very well off, have been good customers of mine for many years. Anyway, there was a chance that his son might pay for the job, so with luck I wouldn't lose out altogether.

It all started when the son brought his father and the father's television over to my workshop.

It was a Rank Arena, model C2251. This was one of the first remote control sets to come on the market, and the fact that there are still quite a few of them around proves that they were a pretty reliable model.

According to my client, this particular set had been bought by his late wife 'when colour TV started' and had received very little attention ever since.

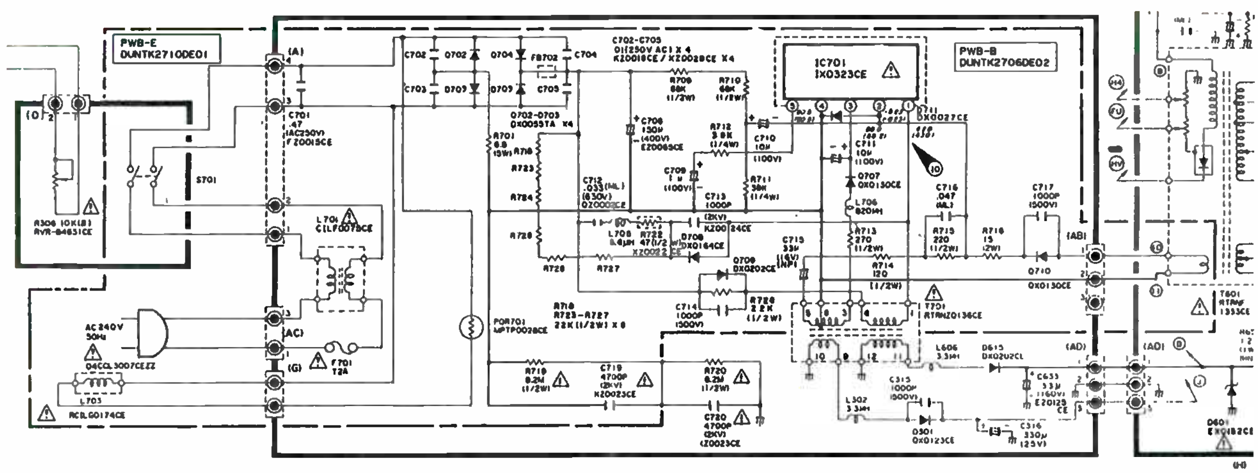
A year or so back, before his wife died, the set had begun to lose its sound — at first for 10 minutes or so at a time, but later for an hour or more.

It was their only set, and watching silent pictures soon became intolerable. So they had the set taken to the workshop of a local service company.

Weeks went by and the set remained with the company — unrepaired, despite repeated requests from the owner.

Then the old lady died, and her husband had more important things than televisions on his mind. So something like six months passed since the set had been taken in for service.

When the elderly gentleman got back into gear, he went after the TV, which he expected to have been fixed and waiting for him for a considerable time. You can imagine his chagrin when he was told



The power supply circuitry in a Sharp CX-1463 receiver, which is virtually identical with that in the CX-1464 discussed in this month's first story. The set concerned kept on killing IC701, the switching regulator chip. It took some time to find the cause of the trouble, but our contributor finally did so using a 'home brew' high voltage capacitor test set up.

that the set wasn't fixed yet, and that they didn't really know what was wrong with it...

So he demanded that it be returned to him immediately, fixed or not fixed. He told them in no uncertain terms that he would get a 'real' serviceman to look into it.

The family has been regular customers of mine for many years, so the son suggested that his father let me look at the set. Dad agreed, and that's how the set came to be on my bench.

There are a few common causes of 'NO SOUND' in these Rank chassis, so I wasn't particularly worried about the job. I suspected that I could 'knock it over after lunch' and perhaps not have to charge more than a nominal fee plus parts. Little did I know what I was going to find...

I tried to fire up the set, to see what kind of picture it had. With a set as old as this, there was a real possibility that the tube was weak and so would not justify the expenditure of much effort on a repair. Unfortunately, the set wouldn't even fire up. It was absolutely dead.

When I got the back off, I found that the DC fuse in the power supply, F601, was missing. If I had known then what I know now, I would have put the back on again and shunted the set out into the yard!

My multimeter told me that there was voltage at the bottom end of the fuse holder, but none at the top end, suggesting that the regulator was turned hard off. I replaced F601 and this restored the full 110-volt main rail, proving that the regulator was in good working order. But still the set made no attempt to fire up.

Next, I turned my attention to the line output stage. In these Ranks, the line output transistor is easily accessible and makes a good test point to trace continuity through the line output transformer back to the power supply.

But in this set there was no continuity — for the simple reason that there was no line output transistor! It had been removed for some mysterious reason, and had never been replaced.

It was while I was poking around the line output area that I noticed a big black spot on the side of the high voltage tripler. I've seen that kind of thing before, and it usually means a quite expensive repair.

To make sure, I removed the tripler from the chassis and took it over to the better light on the bench. Sure enough, there was a deep black hole in the side of the tripler — and something metallic could be seen at the bottom of the hole.

Not only that, but the normally smooth outline of the tripler was bent and bulged at a number of places. It had obviously been subject to considerable internal turmoil, and would clearly have to be replaced. Along with the line output transistor, the fuse, and who knows what else!

The Rank chassis uses a somewhat different EHT arrangement to most other sets. I have tried replacing a Rank tripler with a common ERO type, but have not had a lot of success.

The problem lies in the focus voltage supply and the substitution calls for a great deal of fiddling around. It's a lot easier, although much more expensive, to use the proper replacement tripler.

I contacted the owner and put the sorry story to him. Even using the cheapest substitute tripler I could find this was still going to be an expensive job. Certainly a lot more expensive than a simple sound failure might have been.

Fault of the Month

Sony SL-C35AS Beta VCR

SYMPTOM: Unpleasant warble or flutter in the sound. The picture is good, except that it's disturbed by occasional flashes of noise.

CURE: Check the setting of the tracking control. If it is properly centred, perform the full mechanical tracking adjustments specified in the manual.

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

The owner had no hesitation in asking me to go ahead and finish the job. It had been his late wife's set, and he would like to have it working for sentimental reasons. Just the same, he acknowledged that he might have difficulty in paying for it and might have to pay it off over a few weeks.

These are the sort of pensioner customers I like. They don't have much money, but they never ask for concessions and they pay their bills, even if it takes months. The other sort of pensioner demands a discount even though they can afford three cars and a mobile phone.

Anyway, I ordered a replacement tripler and when it arrived, lost no time in fitting it to the chassis. With a 2SD350A line output transistor salvaged from a wrecked set, and a new fuse in the power supply, the set fired up — with good sound, but an absolutely woeful picture.

It was showing the most severe vertical distortion I have ever seen. The centre line of the picture was about 5cm down from the top of the screen. The top half of the picture was crammed into this tiny space, while the bottom half was stretched out over about twice the remaining screen depth. The scanning lines at the bottom of the picture were as much as 5mm apart, while the lower text bar on the SBS test pattern was right off the bottom of the screen.

I tried the height and vertical linearity controls and both seemed to work, although neither had anything like enough range to correct the horrible distortions on the screen.

Distortion of the vertical scan is not at all uncommon in these Rank chassis. There are several critical electrolytic capacitors that can affect the scan linearity, and it's worth changing these whenever there is any suspicion of vertical troubles.

In this model the caps are C454 and C455, both 33uF/160V; C458, a 10uF/160V; and C468, a 47uF/160V. I changed all of these, but without any improvement in the picture.

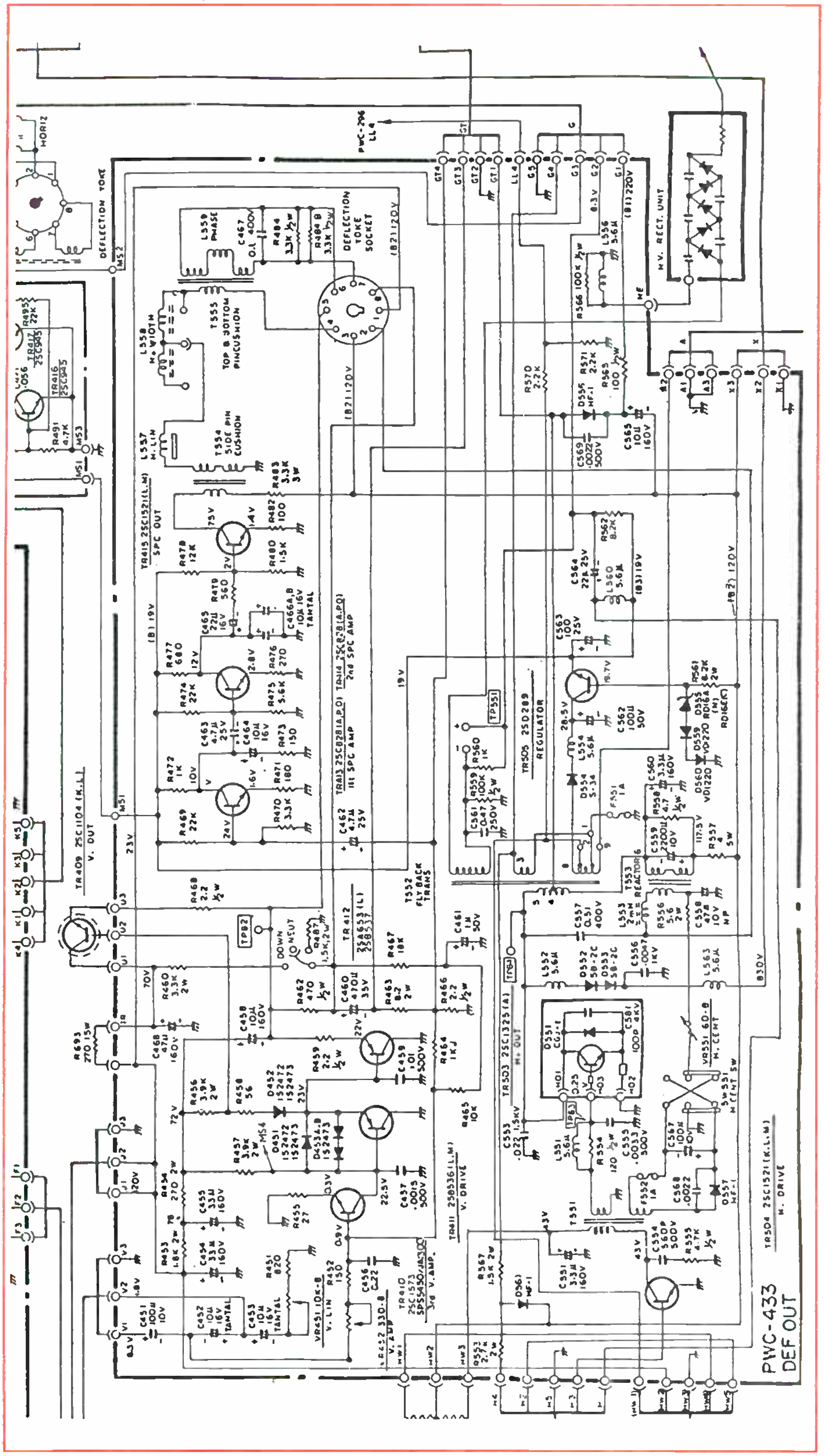
These capacitors are all associated with the vertical output stage, but there are other electros in the vertical amplifier that can also cause problems. In particular, there are two tantalum caps at the input to the amplifier.

These are C451 and C452, both 10uF/16V tantalums. In the past, I had found troubles in these caps to cause height problems, but not linearity ones. I was about to be re-informed.

I decided to pull these two caps and replace them, on the grounds that tantalum caps are unreliable anyway. Tants were chosen originally for their high capacity and extremely low leakage. Modern aluminium electros now approach the same low leakage levels, and so they make a reasonable replacement for tantalum caps in most domestic applications.

I reached my fingers into the corner of the board where these caps normally live — and pulled the first one from the board.

That's right, just pulled it from the board. I didn't need a soldering iron — it had been unsoldered at some time in the past, and the pigtails were just left hanging in the holes. Not only that, but the second capacitor wasn't there at all! It too had been unsoldered, but this time removed completely.



The circuit for the deflection output board in a Rank C2251 — the subject of our second story. It sounded like a simple job, but turned into something of a nightmare. Apart from anything else, some key components had disappeared!

Oh, well — it saved me the trouble of unsoldering them, at least.

I installed a couple of 10uF low voltage electros in place of the tantalums, and up came a perfect picture. It needed a small adjustment on the height and linearity pots, but otherwise it was as good as new.

I let it run all day for a week or more, but heard nothing of the sound problem. It was supposed to give a 'click' and go silent, then another 'click' and resume playing. But it didn't click during best part of a week, and the only silence was when I turned it off at the end of each day.

(That's the problem with 'sound' troubles. You've got to listen to the sound if you are going to find the problem. And listening to the same raucous commercials day in and day out is bad for one's sanity!)

As I have said, I saw and heard nothing of the alleged sound problem. But I did take one precaution against the possibility of future sound problems.

There is a 100uF electrolytic capacitor across the emitter resistor in the audio output stage. When this cap dries out or goes open circuit, it causes odd problems with the picture as well as with the sound. These are caused by audio feedback into the 19V rail, and trouble can show up in any part of the set fed by the 19V rail. In one set, I even traced pincushion distortion to an open circuited audio bypass capacitor!

I replaced the capacitor with a new unit, but of course it made no difference. All I can be sure of is that there's one problem that won't show up for a while.

So that was the extent of the damage. In order to fix a sound problem, someone had blown up the tripler, removed the line output transistor, removed two capacitors in the vertical section, and taken out the main DC fuse.

I think it was just as well that the owner went after the set when he did. If he had waited any longer, there may have been only an empty cabinet left...

String & sealing wax

Now it's back to our contributors — this time to C.B., of Dromana in Victoria. It's been quite a while since we've heard from C.B., and this time he gives us a story somewhat different to the usual TV and VCR tales. He tells it this way:

You know how it is: the drains are blocked, the back fence needs work, your ham project is gathering dust and one of your family asks you to fix their kitchen radio.

Your mouth opens, the words 'No, sorry' are about to pass your lips, when the writings of Machiavelli rise from deep within the subconscious and remind you that it could be useful to have them owe you a favour in return.

"Sure", you say, smiling graciously, all the while hoping that it will turn out to be something simple....

The complaint was a slipping dial cord. The radio was a large six band

[illegible]

'transportable' model covering AM, SW, FM, LO VHF, HI VHF and UHF. A large linear dial scale ran across the front of the radio, driven by a concentric dual speed tuning knob.

It didn't take long to remove the back and main PCB from the radio housing, but the dial cord assembly was a much more complex animal. With six bands covering a large range of frequencies, there were actually three separate dial drums, driving two multiband miniature tuning capacitors and one sealed UHF tuner module.

Sure enough the problem seemed to be the dial cord slipping, where it wrapped three turns around the brass tuning knob shaft.

My first school holiday job had been restringing dial cords for old valve radios, so while this particular setup was fairly complex I figured myself to be an old hand.

The first check was to see if there was sufficient dial cord tension. Clear on that count.

The next job was to clean the brass shaft and dial cord to eliminate possible oil or other contamination that may be reducing the friction. No luck their, either. I followed quite a few other ideas through until the awful realisation dawned. The dial cord had to come off.

Dial cords have a spaghetti-like quality of never laying in the same place twice. Once loosened off and removed they rarely ever go willingly back to their correct place. I've found from hard experience that an accurate drawing of the cord path, position of drums and spring locations is essential.

That done, the cord came off and to my complete amazement, the problem lay with the two tuning capacitors. They were both very stiff to turn.

I made another drawing, to clarify the wiring to the little tags on the back of the AM/FM tuning capacitor, and soon had it desoldered.

Strangely, it now turned freely; but as it cooled off, it returned to being stiff! Closer examination yielded the answer. It was full of wax!

Both tuning capacitors were surrounded by VHF circuits and the nearby small coils had been coated in paraffin wax to help stability and reduce microphony.

I guessed that the radio had been left in the sun and had overheated, a surmise which was later confirmed by its owner. The wax had run into the tuning capacitors, rendering them very hard to turn.

After some experiments with various solvents, both units were soaked thoroughly in three changes of shellite to dissolve the wax.

Following reassembly came restringing of the dial cord, a one-hour job in itself to align all the drums and 'fiddle' everything into place. The remarkable thing is, it all worked! Even the dial frequencies agreed with the received stations.

So a happy ending to an unusual fault is accompanied by a moral: If a relative asks you to repair something for them, think first, then say 'No'.

Mind you, my back fence is in need of some very heavy repair work. I think I'll ask my brother for a hand when I return his radio!

Well, C.B., I hope your brother appreciated the effort you put into his radio, and I hope you appreciate the effort he put into fixing your back fence. Thanks for your story.

That's all for this month. There are still a few contributors' items to come, but we always can find room for more. Please keep your stories coming. ❖

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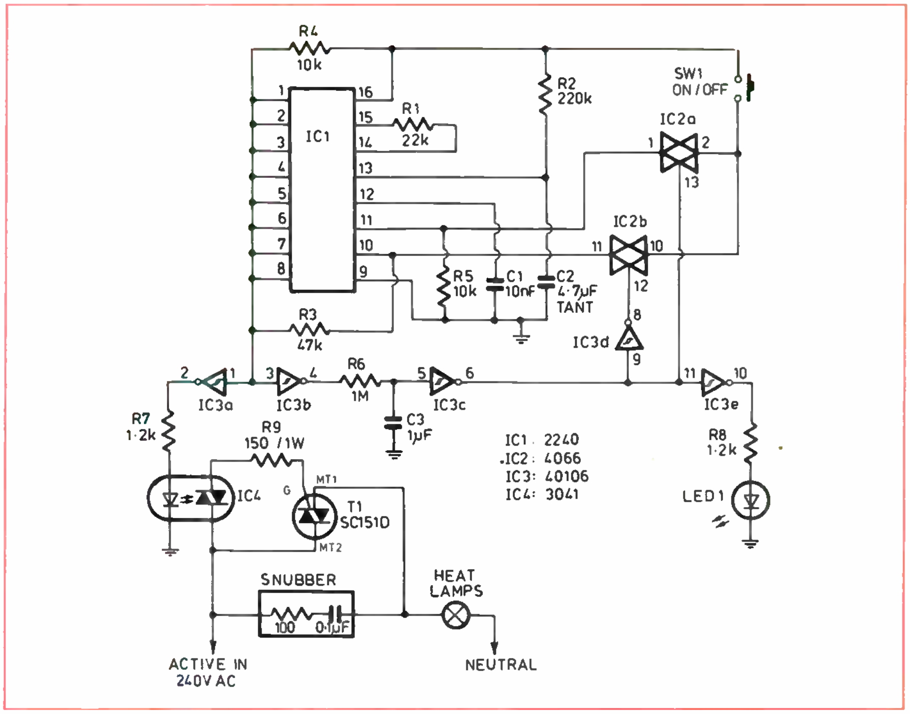
Circuit & Design Ideas

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

Tastic timer



It was with some trepidation that we installed an IXL Tastic in our bathroom, as the heat-lamps have a total power of 1100W. Watch that meter spin! In order to eliminate the possibility of accidentally leaving it on, I designed the following circuit.

The 2240 (IC1) is a programmable timer which is configured to produce an output after about 4-1/2 minutes (R2 x C2 x 255 seconds). This output drives IC3a and IC3b, two 40106 Schmitt triggers. IC3a drives an MOC3041 zero-crossing triac opto-isolator (IC4), which triggers a triac T1. The triac is protected by a snubber circuit and is used to turn on the heat lamps. Heatsinking is necessary for T1.

IC3b is coupled to a timing circuit (R6/C3) — more on this later — and then into IC3c. IC3c drives IC3d, IC3e and IC2a's control pin. IC3d inverts the output of IC3c and drives the control pin of IC2b. (IC2 contains four bilateral switches, though only two are used.)

On 'power up', the circuit assumes the 'off' condition. The output of IC1 is high, thereby producing a low at the outputs of both IC3a (turning IC4 off) and IC3b. IC3b's low causes IC3c to go high, which enables IC2a and disables IC2b (via IC3d), and turns LED1 off (via IC3e).

When the momentary switch SW1 is pushed, a 'high' triggers the start pin (11) of IC1, via IC2a. The output of IC1 now goes low for the timing period. This output is inverted by IC3a to turn on the opto-isolator, and hence the triac. Feel that heat!

And because the output of IC3b also goes high, the output of IC3c will go low after the delay period determined by R6/C3. This low causes the LED to come on, disables IC2a and enables IC2b.

At this point, one of two things can happen. The 2240 timer can go through its entire timing period, after which its output goes high and turns off the triac, leaving the unit ready to be operated again. Or switch SW1 can be pressed again before the end of the timing period.

If this happens, the 'high' is transferred via IC2b to pin 10 of IC1, which resets the timer. So the chip's output goes high, causing the circuit to revert to its 'off' state, to await the next operation of the switch.

Now for that little timing circuit of R6/C3. If it were not there, when the switch was pressed, the unit would turn on, immediately toggle the bilateral switches, turn off, immediately toggle the bilateral switches, turn on... This could happen hundreds of times before the switch was released — hence the approximate one second delay is introduced by R6/C3. The delay is long enough to stop any runaway switching problems, but short enough to allow the unit to be switched off almost immediately after being switched on, and vice versa. The delay does not affect the triac's switching of the heat lamps.

Lawry Goodwin,
Bushfield, Vic $40

DREAMED UP A GREAT IDEA?

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

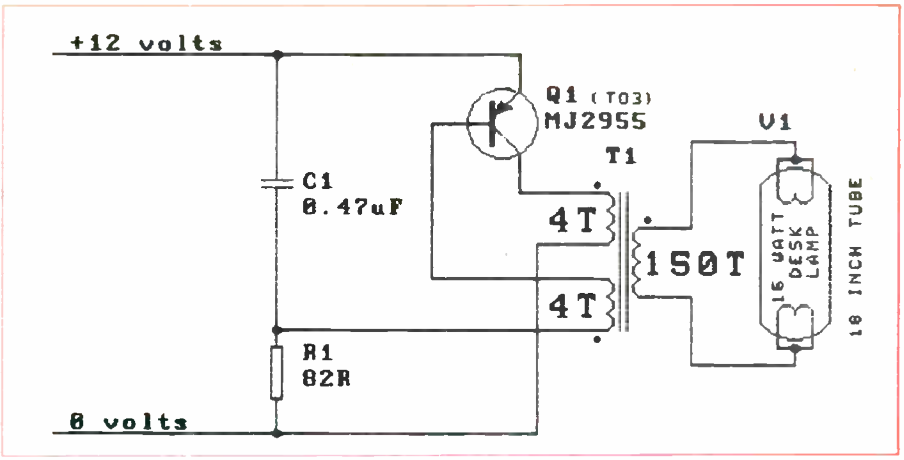
Electronics Australia,
PO Box 199,
Alexandria, NSW 2015

Craft & Design Ideas

Fluorescent lamp driver

This circuit is a revision of Norm Bush's fluoro driver published in *EA* (March 1990). The original driver did not suit me for two reasons. Firstly, I did not have any germanium power transistors handy, and secondly, I wanted to drive a bigger tube.

A quick lash up of Norm's circuit confirmed that a silicon transistor is not suitable for his configuration. However, my modified version does allow the use of a silicon power transistor, with the added bonus of greater power capability. A 40W 'kitchen' tube can be made to light satisfactorily.



With the component values shown on the schematic, the circuit will drive an 18" (15W) desk lamp fluoro to full brightness, drawing 1.2A at 12V. Average voltage across the tube during operation is 140V, and the operating frequency is in the neighbourhood of 44kHz. Observation of the circuit in operation has revealed some points to be aware of:

1. The value of R1 (carbon type, not wirewound) determines the size of the tube to be driven. Within a range of 27-150 ohms, the lowest R will drive 40W, while the largest will drive 4-6W.
2. The power rating of R1 is proportional to tube power, as is the size of the heatsink required for Q1.
3. For a particular tube (e.g. 15W), the value of R1 will determine brightness and proportionally the current drawn.

R1	CURRENT	INTENSITY
150	0.6A	dim
82	1.2A	normal
56	2.0A	bright/hot

4. When operating, if the tube is lit, but has a bluish glow at either or both ends, either the value of R1 is too high or the operating voltage is too low.
5. If a decoupling capacitor is placed across the circuit, the brightness will increase as will the current consumption.
6. T1 is a toroidal type (1" x 1/3"), and good to 100kHz at least. Wire gauges are not critical, so use the heaviest gauge practical (especially for the collector and feedback windings) to avoid I^2R losses. The tube driver winding is wound on first, followed by the collector winding, and then the feedback winding. The two 4-turn windings should be even-space wound on the toroid.

I know that the circuit looks too simple to work, but I have built three of them now, and tried different transistors, tubes, toroids, resistors and voltage supplies — and it always seems to work OK, subject to the above points.

Interestingly, the circuit works well with 'blown' tubes that will no longer start on conventional 240V units!

Paul Moody,
West Brunswick, Vic $40

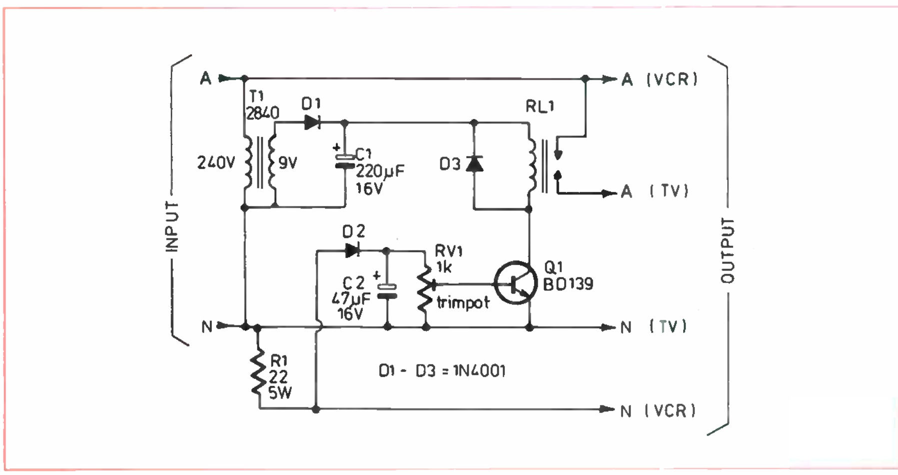
Master/slave power switch

When I saw the Master/Slave Power Switch project in the Jan. issue of *EA*, I felt it would be ideal for using a remote controlled VCR to turn on and off a companion TV.

However, all VCRs draw some current when 'off' to power up timer circuits, etc., and that small current triggers the Master. Also, the triac introduced switching glitches on my TV screen. I designed the following circuit to overcome these problems.

The 22 ohm resistor R1, in series with the VCR neutral line, senses the current drawn by the VCR. A small voltage develops across it, and the current that flows is rectified by diode D2 and charges the 47uF capacitor C2.

A 1k trimpot RV1 across this 'sensing voltage' adjusts the bias applied to the relay drive transistor Q1. The small voltage across R1 during 'standby' is insufficient to turn Q1 on. But, when the VCR is fully on, the increased current will turn on Q1 and activate the mains relay and thus the TV set.



The range of the trimpot should cope with most VCRs on the market; however, if RV1 needs to be set close towards either extreme, then the value of R1 may need to be adjusted.

My prototype was housed in a jiffy box, with the circuit built on a small piece of veroboard. Proper care needs to be taken to insulate the mains relay wiring from the control wiring, and a suitably rated 12V mains relay must be used (e.g. Altronics S4170, DSE P-8014, etc.) Any medium power NPN transistor may be used.

To set up the circuit, initially set the trimpot to minimum 'sense voltage' (wiper to the bottom of the pot). Turn the VCR on, and advance the trimpot until the relay reliably pulls in. Return the VCR to 'standby' mode, and confirm that the relay drops out. Some minor adjustments may be required to find the ideal setting.

Grant Wills,
Gawler East, SA $40

[illegible]

Build the Seas-EA 'Hobart' monitors

This set of compact speakers offers truly superb performance, yet can be built for a fraction of the price you'd pay for an equivalent commercial 'audiophile' system. They use special imported drivers, and are available in a keenly-priced kit which is complete right down to the last screw.

by ROB EVANS

If you've been window shopping for a set of top-of-the-range loudspeakers recently, then you may or may not have recovered from the shock of reading the price tag. When it comes to the imported speaker systems in particular, the figure is of a similar order to what you might pay for a decent second-hand car!

While we could theorise at some length about why this is the case — exchange rates, import duty, freight cost, and so on — it doesn't change the fact that an imported top-flight speaker system will invariably cost you 'an arm and a leg', and possibly several other limbs as well...

With the new Seas-*EA* speakers described here however, we are happy to report quite a breakthrough in the price you need to pay for a set of top of the line monitor speakers. At a total cost of less than $1000, they represent excellent value for a system of this calibre.

While some of the cost savings can be attributed to a reduced labour cost, since you complete the final assembly stages yourself, most of the savings are in fact due to the use of locally sourced components and cabinet manufacturers. Imported enclosures attract substantial freight and duty charges, as you would expect.

The kit for our new 'Hobart' monitors is available from Seas Kitsets, of Pleasure Point in NSW. This firm has employed the considerable talents of local loudspeaker designer Ralph Waters, better known for his excellent range of Richter speakers. Being somewhat of a (self-confessed) perfectionist, Ralph has reportedly spent hundreds of hours refining the sound of the Hobart monitors to the point where they are both accurate, and musically satisfying.

Having also spent an extended period auditioning the speakers, the *Electronics Australia* staff can report that Ralph has been very successful in his quest. In fact their performance took us rather by surprise during our first listening tests, since despite the rather unassuming appearance of the Hobart monitors, the sound quality is really quite stunning.

As you would expect from a set of speakers that are designed to be of 'reference quality' for the audiophile market, the Hobarts offer an extremely

flat frequency response, very low distortion, high power handling, and an extended bass response which tapers off smoothly.

And thanks to both Ralph's development work and the quality of the Seas drivers, they also exhibit both a very impressive transient capability and a commendable off-axis frequency response.

If this kind of performance is for you, Seas Kitsets can now supply a full 'driver' kit for $649, which includes the special Seas drivers and all of the associated hardware you will need to build the Hobart monitors.

If you wish they can also provide a pair of matching high-quality enclosures in fully built-up form, for $349. For more information, write to Seas Kitsets at Lot 3, Pleasure Point Rd, Pleasure Point, NSW 2171, or call (02) 771 3550.

Seas drivers

Before we discuss the Hobart design in more detail, a word or two about the Seas drivers may be in order. Based in Moss, Norway, the Seas company (pronounced 'say-as') has been manufacturing high quality drive units for more than 40 years.

During that time it has earned a reputation (particularly in Europe) for its pioneering work in innovative loudspeaker design and manufacturing techniques.

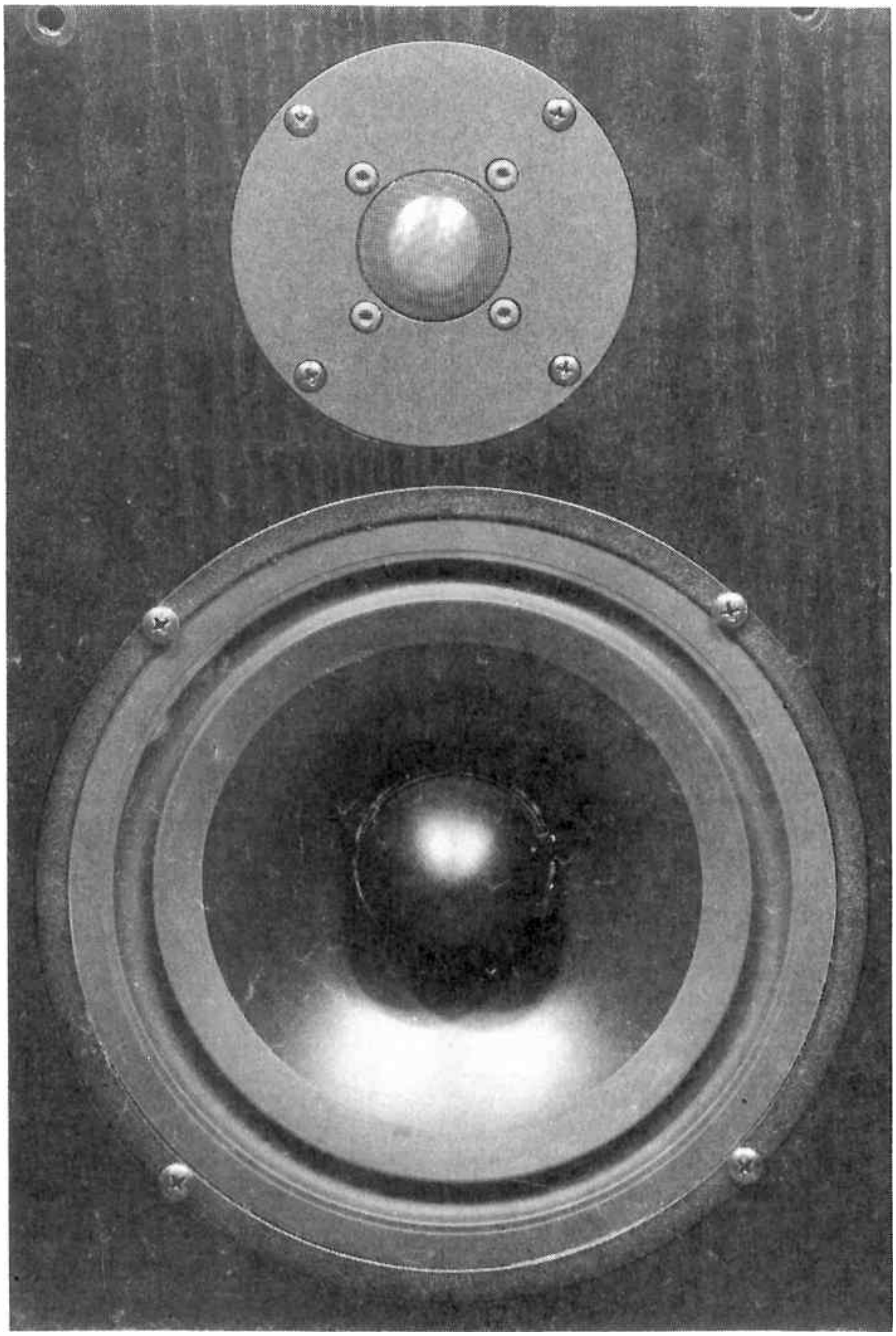
As a specialist speaker manufacturer, Seas is able to tailor the construction of its drivers to a customer's particular needs by offering alternative cone materials, add-on components such as phase plugs, and so on.

Through this flexibility, a strong emphasis on product research and development, and by using tight manufacturing tolerances, Seas drivers have become preferred choice for many of the respected 'audiophile' speaker system manufacturers — Monitor Audio, Epos, Dali and Bang and Olufsen, to name a few.

Thanks to Ralph Waters' relationship with Seas, we can now enjoy the benefits of these unique drive units in the new Hobart monitor speakers, without having to shell out for the audiophile price tag that goes with an equivalent commercial system.

In specific terms, Ralph has elected to use a 200mm Seas woofer equipped with a phase plug (designated H511) for the lower frequencies, and a 25mm metal dome tweeter (H417) for the high end.

Considering Seas' reputation, it not surprising to find that the H511 woofer is really quite a sophisticated unit. While its most noticeable feature is certainly the centrally-mounted phase plug, it also offers a number of other important features which add to its performance capabilities.



The Hobart monitors use a Seas 25mm metal dome tweeter, and a 200mm Seas 'phase plug' woofer. Thanks to the woofer's phase plug and the quality of its construction, it handles all of the lower frequency range right up to around 3kHz.

The cone, for example, is formed in a specially formulated polypropylene material which offers both light weight and high strength, so as to enhance transient performance and reduce distortion respectively. This in turn is supported by a highly compliant rubber surround at its perimeter and a linen spider at the voice coil end, which promotes an extended and linear cone travel.

The voice coil itself is a generous 50mm in diameter, and acts in a magnetic 'circuit' based around a surprisingly large (and efficient) magnet assembly for a driver of this size.

Apparently, Seas take pride in building their drivers to extremely tight mechanical tolerances, which when applied to a speaker's magnet assembly leads to a more accurately focused magnetic field and a consequent increase in

Seas-EA 'Hobart' monitors

driver efficiency. The whole assembly is supported in a rigid diecast basket, by the way.

Despite its seemingly simple construction, the phase plug performs a number of important functions in the H511 driver. The first and most obvious effect is to disperse the higher (midrange) frequencies generated by the cone, resulting in much smoother off-axis response from the system.

In fact, this is probably the most immediately apparent attribute of the Hobart monitors, since you'll notice very little tonal change as you move around the listening room. To further refine the sound, the domed end of the plug is shaped to both smooth and extend the woofer's natural high-frequency rolloff.

The other benefits of the phase plug are realised through the shape around its base, and how it's mounted within the speaker itself. Thanks to Seas' tight manufacturing tolerances (again), the plug is arranged to provide a very small pathway for airflow past the voice coil, which forces a concentrated and high velocity puff of air past the coil with each cone excursion. The end result is a higher (thermal) power handling, due to better voice coil cooling.

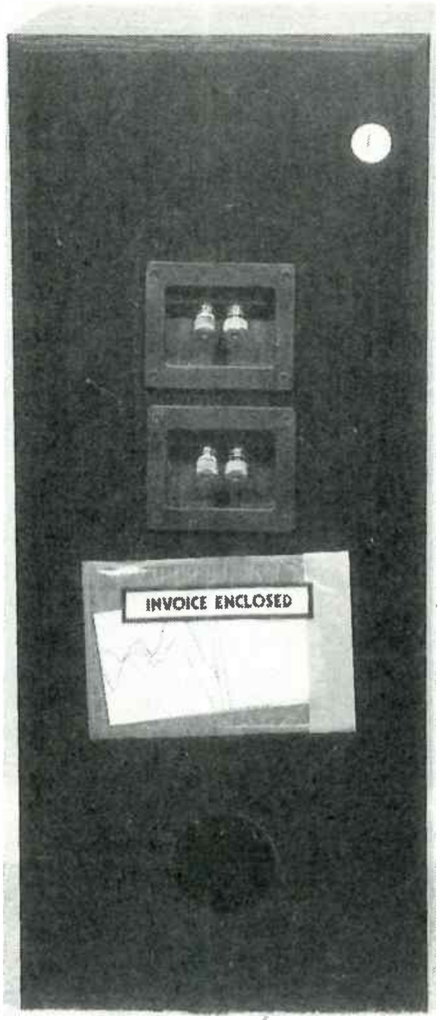
Also, the voice coil of most speakers apparently tends to act as a funnel or trumpet for audible 'hash' produced by the metallic coil former itself, resulting in substantial high-frequency distortion.

In the case of the H511 however, the phase plug is mounted over the pole piece, which effectively fills the entire voice coil region and provides a natural attenuation for any unwanted high-frequency energy. As you would expect, this improves the woofer's distortion characteristics in its upper range.

With all of the above features (plus more), the Seas H511 adds up to quite an extraordinary loudspeaker which delivers first rate performance. In an appropriate cabinet, the H511 offers excellent transient response, low distortion, high power handling, a smooth and very extended frequency response, and of course, wide dispersion.

In a two-way system such as the Hobart monitors, the above properties allow the driver to cover both the low, and a substantial portion of the midrange frequencies — while still leaving the tweeter unit to its intended job of reproducing the high end of the audio spectrum.

As it happens, the Seas H417 tweeter appears to use just as many exotic materials and sophisticated construction techniques as the H511 woofer. Briefly, it sports a 25mm metallic dome, supported on a 'synthetic' rubber surround, and a proprietary double-chamber



The cabinet's rear panel holds a 65mm tuning port, and TWO terminal plates — these connect to the tweeter (top) and the woofer (lower plate) via their associated crossover filters.

scheme loading the diaphragm.

The H417's additional chamber contains an absorptive material and is mounted on the rear of the unit, where it couples to the dome via a vent through the tweeter's pole piece. The idea here is that unlike a conventional or ferro-fluid damped tweeter, the double-chamber arrangement provides an optimum loading for the dome, resulting in lower distortion and greatly reduced compression of dynamics.

The enclosure

The cabinet supplied with the Hobart kit has a volume of around 32 litres and is a standard vented arrangement, but with the tuning port mounted in the *rear* panel, rather than the more conventional front positioning.

The idea here is that unwanted energy produced by reflections within the port itself will not have a direct path to the listener, and will be attenuated by the surrounding furnishings. On the other hand, the relatively pure and non-directional energy produced by the port at the enclosure's tuning point (around 40Hz) is largely uneffected.

All other aspects of the cabinet are quite straightforward, with 25mm MDF high-density particle board used for all panels, acoustic foam used to line the inside panels, and an internal cross-brace positioned just below the bass driver. The drivers are flush-mounted into rebated panel openings, so as to avoid diffraction effects.

The boxes are finished in the Model-T Ford convention (you can have any colour, as long as it's black), and come equipped with grille-covers formed by acoustic cloth stretched over an MDF board frame. The frame itself has an oversized cut-out to match the driver positioning, and all its edges (including around the hole) have been chamfered to minimise diffraction effects.

The crossover

Most readers will be aware that the heart of any high-quality speaker system is the crossover network — there's no point using high-performance drivers if the filter networks let the side down.

It's not surprising then to learn that most of the development time for the Hobart monitors was spent in researching and fine-tuning the crossover circuitry, while performing repeated listening tests.

The resulting crossover uses a minimum of components, with the idea of minimising losses, restricting the overall phase change and maintaining the drivers' excellent transient response.

As you can see from the schematic diagram of Fig.1, the crossover is based on two quite simple networks — a first-order circuit for the woofer and a second-order arrangement to feed the tweeter. You might also notice from the diagram that the two stages are shown as electrically isolated, since there is no *direct* connection between the negative and positive input leads of each section, and each filter input is connected to its own separate terminal plate.

The reasons behind this arrangement are twofold. Firstly, it allows each filter/driver combination to be driven by its own dedicated amplifier, in a 'bi-amped' configuration. Secondly (and less obviously), this allows the two filter sections to be *physically* separated, so that any chance of inductive interaction between the low and high-pass coils is eliminated (however small this may be). To this end, the two crossovers are mounted on opposite sides inside the enclosure.

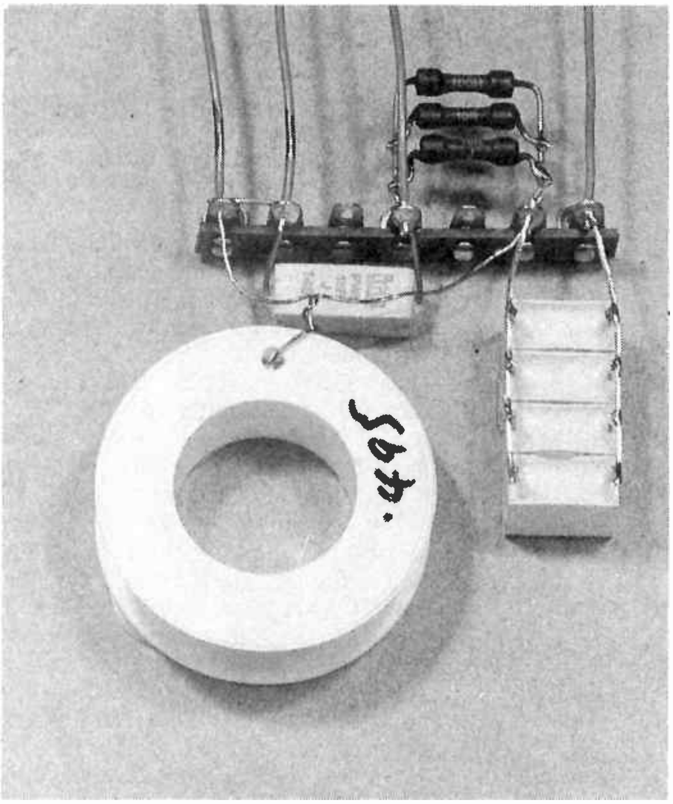
Also, when the system is connected to just one amplifier (that is, *not* bi-amped) then the two crossovers can remain electrically 'isolated' by running separate cables from each terminal plate, to the amplifier's output connectors.

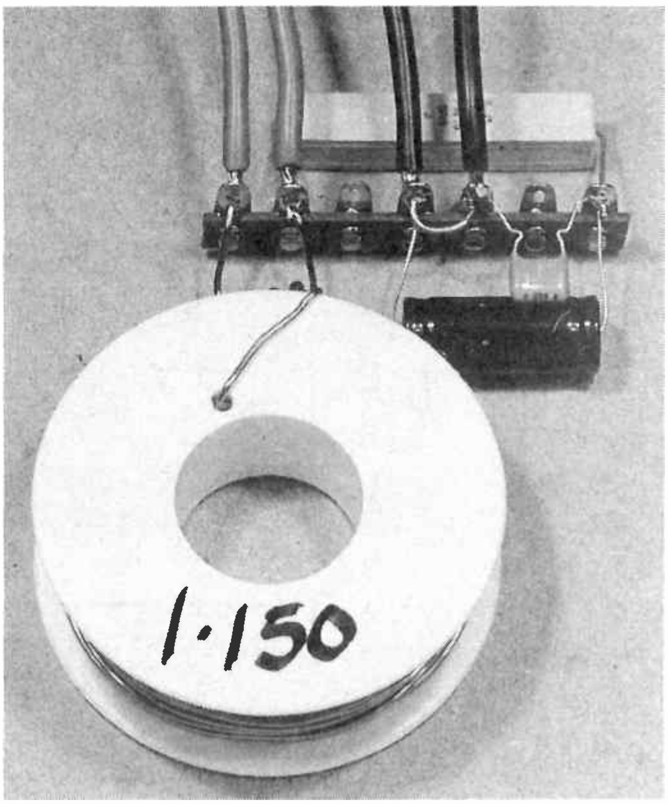
The theory here is that if the two filter sections share the same input wiring as in a conventional arrangement, the large and probably inductive currents flowing in the wires to the woofer will tend to modulate or interfere with the signal applied to the tweeter section. Apparently, this in turn can increase intermodulation distortion and cause a blurring of the stereo image.

The neatly packaged Seas kit includes all of the parts needed for the Hobart monitors.

Referring again to the crossover schematic, the input at the top (HF) terminal plate is applied to a second-order high-pass filter based on 4uF of capacitance formed by the parallel connection of C1 to C4, and the 0.496mH air-cored inductor L1. The signal is then passed to the tweeter via a simple resistive attenuator based on R1 to R4, which reduces the driver's output to match that of the woofer.

The H511 bass driver is fed from the





A shot of the completed crossover filters, before they have been installed in the enclosure. Both the tweeter's filter (shown on the left) and the woofer filter (right), have their major components glued to a small piece of particle board, with all connections made to a short length of tagstrip.

LF input terminals via a single 1.15mH air-cored inductor L2, which acts as a simple first-order low pass filter. Components R5, C5 and C6 are also included to act as a 'conjugate network' to compensate for the woofer's rising impedance with frequency (that is, its inductive nature), and to tailor the driver's high-frequency response.

To ensure the best performance from the crossover, high quality components are used in the critical areas of the circuit. For example, the inductors are of an air rather than ferrite-cored design, and use very robust wire to achieve a low series resistance.

The 4uF capacitance in the tweeter filter is constructed from four 1uF high-voltage (100V) polyethylene com- ponents, so as to ensure a low effective series resistance (ESR) and a high tolerance to signal overload. Also, the series resistors in the tweeter attenuating circuit (R1 to R3) are of special low-inductance types — which incidentally, are supplied by the Australian company IRH.

Not surprisingly, special attention has also been paid to the quality of the interconnecting cable which links each crossover to its respective terminal plate and driver. The woofer filter's connection wiring is formed in heavy-duty cable which has a core area of around four square millimetres, while the tweeter circuit is wired via special silver-coated copper wire insulated by a Tefloncoating.

Construction

Building up a set of the new Hobart monitors is quite straightforward, particularly if you are starting from the Seas kit which includes pre-built cabinets. If you can wield a soldering iron and drive a screwdriver (if that's what you call it), you'll have a new set of high-quality speakers in no time.

On the other hand, if you are experienced in carpentry, you could make your own enclosures and simply purchase the drivers and crossover components from Seas. The enclosure plans are shown in Fig.3.

While the latter method will certainly save you some money, your decision should take into account the high quality and finish of the pre-built enclosures. Considering this, and the time taken to construct the boxes from scratch, we imagine that most readers wishing to build these speakers will opt for the Seas enclosure kit.

Before commencing construction of the kit however, you should check that the following tools are available: a Philips screwdriver, a 25W (minimum) soldering iron, a staple gun, and a fine-toothed saw (to fit the optional braces). At this point, it's also a good idea to check that all of the kit components are present and correct, as shown in the parts/check list supplied with the kititself.

You will also need some type of reliable adhesive, to assemble and install the crossovers. We found that a hot-melt glue gun was ideal for this purpose, since the adhesive cures very quickly and provides a strong bond. If you don't already own one of these handy little gadgets, it may be a worthwhile investment, since they are suitable for a wide range of gluing jobs around the home. By the way, a silicone-based adhesive will also do the job, but you will need to be far more patient because of its extended curing time.

As shown in the shots of the completed crossovers, each set of the components mount onto a rectangular section of MDF board. The boards measure 130 x 195mm, and all of the major components should be glued in place as shown in the assembly diagram (Fig.2).

Begin the crossover construction by cutting the supplied tagstrip into four seven-tag segments, and screwing a section into (roughly) the centre of each crossover board using the non-anodised screws — that is, those with a 'silver' finish rather than black.

Next, glue the four 1uF capacitors neatly together and then to the MDF base as shown in Fig.1, and solder lengths of pre-stripped Teflon wire between the pins and the tagstrip as indicated — this board will be the tweeter filter section.

Then glue the 0.495mH coil and the 15 ohm/5W resistor in place, and solder each connection, noting that one leg of the 5W resistor can be used as the link between the negative tags. After that, install the three low-inductance resistors (R1 to R3), connect four 300mm lengths of the Teflon coated wire to the tags as shown, and mark both ends of the negative leads with a black marker pen.

The woofer filter section can be tackled in a similar manner, but in this case the 1.150mH coil, the 6.8 ohm/10W resistor and 22uF bipolar capacitor are the components to be glued in place. Note that this coil is quite large and heavy, and will need to be solidly attached to the base board. To guarantee that it will stay put, we would suggest that you score the contact surface of both the coil former and the base board with a sharp instrument, and use plenty of glue.

Next, install two 400mm lengths of

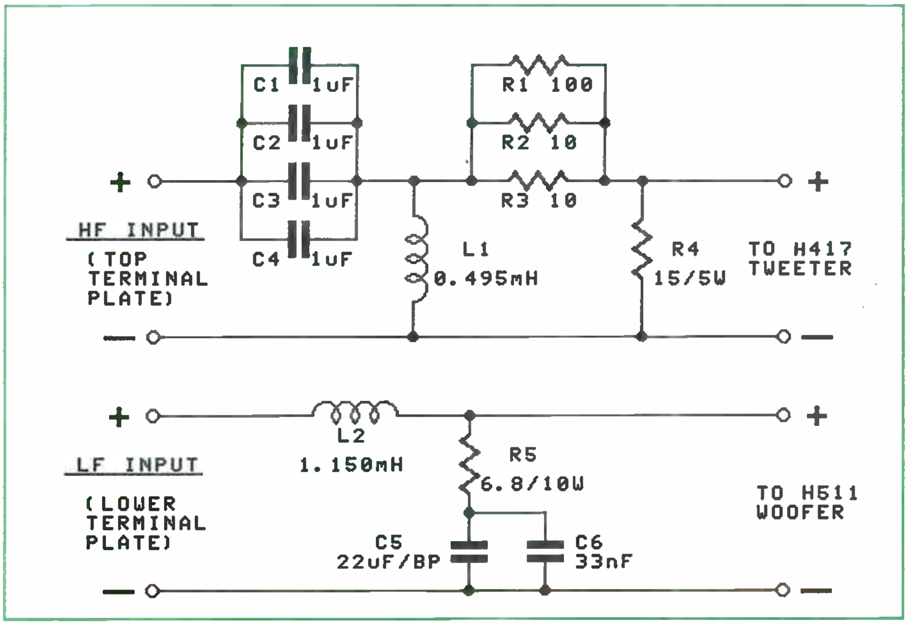


Fig.1: The crossover schematic. The circuit uses very few components in order to promote a smooth phase change through the audio range, and to avoid restricting the fast transient response of the Seas drivers.

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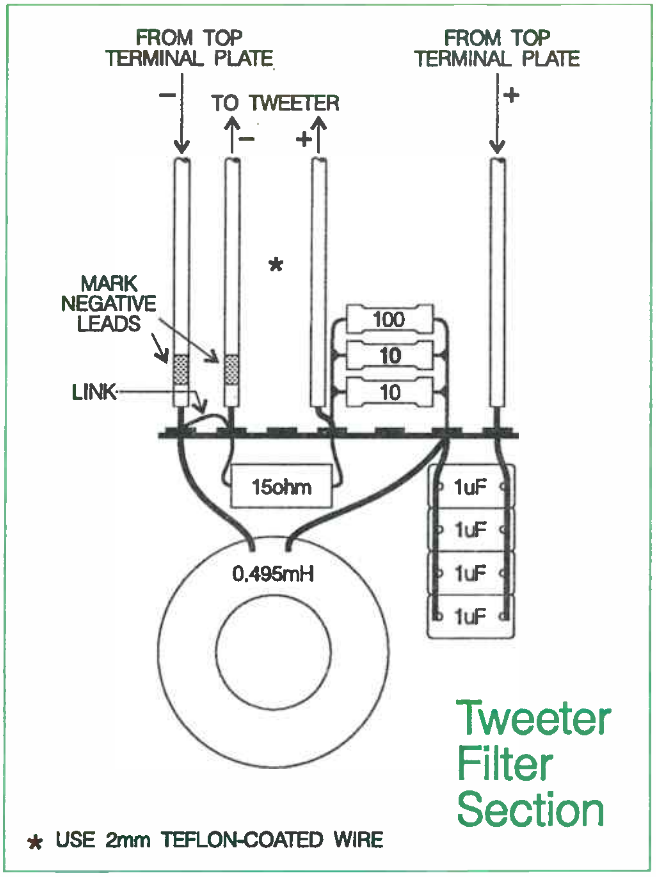


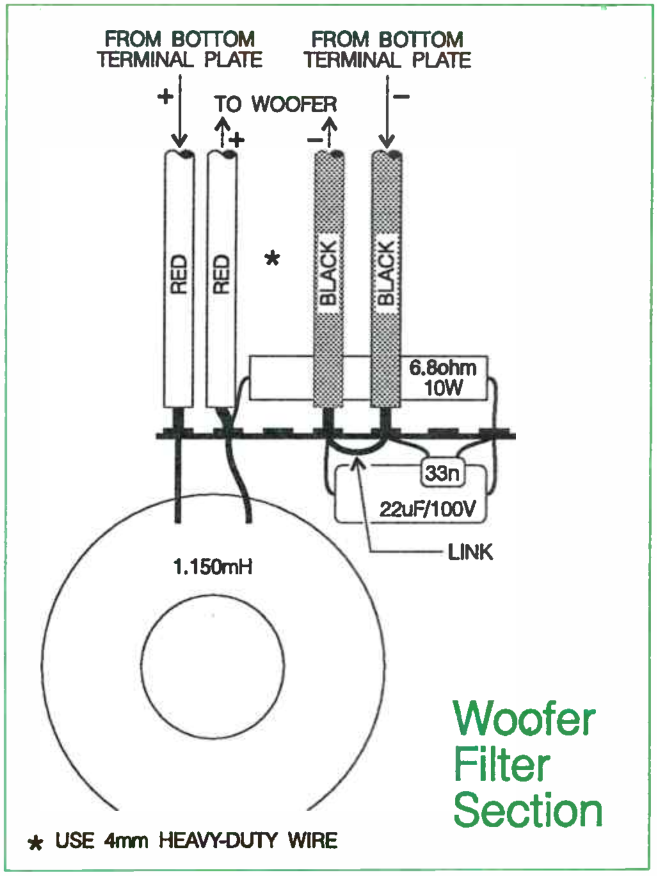


Fig.2: Carefully follow these diagrams when constructing the crossover filters. Note that there are two separate crossover boards for each cabinet — one for the woofer and one for the tweeter, as shown here.

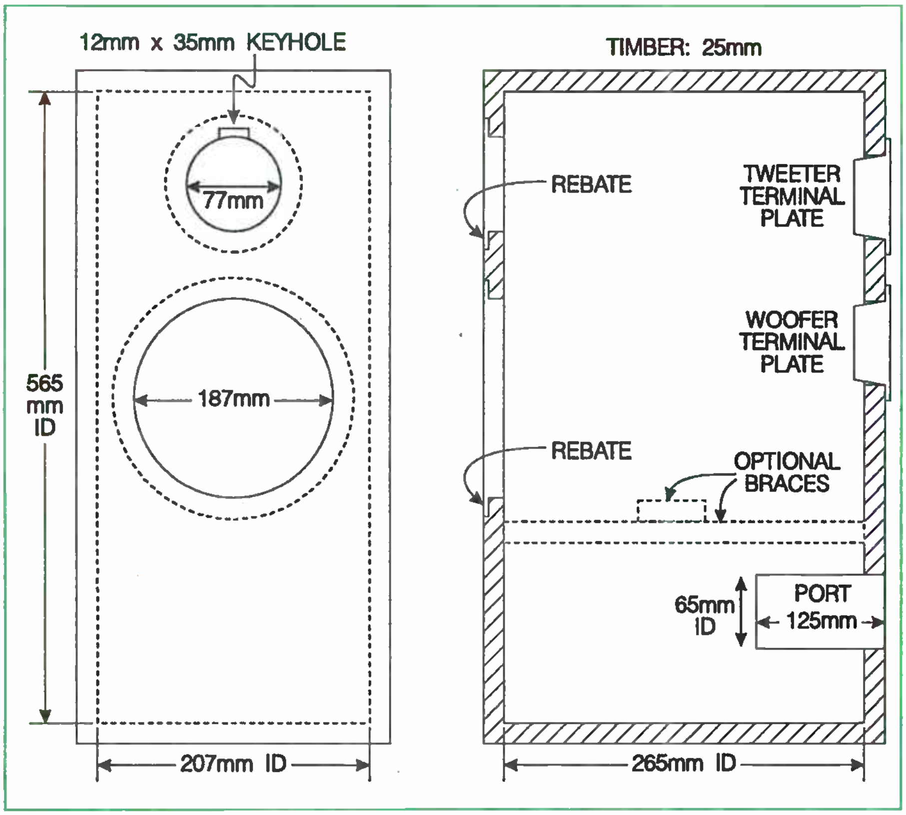


Fig.3: A guide to the enclosure construction, for those who wish to build their own.

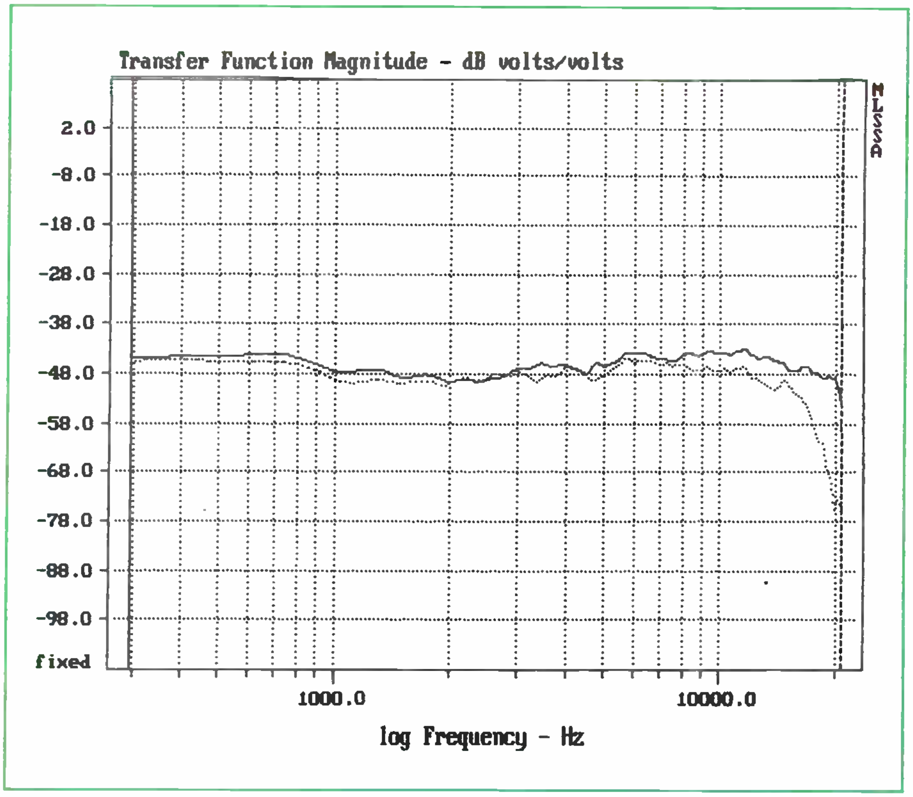
the black 4mm cable to the appropriate tags, then two 400mm sections of the red wire as shown.

Note that both the heat capacity of the soldering iron *and* your soldering technique is quite important at this stage, since these heavy-duty wires really do soak up the heat and dry joints are a definite possibility. Your best bet is to tin all connections in advance — and don't expect the ends of these large wires to fit through the tagstrip holes. Don't forget to install the small link between the negative connections, which should be formed with a section of robust copper wire (say, an offcut from the 1.15mH coil leads).

When you are happy with all of the solder joins on the woofer filter, install the 33nF capacitor as shown. This is best left until last, since the large amounts of heat required to make the other connections would probably damage this smaller component. Finally, double-check your work against the supplied schematics and assembly diagrams.

The completed crossovers can now be installed in the enclosures. They should be screwed or (generously) glued inside the two side panels near

Seas-EA 'Hobart' monitors



A plot showing the on and off-axis frequency response of the Hobart monitors. Notice just how smooth the response is, and how well this is maintained for the off-axis test (as shown by the 'dashed' curve).

the top of the box, with the woofer filter on one side and the tweeter filter on the other.

Identify each filter's input leads, pass the wires through the appropriate terminal plate cutout and trim the wires as required — note that the tweeter terminal plate is normally installed near the top of the box, since this matches the position of the actual driver in the front panel. The remaining crossover wires for the driver connections can also be passed through the appropriate cutouts, and checked for length.

This completed, you should fix suitable lengths of the acoustic foam inside the cabinet's top, bottom, rear and side panels, using a staple gun or contact adhesive. If you have elected to fit the additional bracing supplied with the kit, it should be done at this stage.

The two braces should be cut for a tight fit inside the box, with one trimmed as a front-to-back brace and the other as left-to-right. The best method here is to first cut each brace so that it's around 1mm too long, then slowly and carefully trim the end with a file or fine-toothed rasp, until the brace can be knocked in place with your fist — of course, you will need to cut out four square sections of the foam liner.

The front-to-back brace should be fitted just below the woofer opening, while the left-to-right brace can be installed directly above and glue applied at their intersection.

With the box in its final form, the terminal plates and drivers can now be connected and installed. Note that there are three different types of screws involved here: small countersunk-head types for the terminal plate, small round-head for the tweeter, and larger round-head for the woofer.

Make sure that the screws are not overtightened, the drivers are connected with the correct polarity, and the wires feeding the woofer cannot foul the cone once it's installed.

Note also that with the pre-built cabinets, the drivers can be installed without the need for any sealing material around their perimeter. Thanks to the accuracy of the rebate around driver cutouts and the precise manufacturing of the driver frames, an effective air-seal is formed between these very flat mating surfaces.

If you are not confident of this arrangement however, a *thin* layer of sealing compound can be applied to the rebate — bear in mind though, that this will make the drivers difficult to remove.

As the final touch, the Seas badges (supplied with the enclosure kit only) can be attached to the grilles. These have both an adhesive backing, and a small locating lug which fits into a pre-drilled hole underneath the grille cloth. There are in fact two positions available on each grille; one in the centre of the top and the other at the bottom (both are about 15mm from the edge of the frame). Simply remove the badge's protective backing, and firmly push it in place so that the lug passes through the grille cloth into the hole.

DIY cabinets

If you wish to fabricate the enclosures yourself, refer to the construction guide shown in Fig.3. Bear in mind that the quality of your work will directly effect the speaker's final sound quality, so make sure that your final boxes are very solid and well sealed.

The port is cut from a 125mm length of 65mm PVC pipe, and should be glued in place with a strong adhesive. Note also that the drivers are rebated into the panel, and the tweeter requires a small cutout on one side of the hole to accommodate its terminal block.

As it happens, the rebate is only really essential for the tweeter, and should be of a suitable depth so that the driver's face is flush with the front panel.

Setting up

Before connecting your new speakers for a test run, check the woofer's phase polarity by connecting a 1.5V battery briefly to the LF (lower) terminal plate, with the positive side of the battery to the positive terminal.

The woofer's cone should move *outwards*. If the cone moves inwards, then you have made a wiring error and will need to re-check the all of the internal connections — including the tweeter wiring, just to be sure.

After that, you are ready to audition the Hobart monitors. The recommended positioning is with the enclosures placed on solid stands which raise the tweeters to around ear height when you're seated, and with the rear of the enclosure within 75mm to 400mm from the wall.

Of course, the positioning can be varied to suit the listening room and your own sonic taste, as your ears are ultimately the judge — either way, we're sure the verdict will be extremely positive! ❖

SerialTest

PC-based Protocol Analyser & Data Line Monitor

The new version of Serialtest turns ANY PC into a full-featured serial data protocol analyzer – even laptop and notebook computers – for both synchronous and async data. Serialtest unleashes the power of your PC for data communications testing with a simple, user-friendly interface and either! The new ComProbe plugs in to your printer port. With Serialtest and your PC, there is no longer any need to buy or rent expensive, dedicated protocol analyzers.

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Nonprintable characters displayed using hex, mnemonics, graphics, or dots.
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Captured control signal transitions can be viewed in relation to captured data bytes using timing diagrams.

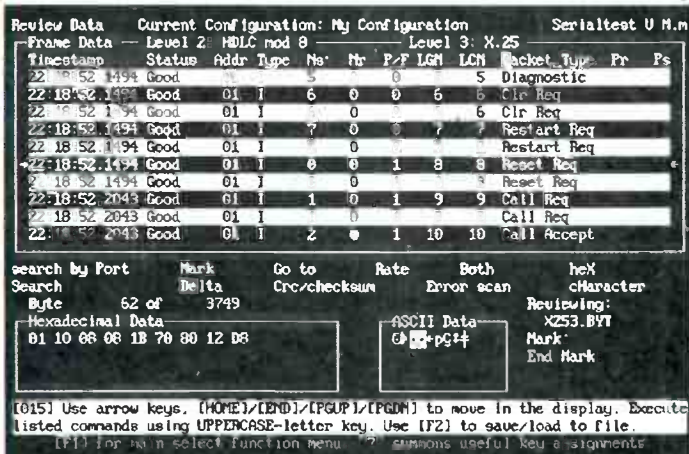
Timestamping: *Absolute or relative display of event time. Delta time and effective data rate calculations.*

Triggers: *Character strings, control signals, and error conditions can be used to activate and deactivate data capture. String triggers can include wildcard characters.*

Device Emulation: *Transmit data entered from the keyboard, Serialtest capture files, or any DOS file. Modify control signals. Use hardware and software flow control including user-defined XON/XOFF characters.*

Configuration Management: *Name and save an unlimited number of configurations.*

User Interfaces: *Pop-up menus and context-sensitive help allow new users to be up and running quickly. Command line options can be used to further simplify operation.*



Digital Voice Recorder Kit Back Again

see Silicon Chip Feb 92. Records up to 512 seconds of speech in up to 4 separate messages. **$135**. Optional case **$20** and plug pack **$18.00**. *Add $10 p&p.*

Soldering Irons & Spare Parts

We are now stocking a full range of Scope soldering irons and accessories. Ideal for maintenance workshops and production lines. Take your pick from –

Superscope

Maintenance and repair iron with manual temperature control for medium to heavy duty soldering

- 20W to 100W adjustable
- Adjustable 200° to 500°C
- 5 seconds to reach 20°C
- Low 4V supply
- Automatic switch-off

Miniscope

The pencil iron with real power. Manual control of temperature while soldering. Suits light to medium duty work

- 10W to 70W adjustable
- Adjustable 200° to 500°C
- 5 seconds to reach 20°C
- Easy owner maintenance
- Low 4V supply
- Automatic switch-off

ET60L 60W 24V Soldering System

- Infinitely adjustable 200°C to 470°C
- Illuminated temperature readout monitors actual tip temperature
- Select tip temperature required
- Zero voltage switching for maximum component safety
- 60W of back-up power – 30W pencil option
- Burn-proof flexible lead

Scope Irons		
SCOPE-ET60L-1	60W Adjustable w/- Disp	225.40
SCOPE-MINISCOPE	MINISCOPE Handpiece (needs PSU)	55.60
SCOPIE-PH20-5PK	5 Piece Hobby Pack	41.95
SCOPE-PSU	Power Supply Unit	63.55
SCOPE-STAND	General Purpose Stand	14.20
SCOPE-SUPERSCOPE	SUPERSCOPE Handpiece (needs PSU)	50.30
Spares for Superscope		
SCOPE-SK2-01A	SS Tip 6.4mm Dual Flat	1.50
SCOPE-SK2-0IB	SS Tip 3.2mm Conical	1.50
SCOPE-SK2-02	SS Stainless Barrel	8.95
SCOPE-SK2-03	SS Element	1.50
SCOPE-SK2-04	SS Bead Retaining Nut	0.40
SCOPE-SK2-05	SS Ceramic Bead	0.20
SCOPE-SK2-06	SS Push Rod	7.70
SCOPE-SK2-06A	SS Push Rod Assembly	10.20
SCOPE-SK2-07	SS Return Spring	1.20
SCOPE-SK2-08	SS Flexible Lead	10.70
SCOPE-SK2-09	SS Bakelite Lock Nut	3.25
SCOPE-SK2-10	SS Brass Nut	2.80
SCOPE-SK2-11A	SS Handle Body Only	7.15
SCOPE-SK2-12	SS Switch Ring	3.60
SCOPE-SK2-13	SS Rubber Grip	0.95
SCOPE-SK2-14	SS Grommet Spring	1.85
SCOPE-SK2-15	SS Grommet Nut	3.60
SCOPE-SK2-11B	SS Complete Handle	20.30

New Electronic Workbench

The Electronics Lab you keep in your PC!

YES you can now build, simulate and test Analog and Digital Circuits without laying your hands on a single component!

It's so easy with Electronics Workbench®. Do it all with the mouse – drag new parts from the parts bin, drop them onto the breadboard and click to run wires. Editing circuits is easy as wires are re-routed automatically.

It's much faster than building real circuits. No faulty parts! It's the result of 10 years innovation and thousands of students, hobbyists and engineers have been using the Workbench since its introduction in 1988.

Analog Module includes

- Comprehensive parts bin includes op-amps, zeners, transistors etc
- Function Generator with sine, square, triangle etc
- Oscilloscope with dual trace, int/ext trigger, nanosecond timebase upto 999MHz
- Bode Plotter for frequency responses and phase shift (-200 to +200dB)
- SPICE Simulation plus transient and steady-state simulation

Digital Module includes

- Comprehensive parts bin with gates, flip-flops, half adders, displays etc
- Word Generator up to 16x8-bits
- Logic Analyser with 8 channels, int/ext trigger
- Logic Converter converts between gate, truth table and boolean

Professional version has inhanced colour interface, supports maths co-processor. Requires IBM AT or PS/2 with 286 or greater, hard disk, 640kB RAM, Microsoft mouse, EGA/VGA and DOS 3.0.
$429.00

Personal Plus Version is monochrome. Requires PC/XT/AT or PS/2, 2 floppies or hard disk, 512kB RAM, Microsoft mouse, CGA/EGA/VGA/Hercules graphis adaptor and DOS 3.0 or greater.
$299.20

> *See the review in Electronics Australia March 92*
> ***"Electronics Workbench is certainly the easiest simulator I've ever used"***
> ***Peter Philips***

Ultrasonic Cleaner

Why pay up to $200? Ideal for PCB and computer parts, jewellery, watches, dentures etc! We still have them for just $150!!

NEW SC-7000 DeSoldering Tool

Now with 100W ceramic heater. Work on up to 12 layer boards. Special antistatic housing. Optional surface mount kit
$482.50 ex tax **$579.00** inc tax

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Fast Australia Wide Service or Your Money Back Plus $5

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We guarantee our Jetservice Courier will deliver to your door faster than any other Australian supplier (including that local supplier just up the road). If we fail, I'll give you your money back plus $5.00 for your inconvenience.

40 Watt Inverter Kit
(EA Aug '85)

This inverter is ideally suited for powering low wattage mains appliances from a car battery. Ideal for camping, boating etc. Typically, it can be used to power an electric shaver, electric blanket electric can opener or a 40W light bulb. Output frequency can be either crystal locked at 50Hz or variable over a small range via internal trimpot. When 240V is available this inverter can be used to recharge car battery.

K 6705 Normally $~~99~~.00
Now **$90.00**

Video Enhancer Kit
(EA Oct '83)

Sharpens up your picture when copying video to video

Unit sharpens picture detail, and can actually improve the quality of a copy by amplifying the top end of the video signal

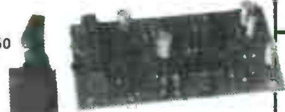
Specifications • Signal to noise ratio 50db ref. 1V p-p • Frequency response (flat): 1Hz to 6.5MHz -3db • Boost and cut plus and minus 6.3db • Gain 0db • Input impedance 68 Ohms
Complete kit supplied with silk screened front panel

K 5825 Normally $~~42~~.50
Now **$35.00**

Screecher Car Alarm
(EA Aug '86)

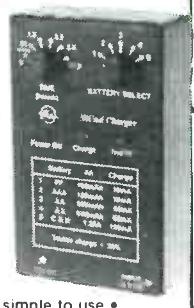
$49.50

K 4360



Deafening 100db Modulated Tone
Now our top selling Car Alarm Kit. Two Sensor inputs — Normally open and normally closed enable simple connection to door, bonnet, boot light, switches etc.

Automatic Charger for NiCads Kit
(EA July '89)



Here is a fully automatic NiCad battery charger that enables differing charge rates as appropriate for AAA, AA, C, D cells or cells in series up to 9V.
Requires M 9020 12V AC Plug Pack $16.95

Features: • Fully punched and screened case • Variable charge rate • Variable timer • Flexible and simple to use • Visual display of charge mode • NiCads cannot be over charged.

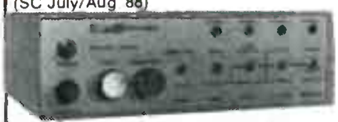
K 1650 Normally $~~38~~.50 Now **$35.50**

Digital High Performance Signal Generator Kit
(SC July '90)

This Digital Sine/Square Wave Generator uses high speed CMOS ICs and a digital filter IC to produce sine and square waves over the frequency range from 0.1Hz to 500kHz. It also features a 4-digit frequency readout and an output level control.

K 2547 Normally $~~155~~.00 Now **$125.00**

Discolite Chaser & Colour Organ Kit
(SC July/Aug '88)



Add Some Colour To Your Next Party. Great For Parties, Shop Displays and Special Lighting Effects

The Discolite flashes party lights on and off in beat with music 4 light channels • Forward reverse and auto-reversing chaser patterns • Strobe function • Alternating light patterns • Music modulation available on chaser and strobe • Inbuilt microphone for beat triggering or audio modulation of lights • Front panel LEDs mimic light display • Altronics Kit pre-punched and silk screened.

K 5805 Normally $~~189~~.50
Now **$129.00**

Video Amplifier Kit
(EA Aug '88)

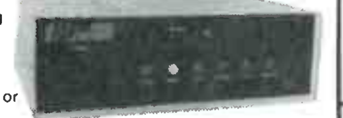
For computers and videos with low video output.

This video amp can greatly improve picture stability and eradicate shimmer, screen swim etc. Two outputs, normal and inverted. Ideal for VCR users. Tired of a grainy or snowy picture? Connect this amp internally to your TV and presto, the improvement is fantastic! (Documentation is quite detailed on connection to TV sets).

K 5850 Normally $~~17~~.50 Now **$15.00**

Digital Voice Recorder Kit
K 9555 **$149.00**
(SC Dec '89)

This Digital Recorder delivers astonishing reproduction of voice and/or music without any moving parts.



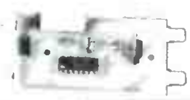
Here is a digital voice recorder that can store 4 different signals, voice, sound or a music source of up to 30 seconds each or one recording of up to 2 minutes.
Typical applications include: • Alarm system messages • Sales messages for customers put 'on hold' • Experimental telephone answering machine • Door Station announcer • Talking displays for shops • Emergency warning message announcement • Operation instructor for machinery etc • Countless other applications where voice or music is required • $100's cheaper than imported digital recorders • Includes instrument case and all components.

Voice Operated Relay Kit
K 5540 **$22.00**
(EA April '82)

This versatile Vox circuit is triggered whenever a noise or sound is made causing a relay to close.
Think of the uses: • Controlling tape recorders • Slide projectors • Eliminate the need for a press to talk button on transmitters • Turn on external porch lights • Paging systems • Hands free intercom switchover • Reaction sensitivity and "On Time" are fully variable

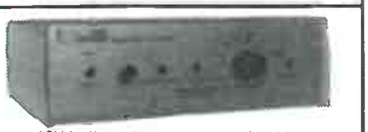
12V Gell Cell Charger Kit
(SC July '89)

This simple circuit will recharge your 12V Gell Cells correctly, increasing their life span. Charging current and voltage is controlled and over-charging is avoided by the IC switching off when the cell is fully charged. **Features:** • Automatic charge rate • Extends life of Gell Cells • 15V DC - 24V DC input • Simple to construct.



K 1685 Normally $~~22~~.50
Now **$20.00**

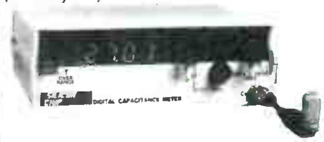
High Capacity Fast Charger for Nicad Batteries Kit
(SC Jan '91)



This charger is designed to operate from a 12V battery. It can charge nicad battery packs from 6-12V at up to 6A, or you custom wire the circuit to charge battery packs up to 30V at a reduced current.
In operation the circuit will recharge a typical nicad racing pack in about 20 minutes.
Features: • Fast charge rate • Switch selectable voltage setting in 1.2V steps from 6V-12V • Fully punched and screened front panel • State of the art digital circuitry.

K 1660 Normally $~~129~~.00 Now **$99.00**

Highly Accurate 4-Digit Capacitance Meter Kit
(SC May '90)



This attractive 4-digit capacitance meter is designed for the workshop or laboratory. It can measure capacitance from 1pF up to 9999uF in seven ranges with an accuracy of better than +/-1%, +/-1 digit.

K 2524 Normally $~~119~~.95 Now **$99.00**

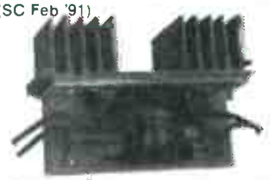
FM Stereo Transmitter Kit
(SC Oct '88)

Turn Your CD Player Into a Mini FM Transmitter.

Simply connect your CD player or any other source to the mini mitter which converts the audio signal to an FM signal. This FM signal then can be tuned in via any FM radio. Great for listening to your favourite CD while washing the car, mowing the lawn or doing the vacuuming etc. without blasting the neighbours. Powered by single 1.5V penlite battery. Single IC circuit. Simple to build and construct.

K 1120 Normally $~~45~~.50 Now **$35.00**

Fluoro Inverter Kit
(SC Feb '91)

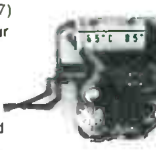


This kit enables you to build a high power DC inverter suitable for driving fluorescent lights from a 12V source typically a car battery. Ideal for use in camping or boating.

K 6350 (16W Version) **$35.95**
K 6360 (20W/40W Version) **$43.95**

Solar Generator Kit
(ETI Dec '87)

Charge Your Batteries Free From The Sun



The Solar Generator charges and maintains your standard 12V lead acid car battery via the sun. Fantastic for maintaining batteries which are not used or checked frequently. Ideal for boats, caravans and remote data acquisition stations etc. Note: Must be used in conjunction with a suitable solar panel.

K 1680 Normally $~~12~~.95
Now **$10.00**

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ALTRONIC COMPONENTS

AM/FM PLL Tuner

A 2210

Normally ~~$229.00~~

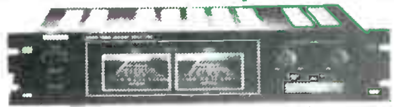
This Month **$199.00**

This fantastic tuner is the ideal add-on to any sound system. Can be used as background music source in restaurants, shops etc or any PA application. Also a great upgrade for the home Hi-Fi.

Features:
• Digital LED frequency readout display • FET FM front end for high image rejection • Phase-linear ceramic filters are incorporated in both AM and FM IF section • Phase-lock loop (PLL) IC for FM multiplex stage • Dimensions: (W x H x D) 435 x 60 x 232mm • Weight: 3kgs.

Two Channel Pro Power Amp 90 Watts Per Channel

THESE UNITS IDEALLY SUITED TO EACH OTHER, BUY BOTH AND SAVE EVEN MORE — ASK ALTRONICS FOR YOUR SPECIAL PRICE!

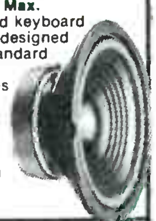


A 2040 ~~$625~~ This Month **$539.00**

This stereo amp is ideal for background/foreground applications. Fantastic for restaurants, shops, disco's, aerobics, PA sound systems and home.
• 90 watts RMS per channel • 2 large power meter indicators • XLR socket for speaker terminal • Output relay to eliminate turn-on and off transients

12" Guitar Speaker

50 Watts RMS, 100 Watts Max.



Attention all guitarists and keyboard musicians. This fine USA designed speaker is supplied as standard equipment to the world famous brand name series Guitar Amps.
• Impedance: 8 Ohm • Sensitivity: 101dB/W (0.5m) • Weight: 2400gm

C 3102 Normally ~~$99.00~~

Now **$79.00**

100mm Super Carbon Fibre Speakers

These amazing little speakers will impress you and your friends. Carbon Fibre is a new high tech material from which these speaker cones are made. Complimented with Barrium ferrite magnets the results are simply amazing. 8 and 16 ohm versions available makes multi speaker installations a breeze. Weatherproof design makes them ideal for car doors and boats!

C 0641 8 Ohm
C 0643 16 Ohm

Normally ~~$39.95~~
This Month **$25.00**
or **$40.00 pr**

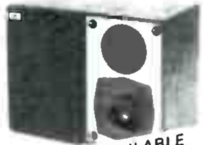
That's Half Price!

Vifa Speaker Kits

These kits use quality Vifa speakers made in Denmark and specially engineered enclosures for optimal performance. Black wood grain veneer make them ideal for any decor and situation. These two way models include high grade crossovers, speaker terminals and removable front grille. Simple construction with only basic tools and skill required. These kits are complete and include speaker cloth, damping material, grille clips, speaker terminals, screws and parts. Outstanding performance for the fraction of the cost of commercial equivalents.

VIFA SA-50

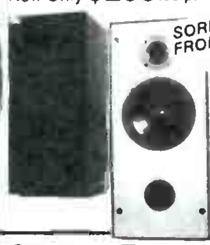
2 Way Bookshelf System,
50 Watts RMS



Normally ~~$399.00 pr~~

Now Only **$299.00 pr**

SORRY — NOT AVAILABLE FROM ALTRONIC DEALERS, AT THESE PRICES



VIFA SA-100

2 Way,
100 Watts RMS

Normally ~~$799.00~~

Now Only **$699.00 pr**

Famous Altronics Inverters

Get 240V AC from your car, truck or boat battery. The Altronics range includes an inverter for nearly every application. Fantastic for camping, boating, farms and anywhere else 240V AC isn't available. Each size inverter is available in kit form or fully built and tested. The 300 and 600 Watt Inverters now feature new improved circuitry using multiple mosfet outputs making them even more reliable with a genuine 300 or 600 watt continuous power rating. Our latest model, the 1200 Watt Powerhouse offers excellent value for money and performance. It features crystal locked circuitry and a massive 2400 watt power surge making it ideal for small fridges, vacuum cleaners, power tools etc.
Any model an absolute necessity where 240V isn't available. Call Altronics today for more information on freecall 008 999 007.

300 Watt

K 6750 Kit Version **$279**
K 6755 Built-up **$379**

Many Hundreds of Altronics Inverters Now in use Australia Wide!

600 Watt

K 6770 Kit Version **$499**
K 6774 Built-up 12V Input
K 6775 Built-up 24V Input **$625**

1200 Watt

K 6790 Kit Version **$799**
K 6792 Built-up 12V Input
K 6793 Built-up 24V Input **$999**

All Models Include Heavy Duty Battery Leads!

New Improved Models
These fantastic inverters now offer even better performance and reliability by utilizing new multiple Mosfet technology and circuit design.

Sensational Dome Tweeter

Ferro Fluid cooled voice coil 60 watts power capability. Silky smooth frequency response 1.5kHz to 20kHz. Wide angle dispersion. In comparative tests we rate this fantastic new Dome Tweeter superior to the VIFA D19! (which costs $45 or more). Incredible low price.

C 3016 Normally ~~$39.50~~ Now **$30.00**

Famous Vifa 5" Woofer

We have a huge surplus of Vifa C13WG-08-08 woofers. These quality drivers offer high performance in both ported and sealed enclosures. Exceptionally smooth response useable up to 5kHz. Careful design and construction using rubber surround makes it possible to obtain an amazing 50 watts RMS power calabicity. Fantastic replacement or new construction speaker.

C 3110 Normally ~~$99.00~~ Now **$49.00**

Stereo Extension Ceiling Speaker Kit

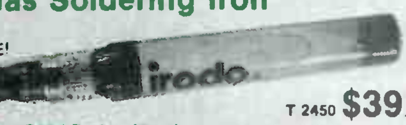
Want a set of high grade extension speakers for the back patio, games room, den, workshop, kitchen? Well here at Altronics we have put together this great kit which includes speakers, grilles, cable, screws and even a wall mounted volume controller. The speakers are our high quality 4" C 0626 dual cone drivers, with stylish white grilles — ideal for mounting in the ceiling. Volume control mounts in standard electrical wall box and includes 6 volume settings as well as off. Includes 2 x 20m cable.

C 0988 Normally ~~$99.00~~, Now Only **$69.00**

Includes Speakers, Grilles, Volume Control & Even Cable!

IRODA Gas Soldering Iron

OVER 2000 ALREADY SOLD AUSTRALIA WIDE!



T 2450 **$39.50**

Winner of the Taiwan Good Design Award
Now you can solder anywhere with this new gas soldering iron.
Features • See through gas chamber (no more guessing how much gas is left!) • Built in ignition cap • Uses standard butane gas • Comes with safety bench stand • Supplied with 2mm soldering tip and blow torch tip • Adjustable temperature from 400°C to 1200°C • Can be easily refilled with standard butane lighter gas • Replacement tips are less than half price of some other brands!

REPLACEMENT TIPS - ALL $4.95 ea

T 2451 Replacement 1mm Conical Tip	T 2455 Replacement Exhaust Port
T 2452 Replacement 2mm Conical Tip	T 2456 Hot Knife Tip
T 2453 Replacement 3mm Conical Tip	T 2458 Blow Torch Tip
T 2454 Replacement 3mm Chisel Tip	T 2457 Hot Blower Tip $10.95
	T 2448 Weller Butane Gas Refill $6.95

Bargain Transformers

Save $$$ - 12V Output for a Myriad of Electronics

Save heaps with this deleted line of 12.6V CT, 150mA transformers. Great for any number of electronic projects etc. Buy 10 and save!

MA2851 Normally ~~$7.30~~

Now **$5.30** ea, or 10 up **$3.75** ea

40MHz Dual Trace Oscilloscope

Q 0160 This Month **$1445.00**

A superb oscilloscope for technicians and engineers working on projects where other instruments would be stretched beyond their capabilities. Where precise measurements of computers, CD's, digital videos, RF applications, high speed digital, and other high speed equipment is a must.

With Features Like: • Delayed sweep for partial waveform expansion • Channel 1 signal output for use with a frequency counter • CH2 polarity inversion switch • Vertical deflection magnification, X5 • Switchable chopping frequency • Scale illuminating system • B Intensity control for bright, magnified waveforms • Variable hold-off for observation of waveforms with complex periods • Single sweep mode for one time or other suddenly occuring events • Sweep magnification, X 10 • Signal delay line for accurate view of high frequency pulse leading edge • Trigger preset function

BONUS - Includes 2 FREE Probes Valued at $99

PHONE ORDER TOLL FREE 008 999 007

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ALTRONIC COMPONENTS

Performance Computer Fans

High quality computer fans ideal for power supplies, amplifiers, computers etc. Reliable Sunnon brand. Full range available for almost any application.

240V Models

F 1020 80mm² **$22.25**

F 1030 120mm² **$24.25**

12V DC Model

F 1050 80mm² **$17.50**

24V DC Model

F 1040 120mm² **$23.90**

Finger Guards

F 1022 80mm
F 1032 120mm **$2.45**

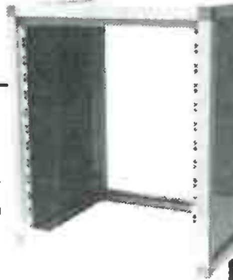
Blank Rack Panels

Save Up To 50%

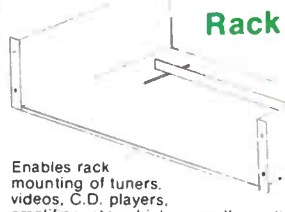
Top quality blank panel clearout. All stock must go at these crazy prices. Stock is limited with definately no back orders at these prices.

2 unit — All $8.00
H 0422 Natural Aluminium
H 0432 Grey
H 0435 Black

3 Unit — All $12.95
H 0423 Natural Aluminium
H 0433 Grey



Rack Shelves



Enables rack mounting of tuners, videos, C.D. players, amplifiers etc. which normally can't be rack mounted. Supplied in flat pack form - easily assembled in minutes. Available in black only.

H 5352 2 Unit (88mm) Normally ~~$49.95~~ Now **$39.95**

H 5353 3 Unit (132mm) Normally ~~$49.95~~ Now **$39.95**

H 5354 4 Unit (176mm) Normally ~~$55.95~~ Now **$45.95**

Australian Designed and Manufactured Professional Series Modular Rack Frames

Suitable for home or commercial use, these fantastic rack frames are durable strong, good looking, light weight and easy to assemble. The frames are available in either Natural Anodised aluminium or Black Powder Coat aluminium and the side panels in Electric Blue or Black Powder Coat finish. Ideal for use in home Hi-fi systems, Professional Audio installations, Band Gigs, Computer Patch panel etc.

Two colours to choose from:
Frames: Natural Anodised or Black Powder Coat
Panels: Electric Blue or Black Powder Coat.

Proudly Made In Australia

		Were	Now
H 5204	Rack frame 4U Nat	~~$139~~	$125
H 5205	Panel set for H 5204	~~$49~~	$44
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H 5319	Panel set for H 5318	~~$110~~	$99
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A LOW COST AUDIO SWEEPER - 1

Oh, no — not *another* audio generator! Ah, yes — but with a very practical difference. This one is virtually a complete low cost audio test system, for analysing the performance of speakers, speaker enclosures, filter circuits and room acoustics. As well as being very versatile, it's also easy to build and inexpensive — appropriate to a time of economic stringency!

by ARTHUR D. SPRING

For 50 years or so, I've been fiddling about with speakers. What's unusual about that, you may respond — after all every household has quite a few of them! Well, I did it professionally, for quite a while. As with many other components, my responsibility was to see that my design department selected units with the best compromise between performance, price and style, from those available for use in our radio and television sets.

The first thing to do was whack in the supplied samples and do an A-B subjective test. This showed up any gross shortcomings. Then we would study the advertising blurb, laden with 'heifer dust', and proceed to optimise the enclosure.

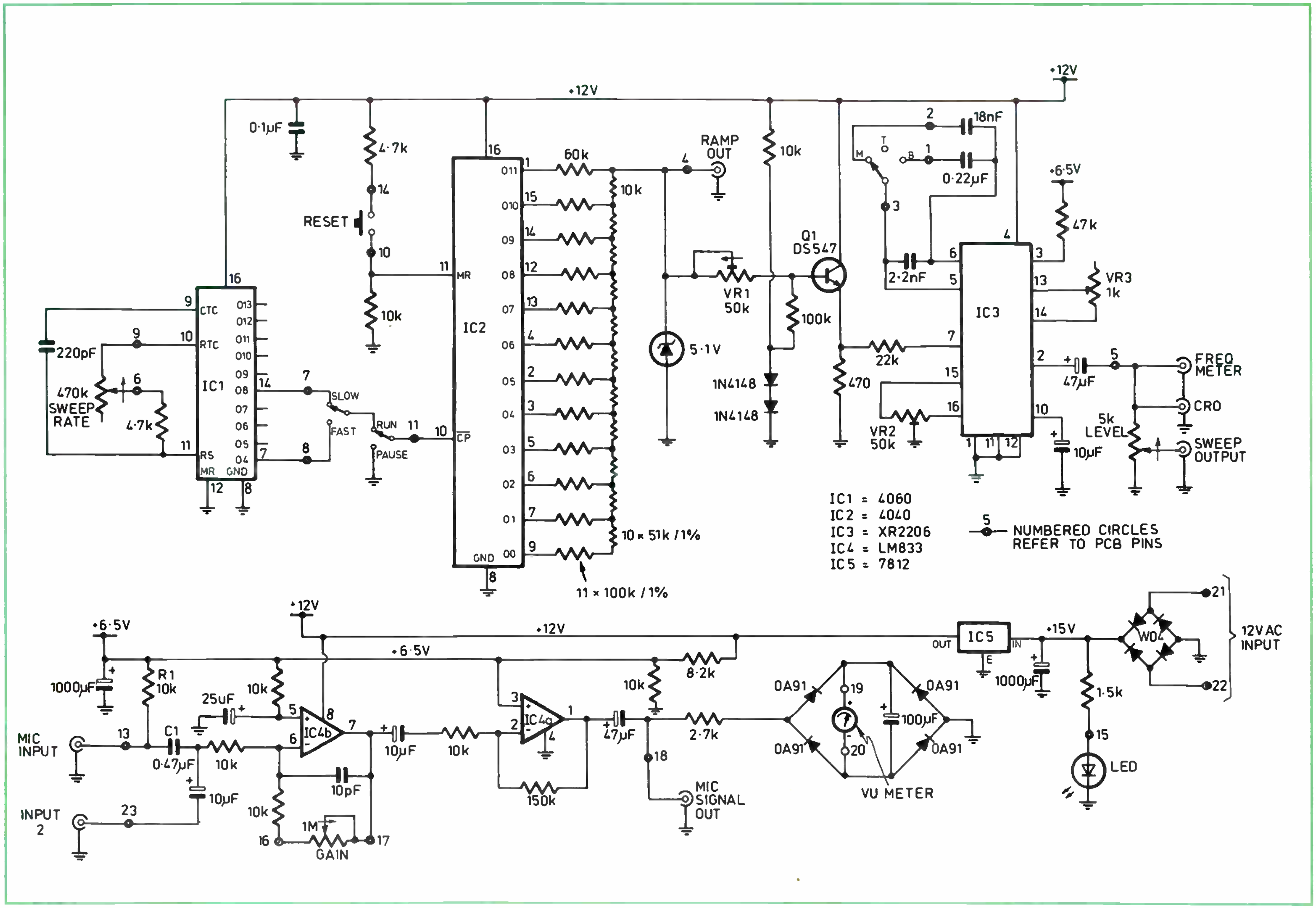
Now this is where it all happens... Before the days of the excellent work by Thiele and Small, which is so helpful if you have all the required input information, we would calculate the box by the practices of the time. Then we'd fabricate one and set up tests using a 'Bruel & Kjaer' chart recorder.

Whilst a good permanent record was obtained, a new slow plot was required for each minor adjustment — very time consuming. Having done all that, it was not unusual to find that a much vaunted, expensive imported unit was very little, if any better than our cheaper Australian-made speakers! Regrettably, due to our misguided government policy, Australian products are now few in number.

But getting back to speaker testing, what was/is needed is a quick method of applying a sinewave tone of varying frequency to the power amplifier driving the speaker, and then studying its acoustic output via a microphone, on the oscilloscope.

Assuming we do not have a totally dead anechoic room and these 'open field' observations are to be made at say two metres from the source, two main problems emerge: standing waves in the room at high frequencies (1000Hz and beyond) and the need to scan very slowly at the low frequency end.

For the first problem, experience has shown that it is not too difficult to get a fairly good idea of the average high frequency performance — in spite of what



Here is the circuit for the sweeper, which as you can see, divides neatly into two separate sections. The section based around IC1, IC2 and IC3 is the sweeping oscillator, while that below it around IC4, is the metering section. IC1 and IC2 generate a ramp control signal, which is used both to vary the frequency of oscillator IC3 and also for the X deflection of the scope.

[illegible]

might at first sight seem to be gross humps and bumps — simply by moving the microphone position. If the peaks persist, one can expect some tonal colouration.

Due to the persistence of vision, the whole spectrum can be rapidly swept — thereby displaying a performance profile of the mid range and tweeter speakers, including their cross-over networks.

The low frequency end (from 10Hz to say 100Hz) is quite different. Here the scan or sweep speed must be quite low, to allow the system to stabilise for a few cycles; otherwise the result is meaningless.

The problem with a low sweep speed is that the CRO displays a slowly moving spot, which is difficult to interpret. My answer is to switch the CRO to normal display (with its own timebase set for a reasonable sweep rate), and still with a low scan speed watch the rise and fall of the waveform. At any point of interest, with the sweeper to be described, you can switch to PAUSE. This causes the scan to stop, allowing you to read the frequency meter and the output level. (Most DFM's will not accurately track a moving waveform.)

To avoid complications by any back wave signal from the box vent, it's a good idea to place the microphone a few centimetres from the cone in the 'near field' position.

Speaker box design has been dealt with by others, so will not be detailed here. Suffice to say, a poor choice can be expensive as well as disappointing. But don't be put off. If you happen to have a quality speaker with a low resonant frequency cone lying about, try pairing it up with a suitable box. But be warned: TEST IT FIRST for a dry or loose cone support, and things like voice coil rattle and buzz.

My own designed 'VERNUS III' organ can produce 500W RMS, via seven amplifier channels. These are fed into a hotch-potch of 16 cones, some of which are quite ancient! The full power is never used — it's there to give 'headroom' for peaks, good linearity and low intermodulation — especially for the pedal section which extends down to bottom C at 31Hz.

Over the years I've acquired wave analysers and distortion meters, and built elaborate sweepers and CRO storage devices. But finally I've come back to first principles and contrived this simple box of tricks. Despite its simplicity, it has proved to be very use-

The Sweeper described in this article is no flash in the pan — it's shown here with three earlier versions, which were used to come up with the best solution.

ful indeed — not just for testing speakers, but also for examining the behaviour of audio filters and similar circuits.

I hope I haven't been too verbose with this background explanation. I say to friends "I've gathered a lot of wisdom in 73 years — trouble is, I've forgotten what it was!"

Well then, so much for the WHY; now for the HOW...

How it works

The sweeper consists of two separate sections: the sweeping auto generator, and the metering amplifier. One generates the audio test signal, to be fed to your amplifier and speaker (or filter, etc), while the other is used to measure the results.

The prime source of our sinewave test signal is an XR2206 'function generator' chip (IC3), which has provision for its operating frequency to be varied by means of a DC voltage applied to pin 7. The actual output frequency is determined also by the capacitance between pins 5 and 6, and here we take advantage of this by using switched capacitors to provide three convenient sweep ranges.

These cover approximately from 18.5kHz to 900Hz, from 2000Hz down to 100Hz and from 190Hz down to 10Hz. This divides the audio spectrum into 'Treble' (T), 'Middle' (M) and 'Bass' ranges, appropriate for testing tweeters, squawkers and woofers respectively. While these XR2206 multipurpose chips do not provide the sine wave purity required for the testing of extremely low distortion amplifiers, they are reliable and more than adequate for most general audio testing work.

To vary the frequency of IC3 in a smooth fashion, we feed its pin 7 with a digitally-generated *ramp* signal. This is produced by IC1, IC2, Q1 and their associated components.

IC1 is a 4060 oscillator-divider. The oscillator section is of the R-C type, with its frequency varied over a wide range (approximately 400Hz to 28kHz) by means of the 470k SWEEP RATE pot. This signal is then fed internally to a 14-stage binary divider, which delivers various sub-multiples at its output pins.

Here we select only two of these: that at O4 (pin 7) which is a /16 signal used for FAST sweeping, and that at O8 (pin 14) which is a /256 signal and used for the alternative SLOW sweeping. The two signals are fed to a front-panel toggle switch, to allow convenient selection, and the one that's chosen is then fed to the RUN/PAUSE switch — which allows pausing of the sweep whenever you wish, for closer examination at a fixed output frequency.

The PAUSE and measure system is much simpler to use than the complications of a satisfactory 'notch' or 'marker' system, when it comes to identifying peaks and troughs, etc. Also, it's possible to creep up to a peak slowly and note the frequency of the -3dB points on the VU output meter — thus permitting calculation of the system Q.

At this stage, of course, we simply have a square-wave 'clock' signal, which is still somewhat faster than our desired sweeping rate. This square wave signal is fed to pin 10 of IC2, a 4040 12-stage binary counter, which is turned into a simple and very economical 'D to A converter' by means of the resistor network connected to its outputs.

Outputs O0 to O10 (pins 9 - 15) are connected to a 'ladder' of 100k and 51k resistors, which produces a very linear DC voltage ramp as IC2 counts up from zero.

The 60k and 10k resistors at the top of the ladder and associated with O11 (pin 1) provide a modified 'weighting' for the top half of the ramp, because of their different values. This together with the 5.1V zener diode shunted across the output of the resistor network gives the final ramp a 'pseudo-logarithmic' shape, regardless of sweep frequency. We do this because it tends to 'spread' the display at the top end — making it easier to interpret.

[illegible]

ABOUT THE AUTHOR

Arthur Spring describes himself as being of 'third generation Anglo/Irish' extraction, and somewhat harshly as 'a poor mathematician with no academic qualifications'. However he spent many years working at Radiokes, Crown Radio and finally in the design lab at Breville Radio, working with his 'mentor' Noel Smith. Later he moved to Jackson Industries, as chief engineer, and his designs for the Jackson Industries 'Precedent' range of radio receivers, radiograms and monochrome TV receivers became widely recognised throughout the industry for their reliability and cost-effectiveness. During that time he also designed the 'Vernus' range of electronic organs.

During his long career, Mr Spring designed a mine detector and other 'non-lethal' equipment, for the Australian Army. While at Jackson Industries his team also pioneered the first 'moulded bobbin' construction for power and other transformers. After Jacksons were absorbed by Electronic Industries, he became an engineering consultant to a metal fabrication firm and also to Jones Transformers, which ceased operations only recently.

Nowadays, he spends his time mainly pursuing a long-time interest in electronic music, along with things like photography and computers.

Incidentally, the name 'Vernus' comes from the Latin, meaning 'Of Spring'...

Note the use of 1% tolerance resistors, to ensure that ramp linearity is maintained. Strictly speaking the 51k resistors in the ladder network should be 50k (half the 100k value), but this is not of great significance here because of our 'fiddling' the ramp into pseudo-log form.

The final ramp signal is fed into pin 7 of IC3 via Q1, connected as an emitter follower and buffer. Pot VR1 is used to adjust the amplitude of the ramp, for optimum sweeping. DC coupling is used throughout to avoid ramp distortion and drift effects. The two diodes are used to give a stable minimum bias for Q1. If desired, the sweep can be restarted from the high end at any time by pressing the RESET button. This resets IC2 to zero count, and the ramp to its minumum value.

I should note here that the sweeping process is a little unconventional, in that it takes place from the high frequencies to the low. This is done to reduce the effects of the inevitable DC discontinuity which takes place at retrace. It causes less distress to the tweeters than the hang-on effects cause to the bass speaker cones at the low end.

The main swept audio output of the generator comes from pin 2 of IC3, with a 5k pot used for convenient level adjustment.

This output appears on the front panel, at an RCA jack labelled SWEEP OUTPUT. Additional connectors fed with the full output signal are provided on the rear panel, and marked CRO and FREQ METER respectively, to allow test signal monitoring with these now commonplace instruments. While these additional instruments are not absolutely necessary, they are obviously very useful when adjusting box vents, filter circuit rollover points, etc.

Also provided on the rear panel is the sweeping ramp signal itself, which is fed to the X-amplifier input of the CRO. This allows the response to be plotted conveniently on screen.

Metering amp

So much for generating a suitable swept audio signal; now for detecting and measuring it — the metering amplifier section. This is the circuitry around the dual op-amp chip IC4, an LM833. IC4b is used as an input preamp stage, with adjustable gain, while IC4a is used as a fixed gain second stage which drives the metering circuit and the rear-panel MIC OUTPUT signal — which feeds to the Y-amplifier of the CRO.

The gain of the second stage is fixed at 15 times, while that of the first stage is adjustable between unity and approximately 100, via the 1M front-panel GAIN pot. This gives an overall gain which can be varied between 15 (23dB) and 1500 (63dB).

For testing speakers and boxes, the metering amp is fed from a home-made calibrated electret microphone, which will be described later on. Not surprisingly this plugs into the front-panel MIC INPUT jack, which also provides the mike with its DC bias voltage via 10k resistor R1.

Note that this front-panel input is really only for use with an electret mike, because of the DC bias. If any other device is plugged in, up to 0.5mA DC can flow through it. Also the 0.47uF input coupling capacitor C1 has also been selected to roll off the low-frequency response; it gives about -6dB at 15Hz.

At the Editor's suggestion, an unpolarised, uncompensated and unbiased INPUT 2 connector has also been provided on the rear panel, thus allowing different microphones to be used. With a suitable voltage divider this input can also be used as a higher-level input, for testing filters and other circuits.

When test signals are fed to INPUT 2, the following specification applies. With the GAIN pot set to maximum, the response is -3dB at 16kHz and at 2Hz; with GAIN at minimum, the response is flat (0dB) to beyond 100kHz, and -3dB at 2Hz. As well as being made available for connection to the CRO, the amplified signal available at the output of IC4a is also fed to a metering circuit. This uses a small 'VU' meter, which has non-linear characteristics and an FSD of 418uA. It is specific to the design, requiring an external bridge rectifier of four OA91 germanium diodes and a 2.7k series resistor.

Other meters may require circuit modifications. The 100uF capacitor connected directly across the meter damps out wild excursions of the pointer — e.g., when banging about with the sensitive microphone.

Power supply for the instrument comes from a small 12V transformer, rated at 150mA. This is fed to a small bridge rectifier, giving 15V DC across the 1000uF reservoir capacitor. A 7812 three-terminal regulator (IC5) then provides a stable, highly regulated 12V supply for the rest of the circuit. The 8.2k/10k voltage divider is used to derive a 6.5V bias line for the metering amp stages, and also for IC3 (pin 3). A second 1000uF capacitor ensures that this bias line is firmly decoupled.

So that's the circuit for the audio sweeper, and an idea of how it works. In the second article, we'll look at putting it all together, and building the matching 'poor man's measuring microphone'.

(To be continued) ❖

Mini Construction Project:

VISIBLE LASER DIODE POINTER

Here's an elegant design for a 'laser pointer' for lectures and sales presentations, which can be built for around half the price of equivalent commercial pointers. It uses a rechargeable NiCad battery and a compact semiconductor laser diode, and features touch control which can provide either continuous or pulsed light output — the latter giving longer battery life as well as easier visibility.

by OTTO PRIBOJ

Some time ago, I purchased a visible laser diode evaluation kit from Sydney firm Oatley Electronics.

This kit was supplied with a 670nm visible laser diode, a heatsink, a collimator lens assembly, a circuit for a suitable constant current source, and the components for this constant current source.

I decided to use the kit as the basis for a laser pointer, but I elected to design my own drive circuit so that I could include several features which I thought would be desirable in such a unit.

My final pointer features touch switching, a choice of either continuous or pulsed (blinking) modes of operation as desired, and a very compact housing.The latter was made possible by the use of some very small rechargeable NiCad batteries which I bought from Jaycar Electronics — for a total cost of only $2 for the 4.8V 100mA-hour rechargable pack!

Even with this small power pack, the pointer can operate in the continuous mode for over one hour — or in the blinking mode for over two hours. Far longer operating times can be obtained by using larger, normal sized batteries.

An important feature of my pointer is the blinking mode of operation, as it not only prolongs the battery life,

but also m akes the resultant pulsing spot of light attract more attention. In this mode of operation the laser diode is made to pulse on and off at a low frequency.

Also of interest is the power consumption when the unit is not in operation. The IC has power applied all of the time, but when the unit is not being used, less that 4uA of current is drawn from the battery. That's much, much less than the self-discharge current of the battery itself.

Circuit description

Briefly, transistor Q1 is used as a switch, in order to apply power to the laser diode via a constant current source made up from transistors Q2 and Q3.

Integrated circuit IC1, a CMOS 4093 quad Schmitt NAND gate, is used for a few functions: as a low frequency oscillator, a body resistance switch detector, and a switch driver to control transistor Q1.

Gate IC1a forms a simple oscillator, in conjunction with R1 and C1. This relies for its oscillation on the hysteresis of the 4093's Schmitt gates. The frequency of oscillation in the prototype was about 3Hz, but if you want the pointer to 'blink' faster or slower, this can be changed by changing the value of R1.

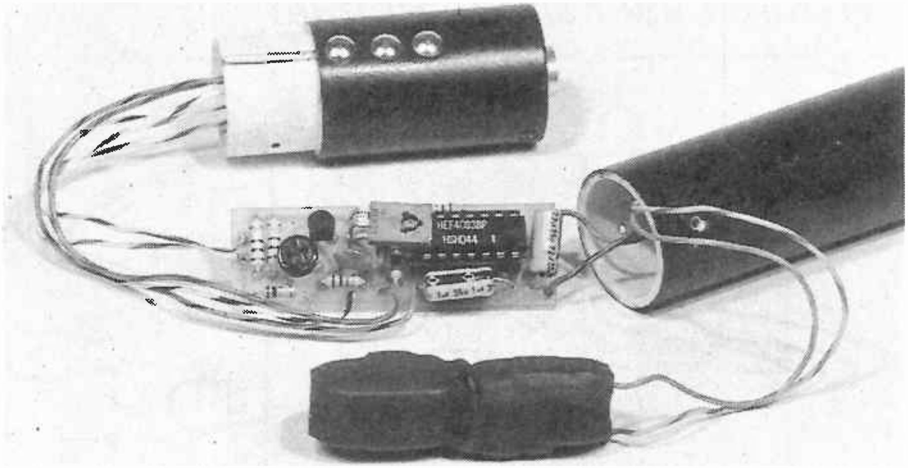
Gate IC1b is used for the pointer's touch control function, in conjunction with finger-contact studs A, B and C.

The input to the gate is normally connected to logic 'high' (1) level via R2. Its output is therefore normally held at 'low' (0), and therefore the output logic level from the paralleled switch driver gates IC1c/d is at logic high (1). This prevents switch transistor Q1 from drawing any base current, and the transistor is turned off — preventing any current from being supplied to the laser diode.

However if a finger is placed between contact studs B and A, the relatively low skin resistance (compared with R2) pulls the gate input level to a 'low' (0), and as a result Q1 is turned on — operating the laser diode continuously. This continues as long as the finger links contacts B and A.

Alternatively if the finger is placed between contacts B and C, this couples IC1a's oscillator squarewave output signal directly to the input of gate IC1b. As a result switching transistor Q1 is made to switch on and off, and the laser diode pulsed in turn. This again continues while the finger links contacts B and C.

Needless to say when the user's finger is removed from all of the contacts, the circuit reverts to its low-current 'resting' mode.



Inside the prototype pointer unit, showing the small PC board which supports most of the components. In the foreground is the compact NiCad battery pack, while the laser diode assembly is hidden in the 'front' section of the case.

Capacitor C2 is included in order to prevent any stray signals from switching on the pointer or damaging IC1.

It is interesting to note, that if C2 were removed, digital information applied to the point labelled B would switch the laser beam on and off. This may be useful for applications such as laser communications.

Current source

A laser diode can easily be damaged by excessive current, and so an adjustable constant current source is used to drive it. Here the constant current source is made from transistors Q2 and Q3.

Transistor Q3 is turned on by R5, when Q1 is turned on. This causes current to flow through the parallel resistor combination R6 and (R7 + VR1), and then through the laser diode LD1.

But the base-emitter junction of Q2 is also connected across the series resistors, and when the current through Q3 and the laser diode is sufficient to generate 0.6V across the resistors, Q2 turns on and bleeds drive current from the base of Q3.

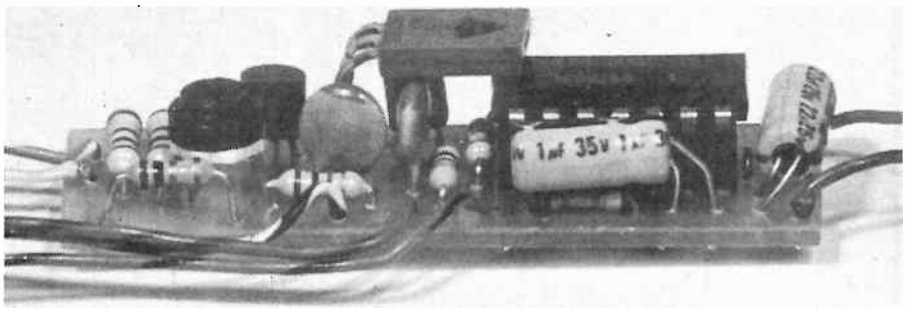
Hence the laser diode current is stabilised at a level given by:

$I = 0.6/(R6//(R7 + VR1))$

The 1Ω resistor in series with the cathode of the laser diode is to allow monitoring of the diode's current. With the laser diode I used, the recommended operating current was 85mA — corresponding to a voltage drop of 85mV across the 1Ω resistor.

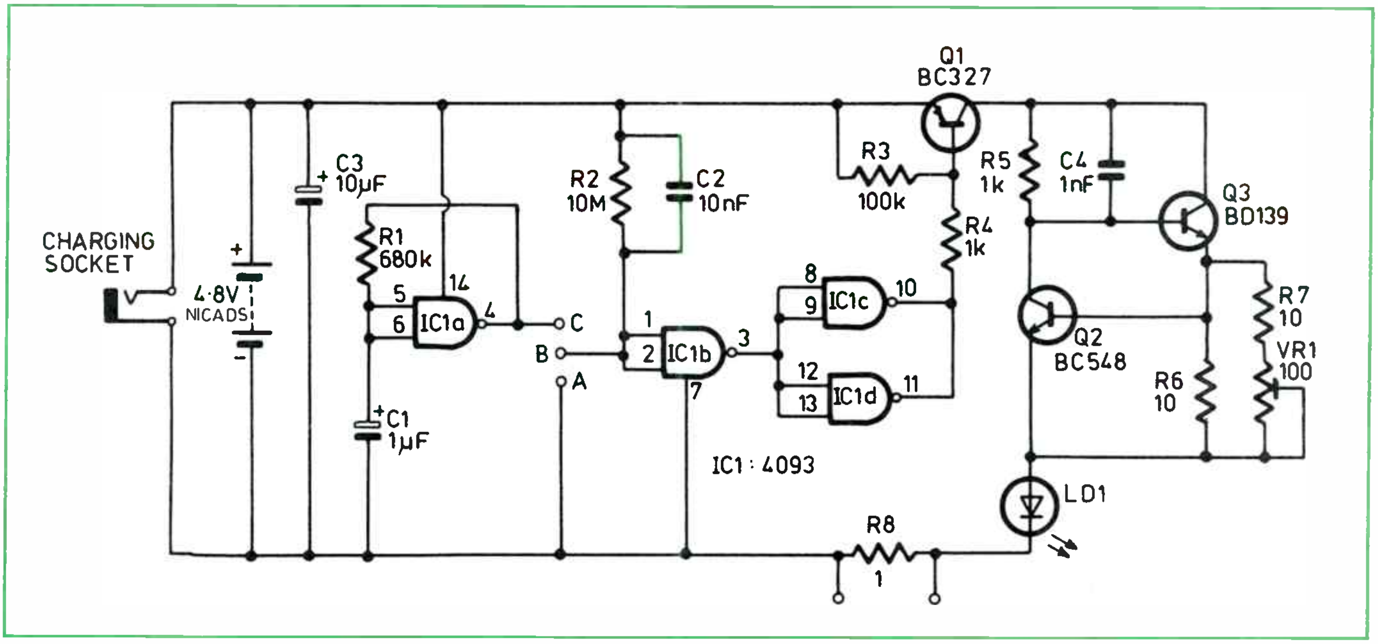
The current is adjusted to this level using preset pot VR1, monitoring the resistor voltage with a digital multimeter. For this test the contact studs B and A should be connected together temporarily, to achieve continuous laser diode operation.

Of course other laser diodes may need a different operating current level. When you purchase your diode, make sure that you receive data on the recommended operating current level.



A side view of the assembled PC board, showing how Q3 and two of the larger electrolytics are bent over to fit inside the case.

Visible Laser Diode Pointer



Here is the schematic for the laser pointer. As you can see, it uses only a small number of components despite its ability to operate in either continuous or 'blinking' mode. Q2 and Q3 form a constant-current source for laser diode LD1.

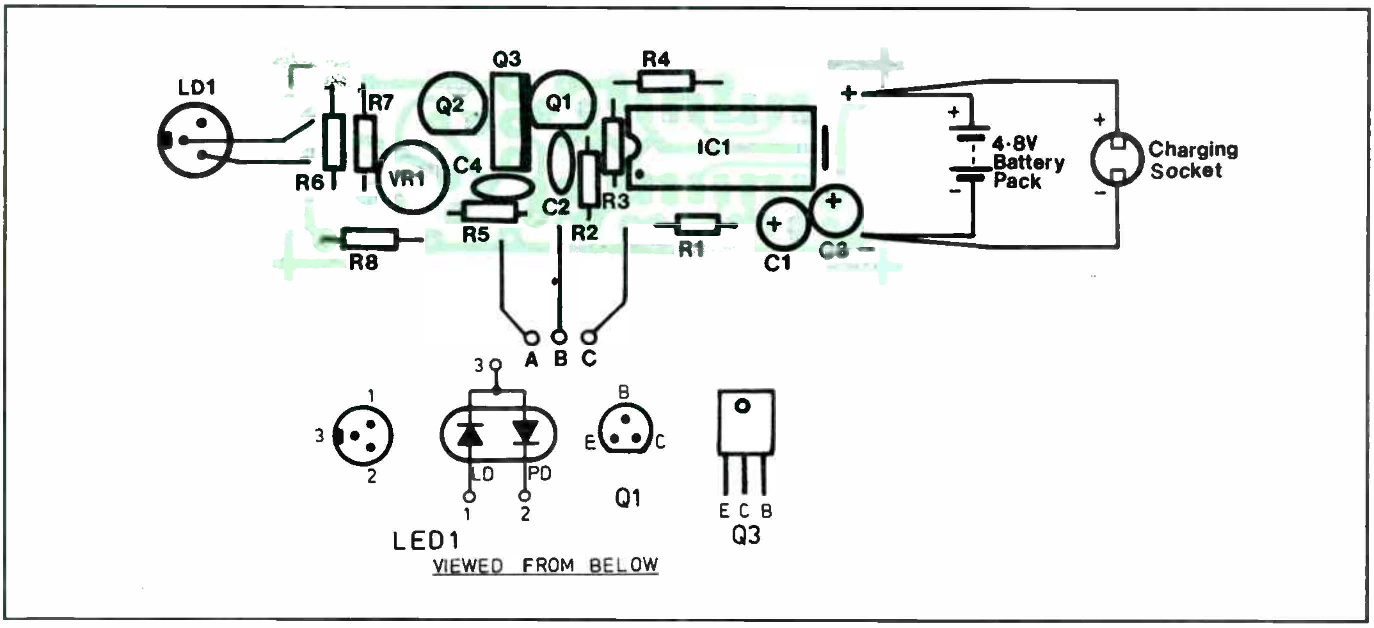
Construction

I have made a number of the laser pointers to date, all housed in cases like the one shown in the photographs. This is made from readily available 25mm diameter PVC conduit, with a total length of 165mm. This is actually made up of two sections, one 40mm long and the other 125mm long, which fit together using a short inner sleeve — which is made from another piece of 25mm conduit, with an axial strip removed so that it will 'spring' inside the two main sections.

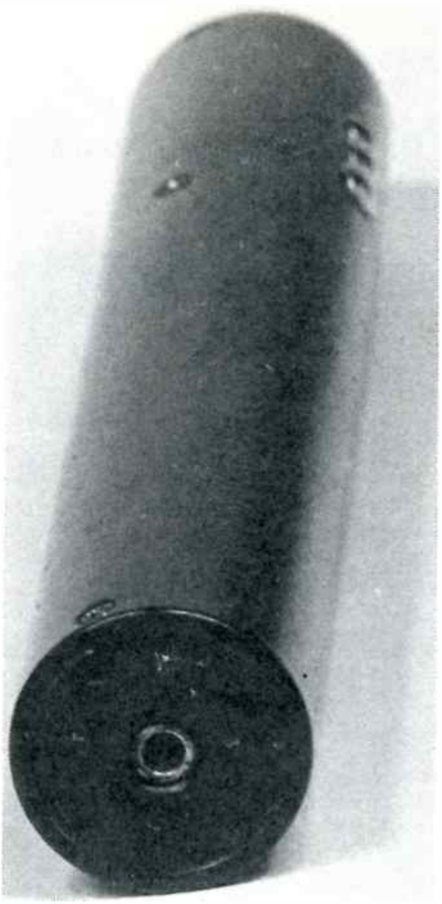
The laser diode head forms the end plug for the 'business end' of the point, in the shorter length of conduit, while a small plug turned up from 25mm PVC rod seals the other end of the longer section. A 3.5mm mini phone jack is mounted in the centre of the rear end plug, to allow convenient charging of the NiCad battery.

The various parts of the pointer case are assembled using 4mm long 1.5mm countersunk head machine screws, and the outside of the assembled case was sprayed with black lacquer — *before* fitting the laser diode assembly, contact studs or charging jack, etc.

Virtually all of the pointer circuitry — apart from the laser diode itself, the NiCad battery assembly and the contact studs — is mounted on a small PC board measuring 19 x 56mm. The etching pat-



It should be easy to wire up the laser pointer using this overlay/wiring diagram and the photographs as a guide.



A 3.5mm socket at the rear end of the pointer is used for charging the internal NiCads, via an external constnat-current charger or plug-pack supply.

tern for the PCB is reproduced here actual size, for those who wish to copy the prototype.

The matching PCB overlay diagram is also provided, but as you can see from the internal photo, some of the components are actually mounted horizontally to allow the completed PCB assembly to slide inside the case. The components involved are the 10uF supply bypass C3, the 1uF oscillator capacitor C1, and Q3 — whose leads are left about 15mm long, so that it can be mounted above Q1 and C2 as shown.

The connections for the transistors and the laser diode are given in the overlay diagram. Note that the laser diode I used actually includes a photodetector diode (PD) in the same package, but this is not used here.

The laser diode heatsink provided in the original kit was a TO-5 type, and some fiddling was required to fit the collimator lens assembly, in order to fix it in a position where it was properly focused. Since I have access to a lathe, I decided to make my own heatsink which also accommodated the supplied collimator.

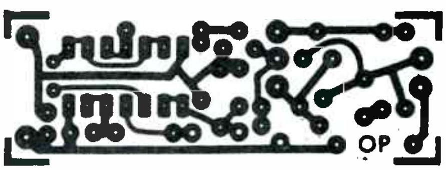
This assembly was machined from a piece of solid aluminium rod, and it is probably much larger than is strictly required. It also served the purpose of providing a neat fitting seal for the front end of the pointer case.

(Editor's Note: We are advised by Oatley Electronics that they now have a complete pre-focused laser diode/collimator assembly, measuring 22mm long and 10mm in diameter, which should be very suitable for this project — especially for readers without access to a lathe. It is available for $135, including postage. Further details are available from Oatley Electronics, PO Box 89, Oatley 2223 or phone (02) 579 4985.)

The three stud contacts used in each of my laser pointers are made from 2mm bifurcated rivets, which are a push fit inside matching holes in the shorter front section of the case. The rivets are available at hardware stores, and have a chrome-plated head. I cut them short, leaving only about 4mm of shank, and drilled a 1mm hole near the cut end to allow soldering of the PCB connection wires when the rivets are pushed through the holes in the case. Needless to say all of the wiring between the laser head, PCB assembly, contact studs, NiCad battery and charging jack needs to be made before the case is fully assembled. Don't use wires that are excessively long, or assembly of the case will be too difficult.

For charging the 4.8V NiCad battery inside the laser pointer, I use a small constant-current supply, with a lead and 3.5mm plug. The supply is set to provide the correct 'overnight' charging current level of 0.1C — here 10mA.

A standard small plug-pack supply could probably be used in a pinch, with a series resistor fitted inside the pointer case to set the current to the correct level. You might also wish to fit a series diode in this case, to prevent the possibility of reverse charging due to swapped plug-pack connections. However a constant-current charging circuit is recommended. ❖



As you can see from this actual size reproduction, the PCB is quite tiny.

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6116-1	2.75	2048x8 2Kx8 CMOS	100ns	24
6116-3	2.25	2048x8 2Kx8 CMOS	150ns	24
6116-4	2.15	2048x8 2Kx8 CMOS	200ns	24
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6264LFP10	4.25	8192x8 8Kx8 CMOS Low Power	100ns	SOP* 28
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6264SLP10	5.25	8192x8 8Kx8 CMOS Low Power	100ns	Skinny Dip 28
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62256LP10	6.75	32,768x8 32Kx8 CMOS Low Power	100ns	28
62256LP15	6.25	32,768x8 32Kx8 CMOS Low Power	150ns	28
62256SLP12	7.95	32,768x8 32Kx8 CMOS Low Power	120ns	Skinny Dip 28
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8000

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TMS2532A45	6.95	32K	450ns	21V	24
TMS2564	5.95	64K	450ns	25V	28
TMS2716	5.95	16K	450ns (±5V, +12V)	25V	24
2708	4.75	8K	450ns (±5V, +12V)	25V	24
2716	3.35	16K	450ns	25V	24
2716-1	3.75	16K	350ns	25V	24
27C16	4.25	16K	450ns CMOS	25V	24
2732	3.95	32K	450ns	25V	24
2732A20	4.45	32K	200ns	21V	24
2732A25	3.45	32K	250ns	21V	24
2732A45	2.95	32K	450ns	21V	24
2732B45	4.25	32K	450ns	12.5V	24
27C32	4.75	32K	450ns CMOS	26V	24
2764-20	3.95	64K	200ns	21V	28
2764-25	3.75	64K	250ns	21V	28
2764A15	4.45	64K	150ns	12.5V	28
2764A20	3.75	64K	200ns	12.5V	28
2764A25	3.25	64K	250ns	12.5V	28
2764A45	2.95	64K	450ns	12.5V	28
2764AOTP	2.95	64K	250ns One Time Prog.	12.5V	28
27C64A15	3.95	64K	150ns CMOS	12.5V	28
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27128-20	7.55	128K	200ns	21V	28
27128-25	7.25	128K	250ns	21V	28
27128A15	4.95	128K	150ns	12.5V	28
27128A20	4.45	128K	200ns	12.5V	28
27128A25	3.75	128K	250ns	12.5V	28
27128AOTP	2.35	128K	250ns One Time Prog.	12.5V	28
27C128-15	5.65	128K	150ns CMOS	12.5V	28
27C128-25	4.95	128K	250ns CMOS	12.5V	28
27CP128-20	5.25	128K	200ns CMOS	12.5V	28
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27256-20	4.95	256K	200ns	12.5V	28
27256-25	4.45	256K	250ns	12.5V	28
27256-30	3.45	256K	300ns	12.5V	28
27C256-15	5.75	256K	150ns CMOS	12.5V	28
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6520A	3.45	40	6810	1.45	24
6522	2.95	40	6818	6.95	24
65C22	4.25	40	6821	1.75	40
6526A	12.95	40	68B21	2.95	40
6532	3.95	40	6840	3.25	28
6545-1	3.75	40	68B40	4.75	28
6551A	3.45	28	6844	7.95	40
65C51	3.25	28	6845	2.45	40
6567	15.95	40	68B45	4.75	40
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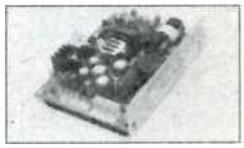

- •Input Voltage: 220-340VAC
- •Input Fusing: AC line fused
- •Input Current: 0.2 Amp (47-63Hz)
- •Dimensions: 1.25" x 3.625" x 4.75"
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30-35 pcs. per oz.	13-15 pcs. per oz.	3-4 pcs. per oz.	0.8 oz. each	5-10 pcs. per oz.	1.7 oz. each

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READER INFO NO. 17

Construction Project:

Low cost Voltage and Current Calibrator

Voltage and current calibrators are usually very expensive instruments, available only in standards labs. Here's the design for a much cheaper version, which can still be used for checking the accuracy of many common instruments. It provides both DC voltage and current outputs, and offers an accuracy of around ±0.2%.

by PETER SIMMONDS

Often a hand-held voltage or current calibrator is wanted by a hobbyist or technician, to generate precise voltages and currents for testing or calibrating equipment. Performance factors associated with calibrators are good accuracy, resolution and stability over both temperature and time.

Regulated power supplies are often used for the task of generating voltages and/or currents, but they are usually too big to be portable, are not that stable and frequently they cannot easily be adjusted to an exact voltage or current. Besides, you usually want to use them for what they have been designed for: powering circuits.

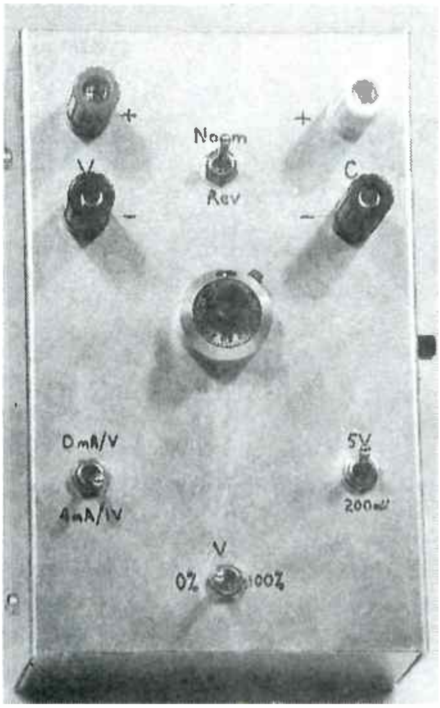
Although there are a number of true calibrators in the marketplace they tend to be too expensive for the hobbyist. There are probably two reasons for this. One is that there is not a great market for them; the other is that they tend to use very sophisticated components to achieve the required accuracy — and these tend to cost more than your more commonly used components.

Components used include low drift, low-offset operational amplifiers, metal film resistors and multiturn cermet trimpots.

The calibrator that I have designed, and describe here, is not going to give you the sizzling accuracy and resolution that you would expect from a machine costing $1000 - $2000 or more, but it will give good performance for the average technician and hobbyist while not breaking the bank balance. You will have a calibrator that will give an accuracy of ±0.2% over the full range, which is better than 8 bits.

I have strong connections with the process control industry, so I was particularly interested in producing a calibrator with the following ranges:

Voltage ±0 to 5V
±1 to 5V
±0 to 200mV
Current 0 to 20mA
4 to 20mA



The author's prototype calibrator may look a little rough, but it works well.

The 0 to 5 volt range was required because most analog to digital converters have a 0 to 5 volt input, while the 0 to 200 millivolts range can be used to simulate transducers such as thermocouples, RTDs and silicon type pressure transducers which have a very low voltage output.

The current range of 4 to 20mA is very common in process control, where pressure and temperature transmitters, etc., operate using a 4 - 20mA loop. When you put a 250-ohm resistor in the loop, the voltage across the resistor is 1 - 5 volts, which explains the need for the 1 - 5 volt range.

This doesn't mean that you are stuck with these ranges, as the circuit is particularly easy to adapt. It just means changing a few resistors to suit your application. This will be discussed later in the explanation of circuit operation.

Other features of the calibrator include a switch which allows you to switch between zero and full range, which is very helpful in adjusting offsets and gains on such things as analog to digital converters. The calibrator also has another switch which allows you to reverse the polarity of the voltage output — which is good for calibrating bipolar devices.

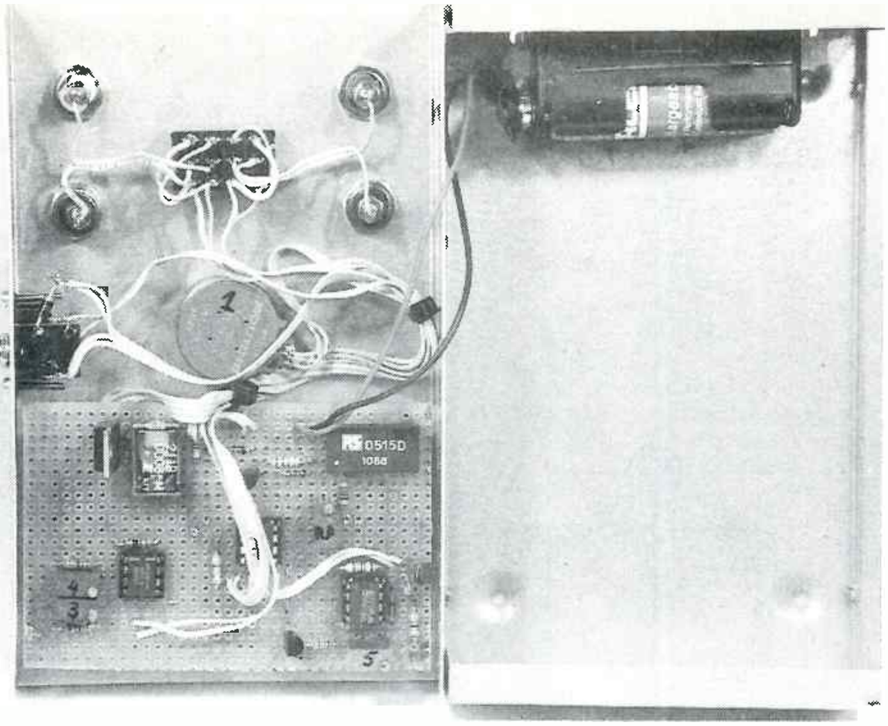
One of my chief requirements was that the calibrator was to be portable and because I hate buying batteries all the time (I like to think I am environmentally conscious, but it is probably beause I am plain downright fiscally tight), I decided to power it using four NiCad batteries.

Hence the calibrator was designed with its own constant current charger. It also has a socket for an external 9V plug pack, which will allow the batteries to be recharged and the calibrator to be powered externally.

Circuit operation

As was stated above, the two main features of a calibrator are accuracy and stability. Hence the resistors used in this

Low Cost Voltage and Current Estimator



Inside the prototype calibrator. It was wired up on utility board, but the author has provided a PC board pattern for readers to build up their units in a more elegant and convenient manner.

circuit are a metal film type with a tolerance of 1%. Similarly the trimpots are 25-turn cermet types and the operational amplifiers feature low offset voltage and low offset voltage drift, with temperature and time.

The full circuit is shown in Fig.1. All calibrators are based around a stable voltage reference, and this one is no exception. The reference ZD1 in this circuit is a TSC04 from Teledyne, which generates approximately 1.26V. If this device is unavailable you can use a number of others, such as the REF12Z or the AD589 from Analog Devices.

The output of the reference is fed into a voltage follower U1a. At the output of the follower is a 10-turn wire wound potentiometer VR1, which has a 10 turn dial. The operator uses this dial to set the voltage or current output as a percentage value of the range.

Connected to the other end of the 10-turn potentiometer is switch S1. It is by the use of this switch that the operator is able to switch in the offset. In the case of the ranges 0 - 5V, 0 - 200mV and 0 - 20mA, throwing the switch will change the ranges to 1 - 5V, 40 - 200mV and 4 - 20mA respectively. The trimpot VR2 adjusts the size of this offset.

The wiper of the 10-turn potentiometer is connected to a voltage follower U2a, which because of its high input impedance reduces the effects of loading on the wiper voltage.

To allow the output to be switched between full scale, zero scale and the variable setting, switch S2 is used. Switch S2 is a three position (ON-OFF-ON) switch and is connected in such a way that it will allow the full scale voltage, zero level or the wiper voltage to be fed to the voltage follower.

The output of the follower U2a is fed to a non-inverting amplifier U3, which is configured in such a way that it can either reduce the 0 - 1.26V span of U2a to 0 - 200mV or increase it to 0 - 5V. This versatility is brought about by the use of switch S3.

Opening S3 means that the operational amplifier U3 operates as a voltage follower. The voltage divider consisting of R7, VR3, and R8 divides the 1.26V output of U2a by a factor of approximately 6.25, to produce the range of 0 - 200mV.

Closing S3 means the output of U2a is connected directly to the non-inverting input of U3, while the resistors R9, VR4 and R10 turn U3 into a non-inverting amplifier with a gain of approximately four times. This configuration produces the output of 0 - 5V.

Now if the ranges 0 - 200mV or 0 - 5V do not suit your application, you can change the values of R7, VR3, and R8 — or R9, VR4, and R10 — to give the ranges you require.

We have still haven't covered the current source, which is also connected to the output of voltage follower U2a. This section consists of the circuitry around U1b and Q2.

At the input of the current source is an adjustable voltage divider R11, VR5 and R12, which allows the current output of the source to be adjusted.

The operational amplifier U1b can be viewed as a non-inverting amplifier, with the voltage at the inverting (Vi) and non-inverting (Vn) inputs being equal. The

TABLE 1
Voltage Output Levels

Offset Switch	Var Switch	Range Switch	Wire Wound Potentiometer	Voltage Terminals
0	0%	5V	-	0 volts
0	100%	5V	-	5 volts
0	Var	5V	X	5*X/100
1	0%	5V	-	1 volt
1	100%	5V	-	5 volts
1	Var	5V	X	(5-1)*X/100V
0	0%	200mA	-	0mV
0	100%	200mV	-	200mV
0	Var	200mV	X	200mV*X/100
1	0%	200mV	-	40mV
1	100%	200mV	-	200mV
1	Var	200mV	X	(200-40)*X/100m

TABLE 2
Output Current Levels

Offset Switch	Var Switch	Range Switch	Wire Wound Potentiometer	Current Terminals
0	0%	20mA	-	0mA
0	100%	20mA	-	20mA
0	Var	20mA	X	20mA*X/100
4mA	0%	20mA	-	4mA
4mA	100%	20mA	-	20mA
4mA	Var	20mA	X	(20-4)*X/100mA

[illegible]

Calibrator

current through the 47Ω resistor R14 therefore must equal Vi/47.

The current through R14 is of course the emitter current of Q2, which in turn consists of the sum of its base and collector currents — and the collector current is essentially the calibrator's output current. By using an MPSA13 Darlington transistor for Q2 instead of an ordinary transistor, with a minimum current gain (H_{FE} = Ic/Ib) of 5000, we can neglect the base current; so that Ic = Ie. Hence the current in R14 is equal to the output current Iout, for all intents and purposes.

(A MOSFET could have been used for the same purpose, but it would have been more expensive and they are harder to obtain).

The 10k base resistor R13 is necessary when there is no load, because the operational amplifier will try to feed current through the base of the transistor into R14, to try and satisfy the condition Vi = Vn. Diode D5 is necessary to produce a negative feedback in case the operational amplifier ever produces a negative voltage output.

Finally the output of the voltage and current sources are connected to switch S4 (a four pole double-throw switch), which allows the polarity of the outputs to be reversed.

Power for the circuit comes from either four AA NiCad batteries or an external power source. The external power source is passed to three points.

The first is a regulator type 7805, which produces a 5V supply for the calibrator circuitry when it is externally powered. The second point is a relay RLY1, which when activated by the presence of an external supply ensures that the calibrator circuitry is powered from the 7805 regulator. In the unactivated position the relay causes the calibrator circuitry to be powered by the NiCad batteries.

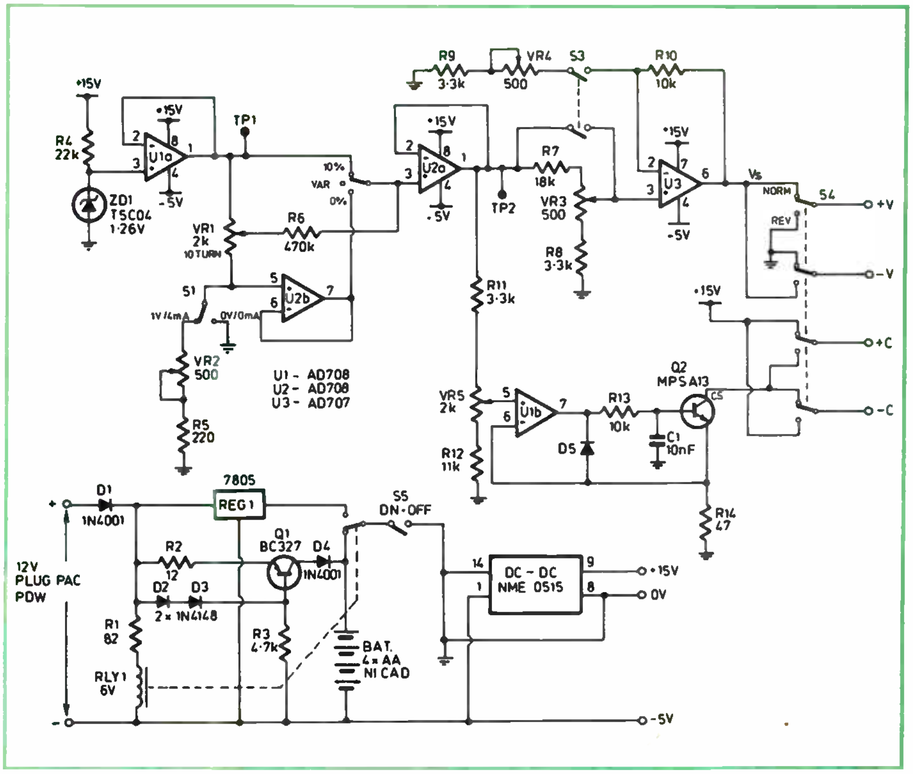
The final point is a constant current charger for the NiCad batteries, based on transistor Q1.

NiCad batteries are supposed to be charged at a constant current of 0.1C, which for 500mAH AA-type NiCads means a charging current of (0.1 x 500), or 50mA.

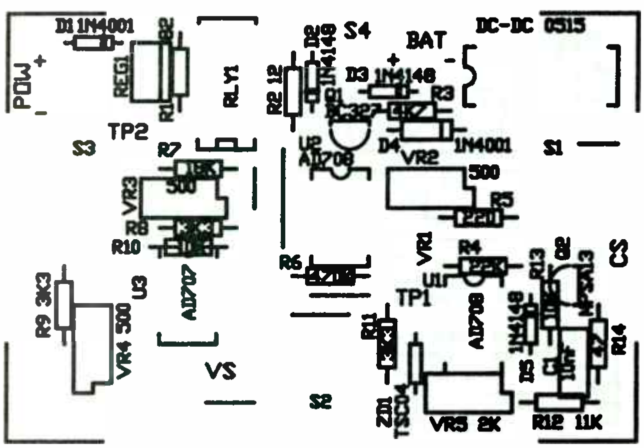
The two diodes D1 and D2 cause the emitter-base junction of transistor Q1 to be forward biased. If the current through R1 (12Ω) increases beyond 50mA, the voltage drop across R1 causes the forward bias across the E-B junction to be reduced and the transistor turns off, which in turn brings the current back to 50mA.

Diode D4 is used to prevent the batteries from being discharged through the transistor when external power is removed. A charging rate of 0.1C means the batteries will be fully recharged in approximately 14 hours.

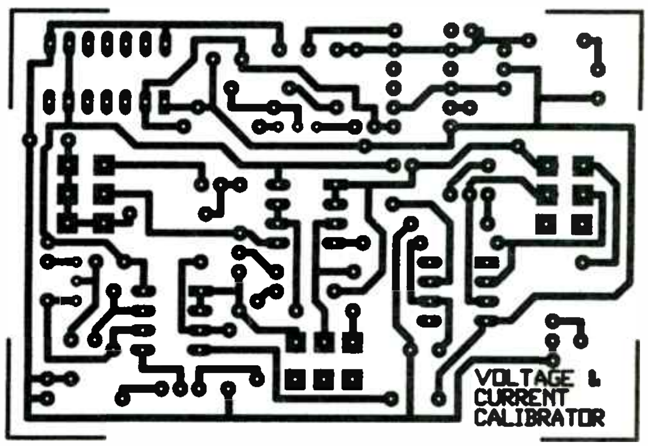
The circuit doesn't remove the batteries from the charger after 14 hours,



Here's the schematic for the low cost calibrator. It provides adjustable DC voltage and current to an accuracy of around +/- 0.2%, making it very suitable for calibration of multimeters and process control equipment.



Here's the wiring overlay for the author's PC board version of the calibrator.



No prizes for guessing that this is the PCB pattern, actual size, for those who like to etch their own.

hence it will be up to the user not to leave the charger on for much longer periods.

The pole of the relay contact RLY1 is connected to a power ON-OFF switch. This in turn is connected to a 5V to 15V DC-DC converter. The 15V output of the converter is used as the positive supply for the circuit.

To achieve accuracy at low voltage outputs on the calibrator, the operational amplifiers need a negative supply voltage. The negative supply voltage is obtained by connecting the +5V raw supply rail to the common of the DC-DC converter and using the common rail of the raw supply as -5V.

Construction

The prototype calibrator shown in the photographs was built up using utility board, but I have produced a single-sided PC board design to make it easier for you to build your own.

To house the calibrator I used an aluminium case from K&W, sized 94 x 150 x 52mm. Holes are cut in the lid to mount the four toggle switches, the four output terminals, the jack socket for the plug pack and the 10-turn potentiometer. A slot also has to be cut for the ON-OFF slide switch.

When the holes are cut, mount the four terminals, the 4PDT switch, the 10-turn potentiometer, the jack socket and the ON-OFF switch into their holes.

The board is supported from the lid using the range, offset and output switches. To mount the three switches onto the circuit board, lie the board on a flat surface with the copper tracks facing up. Mount the switches into their holes, noting that the ON-OFF-ON switch is in its correct place. Now making sure they are standing upright, solder them onto the pads.

Having completed that solder the resistors into place on the circuit board. When soldering in the capacitors and the diodes note their polarity. After completing these, insert the two transistors Q1 and Q2 noting their correct orientation. Now solder into place the integrated circuits, again being careful with their orientation.

Solder five pairs of wires 15cm long onto the board. These wires will be used to connect the board to the battery compartment, the voltage terminals, the current terminals, the jack socket and the ON-OFF switch. A three-core wire should be soldered onto the board for the 10-turn potentiometer.

Having completed work on the board, mount it to the lid using the nuts on the three switches. Now finally solder the appropriate wires to the slide switch, the wire wound potentiometer, the voltage terminals and the current terminals.

Make sure you don't cut the wires too short, in case you have to take the board out for servicing at a later date.

The final pair of wires to solder are to the battery compartment. These should be left 15cm long, so that the two parts of the box can be separated well enough to give good access to the trimpots when calibrating.

PARTS LIST

Semiconductors

1 TSC04 or AD589 voltage reference
1 Newport NME 0515D DC-DC converter*
2 AD708 dual op-amps
1 AD707 or OP-07 op-amp
1 7805 5V regulator
1 MPSA13 Darlington transistor
1 BC327 PNP transistor
3 1N4148 silicon diodes
1 1N4001 silicon diode

Resistors

1% metal film 0.5W: 1 x 12 ohms, 1 x 47 ohms, 1 x 200 ohms, 3 x 3.3k, 1 x 4.7k, 3 x 10k, 1 x 11k, 2 x 18k
Resistor to suit relay (R1)

Potentiometers

3 500 ohm Cermet trimpot, 25 turns (VR2-4)
1 2k Cermet trimpot, 25 turns (VR5)
1 2k 10-turn wirewound with matching 10-turn dial (VR1)

Capacitors

1 10nF metallised polyester (C1)
3 47nF metallised polyester***

Miscellaneous

4 AA NiCad batteries
1 Battery holder for 4 AA cells
1 6V relay, PCB type
1 SPDT toggle switch (S1)
1 SPDT centre-off toggle switch (S2)
1 DPDT switch (S3)
1 4PDT switch (S4)
1 Slide switch ON-OFF (S5)
1 Aluminium Box K&W 94 x 150 x 52mm
4 Terminal post: 2 black, 1 red, 1 yellow or white
1 9V DC @ 300mA plug pack**
1 3.5mm jack socket

*This is the dual converter, i.e., 5V to ±15V. It may be better if the single version NME 0515S was used — i.e,, 5V to +15V. Unfortunately I couldn't obtain the pinout information for this from the distributors Alpha Kilo in Sydney.

**I believe this should be adequate, but tests should be done. I have operated the unit successfully from a 7.5V regulated supply.

***Power supply bypass caps. Connect across the power supply pins of U1, U2 and U3 to ensure stability and low noise.

Calibration & Testing

Before you apply power to the unit, confirm that the orientation of the integrated circuits, capacitors, diodes, and transistors are correct.

For the moment leave the NiCad batteries out.

Now to calibrate the calibrator you will need a 3.5-digit digital multimeter (DMM). A 4.5-digit DMM would be preferable, but the 3.5-digit DMM should be adequate for the job. Connect the common of the DMM to the common of the voltage terminals. Plug the external plug pack into the socket and turn it on. Now push the slide switch to the ON position. No smoke, nothing getting hot? Well that's a good start!

First note the supply voltages are correct. Pin 8 of U2 should be at +15V, and pin 4 of U2 should be -5V. If these are OK, connect the DMM to TP1 and check that the reference is 1.26V ±0.02V.

Measure this voltage exactly, and calculate what 20% of it would be. Then move the DMM to TP2, and switch the offset switch S1 to 4mA/1V. Adjust the trimpot VR2 to produce the 20% voltage calculated above.

Now move the DMM to the voltage output and switch the range switch S3 to 200mV, the output switch S2 to full scale (100%) and the offset switch S1 to 0V/0mA. Adjust the trimpot VR3 to produce 200mV. Now switch the range switch S3 to 5V and then adjust trimpot VR4 to produce 5V.

Confirm that everything is OK by following Table 1, which shows the expected output voltages for various settings of the calibrator controls. Now the final adjustment calibrates the current source. Throw the output switch S2 to variable and the offset switch to 0. Turn 10-turn dial to 90.0 and put the DMM on the 20mA current range. Place the DMM across the current terminals and adjust the trimpot VR5 to produce a current of 18mA.

Again confirm that everything is OK by following Table 2, which shows the output currents for various control settings.

Now switch off the plug pack and put the four NiCad batteries into the battery holder, noting their polarity. Then switch on the plug pack again.

Put the two probes of the DMM across the 12Ω resistor R1 and check that the voltage is approximately 0.6V, indicating a charging current of 50mA. If this is the case the battery charger is working.

After allowing the batteries to charge for an hour or so, remove the plug pack and check that the calibrator will work off the batteries. Note it will take about 14 hours of charging to fully charge the batteries.

Your calibrator should now be complete. ❖

Fluke 10 series handheld DMMs

Philips Test & Measurement has released its new Fluke 10 Series. By restricting the number of measurement ranges offered on the three new models, the meters are able to be offered in the economical price range of $90 to $130.

My first impression on seeing these new meters was how compact and uncluttered they are. Even the most expensive, the Fluke 12, with its extra capabilities, only has one sliding switch and four pushbuttons on its top panel — the ubiquitous multimeter rotary switch is missing!

The meter is protected by the usual rugged Fluke case, whose dimensions are only 140 x 70mm. This means that the meter sits very neatly in the palm of your hand. The test leads plug into the bottom of the casing rather than the top panel, which further adds to the uncluttered appearance of the meter.

Fluke has been able to offer these high quality, low cost meters by dispensing with the less-used ranges on a typical multimeter.

For example, none of the new meters measures current. They are designed, instead, to do first-line checks with truly one-hand operation.

The basic model in the range, the Fluke 10, offers AC and DC voltage measurement (0-600V), diode tester/continuity, and resistance (up to 40 meg). Two pushbuttons and a 3-position slider switch (incorporating on/off) access these functions.

So the various options are selected via a combination of the slider switch and the 'select' pushbutton. For example, the slider selects 'voltage', and the pushbutton toggles between AC and DC; the slider selects 'continuity/ohms', and the pushbutton toggles between the continuity/diode tester and resistance measurement.

The second pushbutton on the panel, labelled 'range', allows you to disable the autoranging function and lock the readings on to one of the various ranges available for each measurement. 'Autoranging' is easily restored by holding down the 'range' button for 2 seconds, or using the 'select' function. If overloading occurs on any range, 'OL' is displayed on the screen.

The continuity buzzer sounds continuously if a resistance of less than 25 ohms is encountered, which also occurs for a shorted diode.

For a good diode, the meter will beeps once for the forward voltage drop of about 0.6V and will display 'OL' for the higher voltage drop when the probes are reversed. Should the diode be open-circuit, 'OL' will be displayed in both directions.

If left on, the meter moves into 'standby' mode to preserve battery life after 45 minutes of inactivity. And, if you wish, the buzzer sound can be easily turned off by depressing the 'range' button during turn-on — allowing you to work in silence.

The next model in the range, the Fluke 11, mainly differs from the first model by having one more pushbutton, plus one extra facility.

The extra button offers 'capacitance', which can be measured in the range 0.001-9999uF. If the meter is connected to a capacitor which is discharging, a 'dISC' message is displayed to warn you of measurement errors. Capacitance can only be selected with the slider switch in the continuity/ohms position.

The extra facility added to the Fluke 11 is called 'V-CHEK' and is active when the continuity/ohm position is selected.

While measuring continuity or resis-

tance, if either an AC or DC voltage greater than 4.5V is encountered, the buzzer will beep and the value of the voltage will be automatically displayed. The message 'LoZ' appears on the screen to inform you of the fact.

V-CHEK will not work in the manual range mode, or if you are measuring capacitance. It is designed for use only on low output impedance power supplies, as the meter has an input impedance of about 2k ohms in this option.

Moving on to the top model in the range, we come to the Fluke 12. A fourth button 'M' has been added to this meter's panel to allow the recording of minimum and maximum readings. In the MIN/MAX mode, autoranging, standby and V-CHEK are all disabled. And the function will not work when measuring capacitance.

But for other readings, the meter will record the maximum and minimum reading, and — if required — the time after turn-on that these have been made (up to a maximum of 99hrs, 59mins).

The meter will beep briefly when Min/Max is selected, and will beep longer when a new minimum or maximum reading has been recorded. As mentioned before, the beepings can be silenced, if desired.

By pressing the 'M' button several times, you can cycle through the recorded data — maximum and minimum readings — and then return to the present reading. If you wish to record and display the times also, then you simply hold down the 'M' button while turning on the power to the meter.

When testing continuity, the meter can capture intermittents as short as 250us, and display them as open-to-short and short-to-open transitions.

Ranges

There are five AC voltage ranges: 4000mV, 4.000V, 40.00V, 400.0V and 600V, all with an accuracy of ±(1.9%+3), 50-400Hz, for the Fluke 11-12 (for the Fluke 10, accuracy is 2.9%+3).

There are also five DC voltage ranges: 4000mV, 4.000V with accuracy ±(0.9%+2), and 40.00V, 400.0V and 600V, ±(0.9%+1). (Fluke 10: 1.5%).

The six resistance ranges are: 400.0 ohms, 4.000k, 40.00k, 400.0k, 4.000M, ±(0.9%+1); and 40.00M, ±(1.5%+3). (Fluke 10: 1.5%+2, 1.9%+3)

The diode range is 2.000V, ±(0.9%+2). (Fluke 10: 1.5%+2).

Capacitance (Fluke 11-12 only) is measured in five ranges: 1.000uF, 10.00uF, 100.0uF, 1000uF, ±(1.9%+2); and 10,000uF,æ(10%+90) typical.

Inside the case

Four self-tapping screws secure the front and back sections of the sturdy case, and when removed, the two halves easily come apart.

Particularly easily, in fact, as there aren't any connecting wires between the battery in its niche on the bottom half and the PCB attached to the top. The usual leads are replaced by two spring clips on the PCB, which squeeze up against the battery terminals when the two halves of the case are pushed together.

The meter 'works' are surprisingly compact, with the largest items being the test lead sockets, the slider switch mechanism and the buzzer. All these are mounted on the visible side of the PCB, along with about 25 components, mainly resistors and capacitors.

A 4cm long ceramic strip containing the precision resistors is clearly visible, and on one of the meters there appears to be evidence of laser trimming of the material to give increased accuracy for the meter's resistance measuring.

On the hidden side of the board are two multi-pin ICs which obviously control all the workings of the meter, and a short strip of multi-layer conducting elastic polymer to make contact with the pushbutton connections.

Another larger strip of this polymer is located immediately above the LCD panel, to make all its connections to the PCB. Hence the absence of the usual wiring.

At first sight, there didn't seem to be any difference between the boards for the Fluke 10 and Fluke 12 models — and the thought did occur that perhaps adding two more pushbuttons to the cheaper model might convert it into the more expensive one!

But the ICs in each model have different numbers (and so are presumably different), and there is at least one additional component added to the Fluke 10's (yes, the 10's!) printed circuit board.

To minimise production costs, it obviously makes sense to have as much in common as possible. (Since we were only sent the Fluke 10 and 12 to be reviewed, it could be an interesting exercise to compare the Fluke 11 and 12, as they share a common manual, and have far more overlap in the functions they offer, e.g. V-CHEK and capacitance.)

Power for the meter is provided by a standard '216' type 9V battery. Plastic barriers surround the battery terminals to prevent either spring clip from accidentally touching both simultaneously.

As mentioned before, the test leads plug into sockets on the bottom of the meter case, at 90° to the usual position at the bottom of the top panel.

Additional insulation has been provided on the terminal plugs, and this completely overhangs the metal contacts. This added safety will be appreciated as the test leads tend to run across the palm of your hand as you hold the meter.

The two probes are fairly standard, with longish handles with finger guards. The metal tips are sharply pointed, with grooves near the end to 'lock' on to component leads.

Summary

Quite a few measurements were made to test the accuracy of the two meters. These included: four DC voltage measurements, ranging from 100mV to 4V; seven resistance values, 350 ohms to 400k; and two capacitance readings, 1-10uF.

These readings were checked against readings from the more accurate Fluke 8050A model, which in turn was checked against the mid-range 6-1/2 digit Hewlett-Packard model HP34401A (which was reviewed in this year's January issue of *EA*). The resistance values were further checked against the HP4263A LCR meter (reviewed in the June '92 issue).

Based on these comparisons, all readings for both the Fluke model 10 and model 12 were well within the claimed accuracy, most being within 0.1%. Only the 350 ohm resistor (0.2%) and the 10uF capacitor (0.53%) were >0.1% — but were still well within the quoted accuracy of 0.9% and 1.9% respectively.

I found both meters to be extremely rugged, very easy to use and accurate in all their measurements.

The pushbutton/slider switch combination means that you can very quickly select any desired range; and their compact construction means that they fit very comfortably in the palm of your hand.

The ranges offered by the three models should prove satisfactory for the vast majority of test situations. Unless you need to measure current or frequency, one of these three models should suit your needs.

The prices for the Fluke models 10, 11 and 12 (ex tax) are $90, $115 and $130 respectively. An additional $20 buys a soft case, or a holster.

The models reviewed came from Obiat. For further information, contact Obiat at 129 Queen Street, Beaconsfield 2015; phone (02) 698 4776 (P.M.) ❖

TECHIE'S GUIDE TO BUYING A PC CLONE

There's never been a better time to buy a personal computer. The price of IBM-clone PCs is probably at an all-time low, partly due to the recession, and partly to the fierce competition. But what type of clone, and what configuration, is going to be best for YOUR needs? Here's the lowdown.

by TOM MOFFAT

Have you been resisting computers? Well, it's time to give in to them now. You no longer have any excuse for not having one — certainly not the cost. The current crop of IBM-PC clones have fallen in price to levels that are downright silly.

I've just been browsing through the *Your Computer* Yearbook of five years ago. It featured a rave review of a NEC PC-AT clone with features similar, but slightly inferior to, the 'cheapie' computers we see advertised today. The NEC had an 8MHz clock speed, 640K of memory, a 1.2MB floppy drive, a 40MB hard drive, an EGA-standard video card, and a colour monitor that could produce 800 x 600 pixel resolution. The price for this little beauty was no less than $10,448.

Now look at what's on offer today: a PC-AT clone with a 16MHz clock speed, one megabyte of memory, a 1.2MB floppy drive, a 42MB hard drive (voice coil driven), a VGA-standard video card, and a colour monitor with 1024 x 768 pixel resolution. Price: around $1300 - $1600.

You can see all the computer dealers are out to cut each other's throats if you read the ads in the computer magazines, or more particularly in publications like the Green Guide that comes out once a week with the Melbourne *Age*. The 'unbeatable deals' seem to apply to the IBM-PC clone family only, on models from the 'lowly' XT right up through the latest '486 machines. There doesn't seem to be much action in the Apple and Amiga area, probably because of the lack of fierce competition provided among the IBM clones.

Ads in overseas computer magazines show PC clones down to $1200, but taking the dollar difference into account, computers in Australia are actually CHEAPER than US prices, for what must be the first time in history. So *now* is the time to buy. But which model? What features? There are just so many; it's so hard to decide.

From here on we will assume that readers are mostly engineering types who will use a computer as a tool instead of the centre-piece of an 'electronic office'. So we will restrict our comments pretty much to the AT and lower-end 386 machines that are so ridiculously cheap at the moment.

What's right for you...

At this stage it is necessary to make a firm decision about what kind of computer user you are going to be. One user type prefers to work with a screen filled with graphics images and icons and menus, using a mouse to point to a symbol representing a particular function or program. This system is known as 'Graphic User Interface' (GUI) and is most commonly represented by the Microsoft Windows system. It is also the system used by Macintosh and Amiga computers.

The other type of user prefers to type commands and program names directly onto the keyboard into the DOS command processor. This is known as 'Command Line Interface' or CLI. Which system you prefer is strictly a matter of personal choice. My own choice is the CLI system; if I want to work on a magazine article called 'Story', I'd much rather type 'EDIT STORY' to fire up my editor, rather than fiddle about trying to lay the mouse pointer on a little symbol of a typewriter or something.

This question about GUI versus CLI has turned into a lusty debate which is currently raging all over the world. You have GUI people and you have CLI people, and there appears to be little middle ground between them. After I made some rude comments about GUI in my 'Moffat's Madhouse' column, I copped one irate letter in the magazine and several other letters and phone calls at home.

How DARE I criticise GUI! Do I still live in a cave? But I'm not the only one who isn't keen on icons and menus. In a recent issue of the prestigious American magazine *BYTE*, a commentator wrote 'I'm getting the very uneasy feeling that GUIs are actually the biggest con job that the computer industry has ever put over on us.'

Putting the emotional debate aside, the question of GUI or CLI will determine the type of computer you should be buying. GUI systems such as Windows need a powerful computer with lots of processing speed. If you intend to use GUI you should really be looking at a 386 machine or better. If CLI is your choice, any of the 286 (AT) style machines should be fine unless you're going to be running some giant desktop publishing or CAD (computer aided design) program. Of course you CLI people can still go for a 386 or 486 computer, if all that power turns you on!

Clock speed

You'll notice that the ads always refer to clock speed. The higher the clock speed, the faster the computer does its job, and the more it costs. In my own applications I've found my 16MHz AT computer even switched to 8MHz has been quite fast enough, but I stick pretty much with 'mean and lean' software. If you're into the big stuff, you may want more speed.

Be aware that there are two kinds of clock speed, the raw hardware clock speed and the 'Landmark' equivalent clock speed. Landmark seems to take into account the efficiency of things like the computer's maths routines to work out a 'corrected' speed. A Landmark speed always looks better; for instance a 16MHz computer will show something like a 21-MHz Landmark speed. It's a bit like 'seasonally adjusted' unemployment figures; things aren't what they first seem.

How much memory?

As for memory, GUI needs lots of it, as do the big CAD and desktop publishing programs. This is no problem, because the

[illegible]

Most clones come in assembled form, but this photo shows the parts inside a typical 'AT' type machine. If you're prepared to buy your machine in this form and assemble it yourself, you can often save even more money.

up-market 386 and higher machines usually have two megabytes or more.

Much of this memory can be used up by multi-tasking — running several programs at once, a function provided by the GUI. The AT class machines usually have one megabyte, but they can be expanded by plugging in some more chips and changing some jumpers on the system board.

My own AT machine with one megabyte (1MB) quite happily runs the various Protel PCB and Schematic CAD packages, as well as word processing, spreadsheet, and several programming languages. It has only complained about insufficient memory once, when running a graphics manipulation package called *Graphworks*. I don't know what this monster did with all the memory, but it was able to make more room for itself on the hard disk when it ran out of system memory. Other graphics packages ran fine in the existing memory with plenty left over.

Graphics adaptors

This brings us to the matter of graphics adapters and graphics standards. These come in all shapes and sizes, but as with clock speeds, you must read between the lines when looking at the ads. Just to get things in perspective, the original IBM-PC came with a monochrome text display card (MDA) if it was for business use, or a colour graphics adapter (CGA) if for home use.

Monochrome gave excellent character quality on the screen, but there was no graphics capability. An outside company called Hercules fixed this with the Hercules Graphics Card (HGC) which combined the original monochrome text capability with a very good mono-chrome graphics system giving 720 x 348 dots (pixels) on the screen — a resolution that still measures up admirably against today's more modern graphics schemes.

Next came the Enhanced Graphics Adapter (EGA), a good all-rounder system that produced up to 640 x 360 pixels in 16 colours. This wasn't far off Hercules quality, and it worked in colour. Many current games are written in EGA with good results. Although the standard is now considered obsolete, some new AT systems are still supplied with EGA. You should really be getting VGA with a new computer nowadays, so if you find a system with EGA, it's your cue to try to beat the price down.

The currently popular VGA (video graphics array) offers 16-colour modes up to 640 x 480 pixels, but the real improvement here is the provision of analog colour. Each pixel can be one of 256 shades, which for all practical purposes means the colours are infinitely variable. The screen moves up from 'cartoon' colour to the rich real-life images produced by digitised colour slides. Although VGA would have a hard time producing moving pictures, the still pictures are MUCH better in quality than even the best colour TV set. VGA can also provide an excellent gray-scale black and white image, even from a colour input.

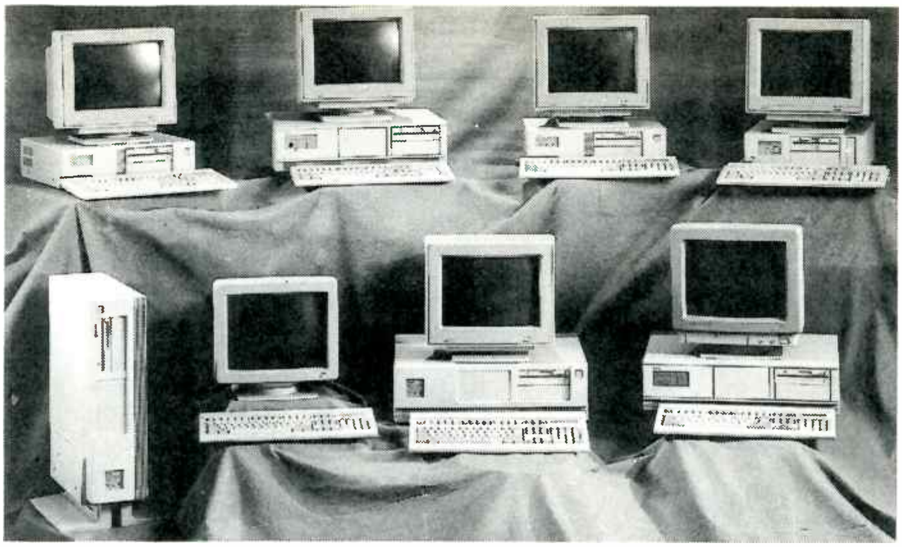
Most times you'll be using VGA in its 16-colour modes, but some drawing programs such as Dr. Halo can handle full analog colour if you are creative enough to drive them that way. Bulletin boards contain many digitised pictures you can download.

These range from porn through to nice landscapes and still lifes, and there seem to be lots of scientific photographs of things — such as NASA experiments and pictures of the planets sent back by spacecraft like Voyager. VGA will let you handle most of these, but Super-VGA will let you look at the finest computer pictures available.

Super-VGA is an extension of VGA, with both 16- and 265-colour modes and resolutions of 800 x 600 or 1024 x 768 pixels. This is very sharp stuff indeed. Most CAD packages like Protel PCB and Schematic let you use these Super-VGA modes, but I have found that the text on the screen becomes so small it is hard to read. The text is razor-sharp; it's just

small, and for guys like me with ageing eyeballs it's better to reduce the resolution to normal VGA at 640 x 480 pixels. Text then becomes correspondingly bigger, although you can't view as much of your drawing at once as you can with Super-VGA. Super-VGA would really come into its own in the CAD world if you had a 19" monitor. You would then have all that nice resolution but the text would be bigger. Trouble is that 19" monitors cost several kilobucks.

As yet Super-VGA is fairly new and there are no firm standards; each Super-VGA card has its own way of selecting the high-resolution modes. So getting something like a CAD program going in Super-VGA is messy; the program usually must supply a special driver for your particular card. Or your card may come with a selection of drivers for different CAD programs. Regardless of how it's done, it ain't easy.



Clones, clones, clones: they come in all different shapes and sizes!

Video RAM

You will notice computer video adaptors advertised with different amounts of memory — such as '256K VGA' or '512K VGA'. This refers to the amount of memory the actual video card itself contains, for storing the video images. Most cards can have more memory added, just like computers.

Most graphics cards have 256K of memory, which allows them to do 16-colour images up to 800 x 600 pixels and 256-colour pictures of 320 x 200 pixels (pretty, but rough). Moving up to 512K lets you use the analog 256 colour modes up through 800 x 600, with a 16-colour mode of 1024 x 768. Doubling the memory again to 1 megabyte lets you work with full analog colour with the 1024 x 768 resolution.

My own Super-VGA card stops at 512K so I've never seen the results at 1024 x 768x 256. They are said to be quite startling. There is one picture of this standard on a Hobart bulletin board, and the thing is over 600K long.

Many people will scoff at playing around with pictures on computers. Some bulletin boards have also declared them frivolous, and have stopped dealing with them. Fair enough, digitised picture files are of absolutely no practical use to anyone. But neither is a bowl of flowers, although some of us find it pleasant to have them on our desks. Computer pictures are much the same — they're just there to make us happy, I guess.

It's important to realize that any modern video card is downward compatible; it can emulate all the standards that came before it. So a really nice Super-VGA card will also handle normal VGA, EGA, CGA, and usually Hercules. They are supplied with a program that switches them, so that a VGA card emulating Hercules will have all the special Hercules data registers sitting there at their correct addresses. The cards also come with their own video BIOS program, which replaces the one already in your computer. The new BIOS lets your software select its own video mode, be it CGA, EGA, VGA, or Super-VGA, by simply specifying a particular mode number.

As for the video monitors supplied with el-cheapo computer systems, they range from amazingly good to absolutely abysmal. The bad ones have washed out colours and colour fringing around what are supposed to be white characters on a black screen. Good monitors have deep rich colours, and an analog Super-VGA photograph on one of these should glow, like a projected colour slide.

It is possible to spend good money on a video card that can do 1024 x 768 graphics, only to find that your monitor can't handle it. The many video modes use different scan rates; some monitors can handle them, some cannot.

If you are buying a Super-VGA system, make sure you see that YOUR new card produces all the advertised graphics modes while attached to YOUR new monitor, before you take delivery of the system. The graphics card should come with a disk containing a test program to generate text and graphics images in every standard it is capable of displaying.

Disk drives

Enough of graphics, now to the disk drives. Your new el-cheapo computer will have a hard disk drive; I don't think it's possible to buy a machine without one nowadays. Most of today's hard drives hold 40MB (megabytes) or a little more. You should be offered a 'voice coil' type hard drive, which uses a much more efficient head moving system than the earlier stepper-motor method. You can tell a voice coil hard drive when it's working; it makes little 'ticking' noises that sound like they are coming from the voice coil of the computer's speaker.

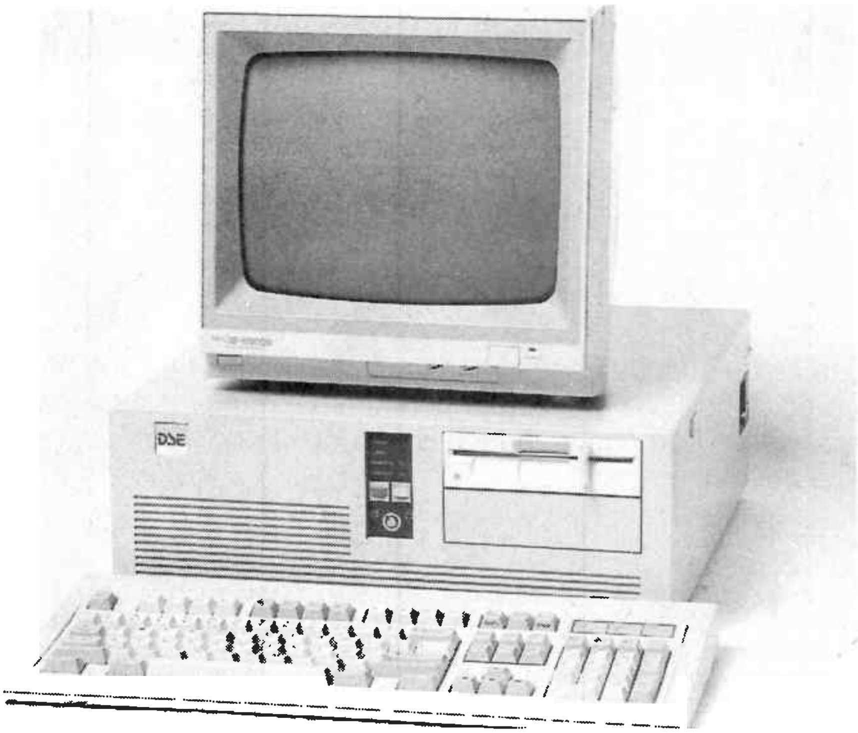
Most computers offer you a choice of a 5-1/4" 1.2MB, or a 3-1/2" 1.4MB floppy drive. Be a pig, take them both. It will probably cost you around $130 extra, but then you can use any disk made for the PC and swap files with your laptop if you have one.

Which DOS?

Many computers come with the MS-DOS operating system supplied (the machine won't run without it). You may be given a choice of DOS Version 3.3 or Version 4. Definitely select version 3.3, even though it is a bit older. Dos Version 4 is big and bulky, slow, and full of bugs, whereas Version 3.3 is tried and tested and very reliable. If you're doing some software development or just some quiet hacking, it's infuriating to spend all day chasing some pesky bug only to find out it's been supplied free of charge in your copy of DOS.

As this was being written, DOS Version 5 has hit the streets — an embarrassingly short time after DOS 4 emerged. Is Microsoft hoping DOS 4 will quickly slide into oblivion, before it causes any more trouble?

You may not be given the choice of choosing DOS Version 5 with an el-cheapo clone, as it's generally being sold



A fairly typical 'AT' level clone, in this case from Dick Smith Electronics.

separately. So far it seems quite an improvement on DOS V4, so it may be worth spending $130 or so more, to get it.

Modems

Some of the best software for the PC comes from bulletin boards. This is generally 'Shareware', meaning that you're meant to pay for it if you decide to use it regularly. The same Shareware can be purchased on disk, but you still have to pay the program's author even after forking out $15 or so for the disk. With a modem you can get the disk files for the price of a phone call.

You must be a 'member' of a bulletin board to extract software from it. This generally costs nothing other than a pledge of good behaviour. As well you're expected to send programs TO the board from time to time. Some bulletin boards suggest a small donation might be appropriate, say $20 a year. There are plenty of bulletin boards to choose from; I am a member of five of them, just in little old Hobart.

A modem is the gadget you use to connect your computer to a phone line, so that it can communicate with the bulletin board (or other computers) via audio tones. Communication can take place at speeds ranging from 300 to 9600 baud (roughly equal to bits per second) or so. If you're buying a modem, go for the highest speed you can afford — 300 baud is miserably slow, 1200 is four times as fast, 2400 is twice as fast again. You are usually limited in time to an hour or so per session on the bulletin board, so with a slow modem you will not be able to download some of the larger files.

A modem usually sits in its own little case somewhere next to or on top of the computer. Some types are actually a card that plugs into one of the expansion slots within the computer. These give more value per dollar, because you don't have to pay for a flashy case for the modem. My own internal-style modem, with a top speed of 1200 baud, cost around $150.

Printers

If you're going to use your computer to write letters or articles or school reports, you're going to need a printer to plaster your masterpiece onto a sheet of paper. Printers vary in quality and cost from the lowly nine-pin dot-matrix cheapie through 24-pin letter quality printers to ink-jet and laser printers. You of course want the best performance you can get without breaking the bank.

'Letter quality' is really in the eye of the beholder. Some people insist on print that looks like it's been typeset, so they fork out for a laser printer. These are expensive to buy and expensive to run, but they are the very best in quality, both for text and graphics.

The 24-pin 'Epson'-style letter quality printers seem to be the in thing at the moment. Sometimes these are supplied as part of a computer purchase package.

I use two printers with my own system. The top performer is a 10 year old C-Itoh 9-pin model that cost something like $1200 when new. This printer has several different fonts, and full graphics capability. For letters I can use its graphics mode to print a 'letterhead' at the top of the page, and then turn it loose in its proportional-character mode for the letter proper. This produces a lovely result that a modern 'letter-quality' printer would find hard to match. If you find one of these C-Itoh's on the used market, snap it up without hesitation; you'll never be sorry.

My second printer is a little Brother thermal model, which I use for program listings and fiddling about. Since its 'black' is contained within the paper instead of a ribbon, there is no worry about thrashing the ribbon to death printing out deep black graphics images such as satellite pictures. The paper isn't too expensive and the thing will run quite happily on some types of fax rolls.

If you *really* want top letter quality and don't need graphics printing, you can't beat the good old daisy-wheel printer. These are constructed like an electric typewriter, with a hammer that hits a plastic shape to impress a character on the paper. The print looks just like it came out of an electric typewriter instead of a computer, so that people might think you're prosperous enough to employ a secretary.

The downside of daisy-wheel printers is that they're slow and noisy, and the best quality carbon ribbons have to be replaced after only one pass through the printer. As far as I know, daisy-wheel printers are no longer made; they've been replaced by the laser printer for top quality work. But because they're no longer trendy a daisy-wheel job can be yours, used, for a couple of hundred dollars or even less. You can change the character font by slipping a different daisy wheel into the machine, and since they're considered obsolete, the wheels are being sold out at rock-bottom prices.

Summary

There you go then, the cheapskate's buyers' guide to PC clones. If you're looking to purchase one, now's the time to strike because there are some remarkable deals to be had at the moment.

If this miserable recession will ever end, I suspect the asking prices for computers will be among the first to go up. People keep saying they'll never be any cheaper, but then that was the conventional wisdom when I bought my AT-clone about eight months ago. The thing retailed at $2200 — never to be cheaper! Now you can get exactly the same thing for $1600.

Ah well, them's the breaks! ❖

AUTOMOTIVE ELECTRONICS

with MAJOR AL YOUNGER (USAR, Ret.)

Engine basics - 2

Last month we discussed the basic four stroke/cycle engine, and the importance of getting back to basics. This time we look at engine efficiency, the effects of spark timing, compression, and an often overlooked subject: fuel. While we can't do much about this product itself, we should know how its constituents can affect engine operation.

The process of mixture or 'air-fuel ratio' (AFR) preparation, accomplished variously by carburettors or fuel injectors, has a vital effect on an engine's combustion and thermal efficiency. In terms of fuel savings, there is an enormous promise in engines that will accept leaner AFR's.

A fractional gain of a percentage point in fuel savings can only be accomplished by rigid controls — for example the engine must be arranged to burn as lean a mixture as possible, while still burning all the fuel reliably. Too lean a mixture will tend to extinguish the flame prematurely, which would cause an increase in HC (hydrocarbons) and CO (carbon monoxide) emissions. A mixture that is much too lean will lead to ignition failure, and the engine stalls.

Fig.1 shows a typical pressure-volume (flame) diagram for a four-stroke engine. Top dead center (TDC) is at B and bottom dead center (BDC) is at A. The stroke from A to B is the compression stroke; B to C is the power stroke; C to D is the exhaust stroke and D to A is the intake stroke. The valve openings and closures are defined by points 1 to 4. The ignition spark occurs at point 5 and the flame extinguishes at 6.

Compression ratio

A high engine compression ratio gets more energy out of the fuel charge. The pressure gain with an 8.5:1 ratio is about 500psi, while the gain with a 10:1 ratio is about 750psi. This is a large gain in thermal efficiency and power, because less heat is lost to the cooling system and more of the fuel's calorific energy is put to useful work. However, the peak combustion temperature, although of shorter duration, rises. This generates unwanted pollutants, unless it is very precisely controlled.

Many manufacturers have lowered the combustion ratio and increased the stroke, to lessen pollutants — another trade-off.

The high compression engine requires fuel with a high *octane number* to prevent 'knocking' (pre-ignition). A higher octane number means less chance of knocking, and *slower* burning (contrary to common belief).

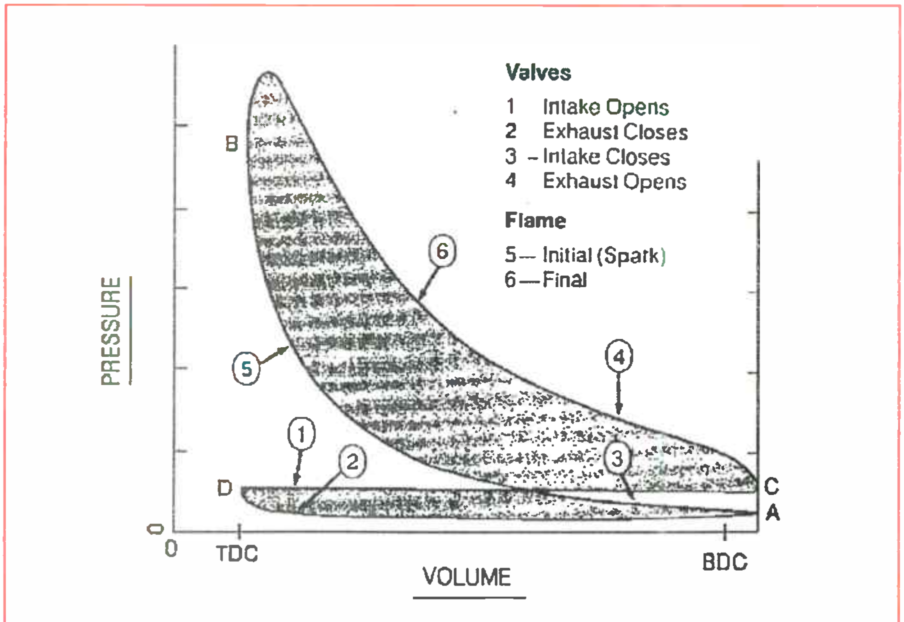


Fig.1: A typical pressure vs. volume 'flame' diagram, for a four-stroke engine.

Optimum AFR

To obtain complete combustion, the ideal AFR is 14.7:1 (Fig.2). At this point all hydrogen and carbon in the fuel are burnt, releasing its full potential heat energy without leaving any residual oxygen or unburnt carbon. The combustion products are non-toxic, non-polluting and harmless carbon dioxide and water vapour. This theoretical ideal AFR (14.7:1) is known as the *stoichiometric* ratio, and is determined by the chemical compositions of gasoline and air.

There are many other factors that will effect perfect combustion, as well:

- Any electrical malfunction that prevents the spark from igniting the fuel mixture (no spark)
- A lack of mechanical integrity which allows fuel to escape (poor sealing rings or leaking valves)
- A low cylinder surface temperature. This rapidly draws heat from the fuel HC molecules, preventing them from maintaining or reaching combustion temperature (no thermostat or too much ignition advance — i.e., faulty timing.

In fact many factors are involved in producing perfect combustion. These factors all need to be understood, as they collectively contribute to the basics of engine operation.

AUTOMOTIVE
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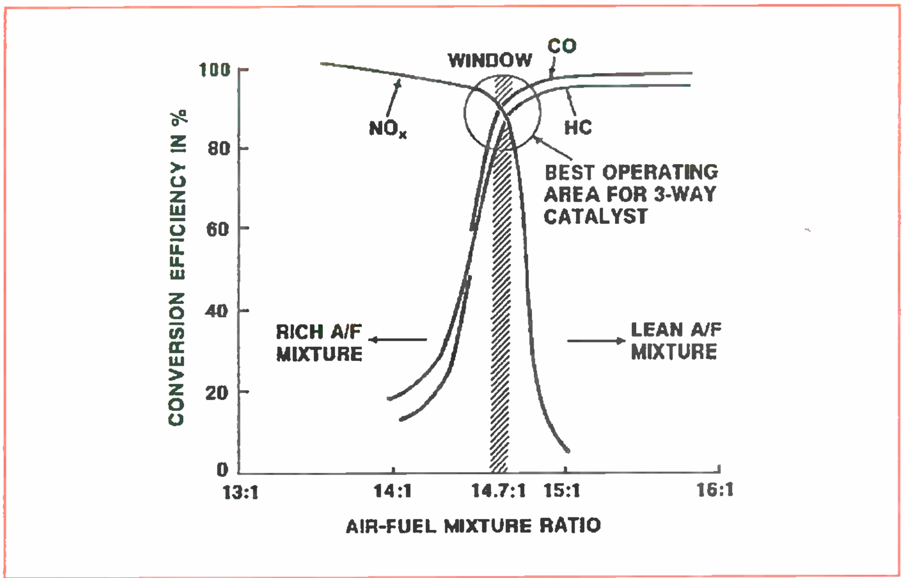

Fig.2: For the highest efficiency in converting the fuel's calorific energy into mechanical energy, the engine's air/fuel mixture ratio should be 14.7:1.

About fuels

The basic engine fuel (gasoline) you get from the bowser is designed and made for the majority on vehicles on the road. Present products provide satisfactory results for both carburettor and fuel injected vehicles.

It's a fact that raw gasoline will not burn. It must first be changed from a liquid to vapour, and then supplied with an adequate volume of oxygen. At this point it becomes a highly volatile and dangerous element — only an infinitesimal spark is required for an explosion.

This is witnessed at least monthly in Australia, by the numerous boat explosions. Gasoline vapours are heavier than air, and always travel to the lowest point — i.e., the bilge. Treat gasoline as a high explosive and handle with extreme caution.

A note to laymen: a fuel-injected vehicle has pressure in the fuel lines, even when the ignition key is 'off'. When the fuel line is opened, raw fuel will flow until the pressure drops. If it flows onto a hot engine or exhaust system — POW!

The fuel (gasoline) used by most car engines is a hydrocarbon, made up of about 15% hydrogen and 85% carbon. There are other ingredients, which will be discussed later. You might remember from your school science that air is a mixture of 21% oxygen, 78% nitrogen and 1% other gases. It is only the oxygen which combines with gasoline to cause combustion.

Before the fuel can be thoroughly mixed with the air in the proper proportions, it must be broken up, or atomised (vapourised) into finely divided parts. The mixture must be adjusted to an engine's speed, load conditions and temperature. And the total volume as well as the AFR must be continuously adjusted to conditions. Or, once the AFR has been determined, the total volume required by engine demand must be satisfied, while still maintaining the correct AFR. All this is done by the device that furnishes the fuel: either a carburettor or an injector.

Fuel quality

Gasoline is obtained by refining crude oil. As crude comes from the ground, it is a mixture of thousands of different chemicals that range from extremely light gases to semi-solid carbon-containing materials such as asphalt or paraffin wax. The gases are dissolved in the other components of the crude, because of extreme pressure at which petroleum is stored in the ground.

A major ingredient, depending upon the oil field, is sulfur — which must be removed. Sulfur gives bad odours, is poisonous, corrosive and may reduce the efficiency of anti-knock compounds.

The refining processes do not remove 100% of all unwanted ingredients. Some producers advertise a 'clean' gas. This just means that most impurities have been eliminated, and the remainder will not adversely effect the fuel's ability to burn or clog the system.

Then why are fuel filters required? Because no one could afford absolutely 'pure' fuel. It's another trade-off.

The ingredients that are inert — that is, they neither aid or detract from combustion — remain, because they're too costly to remove. Some of these ingredients are *olefins*, which when subjected to heat, become a glue-like substance. Olefins are the cause of those well-known 'engine gums and tars'. When fuel enters the engine, which is hot, the olefin coating action starts. The deposit first appears like a clear wax, but turns darker as other foreign substances stick to it. It then grows, becoming a restriction to mixture flow and an insulator. When it reaches inside the engine, it collects carbon deposits, which when superheated cause pre-ignition. This becomes a long term problem — meaning it takes about 30,000 kilometres on a new engine, before it effects the engine's operation.

Motor mechanics know the effects of these 'gums and tars' and offer a service to clean the fuel system and engine internally. This is often advertised as 'engine de-carbonisation' — in fact one machine is named *The DeCarbonizer*. This suggests that the machine dissolves carbon — yet, as any high school science student has learned, man has not invented a solvent that will melt carbon.

I saw such a machine at a recent auto show. The factory representative stated, "...it melts carbon". I told him he was wrong — it only dissolves the substance that holds the carbon. I mention this because lay people, at the show, were overheard saying "Oh! They've found out how to melt carbon".

Of course the end result is the removal of the gums, tars *and* carbon — we just have a communications gap.

There are other methods to rectify this problem. Filters? No, because olefins cannot be filtered out. The solution is additives to the fuel. Either in the fuel when purchased (advertised as 'high detergent'), or as an after-market product that is poured into the fuel tank.

Nothing is free; the best grades of fuel cost more, because they're better. The additive you pour in the fuel tank also has a cost. So a choice is available. Many find a rotation method suits them — every other tankful, they use the best grade of fuel or an additive.

Leaded fuels

Something that really puzzles me: Why do we still use leaded fuels? The general public now realises the danger of leaded products. Many countries have 'outlawed' leaded products. Don't tell me it's because there are so many vehicles designed for leaded fuel, because unleaded fuels will work in those vehicles.

The only problem I have ever found, was some outboard marine engines

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which experienced piston ring fouling (gummed rings). Whether the best grade of fuel had been used, could not be determined. In any case, I have not heard of adverse affects in an auto engine.

By this time, you're probably asking "What does all this fuel stuff have to do with engine basics?"

Learning a bit about fuel, when it comes to engine basics, is akin to reading the label on prescription medicine, to find out the side affects. But guess what — most often it either isn't there, or we don't read it. And it's surprisingly hard to find information on fuels...

If you care about what you put into your mouth, think about what's put into your fuel tank. Medicare may pay for your health bill, but *you* pay the car's repair bill.

What about condensation? Normal condensation, which effectively adds water to the fuel, normally does not effect vehicles in the short term — although it may in some regions. Special filters which trap water are becoming popular in the after-market.

As you know, gasoline floats on water and this can cause steel tanks to rust. But most fuel tanks are now aluminium, plastic or internally coated.

I have 'fixed' many cars by telling the customer to purchase a 'higher grade' of fuel. All major suppliers provide a higher grade.

Review

Do not neglect fuel considerations. Most high performance or luxury vehicle engines require a higher grade of fuel. What is best suited can only be determined by experimentation.

Additives work, but read your owner's manual if the vehicle is still in warranty. If used, make sure it is a reliable brand and read the label for specific instructions for your car.

The use of metal fuel storage tanks, by your supplier, greatly increases the chances of fuel contamination with water and rust, especially in areas with a low 'water table' — meaning the tank rests in water.

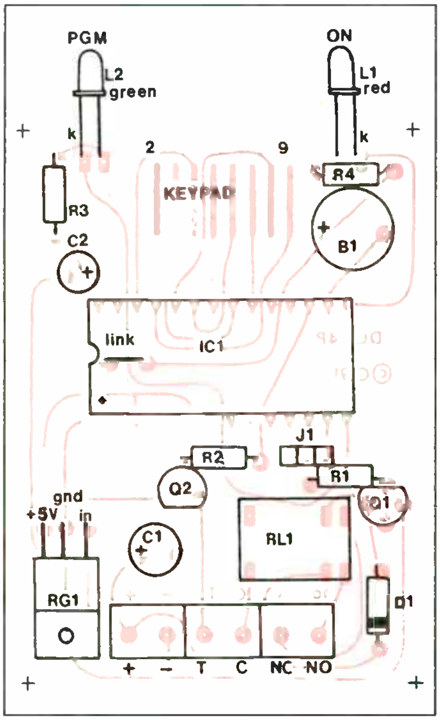
And please — be aware of the volatility of gasoline, and the highly explosive nature of its vapour.

Next month we'll look at one of Dr Kettering's best-known inventions: the conventional ignition system, and how it works. ❖

NOTES & ERRATA

PROGRAMMABLE LOW COST CODEPAD (June 1992):

The overlay diagram for this project was printed the wrong way round. The correct diagram is printed under.



GEIGER COUNTER (April 1992):

The click rate should be two to twenty per *minute*, not per second. Replace IC1 with a 4093, as some types of 4011 produce random oscillation.

When the tube is fitted to an extension probe, make sure the 10M anode resistor (R5) is located in the probe with the tube, to minimise the effects of lead capacitance. Also use a twin shielded cable, with the braid connected to the common of the PCB to minimise noise pickup.

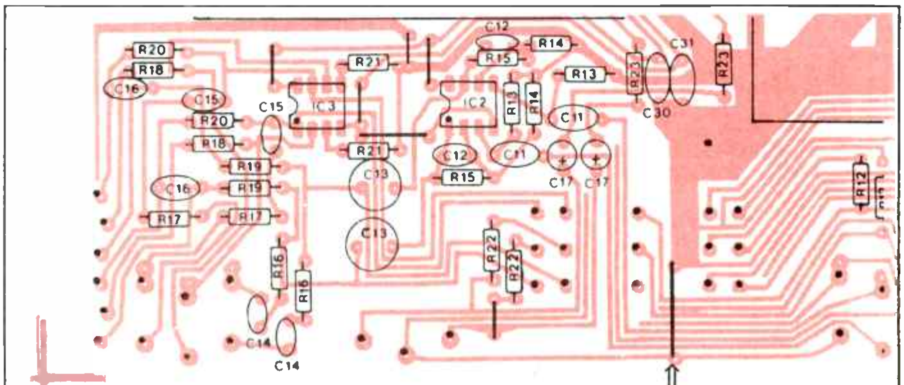
Further noise immunity can be achieved by reducing the values of R3 and R4 to 470k. Geiger tubes are now available from Oatley Electronics that are responsive to Alpha rays as well as Beta and Gamma rays.

Add an extra $50 to the kit price for this type of tube. Other tubes are available also; contact Oatley Electronics for details. You'll need to cut a hole in the case to allow the Alpha rays to penetrate to the tube. Alpha rays have little penetration, which makes them difficult to detect.

PLAYMASTER 30+30W AMPLIFIER (April 1992):

There is a link missing from the component overlay diagram shown on page 70. An additional link should be installed in the PCB as shown below.

Also the number of links as stated on page 68 under the heading 'Construction' should read 14 rather than 13.



Add link here

ACTIVE CROSSOVER (May 1992):

The tables shown in this project have been transposed. The component values shown in table 1 will give cascaded Bessel filter responses rather than the Riley-Linkwitz cascaded Butterworth responses described in the test.

Constructors of cascaded Butterworth filters are reminded that R13 is changed to 15k and R15 is omitted as stated under 'Building a System'.

The circuit shown in Fig.11 is correct for producing a cascaded Bessel filter response with a crossover frequency of 2415Hz. As described in the article this will suite the Vifa SA-100 speaker kit.

SOLAR BATTERY CHARGER (February 1992):

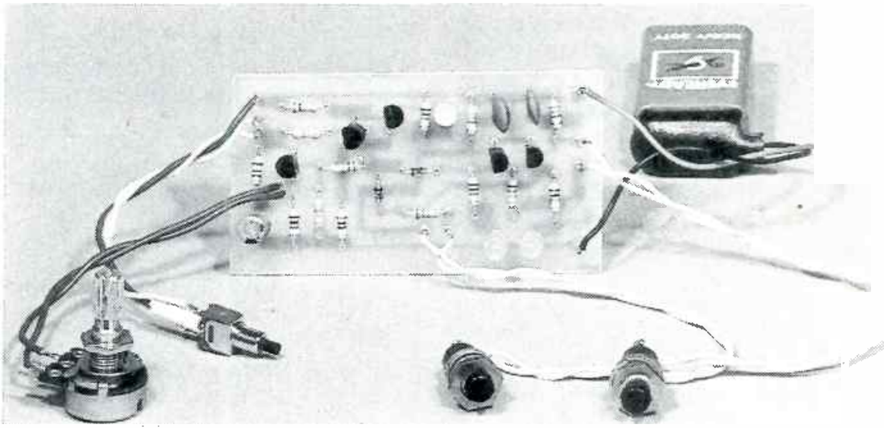
R2 is a 22 ohm resistor. R1 should be 180k, not 180 ohms as shown in the circuit schematic and in the parts list. This errata would have been supplied by Oatley Electronics to purchasers of the kit.

Experimenting with Electronics

by PETER MURTAGH

'Quick fingers' reaction tester

Here is a circuit for a simple reaction tester game for two competitors. After a variable delay, it lights the 'start' LED, then allows only the first person to press their button — the winner — to latch on their LED. And if someone anticipates the start signal, then it even delays the 'start' turn-on to show that they have 'jumped the gun'.



This circuit combines a few of the ideas which we have used in previous projects. In the December 1991 issue of *EA* we gave the circuit for a variable-time delay switch. We have used a similar circuit this month to determine when the start LED comes on.

Also in February, our light switch used the snap-on property of a Schmitt trigger — we have added this as well. And finally in our timer circuit in June 1992 we used two complementary transistors (BC548 and BC558) to make the equivalent of a PUT (Programmable Unijunction Transistor). This month we are using *real* PUTs, 2N6027s — one for each contestant — to latch on the winning LED.

This is how you play the game. For fairness, have a third person vary the setting on RV1 to set the time delay, then press PB1 to extinguish the start LED, LED1. Sometime later, within 2-8 seconds, LED1 will light. After that, the first person to press their pushbutton (PB2 or PB3) latches on their LED, and locks out the other person. He or she is the winner — their LED is on, along with LED1.

However, if someone were to 'cheat', or accidentally press their button early, then their LED comes on, but without LED1 — at least for quite some time. This makes it is easy to pick a winner from a non-winner!

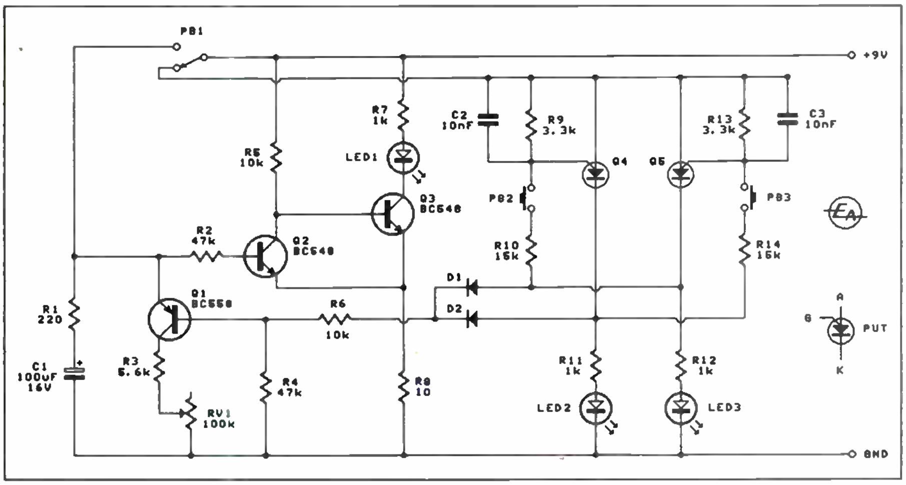
To play another game, you need to unlatch the PUTs. When you press PB1 to charge up the timing capacitor, you also disconnect the power to the two PUTs. So starting a new game automatically clears the result of the previous one.

Construction

If you built last December's delay switch, you might decide to use this instead of this month's part of the circuit built around Q2 and Q3. Just remember that you will still need to insert transistor Q1 in the discharge resistance network. Also, the delay switch circuit does not have a Schmitt trigger, so the start light won't come on as suddenly.

As usual, construction is quite simple. Solder the more rugged components first, followed by the more heat-sensitive ones: resistors, capacitors, diodes, LEDs, then transistors. If you wish to make a more permanent game, then place the PCB in a box, with the three LEDs, pushbuttons PB1-PB3, and variable resistor RV1 mounted on the top. Take the usual care with the polarised components. By this time, you should be familiar with most of them — only the PUTs are new. So refer to Fig.3 to identify the leads for Q4 and Q5.

Note the different way of labelling the leads on a PUT: anode (A), gate (G) and cathode (K). To make it easier to identify these leads — as you can see in Fig.3 —



The schematic diagram shows the 'start light' delay circuit built around transistors Q2 and Q3, while PUTs Q4 and Q5 latch on their LEDs for the quicker contestant. The role of Q1 is to further delay the lighting of LED1 when someone prematurely presses their pushbutton.

[illegible]

[illegible]

the anode, gate and cathode of the PUTs are in the same relative positions as the collector, base and emitter of the BC548-558 bipolar transistors.

Changes

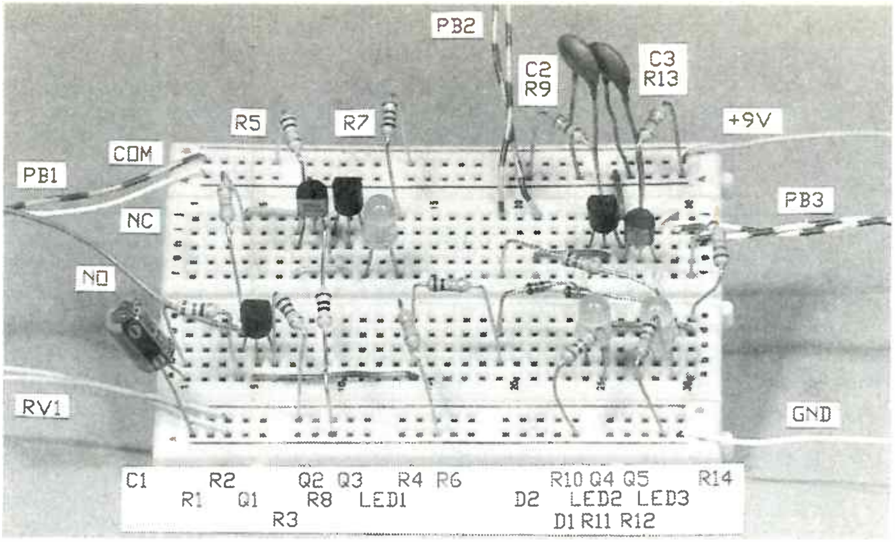
To vary the time delay before LED1 lights, we used a 100k rotary pot. We did this because it was the easiest way to change the resistance value, and we imagine that you would want to change this quite often to make it harder for the contestants.

For a set delay time, it would become fairly easy to anticipate when the 'start' LED will come on. As mentioned earlier, the values of R3 and RV1 give an interval of about 2-8 seconds, with R3 setting the minimum time. So the first change could be to lengthen the maximum time — we doubt that you would want the minimum any smaller. But be careful not to make it too long — you don't want the contestants to become bored and lose interest!

Another change — this time to save money — is to replace the rotary pot with a trimpot. While cheaper to buy, a trimpot is not as convenient, since you need to use a screwdriver to adjust its value. Or, if you don't mind a fixed delay time, leave RV1 out altogether. Give R3 a value of 27k, insert a link between the RV1 pads, and the delay should be about 4-5 seconds.

And another possible economy modification: replace the reasonably expensive SPDT pushbutton (PB1) with two cheaper pushbuttons, one with normally closed contacts (for the power to the PUTs), and one with normally open (for the capacitor). By taping the two buttons together, you can press them both at the same time, and so you really have a SPDT button.

If you don't press these two buttons together, the problem could arise that you clear the contestants' LEDs before turning off LED1 — you will find that an eager contestant will quickly press their button, claiming "the start light is on"!



If you can't see all the connections on our breadboard layout for our 'reaction tester' circuit, refer to the schematic diagram for more details.

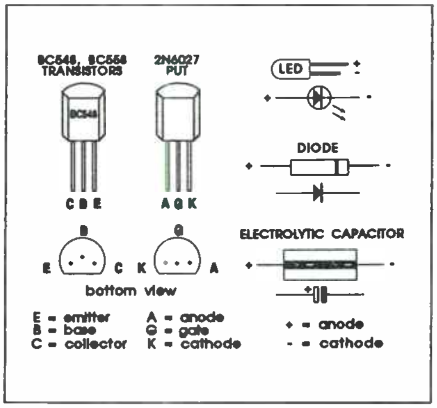


Fig.3: The component leads identification diagram. The anode, gate and cathode leads for the 2N6027 PUT correspond to the collector, base and emitter leads for a BC548-558.

How it works

Let's look first at the delay circuit which starts the game. Transistors Q2 and Q3 form a Schmitt trigger which turns LED1 on and off.

When PB1 is pressed, capacitor C1 rapidly charges up via the current-limiting resistor R1. The charged-up C1 turns on transistor Q2, which turns off Q3 — LED1 is off. If transistor Q1 is off, C1

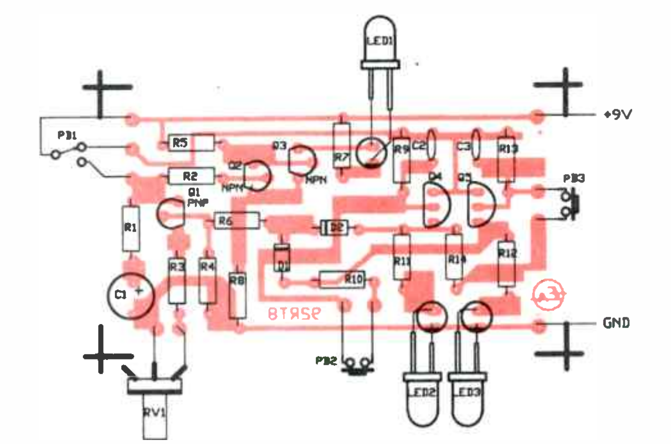


Fig.1

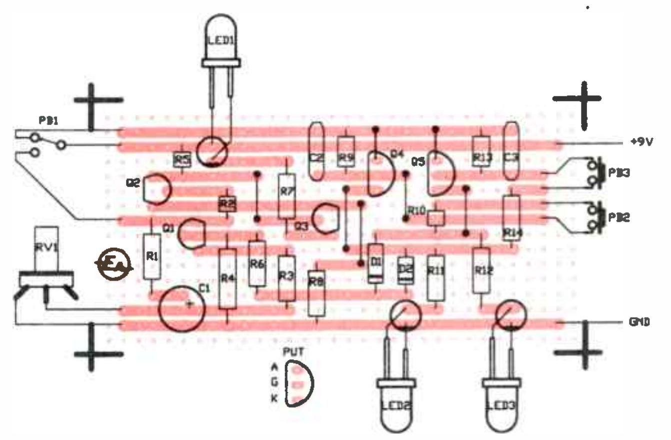


Fig.2

Fig.1: The component layout on the printed circuit board. Button PB1 both clears any latched PUT as well as charging up capacitor C1. The pot RV1 varies C1's discharge time, which determines how long LED1 will take to light.

Fig.2: The stripboard layout. Mount resistors vertically, when the space on the board is less than 10mm. Also, bend the anode leads of the PUTs so that they connect to the track two strips further up.

discharges very slowly (more about this later); but Q1 is normally on, so C1 discharges via R3 and RV1 — taking somewhere within about 2-8 seconds.

As we saw in our light switch circuit, the advantage of a Schmitt trigger is that it rapidly turns on and off. It does this via the voltage drop across the shared emitter resistor R8. (Refer to the February issue for a more detailed explanation of how it works.)

As Q2 starts to turn off, Q3 starts to turn on, which in turn hastens the turning-off of Q2. The overall effect is that Q2 rapidly turns off, and Q3 rapidly turns on. This snap-on effect means that LED1 lights up very quickly.

Now for the circuit built around the two PUTs. To turn a PUT on, there must be a voltage difference applied between its anode and gate. (And because of the nature of a PUT, once it turns on, it also latches on, until all anode current ceases.This is why, to start a new game, button PB1 needs to disconnect the anodes from the +9V supply line.)

So, when the power is first switched on, the gate voltage on both PUTs Q4 and Q5 is +9V, via pull-up resistors R9 and R13. Neither Q4 nor Q5 should turn on. But in practice we found that they were too sensitive — LEDs 2 and 3 insisted on latching on!

This undesired effect occurred because of the internal gate-cathode capacitance of the PUTs, which results in a very brief voltage difference between the anode and gate at power-on. This voltage spike proved sufficient to turn them on. Adding capacitors C2 and C3 removed this problem by adding a low impedance pathway to bypass the turn-on spike.

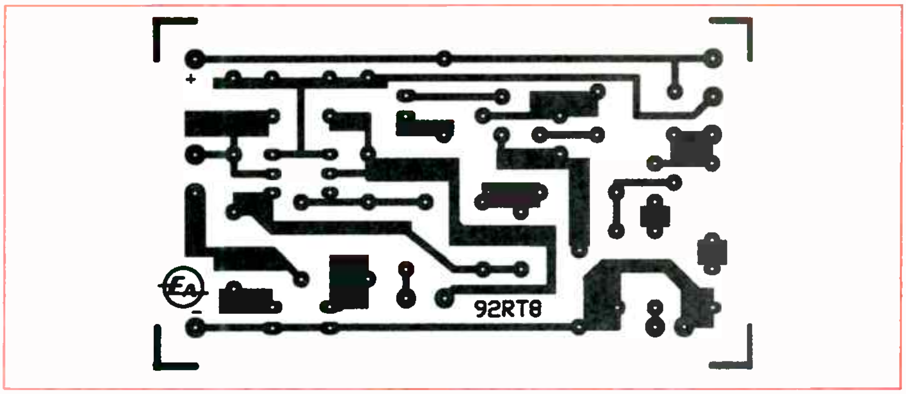
The circuit is now activated, so the game can commence. Suppose that contestant 1 is the first to press his or her button, PB2.

At this point, since PUT Q5 is not conducting, the voltage at the top of resistor R12 is low. PB2 connects resistors R9 and R10 as a voltage divider with almost a full 9V drop across them, giving sufficient bias across the anode-gate of Q4 to turn it on. LED2 now lights, and the voltage at the top of R11 rises to about 8V.

Our slower contestant now presses PB3. The voltage drop across the R13/R14 combination is now only about 1V, which means that there is insufficient bias across the anode-gate of Q5 to turn it on. The winner has locked out the loser.

Of course, if PB3 is pressed before PB2, contestant 2 will similarly lock out contestant 1.

The final part of the circuit concerns transistor Q1. Before either contestant presses their button, diodes D1 and D2 are



This is a full size reproduction of the PCB artwork which can be used to etch your own board.

reverse-biased, so do not conduct. The pull-down resistor R4 ensures that Q1 is biased on. With the transistor on, capacitor C1 has a relatively low value resistance discharge path.

But the moment that either PB2 or PB3 is pressed, either D2 or D1 will conduct — the two diodes act as an OR gate. The voltage applied to the base of Q1 now goes high, so the transistor stops conducting.

C1 must now discharge via a higher resistance pathway: R2, Q2 and R8. This means that it now takes C1 about three times as long to discharge. You now have more than sufficient time to notice when a contestant's LED is lit prematurely — LED1 will not come on until a long time after it.

I think that you will have a lot of fun using this month's circuit. Over to you to find your most 'reactive' friend — the one with the quickest fingers!

Transparencies

A high contrast, actual size transparency (negative) for the PCB used in this circuit is available for only $2. This will allow you to etch your own printed circuit board. This special price applies for transparencies for all projects in this series only. Write to *EA*'s reader services division.

Happy experimenting — and please send us your comments on the circuits we have published as well as ideas for future projects. ❖

PARTS LIST

Miscellaneous

PCB 79 x 46mm, coded 92RT8
3 LEDs, any colour
1 SPDT pushbutton PB1
2 momentary-make pushbuttons PB2,PB3
9V battery
hookup wire, solder, etc.

Resistors

1	100k		linear rotary pot RV1
All 1/4W, 5%			
1	220ohm	R1	red-red-brown
2	47k	R2,R4	yellow-purple-orange
1	5.6k	R3	green-blue-red
2	10k	R5,R6	brown-black-orange
3	1k	R7,R11,R12	brown-black-red
1	10ohm	R8	brown-black-black
2	3.3k	R9,R13	orange-orange-red
2	15k	R10,R14	brown-green-orange

Capacitor, PC-mount electrolytic

1 100uF, 16V C1

Capacitors, ceramic

2 10nF C2,C3

Semiconductors

2	1N4148 signal diodes	D1,D2
1	BC558 PNP transistor	Q1
2	BC548 NPN transistors	Q2,Q3
2	2N6027 PUTs	Q4,Q5

Information centre

Conducted by Peter Phillips

Who's to blame?

The theme this month, more or less, is mistakes. The world scene is commented on by two letters, a manufacturer's error is described and a few mistakes of ours are pointed out. To get even, we take Lewis Carroll to task in the What?? question.

Hindsight is a marvellous, if frustrating thing, as it allows us to see the errors — generally when it's too late.

On a global scene, if we could do it all again, there would probably be a universal mains voltage (240V of course!). A standard mains frequency would be used (I like 60Hz) and gramophone records would probably spin at a speed directly related to the standard frequency. Think of the savings, in both hardware and confusion!

On a more local level, if we had foresight instead of hindsight, there would be no mistakes in *EA*'s projects and the need for errata would be eliminated. Sighs from many readers! But since we lack foresight and have to settle for hindsight, the errors occur — and all we can do is point them out, explain why (if possible) and try that bit harder next time.

Not that we're the only ones who make mistakes. As you'll read further on, manufacturing errors are not entirely unknown. As someone once said, there are many 'things up with which we must put'...

But before we get too involved in mistakes, first an answer to an enquiry by a young programmer...

SW to digital

Using computers with Morse code is certainly not new, as our next correspondent writes. But how about interfacing a SW radio to the computer, rather than a Morse key?

I am 13 years old and I have recently made a program to decipher Morse code. It uses pin 8 on the RS-232 port of my computer, where a high voltage is interpreted as key down, low voltage is key up.

I was wondering if you had any suggestions how to convert a tone from a SW receiver to a digital signal. I can't think of anything, and I'd appreciate some help. (J.B., Glen Waverley Vic).

Good going J.B., a budding programmer with Morse thrown in! Converting a tone into a digital signal is relatively easy. All that's needed is a circuit that switches on during the presence of a tone, then switches off in its absence.

The circuit in Fig.1 is an example, in which a half-wave rectifier formed by D1 and C1 converts the AC tone input to a DC signal that switches the transistor.

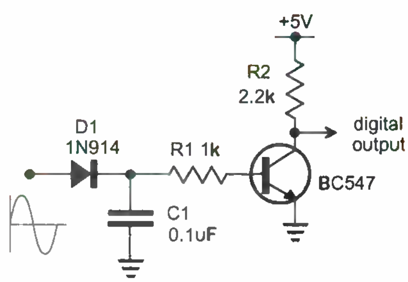


Fig.1

This circuit has been tested and the transistor switches on (output is a low) when a tone of around 1kHz at 2V p-p is applied to the input. It switches quickly, so a series of input tones should produce a corresponding series of digital pulses at the output.

The transistor output could then be connected to a digital inverter (such as a 74LS14) to interface to the computer.

Your Morse software would then treat this signal in the same way as it handles the output of your Morse key. I hope this helps you, J.B.

AM distortion

I've received two letters giving suggestions why bass distortion could occur in an AM radio. This problem was described by a reader (R.S., Glen Waverley Vic) in the May 1992 edition. Both letters suggest design errors in the radio, which was my suggestion in reply to the original letter.

The bass distortion referred to in May may be due to the type of AM detector used in the radio. I encountered this problem some years ago when I was experimenting with a simple TRF tuner.

To achieve a 'loud' sound, commercial AM stations modulate the carrier as much as they possibly can. If you have ever looked at the modulated carrier of a commercial AM station on a 'scope, you will see that the negative peaks of the modulation reduce the carrier to virtually zero.

The forward characteristic of a diode, while quite linear when operating 'up the curve', is rather non-linear near its turn-on region. If the radio mentioned by R.S. has a simple diode detector in its AM section, it will produce distortion on the negative peaks. Since the bass in most music has the highest amplitude (especially if the station applies some bass boost), then distortion will be most evident on the bass frequencies. (R.C., Pakenham Vic).

This seems a reasonable explanation, although to the best of my knowledge, just about *all* of today's AM radios have a diode detector. Stereo AM receivers have extra circuitry, but a diode detector is still somewhere in the chain.

Rather than blame the diode detector, I suspect it's more to do with the design of the detector circuit. For example, the higher the input impedance of the stage following the detector, the less the dis-

[illegible]

tortion. No doubt there are other design considerations, such as the value of the RF filtering components in the detector circuit. But I have to agree that the detector is a likely source of this type of distortion.

The next letter refers to a particular brand of radio. While the letter doesn't really offer a reason for bass distortion, it describes how the writer eventually solved the perplexing problem of hum, including finding and fixing a manufacturer's error:

Some years ago I purchased an AGS model AF374 AM-FM stereo tuner, despite the poor review given by Choice magazine. The review complained of a high level of noise, but I found that the main source of noise was 50Hz hum.

I decided to see if I could get rid of the hum, and my first course of action was to connect a 4700uF/25V electrolytic capacitor across the 14V supply line. This reduced the hum considerably, but did not eliminate it. Because hum is usually caused by either ripple on the supply line or by earth loops, it seemed the next thing was to suspect earth loops.

I then decided to isolate the mains transformer from the metal chassis of the radio. I have found this an excellent way of eliminating earth loops, while retaining the electrical safety of the appliance.

In the receiver, the transformer is the only component connected directly to the mains supply, and is the only component that needs to be directly earthed. It was easy enough to secure the transformer to the chassis with nylon nuts and bolts, with the transformer mounted on a piece of 3mm bakelite. I soldered the mains earth directly to the transformer, leaving the rest of the receiver isolated from this earth connection.

This further reduced the hum, and I left things alone for the next few years. However, I was always bugged by the small amount of hum that still remained. Then the stereo indicator lamp failed. I decided to replace the incandescent type with a high intensity LED, which required changing the value of the current limiting resistor connected in series with the lamp. I measured the supply rail voltages to make the necessary calculations of the required resistor, and noted that the supply voltage seemed higher than usual.

And then I saw the fault! The circuits in Fig.2 show the error, in which the manufacturer had connected the pilot light to the decoupled/filtered supply, and the tuner supply to the point intended for the pilot light. Because the power supply was constructed on a tag strip, it was a simple matter to exchange the wires. After correcting the mistake, the hum fell to virtually zero, even with my additional 4700uF capacitor removed.

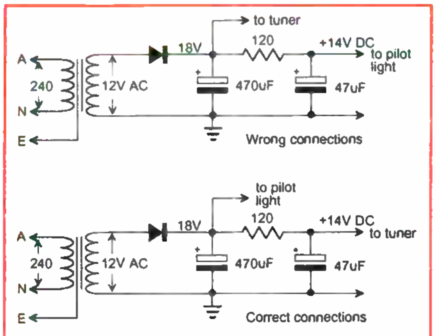


Fig.2

I can't help wondering how this fault escaped the attention of those involved in aligning and testing the receiver. However, the tuner now works very well, and if anyone has one of these receivers, or sees one for sale at a bargain price, the fault is easily fixed. (B.H., Heathmont Vic).

Thanks B.H. — it's quite a story, and one well worth including here. It highlights the point that receiver design (or in this case, testing) can at times be rather random. On the point of earth loops, I test for this by connecting the suspect equipment to the mains using a double adapter with the earth pin removed. If this check doesn't remove the hum, then I need to look elsewhere. If it does, then your comments on electrically isolating (and earthing) the transformer are most appropriate.

Why 240V?

Following a letter in the March edition concerning the apparently arbitrary selection of 240V for the mains supply, a number of readers have written offering some reasons. Here's the first letter...

The earliest commonly used electricity supply systems were 110V DC, a choice probably largely influenced by Thomas Edison. I have been given two possible reasons for this:

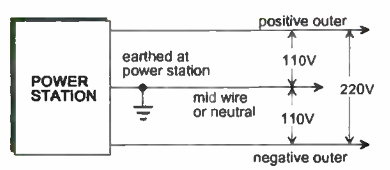


Fig.3

(1) The additional 10V was to allow for voltage drop.

(2) The Daniel cell, which was commonly used in those days, has a terminal voltage of 1.1 volts. A bank of 100 cells gives 110V.

With the increasing use of electrical equipment that included electric motors, the three-wire DC system was introduced. This system (see Fig.3) had the advantage of providing two voltages: 110V for lighting (between either outer conductor and earth) and 220V between the outer conductors for heavier loads. To further reduce voltage drop and the size of the conductors, these voltage were sometimes doubled giving 220V/440V. This system was used in some country towns, up to and even after 1945.

In WA, a three-phase AC voltage of 440V is used, giving a single-phase voltage of 254V, which is usually specified as 250V. The rest of Australia seems to have followed the UK values of 415/240V. I've been told that WA initially had a 40Hz supply, as a result of buying a system 'on the cheap' from South Africa.

It seems South Africa realised the folly of having a non-standard supply frequency, and off-loaded it at a bargain price. WA converted to 50Hz just after World War 2. Apparently, South Africa hoped to use 40Hz for their rail system as no rectification was required. Norway has used 33.3Hz for this purpose, although flicker becomes noticeable in incandescent lamps. (J.E., Bull Creek WA).

The next letter makes a similar point, and continues with a few thoughts on why 78rpm and 33.3rpm were used for records.

Why 240 volts? I suppose the answer to that is why not? I've enclosed a copy of two pages from the third edition of Reference Data for Radio Engineers, Federal Telephone and Radio Corporation (an associate of ITT).

As you can see, it's almost pick a number. Compare Norway with a choice of 220, 230, 130, 127, 110, 120 and 150V, all at 50Hz, plus 220V DC, to Italy's 150, 127, 125, 115, 220 and 110V at frequencies of 42, 50 and 45Hz. And I used to think we had a problem with the choice of 200, 230, 240 and 250V at 40 or 50Hz in Australia! The AC voltages often mirror the DC voltages, and DC systems would have been the first in many cases.

The choice of voltage is largely a matter of economics and minimising total costs. That means balancing the costs of heavier cables to deliver the

[illegible]

[illegible]

[illegible]

same power with the higher costs of increased insulation. This is probably an over-simplification, but your correspondent might like to work out the extra cost of a cable delivering 1kW at 200V with one delivering 1kW at 240V, with the same losses.

Concerning the speed of gramophone records, I seem to recall that there were a number of record speeds in the early days, with gramophone players having a speed control to allow the speed to be set to suit the record. In due course, commonsense prevailed and the nominal value of 78rpm was settled on as about the average.

In fact, the speed is 77.92rpm +/-0.5% for 50Hz systems and 78.26rpm +/-0.3% for 60Hz systems. (I didn't know this either, until I looked it up!) The reason for the odd speeds is that these are the closest you can get with a stroboscope that has 77 bars (50Hz) or 92 bars (60Hz). I'll leave you to do the sums for yourself.

The choice of 33.33rpm for LP records was almost certainly a commercial decision. When these records were introduced around 1950, most broadcast stations would have had dual-speed turntables to play normal 78's and the 16" diameter 33.33rpm transcriptions that were used for all the recorded shows of that era. The stations had only to fit special pickups, to allow the new LP's to be played.

Why was 33.33rpm chosen for transcription records? This was most likely an engineering decision. The requirement was for a record that would play for a little more than 15 minutes per side, with a frequency response of about 50Hz to 8kHz.

Given the limitation of the equipment and recording media available a 16" disc recorded at 120 grooves per inch gave the required playing time and technical quality. There was also another standard of 16.67rpm, used to record speech and limited mainly to uses such as 'talking books'.

This information is from the Radiotron Designer's Handbook, 4th edition, 1952, by K. Langford-Smith. The chapter on recording lists 317 references which would be worth following up for anyone who wants further information. (A.F., Balwyn Vic).

My thanks to both writers for this information, which supports my theory that most things in this world are developments of previous developments. Somewhat Darwinian, perhaps!

And now for a few letters about projects. The first makes its point rather strongly...

Dolby Decoder

In reference to the Dolby Surround Sound Decoder, January 1992. If the following criticism is incorrect, please disregard this letter.

On page 78, the PCB patterns have tracks touching each other where they shouldn't. This occurs at least six times in the artwork. Next, page 77, layout diagram, C2 should be C5, R15 (on bottom) should be R12, C5 should be C2, C28 should be C20 etc, etc. Page 79, parts list shows capacitors are C1, 51(?) as 1uF electrolytic. C132(?) a 22nF polyester. Etc...

Two issues of EA have been published since this project, and I haven't seen any notes referring to these stuff ups. If you have ever tried to manufacture a double-sided PCB at home with very limited equipment, you would understand my anger.

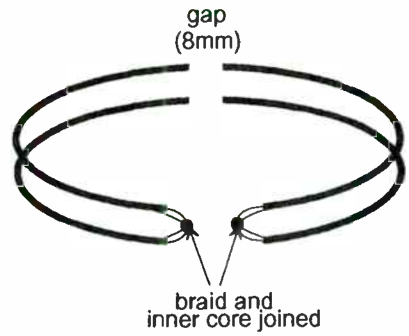


Fig.4

The project idea is great. But is it too much to ask to get it right! Could you reprint pages 73, 77, 78 and 79, this time correct! From a very grumpy subscriber. (D.C., Narangba Qld).

The errata you've raised was presented in July, but I've printed your letter here to show we also include the brickbats. I'm not sure if your anger is about the errors (which no one else has raised) or about the use of a double-sided PCB.

Certainly we need to take responsibility for these errors, although checking component numbering on a PCB layout is almost impossible unless we actually build a sample project from the final article before sending it to the printer.

Obviously these are drafting errors, with 2's being confused with 5's and so on. The parts list errors are typesetting problems, with extra characters sneaking in accidentally. I doubt if these confused too many people.

The artwork is beyond our control, as this was processed from the original supplied by the designer of the project. Touching tracks are usually fairly obvious, and although we try to produce the best copy if the original artwork has problems, there's not much we can do. In any case, you can purchase a ready-made board from various PCB suppliers, which gets around the problem of making a double-sided board with limited equipment. These suppliers advertise regularly in *EA*.

To limit our projects to single-sided boards (with high quality artwork only) would mean a reduction in the number of projects. Most people seem to understand this, and accept these occasional problems (probably rather unkindly at the time), so it seems unfair to others to exclude otherwise excellent projects. Still, your point is taken, D.C. — although the errata, rather than a complete reprint of the offending pages is a more economical way of remedying the mistakes.

'Miracle' Antenna

I've received several letters that indicate a degree of confusion on whether a space is required between the ends of the dipoles, with the 'Miracle' TV antenna described in the May issue.

It seems the article didn't make the point very clearly, in its attempt to describe what is really a very minor point. The simple answer is: put a cut in both dipoles.

The article attempted to say that one dipole can extend right around the perimeter of the circle and the other (for UHF) should have an 8mm space cut halfway. There is little benefit in this as it turns out, so cut them both.

In fact, the use of two dipoles is simply to give a stronger construction, and a single loop of coaxial cable, (with the 8mm cut) will serve the purpose. Coaxial cable is used to give a broad surface area for the dipoles, and conventional wire can be used if required. The diagram of Fig.4 may make things a bit clearer.

TV CRO

The TV CRO Adapter published in March-May-June 1991 has met with some success, I'm pleased to report. This is a complex project, and feedback suggesting it works (I told you so!) is always welcome. Here's two letters about this project, with two different comments. The first reads:

I have built your CRO adapter and all in all I'm quite happy with the result. My query is about a minor annoyance, and

concerns the extraneous dots that appear at the upper left of the monitor screen. This can be seen in the photos of March, page 86, and June page 73. I can live with this, but I am curious why these dots are present and whether they can be removed. (G.C., Eungai Creek NSW).

I think the reason for the dots has something to do with the monitor you are using. I used two different types of monitors (both with direct video input) during the development process, and since receiving your letter I have tested the prototype on a third monitor.

There are no dots on the screen for all three, regardless of the input conditions. If you look at all the photos in the three articles, you'll see that the only time the dots appear is in the photos you refer to, and this same monitor is shown on page 86 of the March '91 edition, this time 'dot free'.

I suspect there are a number of possible reasons, including adjustment of the vertical and horizontal sync (either the monitor's or the adapter's). However, it may be that the sync system in the monitor you're using won't allow the dots to be eliminated.

I also found during the development process that the location of the various interconnecting leads affected the display to some extent, depending on the type of monitor.

Another possible reason is the bandwidth of the monitor. It may be that my monitors have a limited bandwidth and don't usually show the dots, except in the photo you mention. I don't remember the conditions that existed when I took this photo, but I suspect the set-up was altered afterwards.

For the dots to appear, there has to be a signal to cause it, and a possible reason is a glitch occurring at these lines. However, there is nothing happening at these lines, so I can't really give a likely cause.

However, in summary I think the reason is not so much a design matter but something less technical, such as those I've described.

The next writer is not quite as satisfied, and suggests a rather different approach to the A to D section. Space doesn't permit me to include the entire letter, but here's the basic intent:

Having constructed the TV CRO adapter in March-June 1991, I found that despite the prototype's good performance, I could not match it with mine.

Despite all care to minimise noise in the analog section, the triggering showed tearing, because of the need to scan the waveform 128 times per input scan with exactly the same triggering environment. At this stage I have shelved the project.

It occurs to me that the multiple scanning of the waveform ruins both the triggering stability and the bandwidth in one hit. I have begun to consider mapping the input and output of the RAM using a CMOS flash converter, such as the National ADC0881. Using a flash converter to provide the 'row' number directly, a bandwidth of 10MHz could be achieved, or 20MHz using multiplexed converters.

By using the existing Store/Display mode signal to define the circuit configuration, bus transceivers could be used to either write flash-converted data into the RAM, or to scan the mapped data out via the original shift register.

Perhaps you, or a reader might consider this as a 'drop-in' replacement for the RAM PCB, making this project even more valuable. It would give faster scanning of low frequencies and a 10MHz Nyquist bandwidth. I would be the first to use the upgrade. (I.R., Pearce ACT).

Thanks for the idea, I.R. If time permits I will examine this approach, as extending the bandwidth is certainly worth the effort. However, the problem of poor triggering is not typical, as I've seen the finished efforts of others who have built this project. In all cases, the project worked as described.

Certainly there is small amount of 'jagging' in the waveform, due to the digitising process. However it's never more than one or two pixels either side of the correct waveform.

Perhaps there is a problem with earthing or lead dress. Maybe you have a noisy trigger comparator, or something similar. If you find the answer, I'd be pleased to present it, as being the designer of the project, I have a more than usual interest.

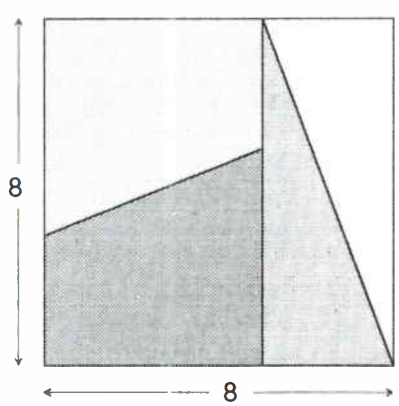


Fig.5

NEW KITS FOR EA PROJECTS

Jaycar Electronics has advised us of the release of new kits for the following *EA* projects:

LOW COST AUDIO SWEEPER (August-September 1992): The Jaycar kit is complete with all specified components except for the microphone assembly. It includes 1% resistors and MKT metallised polyester capacitors throughout. A front panel label is provided, to match the 'Jaybox' case as specified. Listed as catalog number KA1744, the kit is priced at $99.00. An electret microphone insert suitable for use in the microphone is available from normal stock: type AM-4010, priced at $1.95.

NOTE: This information is published in good faith, from information supplied by the firm or firms concerned and as a service to readers. Electronics Australia cannot accept responsibility for errors or omissions.

What??

This month's question is not really electronic, but a rather popular mathematical conundrum. It was originally posed by Lewis Carroll (of *Alice in Wonderland* fame) and sent to me by Don Law, of Tumblong NSW. I'm posing the question somewhat differently to how Lewis Carroll might have, with assistance from a computer drawing program.

The original question (I think) was posed along the lines of 'show how 64 equals 65'. To help you, I've drawn a square measuring 8 units by 8 units and divided it into four sections, shown in Fig.5. By cutting out the sections, it's possible to arrange them into a rectangle measuring 5 by 13 units (which gives an area of 65).

So the first part of the question is: how are the sections arranged? But as we all know, 64 doesn't equal 65 (except in Wonderland) — so the next question, assuming you've got the first, is: where's the mistake?

Answer to July's What??

There are a total of five possible values, including the example given in the question. The other four are:

570 ohms, from 10 + 560, 100 + 470 and 180 + 390.

660 ohms, from 100 + 560, 270 + 390 and 330 + 330.

780 ohms, from 100 + 680, 220 + 560 and 390 + 390.

830 ohms, from 10 + 820, 150 + 680 and 270 + 560.

By the way, it's not possible to find a resistance that can be made up in four or more different ways from the E12 range. ❖

JAYCAR END OF WINTER BARGAINS

10" WIDERANGE SPEAKER BARGAIN

These speakers were purchased from Philips, manufactured in Asia and designated for a stereo system that never happened. We are happy to pass on the savings we made to you.
The speakers are a twincone widerange unit with a foam roll surround. The cone is black, with the twincone's white. Their impedance is 4 ohms.
These would be ideal for use in car stereos or extension speakers for Hi Fi. Most stereos will happily accept 4 ohm loads. Power handling is 50 watts RMS.

Full Specifications

Power Handling	50W RMS
Impedance	4 ohms
Resonant Freq.	38Hz
Freq. Response	38 - 20kHz
SPl	90dB 1 watt
Magnet Weight	17.7 grams
Total Weight	1,500 grams

Cat. CE-2330

$20 ea ABOUT 1/2 PRICE

POTENTIOMETER MADNESS - INCLUDING SWITCH POTS!

We have purchased a large quantity of Philips brand pots. These include single gang, dual gang, single gang with switch and dual gang with switch, in log and linear. Switchpots are almost impossible to buy. This may be your last chance. We have available two packs of pots. One is a log pack, the other a linear pack. Each pack is supplied with some nuts to suit, as Philips pots have a unique nut.

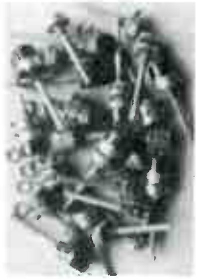
LINEAR PACK

Total 25 pots. Types supplied are single, dual, single switched, dual switched. Values included in packs are 220R, 47k, 100k, 220k, 470k, 2.2M, 4.7M. Other values may be supplied but we can't guarantee every pack will get one. Cat. RP-3900

LOG PACK

Total 25 pots. Types supplied are single, dual, single switched, dual switched. Values included in packs are 470Ω, 47k, 100k, 220k, 470k, 1M, 2.2M. Other values may be supplied but we can't guarantee every pack will get one.
Cat. RP-3901

ONLY $10 per pack
That's only 40¢ a pot and the majority supplied are switch pots!



QUALITY PHILIPS WIREWOUND POTS

We currently sell one 100Ω wirewound pot for $9.50. Extremely expensive! We have now increased our range enormously and made them affordable

Value	Cat. No.
2.2Ω	RP-3970
3.3Ω	RP-3971
4.7Ω	RP-3972
10Ω	RP-3974
22Ω	RP-3975
33Ω	RP-3977
100Ω	RP-3980
330Ω	RP-3982
470Ω	RP-3983
3.3k	RP-3988
4.7k	RP-3989
10k	RP-3992
22k	RP-3994

Some values are in limited quantities, so grab them whilst you can.

ONLY $4.95 ea

ENHANCED XT/AT COMPATIBLE KEYBOARD BARGAIN 101 keys

See catalogue for full details Cat. XC-5090

$79 SAVE $30

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European made, by Siemens. These are a 100μF 250V PC mount. They actaully have a lead out each end, but one is factory bent down the capacitor so it can be PC mounted. Made to DIN 41316 standard. Size 40 x 20 diameter mm

1 - 9	$1.00	10 - 99	70¢
100 - 999	50¢	1000+	40¢

Cat. RE-6155 Price includes sales tax

L E D S

10mm FLASHING

Now available separately

Red	Cat. ZD-1965	$4.95
Green	Cat. ZD-1966	$4.95

L E D S

BLUE

Finally available at a realistic price. These are waterclear (i.e. they look clear but light up blue) because waterclear have a higher light intensity.

Size	mCd	Cat	Price
3mm	14	ZD-1751	$3.95
5mm	14	ZD-1727	$3.95

YORK STREET STORE MOVES

The Jaycar store in York Street, Sydney has moved 100 metres towards the Town Hall to 129 York Street. Same fax and phone number. Call in and see our beautiful new store.

DUAL DISPLAY DMM

AVAILABLE MID AUGUST

NEW from Jaycar

Jaycar are proud to announce the first handheld dual display DMM available, and it's under $200!!
The dual display allows the user to select a wide variety of measurement combinations. It is particularly useful in applications requiring two different measurements of the same signal, i.e. a Vac value can be viewed on the primary display while its frequency is shown on the secondary display. This meter also has all the features you could ever ask for on a DMM.

FEATURES
- 3 3/4 digit, 4000 count
- Bar graph
- 0.1% accuracy DCV
- Autoranging and manual
- Min/max hold
- Measurement hold
- Relative mode 1 (value difference)
- Relative mode 2 (% value difference)
- Stop watch 0.1 sec - 10 min
- Frequency counter 10Hz - 200kHz
- Capacitance 4nF - 40μF
- Transistor test
- Diode test
- Audible continuity tester
- Auto power off

Cat. QM-1525

$199.50

Jaycar have purchased the entire stocks of some lines of Arista brand products. Check the savings over normal catalogue prices. Most are well under 50% OFF. Catalogue prices are shown for you to appreciate the huge savings.

Flexible Multicore Cable with Black PVC

TYPE 1

9 Core Shielded
- 4 x shielded single core
- 2 x Shielded twin cores
- 1 x single core
- 1 x drain wire
- Sheath outer diameter 9mm

Cat WB-1540

1991 Cat price $7.45 p/meter
Jaycar price .95¢ p/meter
50 meter roll $39.95
Save over 80%

TYPE 2

12 Core Shielded
- 6 x shielded
- 2 x Shielded single cores
- 2 x shielded twin cores
- 2 x single cores
- 1 x drain wire • 1 x foil
- Sheath outer diiameter 10mm

Cat WB-1542

1991 Cat price $9.95 p/meter
Jaycar price $1.20 p/meter
50 meter roll $49.95
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75 Piece Cable Tie Assortment

25 pieces each of three different sizes of cable ties. Lengths are 66mm, 122mm and 192mm. Supplied in a handy plastic display, which doubles as a storage box, self locking, white colour. Ideal for the hobbyist, electrician, or serviceman.
Cat HP-1203

1991 Cat price $9.95
Jaycar price only $4.95

Walkman Battery Packs

TYPE 1

1 x 'C' size. External battery holder for 'Walkmans'
- Holds 2 x "C" size batteries
- Batteries wired up in series
- 3 volt DC output
- Output lead supplied with 1 x 1mm, 1.3mm, 2.1mm and 2.5mm DC plugs.

Cat PH-9284

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Jaycar price only $2.95
Save over 70%

TYPE 2

3 x 'C' size.
- Holds 3 x "C" size batteries
- Batteries wired up in series
- 4.5 volt DC output
- Output lead supplied with 1 x 1mm, 1.3mm, 2.1mm and 2.5mm DC plugs.

Cat PH-9286

1991 Cat price $14.95
Jaycar price only $3.95
Save over 70%

BUTANE MICRO TORCH BARGAIN. YOU WON'T BEAT THIS PRICE ANYWARE!!

Refillable butane gas torch with its own ignition system, simply requires a push of a button to ignite. This unit really churns out the heat up to an amazing 1,300°C. It has an adjustable flame control and on full power has a flame length of about 60mm. The micro torch has a huge gas tank, so with intermittent use, the gas will last for ages. Also supplied with a base so the unit can be safely supported when standing alone. This torch has many uses, EG, welding, brazing, jewellery, plumbing, home workshop, bonding glass, shrinking heatshrink tubing, lighting BBQs, burning oid paint, etc. Height 140mm. Cat TS-1415

1991 Cat price $94.95
Jaycars normal price $59.95
Now only $29.95
SAVE OVER 65%
Be quick, don't miss out

SPEAKER CABLE PACK BARGAIN

14 x .14 Grey speaker flex. Designed for connecting speakers to Hi-Fi systems, car Hi-Fi installations, alarms, public address and other audio applications.
2 x 5 meter pieces, blister packed.
Cat WB-1700

1991 Catalogue price $4.95 per pack
Jaycar price only $1.95 per pack

High Quality Polycarbonate/ MKT Capacitor Pack

This pack includes approximately 75 high quality capacitors. They are mostly Philips and Wima brand high quality European made capacitors.

Capacitance values include: 270pF, 0.0015, 0.015, 0.022, 0.033, 0.047, 0.068, 0.15, 0.18, 0.22, 0.27, 0.33, 0.39, 0.47, 0.56, 0.68, 0.82µF in voltages including 50V, 63V, 100V, 250V, 400V, 630V, and 1000V.
Most of these capacitors cost around $1 each, so 75 pieces for $10 represents an absolute bargain. There is a limited quantity of packs available.
Cat. RG-5195 **$10**

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Features: • 40 Watt power handling • Japanese Clarion brand • High quality • Complete with grill
Dimensions: Grill 126mm sq
Mounting holes 124mm diagonal
Spk frame 120mm sq
Depth including grill 50mm
Cat AS-3011

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Remote keypad to suit Cat. LA-5183 **$49.95**

[illegible]

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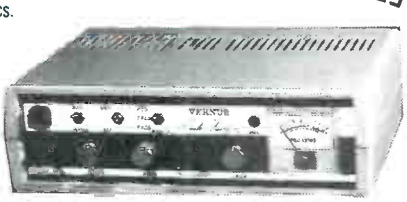
LOW COST AUDIO SWEEPER KIT

NEW From Jaycar

Ref: EA August 1992
This is not just another audio generator, but a generator with a difference! This kit is virtually a complete low cost audio test system, used for analysing the performance of speakers, speaker enclosures, filter circuits and room acoustics. The 'sweeper' works by applying a sinewave tone of varying frequency to the power amp driving the speaker, and then studying its acoustic output via a microphone, on a CRO.
Frequency range 10Hz to 18.5kHz.
The Jaycar kit comes complete with the 'Jaybox' front panel label, PCB, VU meter, plus all specified components. External microphone assembly not included.
Cat. KA-1744 **$99**



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by PETER LANKSHEAR

My favourite 'Dinosaur': the Majestic 90

Someone has aptly referred to American console receivers made from 1928 to late 1930 as 'Dinosaurs'. Reptilian dinosaurs were very successful, some extremely large; but most disappeared over a short period — to be replaced by more compact and advanced animals. The same thing happened when the big TRF receivers gave way to compact superheterodynes...

Fortunately, the era of the big TRF 'Dinosaurs' came before imports of American receivers were restricted. As a result, some good examples of these monsters can be found in Australasian collections.

My personal favourite from this period is the Majestic 90 series, and no receiver was more appropriately named. Majestic they certainly were — massive, and although built using what was already an obsolescent technology, they were nevertheless an outstanding and most successful family of receivers.

Most remarkable was the meteoric history of the manufacturer, Grigsby-Grunow of Chicago. Founded in 1921, the Grigsby-Grunow-Hinds Company as it was originally called, first made celluloid sun visors for cars. In 1924, they entered the rapidly growing radio industry, making horn speakers with celluloid horns. The following year they were ready for a rapidly growing demand for battery eliminators, with the 'Majestic A and B Current Supply'.

During 1926 and 1927 their next model, the 'Super-B' eliminator was so successful that the company became very profitable. But then disaster threatened: AC powered valves became freely available. With battery eliminators out of fashion, a rapid change in product was essential for survival.

Early in 1928, the company reorganised as Grigsby-Grunow, and raised a public share issue of $800,000. They extended their plant, leased further space and commissioned Radio Frequency Laboratories to design them a receiver. RFL obliged with an eight valve neutralised-triode TRF, with three type 226 directly heated valves as RF amplifiers, a type 227 indirectly heated grid leak detector, and another 226 audio amplifier driving a pair of 171A output triodes. The rectifier was the inevitable 280. A significant feature was a moving-coil loudspeaker.

The initial 60 and 70 series both used this same chassis, the main differences between models being the elaboration of the cabinets.

Mass production

Henry Ford had demonstrated the efficiency of the mass production line — concentrating on one model, with each worker skilled at a few repetitive tasks. Grigsby-Grunow adopted similar methods with equal success, and claimed that less than 15 worker hours were required for each receiver produced.

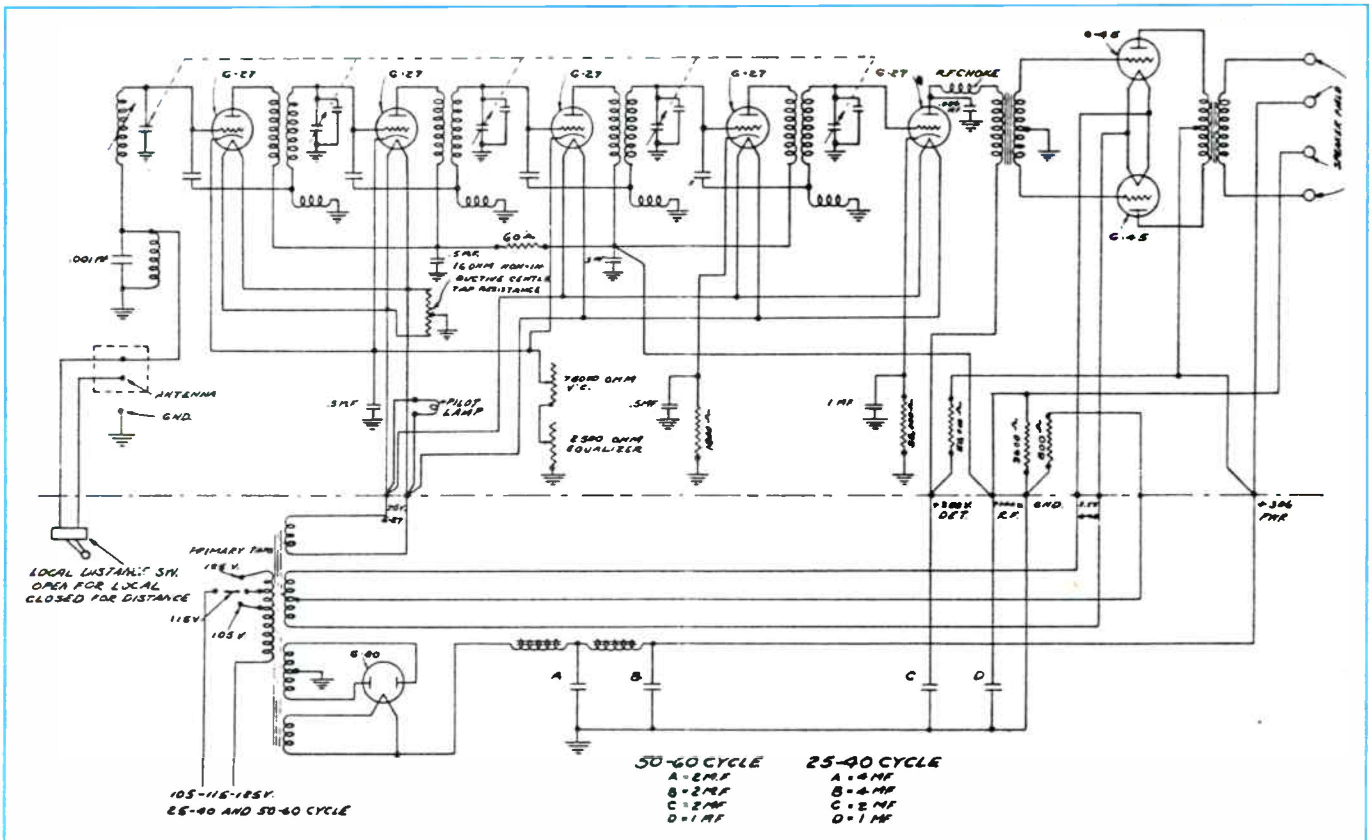
Whereas most radios were still made with moving-iron speakers, even the lower priced Majestic receivers had massive moving-coil units — efficient, and with enough bass and volume to flatten the competition. The unbeatable combination of dramatic audio quality and competitive price guaranteed Grigsby-Grunow's success.

Early in 1929, a new handsome console cabinet known as the 70B was introduced, with the original chassis modified using a separate power supply. At the same time they introduced a deluxe chassis for the up-market model 180 series. The 180 had 227 valves instead of the type 226, and a high power audio amplifier using large type 250 output triodes.

'Mighty Monarch'

By July 1929, when RCA was already selling receivers using the type 224 screen grid valve, RFL had developed for Grigsby-Grunow a third 'all triode' circuit: the unique model 90. This retained a separate power supply and used

The model 90, on the left, was the budget-priced version fitted with the 90B chassis. At right is the more ornate model 102 radio-phonograph combination.



Except for a mains ballast resistor and separate power supply, the circuit for the earlier model 90 was practically identical to that for the 90B, shown here. The model 100 radio-phono chassis had an added changeover switch.

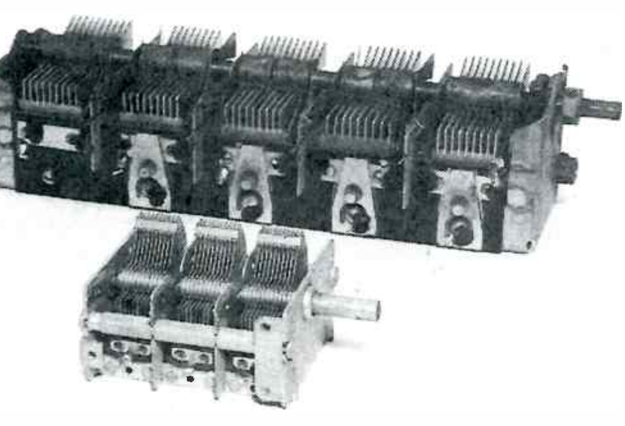
a pair of the newly introduced type 245 output valves, following a string of 227 indirectly heated triodes.

Sales were phenomenal, and by August 1929, 11,000 employees were making 5000 receivers a day! With a turnover for the year ending 31 May 1930 of $61,000,000 and 25% of national radio production, Majestic were America's No.1 radio manufacturer. They were even making their own valves! Majestic had certainly made remarkable progress in two years.

For the first half of 1930, a modified chassis, the 90B was produced. The 90B retained the model 90 circuit, but with an integral power supply. As before, the one chassis was used with various cabinet styles. The model 100/100B 'radio-phonograph' chassis had the addition of a changeover switch.

Called 'The Mighty Monarch of the Air', the 90/90B was probably the last major neutralised-triode receiver to be developed, and was unique in several significant ways.

Readers familiar with valve superheterodynes will know that superior models had a stage of tuned RF amplification ahead of the mixer valve. Two tuned stages before the detector were common in TRF receivers, with some larger models — including the Majestic model 70 — having three tuned amplifiers and a four-gang tuning capacitor.



This picture says it all: the Majestic's huge five-gang tuning capacitor dwarfs a standard three-gang model.

FIVE gang capacitor

Not so the 90. It had FOUR fully tuned RF stages preceeding the detector, requiring a *five*-gang tuning capacitor! Operating with this enormous gain at one frequency, stability could have been an insurmountable problem; but with short leads and plenty of shielding, RFL achieved a sensitive and stable design.

The grid-leak detector of the model 70 was replaced in the 90 by a more suitable anode-bend detector, driving the output valves through an audio transformer. With no intermediate audio voltage amplifier, the detector had to work hard, for at full output those 245 output triodes required 100 volts of grid to grid drive!

All this was powered by a husky power supply using the usual type 280 rectifier.

One claim made for the Majestic 90 was that it was 'hum free'. With the majority of early mains powered receivers, this statement could have been treated with a large dose of scepticism, but with its good filtering and low audio gain, the 90 series really was quiet.

A detailed study reveals that for all its

size, the 90B has relatively few components. For example there are only seven resistors, three of them carbon; two mica capacitors; and a grand total of only 8.5uF of paper filtering capacitors. But the unusual features start right at the aerial terminal.

Aerial coupling was often a compromise. Close coupling was efficient, but upset ganging by detuning the input circuit. Loose coupling minimised the detuning, but was inefficient. With a method first used in the model 70 chassis, RFL solved the problem in a novel and ingenious way.

The input circuit is actually a form of pi-coupler, with the input section a fixed 1nF (.001uF) capacitor bridged by an RF choke static leak, and the first tuning capacitor as the output element. A tuning coil with variable inductance controlled by a copper 'hat' joins the two capacitors. This hat is connected to the left-hand control knob, by a linkage and a shaft; rotating the knob varies the inductance to resonate the input tuned circuit. The resonant point varies with different aerials and is quite sharp, but needs only minor adjustment over the band. To cope with very strong signals, a local/distance switch adds a capacitor in series with the aerial — actually the capacitance between the two switch leads.

The first three RF stages are identical. Each has a 227 valve neutralised by coupling to its grid, via a neutralising capacitor, a small out of phase voltage from the tuned winding of the following stage. Gain is controlled by varying the bias on these stages, with all three cathodes connected to the 75k ohm volume control.

Solidly made electromagnetic speakers gave Majestic sets the edge on their more expensive rivals, many of which still used magnetic cone speakers.

This control is connected to earth via another variable resistor, called an 'equaliser'. The uninitiated could have trouble locating this control, because it is actually coupled to the rear of the tuning capacitor shaft! Its function is to compensate for the change in receiver gain over the tuning range — varying from about 500 ohms at the low frequency end to 2500 ohms at 1500kHz.

The fourth RF amplifier is similar to the previous stages, again using a 227 valve, but with a fixed cathode bias resistor of 1.8k ohms. This optimises operation to provide plenty of detector drive.

Known as 'anode-bend', 'plate' or 'biased', the detector has a 34k ohm cathode resistor to bias the valve practically to cutoff, and has large signal handling ability with relatively low distortion. A key component is the interstage audio transformer, required to provide a very high grid drive voltage to the output stage. It has a 1:5 turns ratio and, for its time, a remarkably good frequency response — measuring only 2.0dB down at 25Hz and 8kHz.

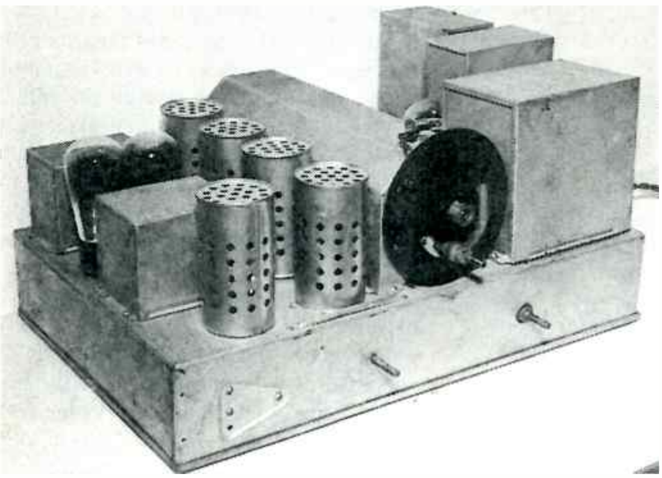
In 1930, a push-pull pair of 245 output valves was practically universal in all but the smallest mains-powered American receivers. The Majestic can turn out at least three watts of good quality audio power, via an output transformer as large as some receiver power transformers. Bias is provided by a 800 ohm resistor, in the filament return lead of the 245's.

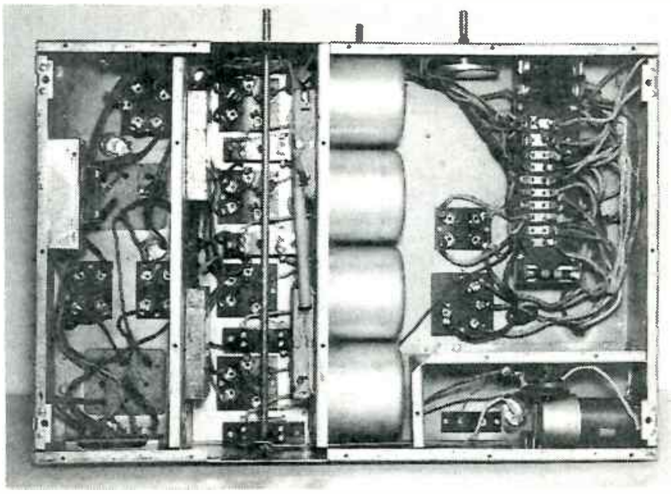
Impressive supply

The power supply is very well designed. Although the largest capacitors are only 2.0uF, the hum level is practically inaudible. As electrolytic capacitors were not in general use in 1930, the only choice was large and expensive paper dielectric types. Consequently, capacitor values were kept as low as possible by using large chokes and several sections of filtering.

Another problem was the current rating of the 280 rectifier, which would have been exceeded with capacitor-input filtering. The choke-input configuration was therefore necessary, but this has the disadvantage of needing high power transformer HT voltages. In fact, the rectifier in a Majestic 90 has 1000 volts plate to plate. One works on a live chassis *very* carefully!

Finally there is the loudspeaker, a major factor in putting the Majestic receivers so far ahead of the competition. Weighing an impressive 6.8kg, the G3 'Colortura' model used in the 90B has a 210mm diameter cone (8"), made from fabric coated with sputtered zinc and with a cloth surround. There is no spider, but the cone is shaped to cover the end of





Left: A massive 90B chassis weighs 25.5kg, or exactly half a hundredweight. The five-gang tuning capacitor is in the long central shield box. Right: Access to inside the chassis is only gained by removing some 20 machine screws which attach the base plate. The four central shield cans house the RF amplifier stage tuning coils, with the aerial coil at lower right.

the centre pole piece and is positioned by a centring screw.

The speaker's field winding forms part of the voltage divider supplying the RF valves, and operates at about 50mA. It is wound with nearly seven kilometres of 36 SWG wire!

Logistics exercise

The smooth production by 11,000 people of 5000 complete radio receivers each working day — or one every 5.76 seconds — required considerable organising ability. William C. Grunow had been a captain in World War 1, and this experience must have been an advantage in controlling Majestic's 'army' of workers. Astronomic quantities of raw materials were required. For example, more than sufficient wire to encircle the Earth was used each day, while valves were needed at the rate of 5000 each hour.

There was no stockpiling. Contractors were expected to deliver a steady supply of materials, at the most only a few hours in advance of consumption — with serious consequences if there were any delays. There was a standing order for 30 railway boxcars each day, to take the finished receivers to the distributors — who had to accept their quotas regardless.

With the ruthless methods and meteoric rise in fortunes, the Majestic bubble had to burst. The depression, expensive fixed assets and inroads by firms like Philco put Grigsby-Grunow on the downward slide during 1931. By November 1933, they were in receivership and an asset sale was advertised in October 1934.

How does a 90B measure up today? Very well, although it demands a little skill in managing the aerial tuning. Reproduction that was impressive in 1930 is still quite acceptable, even if the high RF selectivity makes it sound a bit 'mellow'. The sensitivity is about the same as for the average five-valve superhet, but there is an impressive quietness in the background to weak signals.My 'living fossil', which I bought 15 years ago for only $25, still gets regular use. ❖

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SHORTWAVE LISTENING

by Arthur Cushen, MBE

Frustration in frequency allocation

The frustration at being unable to hear clear channels for shortwave broadcasters was emphasised at a recent meeting in Budapest, Hungary. Also, this month, there are details of the expansion in specialised programmes being broadcast by Radio Canada International, recovering from its budget cut in 1989.

According to Radio Nederland, 40 broadcasters attended a recent meeting in Budapest, Hungary. When they put their schedules on the table, they found that 1180 frequencies were incompatible — with two transmissions on the same frequency, while 214 stations were judged to be operating on the same channels, to the detriment of both transmisisions.

One of the reasons for such bad planning is that while most countries change frequency only twice a year in Europe and North America, when they move from standard to daylight time, some countries still persist in making seasonal changes four times a year. If this problem could be overcome, all stations would make frequency changes at the same time.

Similar problems were discussed at the World Administrative Radio Conference held recently at Malaga in Spain, as noted in a previous column. Now, further information has been received, following the close of that Conference, which was attended by more than 1400 delegates from 127 countries. The final acts of the Conference will come into force on October 12 1993, for AM broadcasting, but at a much later date for the use of SSB.

The United States filed several reservations concerning the final acts of the Conference. These included the statement that there were not adequate frequencies made available for the broadcasting services, particularly below 10MHz, despite an earnest effort to do so.

The broadcasters' requirements far outnumber the channels available — more spectrum is urgently needed between 6 - 11MHz. Planning will not work efficiently without additional frequencies being made available.

The United States stated it would take the necessary steps to meet the needs of its broadcasting service — that is, that it would disregard some of the decisions made at the Conference in Spain. It also said that it would take appropriate steps to counter jamming.

The full frequency allocations made for international broadcasting have been released, and the present and future band allocations are summarised in Table 1.

This gives a total additional allocation of 790kHz to international broadcasting — although it is obvious that many of these additional allocations had already been taken over by international broadcasters, before the actual authority was given.

Canada expands service

The budget cut that hit Radio Canada in 1989 meant that all English broadcasts especially designed for shortwave listeners were cancelled, and English programmes became a relay of the Domestic Service of the Canadian Broadcasting Corporation. Gradually this trend has been reversed, and specialised programmes for the External Service are now part of the schedule from Montreal.

As well as transmitting from Sackville, New Brunswick with its 250kW transmitters, RCI is also using the facilities of Austrian Radio, the BBC transmitters at Skelton (UK), Radio Japan at Yamata, Radio Beijing with two sites in China, transmitters of the Korean Broadcasting System, Sines in Portugal, and the Vertachtal relay in Germany.

With this extensive network of relay stations, Radio Canada has increased its output with weekly programmes in Russian

AROUND THE WORLD

BOUGAINVILLE: Radio Free Bougainville continues to be received on 3880kHz up to around 1100. The island is subject to a blockade from Papua New Guinea, but the broadcasts in Pidgin and English are still being received. The programmes are sponsored by International Amateur Radio Network, a group promoting amateur activity worldwide, in the field of conflict and emergency. This group should not be confused with the International Amateur Radio Union, which is the worldwide umbrella organisation for radio amateur countries.

ISRAEL: The latest schedule indicatesthat broadcasts in English are at 0400 - 0415 on 11,588kHz; 1000 - 1030 on 17,545kHz; and 1300 - 1325 on six frequencies including 15,650kHz, which is beamed to Australia (but not on Friday or Saturday).

LAOS: Broadcasts from Vientiane are heard through a relay on a Russian transmitter on 15,190 and 17,860kHz, with a broadcast in French from 1100. The English transmission is at 1330 - 1400 on 7113kHz.

LATVIA: Riga is heard at 0430 with a series of chimes and then a programme in Latvian, on the frequency of 5935kHz. The same frequency is used on Sundays for a broadcast in English at 0700 - 0730.

PHILIPPINES: FEBC Manila is now on 11,690kHz from its opening at 0900, in English, and has news at 0930. This offers fair reception with co-channel interference, while the other frequency 9800kHz, which carries the same programme, is often inaudible. Radio Veritas Asia has been heard opening at 2100 on 11,790kHz, when they commence a broadcast to Asia. At sign-on a complete schedule of all the many languages broadcast is given, with the transmission running through to 0230. After these details in English, the programme continues in Mandarin.

PORTUGAL: Radio Portugal, Lisbon provides fair reception during our afternoons. The full schedule of English programmes, which includes a DX session on Friday, is at 0230 - 0300 on 9555, 9600 and 11,840kHz; 1900 - 1930 on 11,740kHz; 2000 - 2030 on 15,250kHz; and 1530 - 1600 on 21,515kHz. All transmissions are Monday-Friday only.

VATICAN: Vatican Radio beamed to the South Pacific has added a new frequency 15,090kHz for English at 2245 - 2305. Two other frequencies, 9600 and 11,830kHz, have been in use for several months carrying this transmission.

[illegible]

TABLE 1 International Allocations		
Metre Band	Present Band	Expansion
49	5950 - 6200kHz	5900 - 6200kHz
41	7100 - 7300kHz	7100 - 7350kHz
31	9500 - 9775kHz	9400 - 9775kHz
25	11,700 - 11,975kHz	11,600 - 12,100kHz
22	13,600 - 13,800kHz	13,570 - 13,870kHz
19	15,100 - 15,450kHz	15,100 - 15,800kHz
16	17,700 - 17,900kHz	17,480 - 17,900kHz
—(New)	—	18,900 - 19,020kHz
13	21,450 - 21,750kHz	21,450 - 21,750kHz
11	25,600 - 26,100kHz	25,600 - 26,100kHz

and Ukrainian, which are carried on both their local networks — as well as a 15 minute daily Arabic programme on mediumwave, now relayed by Radio Monte Carlo, Cyprus.

The transmissions in English best received in the South Pacific are the Monday to Friday English News and features, from 0515 - 0600UTC on 6050, 6150, 7295, 9750, 11,775 and 17,840kHz.

During our morning listening, a transmission in English at 2100 is heard on 11,880, 15,150 and 17,820kHz, while at 2200 the frequencies 9755, 11,705, 11,905 and 13,670kHz are used. The transmissions continue up to 0100 on 9755kHz on a daily basis.

Radio Canada International has made an agreement with the Canadian International DX Group who are verifying reception reports on behalf of RCI; thus providing the manpower to confirm the letters from listeners received in the Montreal studios.

The mailing address is Radio Canada International, PO Box 6000, Montreal, Canada, H3C 3A8.

The headquarters of Radio Canada in Montreal, from which programmes originate to be carried by relay stations in seven countries.

Italian relay service

In 1987 a group gathered in Milan, Italy to organise a radio relay service which would carry programmes produced professionally by various organisations.

These independently produced cultural programmes would be carried on shortwave, with a potential audience in Europe of 50 million. A 10kW transmitter was purchased, and in November 1988 the Italian Radio Relay Service commenced operation.

The station broadcasts religious, informative and cultural programmes, on national and international levels, using the frequency of 7125kHz. While its initial test broadcasts were on 9815kHz, in recent weeks the above frequency change was made. Sign on is at 0500, earlier than the schedule which announces an 0600 sign on. This programme consist generally of popular music, but on some occasions from 0500 there is a transcribed American gospel programme.

The station uses USB (upper-sideband modulation) which allows much more power to be used in the actual modulation of the signal. In order to broadcast with a certain amount of 'punch' in the crowded international bands, the station has started to use analog and digital processing. The transmitter site is in the Po Valley just outside Milan, and uses 'L' shaped dipoles.

The main target area is Europe, North Africa and the Middle East.

The station's schedule is Monday to Friday 0500 - 0900, and at times 1000 - 1500; daily, 1930 - 2045; Saturday 0500 - 1000 and 1400 - 1600; Sunday 0500 - 1600. All broadcasts are on 7125kHz in the 41 metre band, but the station has alternative frequencies of 7105 and 9815kHz. Broadcasts are in English, Spanish, French, Russian and Polish.

The address of the Italian Radio Relay Service is PO Box 10980, I-20110, Milan, Italy. Return postage should be enclosed with your reception report.

Gospel services from Russia

The many transmitters lying idle in the former Soviet Union (which were previously used for jamming), are being taken over by various groups in the Moscow area and used for commercial programming. In Siberia two are being used for gospel broadcasts.

The Far East Broadcasting Company, which was established in Manila, Philippines on June 4, 1948, has extended its gospel service. Now more than four decades later, it operates transmitters in the Philippines, Korea, United States, Seychelles and Saipan. It covers two thirds of the world, and broadcasts in 100 languages. FEBC's latest venture is FEBC Russia, which broadcasts on 4060, 5965 and 9560kHz, with English at 0900 - 1030. But there is generally some interference from Swiss Radio International on one channel, while the other two channels have not been received at a readable level. Reports should be sent to FEBC Russia, PO Box 21-28, Khabarovsk, 20 680020, .Russia, or alternatively they could be sent to FEBC, PO Box 2041, Manila, Philippines.

Adventist World Radio, Russia, broadcasts in English on 11,855kHz from 1300-1400. At 1400 reference is made to the transmission from 0200 - 0500 and 1300 - 1700, while a further English broadcast is carried on 9835kHz, 1900 - 2000. Reports to AWR Russia can be sent to the studios in Guam of KSDA, PO Box 7500, Agat, Guam 96928. ❖

This item was contributed by Arthur Cushen, 212 Earn St. Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time.

Electronics Australia

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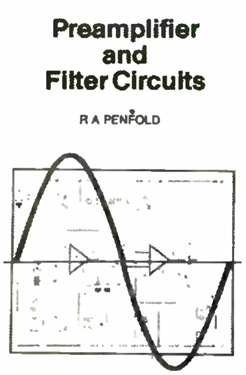

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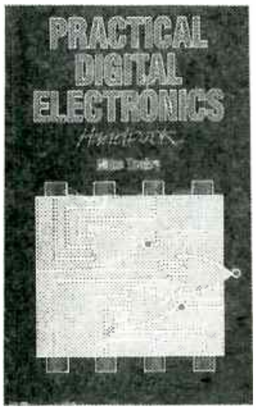

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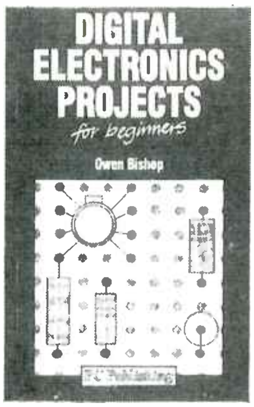

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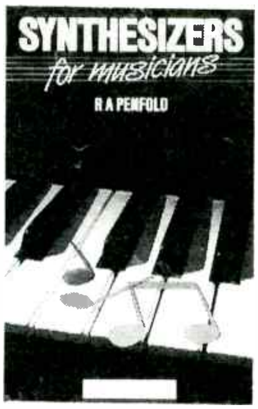

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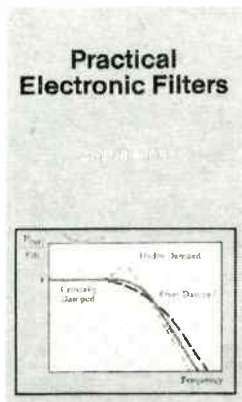

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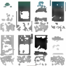

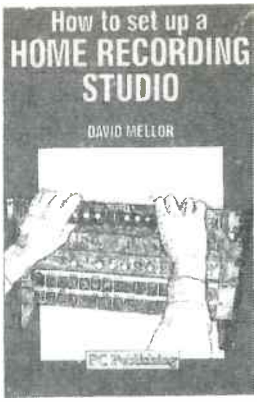

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If you have a studio at home or are about to set one up, this book is for you! It describes the setting up of an 8 to 16 track studio with an outline of the musical and recording gear needed.
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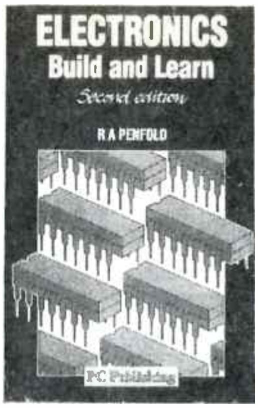

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This book is the perfect balance of theory & practice. It introduces common electronic components and how they are built into useful circuits. An essential for the beginner, providing practical tests and experiments.
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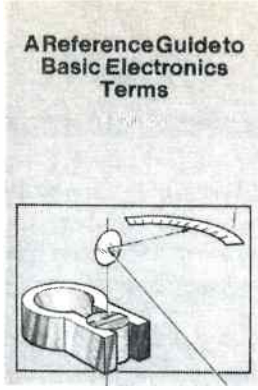

A Reference guide to Basic Electronic Terms
A comprehensive A to Z guide of electronic terms. This book chooses and explains some of the more important fundamental terms (over 700), making the explanations easy to understand and avoiding high level mathematics.
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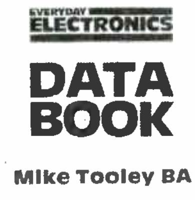

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This book is an invaluable source of information of everyday relevance in the world of electronics. A must for everyone involved on electronics who wants to put theory into practice.
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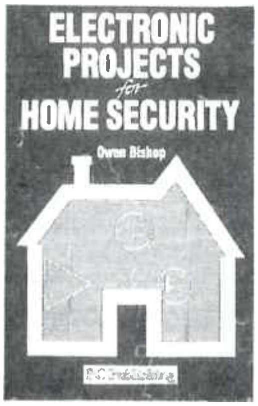

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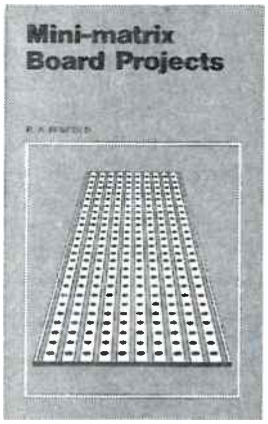

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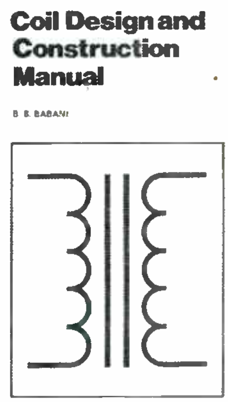

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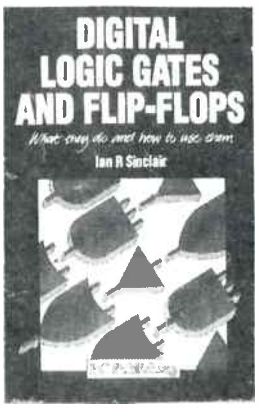

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This book takes the reader through the creative possibilities of the personal computer. Full of practical tips on equipment plus explonation of sequencing, sampling and notation.
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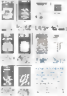


50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

August 1942

Locating bomb fragments: A 'magnetic finger' that locates tiny fragments of bombs and shells in the human body with uncanny accuracy is likely to be adopted for use by the Medical Corps of the armed forces.

The 'finger', which was invented by Samuel Berman, an engineer employed by the Independent Subway System, has been tested at the Post-Graduate Hospital. Pinhead fragments can be found at a depth of a quarter of an inch. When the 'finger' approaches hidden metal an indicator reacts.

Turn out your spare parts: There is no need to remind you that new component parts are now very scarce. In most lines we have reached the position where there are simply not enough to go around. More and more, we are being compelled to turn out our stock of spare parts in search of possible substitutes.

'Radio and Hobbies' makes it possible for enthusiasts to help one another by selling their accumulated collection of components. Charges for items in the 'Wanted to Buy, Sell or Exchange' column will be accepted at the rate of 9d per line for a minimum of three lines — making the minimum charge 2s 3d. You can count on six words to the line.

August 1967

Pyroelectric thermometers: A recent study investigated the feasibility of using pyroelectric materials as thermometer sensors to measure minute temperatures changes in the cryogenic region. Pyroelectric materials are asymmetrical crystals that become polarised by changes in temperature.

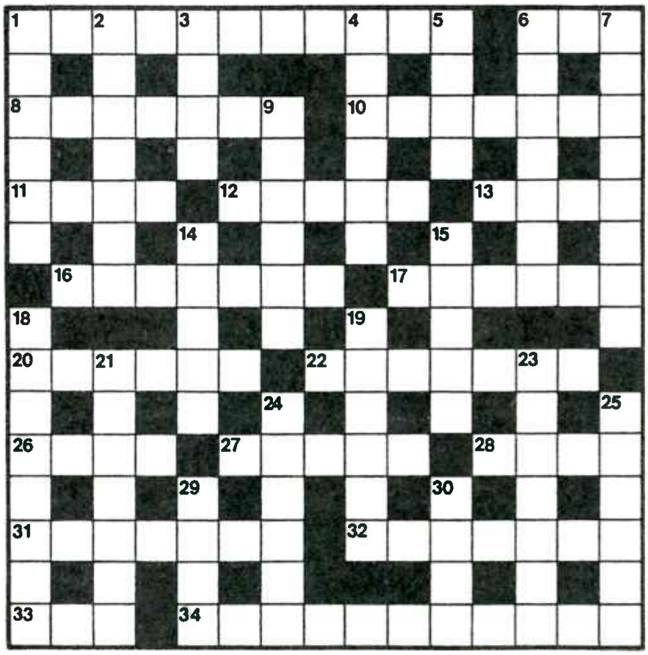
Pyroelectric crystals can be regarded as having a built-in electric polarisation. At constant temperature it is not evident. However, when the temperature of the crystal is raised a small amount, the magnitude of the polarisation changes. Conversely, if the temperature is lowered by the same amount, the absolute magnitude of the change in polarisation is the same, but the direction of the change is reversed.

Research has shown that a thermometer employing such materials as sensors would make possible the measurement of temperature differences smaller than one millionth of a degree, a limit now unobtainable.

Fuel cells in action: Fuel cells are being tested by US forces in Vietnam as a substitute for diesel generators to provide power for communications use. The cells offer silent, portable power for military use, but will not be competitive with internal combustion engines for many years.

Fuel cells, regarded by many as the possible source of power for automobiles in the future, convert the energy of a fuel, such as hydrogen, directly into electricity by chemical action. Thus, it dispenses with the intermediate stage requiring fuel to be burnt to power an engine. ❖

EA CROSSWORD



ACROSS

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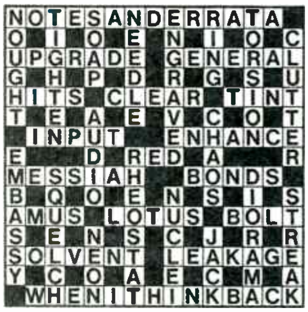
SOLUTION FOR JULY



EA with ETI marketplace

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Amateur Radio News

Albury-Wodonga field day

Twin Cities Radio and Electronic Club Inc., based in Albury/Wodonga, has sent details of its inaugural field day, which is to be held on Saturday 8th August between 1000 and 1630 hours (10am - 4.30pm).

The venue is Murray High School, on the corner of Kaitlers Road and Kemp Street in North Albury. The entry fee will be $4.00 per person, or $6.00 per family.

Activities planned for the field day include demonstrations and talks regarding amateur TV, packet radio, satellite communication and weather balloons. There will also be a radio 'fox hunt'.

Commercial equipment suppliers such as Yaesu, Kenwood, Icom, Stewart Electronics and Nally are also expected to provide displays and sales stands, while there will be plenty of room for swapping and selling used gear or components.

Hot and cold food and drinks will be available throughout the day. Visitors to the area will also be assisted via 'talk in' channels, via the Club's station VK3RNE. This will be operating on 147.000MHz and 146.500MHz (simplex) in the 2m band, and 439.425MHz in the 70cm band. VK2RAY will also be operating on 438.575MHz.

Further information is available from Greg Sargeant VK2EXA on (060) 21 1741 (BH only), or by joining into the Club's net on 3.560MHz each Thursday at 1000Z. The TCREC's mail address is PO Box 396, Albury 2640.

WIA accepts the term 'ham'

The term 'ham' has been widely used around the world to denote licensed radio amateurs, for many years. To our mind, it is a time-honoured term which carries with it a certain amount of endearment, and even respect for amateurs' technical knowledge and achievements. In America, the terms 'ham radio' and 'radio ham' are used with pride, as well they might be.

However for a long time, Australia's WIA and some of its more sensitive members have somehow seen the term as one of supposed denigration. As a result, whenever a magazine like *EA* has used it, we have usually been 'jumped on'.

Often there has been a suggestion that the 'only correct term' for radio amateurs is 'operator in the amateur radio communications service', or something equally long winded, pompous and off-putting.

The usual justification for such fancy terms is that the ITU classifies those segments of the spectrum allocated for use by amateurs, with similar terminology.

However this has always seemed something of a rationalisation, reflecting more a belief that amateur radio has an 'inferiority complex' and needs to call itself by a fancy name in order to gain society's respect. The fact that a high-falutin label tends to discourage young people from entering the hobby seemed to be forgotten.

Now, however, the WIA seems to have softened its stance. In a recent issue of *Amateur Radio*, an item by Bill Roper VK3ARZ notes that Federal Council has repealed its policy of actively discouraging the use of 'ham'. He hastens to note that this doesn't mean the WIA is actively advocating its use — just that it's OK for people to use it when describing a radio amateur.

After all those years, it's a start. Perhaps soon they might remember all of the important contributions made to radio and electronics over the years, by people who were happy to call themselves hams, and also be prepared to wear the name with pride.

A bit more loosening up won't hurt, fellas — when people start getting supersensitive about labels, it's often a sign that their activities have become moribund.

VK2RWI packet BBS upgrade

The NSW Division of the WIA has also advised that its packet radio BBS on VK2RWI is being upgraded to allow operation at 2400bps as well as 1200bps.

During the upgrading process there may be breaks in the service from time to time, but users are asked to be patient — the benefits of the upgrade will be well worth the minor hassles.

The satellite's FM repeater is enabled during the first four minutes of each 10-minute period — i.e., from 0000 to 0004, 0010 to 0014, and so on — with the remaining six minutes used for telemetry and data transmissions. ❖

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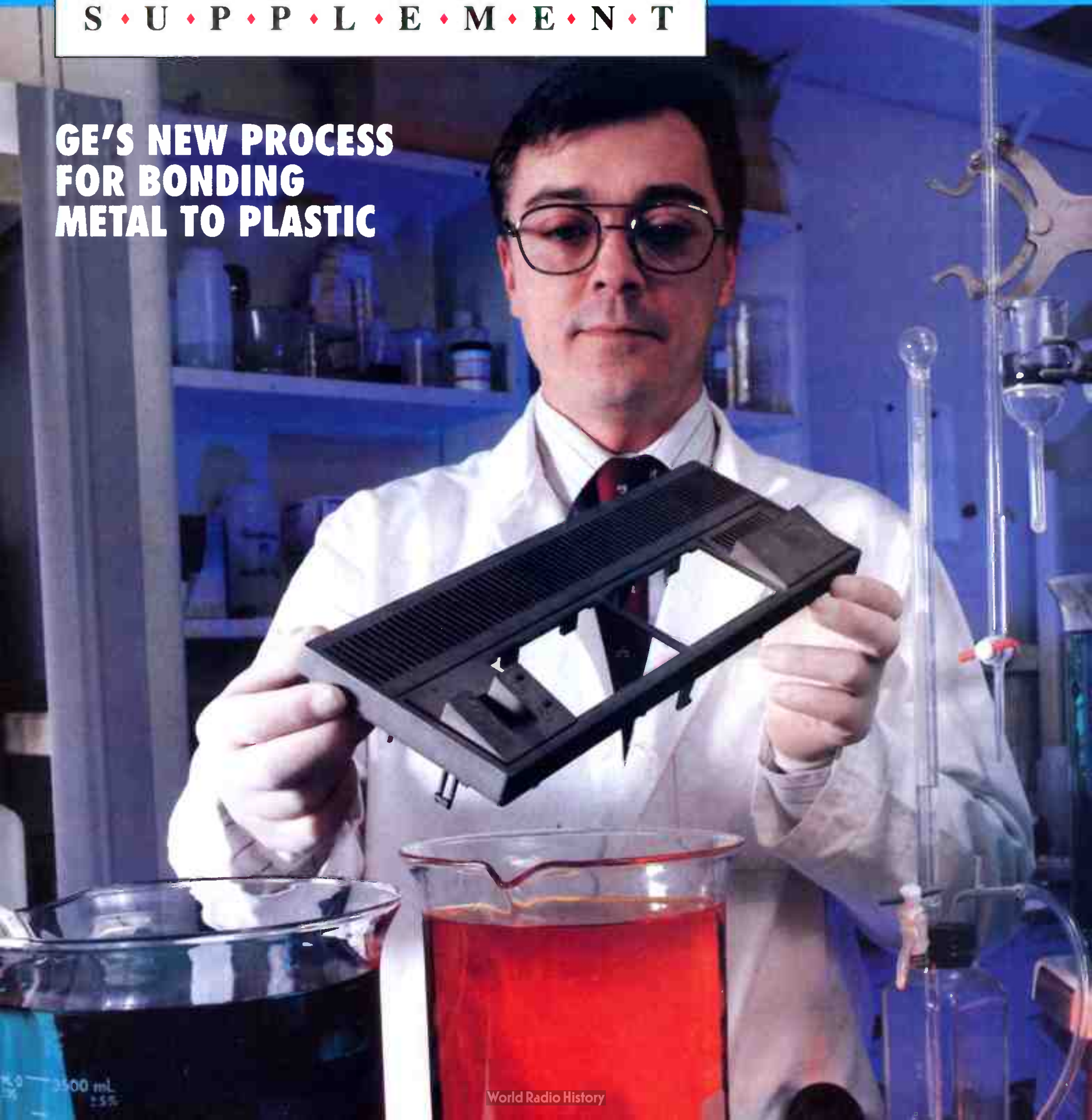


NEWS HIGHLIGHTS

SYRINX DESIGNS APPLE SPEECH CHIP

Australian speech technology R&D firm Syrinx Speech Systems, founded by Dr Clive Summerfield and Professor Trevor Cole in 1989, has delivered to Apple Computer its designs for new chips which implement powerful speech analysis algorithms. The chips are intended for use in future Apple systems, which will be able to respond to spoken commands.

Developed under a contract from Apple's R&D Group in Silicon Valley, the Syrinx chip designs implement an algorithm which models the human ear's cochlea.

Standard off-the-shelf chips were unable to provide the necessary capability to perform the algorithm in real time, but Syrinx was able to use its expertise and chip design methodologies to achieve a design which not only runs in real time, but squeezes two independent cochlea models on a single chip.

A paper describing the new chip design was presented at the 1992 International Conference on Acoustics, Speech and Signal Processing (ICASSP), held in San Francisco.

X-RAY SYSTEM USES PLAIN PAPER

Toshiba's R&D Centre in Japan has developed an X-ray imaging system which uses an electrophotography technique, similar to that in a photocopier, to produce images on plain paper rather than silver-halide film. The system produces finished images 10 seconds after exposure, making it very suitable for both medical and industrial applications.

In place of the photosensitive drum used in a copier, the system uses a flat aluminium plate with layers of fluorescent phosphor, a transparent electrode and an organic (phthalocyanine) photoconductor on its underside. During X-ray exposure the radiation penetrates both the subject and the aluminium plate, causing fluorescence of the phosphor layer. This causes a charge 'image' to develop on the surface of the photoconductor, and this in turn attracts toner particles. The charge is then transferred to the paper, and fused in the usual manner.

To achieve the system, Toshiba's R&D team had to develop a new kind of fluorescent layer, with greater sensitivity than existing types. They finally developed one based on a layer of Gd_2O_2S:Tb, only 200um thick. The transparent electrode covering this is of indium tin oxide, deposited using vacuum evaporation.

Thanks to the sensitivity achieved with the new fluorescent layer, the imaging system is roughly 10 times more sensitive than existing silver-halide film imagers. This makes it possible to use lower X-ray intensities, for the same image contrast ratio.

THAILAND BUYS UNSW VANADIUM BATTERY

Unisearch, the University of NSW's R&D/technology transfer company, has signed an option agreement with Thai Gypsum Products Co Ltd for development of the vanadium battery technology developed at UNSW, by a team led by Associate Professor Maria Skyllas-Kazacos of the university's School of Chemical Engineering and Industrial Chemistry.

In return for a major investment in the commercial development of the technology, Thai Gypsum will acquire a licence to make, market and develop the battery for end-user domestic applications in much of South-East Asia.

The UNSW battery has many technological advantages over other existing battery and electrical power storage systems. Among these advantages are that its storage capacity is governed only by the volume of vanadium electrolyte, so there is no limit to the capacity; the electrolyte contains only the one metallic element, so contamination is minimised; the electrolyte can be recycled indefinitely; and finally it is possible to 'recharge' a battery extremely rapidly, by replacing spent electrolyte with 'charged' electrolyte.

$40M CENTRE FOR PARRAMATTA

Telecom Australia has opened its newest and most advanced telecommunications centre, the $40 million, 10-storey Parramatta Communications Centre.

NSW Premier Nick Greiner, officially opened the new exchange facility, which will bring high tech telecommunications services to residents and businesses in Parramatta CBD and Sydney's West.

Frank Blount, AOTC Chief Executive Officer, said the centre was part of Telecom's major long term investment strategy. The company would spend $40 billion in the next five years to meet Australia's present and future telecommunications needs with the world's best and most advances services.

Mr Greiner tested new telecommunications technology at the centre, and made a phone call using a prototype videophone.

As part of a technology demonstration, Mr Greiner also remotely controlled a video camera located on the top of Telecom's Kent Exchange in the Sydney CBD.

MORE EXPORTS TO CHINA, JAPAN

Ericsson Australia has signed a long-term agreement to supply up to 300,000 telecomm lines to the province of Liaoning, in the north of the People's Republic

DSE ACQUIRES NZ'S DAVID REID CHAIN

Dick Smith Electronics' wholly owned subsidiary in New Zealand, Dick Smith Electronics NZ Ltd, has acquired the operations of David Reid Electronics Ltd, a long established company of 22 stores throughout New Zealand. The acquisition was timed for April 1st, 1992, subject to New Zealand Commerce Commission approval.

The merged operation will use the existing David Reid Electronics administration and warehousing complex in Auckland, and will be headed up by Rob Vincent, the General Manager of Dick Smith Electronics NZ Ltd.

Dick Smith Electronics currently has 65 stores throughout Australia, and the addition of the David Reid stores takes the total in New Zealand to 37. The combined company will have in excess of 1100 employees and will operate in every major centre in Australia and New Zealand.

of China. The project will modernise the province's rural telecomms network with digital technology, and is due to be completed in 1994. The province has 40 million inhabitants and is serviced by a network mostly based on Ericsson's AXE switching equipment.

The new Liaoning project follows Ericsson Australia's success in winning a $40 million contract from the city of Ningbo, on China's eastern seaboard.

That order, for 165,000 lines for metropolitan use, was recently completed on time. All equipment was manufactured at Ericsson Australia's plant in Victoria. The city of Ningbo has also placed an order with Ericsson for $2.4 million of Australian-manufactured exchange equipment.

In addition to these exports to China, Ericsson Australia has signed a contract with Tokyo Digital Phone to supply and install a cellular mobile system worth $140 million. The contract covers the initial phase of a network to provide a capacity for 150,000 subscribers, in the Tokyo metropolitan area. The network will operate in accordance with the Japanese Digital Cellular Standard, in the 1500MHz band, and will be operational in July 1994.

AUSPACE DELIVERS SATELLITE UNIT

Canberra firm Auspace have completed the task of building the Infrared Focal Plane Assembly (IRFPA), a part of the Along Track Scanning Radiometer destined to become part of the European earth observation satellite ERS2. The satellite is due to be launched by Ariane rocket in 1994, and will make detailed observations of the world's oceans.

The IRFPA is the detector section of the ATSR, and converts the weak light signals into an electronic signal. Auspace engineers were involved in the redesign of the IRFPA to get improved performance at low temperatures. Great care had to be taken to ensure that the optics were not contaminated by dust and other foreign substances, and the final assembly took place in Auspace's clean room. A special computer-controlled optical test configuration was developed to achieve final alignment and calibration.

The IRFPA hardware has now been sent to Rutherford Appleton Laboratory in the UK, where it will be integrated into the complete radiometer instrument.

FIRM MARKETS SOFTWARE GLOBALLY

Worldcorp, a company specialising in international marketing of computer products, has opened an office in Sydney. The company has other offices in Taiwan, USA and the UK, with further branches planned for New Zealand, South Africa, India, Canada, Japan, Germany, France and Scandinavia. Its headquarters are in Irvine, California.

As well as offering marketing assistance to dealers, distributors, developers and manufacturers for their domestic markets, Worldcorp offers clients access to extensive but inexpensive international marketing resources. There are four standard packages, starting with an Image Program costing US$500 per month and running up to the Launch Program, which includes full sales and marketing support and preparation of launch ads and press releases. This costs US$4500 per month.

Further details are available from Peter Klanberck at Worldcorp, 1A/91 Old Pittwater Road, Brookvale 2100; phone (02) 905 1937.

PCB, CABLE ASSEMBLY SERVICE

The NSW Department of Corrective Services operates an electronics workshop facility at Bathurst Gaol, and the facility is able to undertake assembly of both PC boards and computer data cables.

PCB assembly facilities include through-hole loading and full soldering, plus the ability to rework all types of PCBs — both through-hole and SMT. Data cables can be assembled using a wide variety of connectors, including subminiature D, Centronics, co-axial types (BNC/TNC/Twinax/Coax/Wang), modular telephone connectors, DIN types etc. IDC assembly of connectors and headers is available, also assembly using

The NSW TAFE's new $7 million Automated Manufacturing Technology Centre at Lidcombe (western Sydney) boasts a number of large computer controlled machines, like those shown here with Centre Manager Gary Holborow. As it happens, the machines are mounted on special 'hovercraft' bases which allow them to be moved around effortlessly when required, on a cushion of air.

Molex and faston connectors. The work can be computer tested, and provided with documentation.

Further information is available from David Baird, OIC Electronics Facilities, Bathurst Gaol, Browning Street, Bathurst 2795; phone (063) 31 1211.

YET ANOTHER VIRUS

Australia anti-virus expert Roger Riordan, of Cybec in Melbourne, advises that yet another virus has been discovered in the MS-DOS environment. The new nasty has been dubbed 'Troi Two', and is apparently related to the Troi virus reported in the UK in May.

According to advice from Cybec, the virus adds 512 bytes to .EXE files, containing the string 'TROI TWO'. It does not appear to contain a warhead, but can cause system crashes with Versions 3, 4 and 5 of DOS.

Cybec has updated its latest version of the anti-virus program VET, version 6.931, to detect and remove Troi Two. Further information is available from Cybec, PO Box 205, Hampton 3188; phone (03) 521 0655.

US PROJECT FOR VIDEO COMPRESSION

In a move expected to significantly advance television broadcast technology, two US companies have announced plans to install the first operational digital compression satellite delivery and insertion system for television advertising. The delivery and insertion system will be based on Scientific-Atlanta's vector quantisation (VQ) approach to compressed digital video (CDV), and is expected to be further developed for the delivery of syndicated and other programming.

Atlanta based Scientific-Atlanta will develop the new system for Chicago based Mediatech, which is the industry leader for advertisement duplication and distribution services in the United States.

Under the terms of a working arrangement between the two companies, Scientific-Atlanta will provide an end-to-end satellite digitally compressed advertising delivery, storage and insertion system designed to reduce time and costs for television advertising distribution while achieving significant improvements in video quality. The system is based on existing Scientific-Atlanta satellite transmission, conditional access and digital compression technologies, although certain aspects of the system remain to be finalised.

LAST INMARSAT-2 GOES INTO SERVICE

The first generation of commercial satellites purpose-built for global mobile communications became fully operational on Sunday, May 31, when Inmarsat-2 F4 took its first call.

The satellite, launched aboard an Ariane 4 rocket from Kourou in French Guiana, went into service in geostationary orbit over the Atlantic Ocean West region at 54° west longitude, an area that covers all of North and South America except Alaska, plus the western halves of Europe and Africa.

Inmarsat-2 F4 is the fourth and last of the second generation satellites operated by Inmarsat, the London-based 64 member international cooperative, which together cost more than US$600 million to build and launch.

Gene Jilg, director of Inmarsat's satellite programmes, said: "The in-orbit performance of the Inmarsat-2s has been successful by any standard. We have launched four spacecraft within 18 months and all are operating beautifully. We have every reason to expect that they will continue to supply superb mobile communications well into the first decade of the 21st century."

NASA HELPS IMPAIRED

A pair of computer driven glasses, derived from the space program, that can help millions of Americans afflicted with certain low vision problems, has been unveiled in Baltimore. The Low Vision Enhancement Project is a product of NASA's Technology Transfer Program in cooperation with NASA's John C. Stennis Space Center and the Johns Hopkins Wilmer Eye Institute.

Scientists from Stennis Space Center and the Wilmer Eye Institute used NASA technology developed for computer processing of satellite images, along with head mounted vision enhancement imaging systems originally generated for potential use on Space Station Freedom. This transfer of Technology will make it possible to improve the visual capability of low vision patients by appropriately enhancing and altering images to compensate for the patient's impaired eyesight.

"This is what we call an enabling technology. It will have an impact far beyond this one application," said Dr Doug Rickman, NASA's Low Vision Project Manager at Stennis Space Center's Science and Technology Laboratory.

The low vision enhancement system consists of a computer, an auxiliary camera and a pair of wrap-around video screens which are worn like eye glasses by the person suffering from a particular visual malady. The camera sends the image to a computer based system. The computer already programmed to correct for the visual problem of the individual,

NEWS BRIEFS

- Paul Delaney has been appointed ***Siemens'*** NSW Sales Manager for electronic components. He was previously national sales manager for Siemens' semiconductors.
- The ***National Electrical and Electronic Industry Training Committee*** recently honoured two of its loyal and long serving members. Fred Hall was made a life member of the committee, and Dick Brett received a plaque recognising his long service.
- Victorian-based rack manufacturer ***MFB Products***, has moved from its old Bayswater address to larger premises at 114 Lewis Road, Wantirna South 3152.
- ***VSI Promark Electronics*** has also moved its Adelaide and Perth offices to new locations, to provide more space. The new addresses are Unit 8, 27 College Road, Kent Town 5067; phone (08) 362 0944; and Unit 8, 5 Hasler Road, Osborne Park 6017; phone (09) 244 4044.
- The ***IREE*** will hold its ACOFT-17 '92 conference at the Wrest Point Hotel Casino in Hobart from Sunday, November 29th - Wednesday, December 2nd. It will deal with all facets of optical fibre and optical waveguide technologies. Original contributions are solicited. Address all correspondence the the Conference Secretary, ACOFT-17 '92, IREE Head Office, PO Box 79, Edgecliff 2027; or phone (02) 327 4822.
- Mr John Magee has been appointed as General Manager for the ***Vicom*** group of companies. He was previously MD of Motorola Australia and also MD of Terumo.
- Graham Darley has joined ***Stanlite Electronics*** of Lidcombe, Sydney, as senior executive for business development in civil telecommunications.
- Hewlett-Packard has announced that it has acquired the Santa Clara, California-based ***Avantek***, a maker of microwave semiconductors, components and assemblies.
- The new General Manager of ***Philips Components*** is Geoff Billingsley, replacing Bill McCormick who has retired after 37 years with the company.

manipulates the images and sends them back to the patient. They are displayed on small video screens which have roughly the same field of view as eyeglasses. "But instead of looking through ground glass, you'll be looking through a computer." said Rickman.

VUT STUDENT WINS IREE PRIZE

Stephen Curtolo, a graduate of the Department of Electrical and Electronic Engineering at Victoria University of Technology, has won the prestigious 1992 Student Prize sponsored by the Institution of Radio and Electronics Engineers Australia, for a device he developed which allows a mobile amateur radio to be used like a mobile telephone.

Mr Greg Martin, Lecturer in Electronic and Electrical Engineering at Victoria University of Technology, said Mr Curtolo's project, entitled 'Microprocessor Controlled Amateur Radio Telephone Patching System' combined an excellent mix of hardware and software design.

"The design takes advantage of recent deregulation of the telephone network to produce a new device which connects an amateur radio base station to the switched telephone network," Mr Martin said. "This allows a mobile amateur radio to be used like a mobile phone, to receive and make telephone calls, all for the cost of a local call."

Mr Curtolo's success was the third consecutive year in which a student from Victoria University of Technology has won the IREE prize.

He competed against finalists representing Monash Clayton, Monash Caulfield and RMIT in the IREE competition, which involves giving a 15-minute overview of the student's final year project, followed by answering questions from the audience.

WORLD STANDARDS ON CD-ROM

ILI of the UK has developed and produced 'Standards Infodisk' — a CD-ROM containing full details on 180,000 worldwide standards, from a wide range of bodies like ASTM, IEEE, ASME, BSI, API, DIN and even Standards Australia.

Users can find all the standards that relate to any chosen subject, or they can search for specific details on a known standard, or they can examine standards referenced in other standards — in fact, almost any way they like to find out almost all they ever wanted to know about standards.

Scientists at the General Electric R&D Centre in Schenectady, New York, have developed an improved process for nickel-plating high strength LEXAN polycarbonate resin plastic. GE's team leader Kenneth P. Zarnoch, displays a plastic component after it has been 'metallised'.

The quarterly updated disc is available in Australia from ACEL Information and so is more information about it. Phone ACEL Information in Sydney on (02) 922 6088 or Melbourne on (03) 826 6099.

2000TH INMARSAT-C TO AUST VESSEL

Australia's largest supply vessel, the *Lady Dawn*, which services the offshore oil and gas industry, has become the 2000th maritime Inmarsat-C customer with services provided by OTC Maritime.

Inmarsat is an international cooperative that provides two-way direct dial mobile satellite telephone, telex, facsimile and data services to ships, land transportables and aircraft stations worldwide. OTC is a founding member of Inmarsat, and represents Australia on its Governing Council.

Captain Ian Kerr, the Operations Manager of Australian Offshore Services (AOS), a division of P&O Maritime Services which owns the *Lady Dawn*, said the company will use Inmarsat-C to enhance communications between the vessel and the Melbourne head office.

"Four of AOS's vessels now have Inmarsat-C terminals to provide an improved and more comprehensive service than radio communications," Captain Kerr said.

RAMTRON WINS MORE SEMICONDUCTOR PATENTS

Australian-owned semiconductor maker, Ramtron International Corportion has been granted six fundamental semiconductor memory patents by the US Patent and Trademark Office.

The patents contain 136 claims covering the use of Ferroelectricmaterial in a broad range of nonvolatile semiconductor products, and methods of manufacturing high-density CMOS dynamic random access memory (DRAM) products.

The patents granted Ramtron during the last 12 month period include: #5,109,357 - 'Charge Magnified DRAM Cell'; #5,104,822 - 'Method for Creating Non-Patterned Contacts and Stacked Capacitors'; #5,075,817 - 'Trench Capacitor for Large Scale Integrated Memory'; #5,043,790 'Self Aligned Contacts Using Two Nitrides Process'; #5,024,964 'Method of Making Ferroelectric Memory Devices'; and #5,005,102 - 'Multilayer Electrodes for Integrated Circuit Capacitor'.

The recently awarded patents have increased Ramtron's portfolio of issued US and international patents to 32, with an additional 75 patents filed in the US, Europe and Japan. ❖

An experimental thermal oscillator

While crystal, ceramic resonator, LC and RC oscillators have received their fair share of attention in electronics literature, there is very little to be found on oscillators based on thermal time constants. This article presents the design for such a device, and will hopefully dispel the common misconception of thermal systems as being power hungry and very slow.

by DONALD KAY

My endeavour to design and assess an oscillator based on thermal time constants came about from the need to produce a physics paper. The topic had to be a little out of the mainstream, if it was to be interesting, and be 'new work'. So I nominated the topic and then set about the design.

Immediate thoughts turn to car 'turn indicator' flasher units. These are usually a simple two-pin device that connects in series with the indicator lamps, to produce the flashing. The conventional type consists of a heater element and a bimetal strip. The bimetal strip makes a switch that switches off the current through the heater when it gets to a certain temperature.

The strip then cools until the switch changes state again, and switches the heater back on. The devices consume a substantial amount of power, but as this is small compared to the power consumed by the lights this doesn't bother the automotive engineer.

The concept of having a sensor heating and cooling between two trip points is a simple one, but has some real disadvantages. Firstly the lower trip point must be higher than the highest ambient temperature (excluding refrigeration systems). Secondly if the period is not going to be greatly effected by the ambient temperature, the trip points must be very much higher so that variations in ambient temperature represent only a small part of the operating temperature.

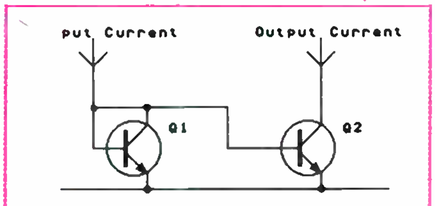


Fig.1

High temperatures imply either large amounts of power, or very low thermal mass. There is of course a better way. As rates of heating and cooling are related to the temperature of the surroundings, then the trip points should be in terms of this temperature. So we heat and cool between two trip temperatures just above the ambient temperature, and as the ambient temperature changes so do the two trip points. In this way we have removed the fundamental temperature coefficient and the need to run at high temperatures.

The idea is simple enough, and I set about it in a very direct but clumsy way with two temperature sensors. One of the sensors had a resistor heat-shrunk to it as a heater. And sure, it worked — but it lacked elegance.

Rather than absolute temperature sensors I should have been using temperature comparators. This thought led to the idea of using the traditional semiconductor 'current mirror' circuit (Fig.1).

A current mirror

Current mirrors are widely used in the biasing of analog bipolar ICs. The circuit has an input to which a current is applied. A very similar current is produced at the output, regardless of the output voltage.

This assumes that the transistors are identical and that they are at the same temperature. If their temperatures vary

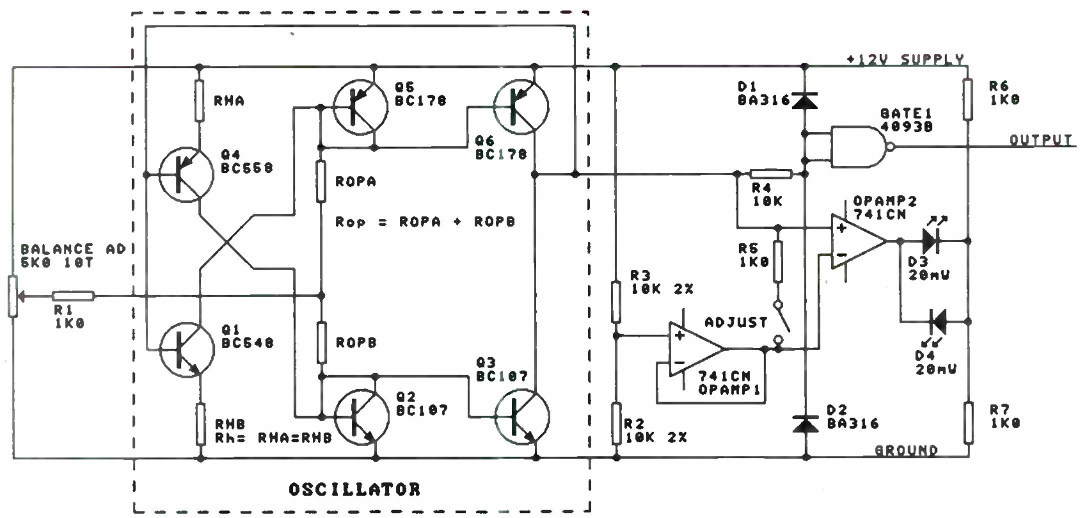


Fig.2

[illegible]

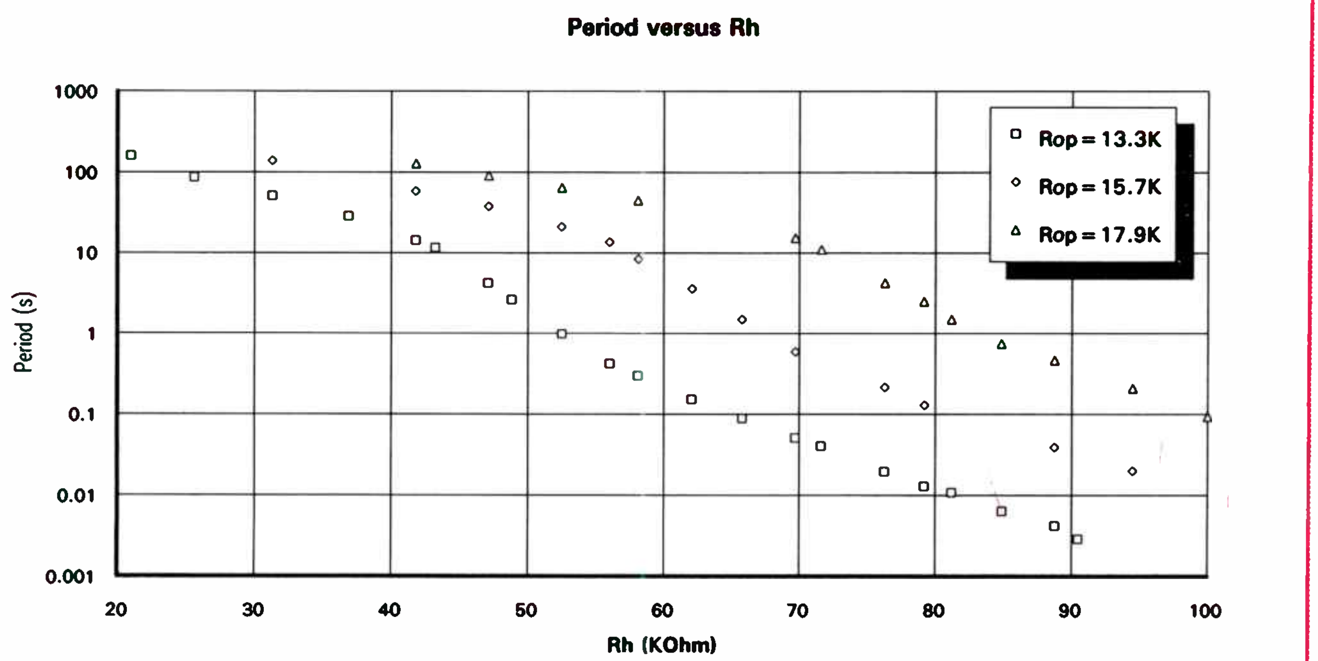


Fig.3

even slightly, the current ratio changes significantly. For two BC547's with 1mA going in and the second transistor only one degree C warmer, the output current is about 1.07mA or 7% higher.

Current mirrors are many times more sensitive to *differences* in temperature between transistors than they are to the *absolute* temperature of the transistors. This feature alone makes them desirable to use in our oscillator, but they have another nice feature.

As the temperature difference appears as a current output not greatly effected by the collector volts, we can alter the collector volts without directly changing the output. However as the power changes with the voltage, the self-heating of the transistor changes. So now we have a temperature comparator *and* a controllable heater, all in one.

The circuit

In thinking about how to establish a trip point from the current variation and control the collector volts, I toyed with the idea of an NPN mirror connected directly against a PNP mirror — and it all just fell together. The circuit is shown in Fig.2.

So how does it work? Let's start by looking at the biasing current path provided by Q2, ROPB, ROPA and Q5. The current through this path will cause the voltage across Q2 and Q5 to be just that required to produce the same current on the collectors of Q3 and Q6 respectively, assuming all the transistors are at the same temperature.

Q2 and Q5 will be at the same temperature, as they have the same current and voltage across them. They form the thermal reference point for the oscillator.

Let's assume the output at the collectors of Q3 and Q6 is low. In this state, because of the feedback path, Q1 is completely off and Q4 is injecting an additional current determined by RHA into Q2 (This current is a fraction of the bias current). The extra current into Q2 means Q3 can sink more than Q6 can source, thus ensuring the output stays low. Not for long, though. Q3 and Q6 may have the same current through them, but Q6 has the full supply voltage across it and as a result is going to warm up much more than Q3. As it warms up, it can source more and more current for the same base emitter voltage — until finally it can source an extra amount equal to the extra current introduced by Q4 via Q2.

With Q6 being able to source more than

Current mirrors as temperature comparators

Unless you are in the business of designing ICs, you may be forgiven for not being familiar with current mirrors. These circuits produce an output current that is some fixed ratio (determined by transistor design) of the input current, regardless of the output volts.

The circuits are simple and lend themselves to having multiple outputs. As a result many analog ICs establish a single reference current and put this into a series of mirrors, which gives the IC designer the bias currents he wants — all with values that are fixed ratios of the initial current. Remember transistors are easier to cope with in ICs than resistors, and in doing this we can determine the biasing throughout an IC with only one resistor.

The simplest mirror consists of a diode-connected transistor providing a base voltage to an output transistor, as shown in Fig.1. If the transistors are equal and we ignore the base currents, then the voltage across the diode-connected transistor is exactly that required by the base-emitter junction of the second transistor to produce the same current. (The collector current of a transistor is a function of the base-emitter voltage.)

When the temperature of a transistor is increased, it is said that the base-emitter voltage is reduced. Another way of looking at this is that it can supply more current, for the same base emitter voltage. Hence if the output transistor is hotter than the diode connected transistor, the output current will be higher also.

If we take a fairly classical DC transistor model, and work out the voltage on the input transistor and the current this will cause in the second transistor, we find the relations between temperature difference and current difference are:

$Td = -T.Id/(I.\ln(I/A))$

and

$Id = -I.Td.\ln(I/A)/T$,

Where Td is the difference in temperature, Id is the difference in current, T is the absolute temperature, I is the current and A is a constant according to the transistor. Typically A is of the order of a million for small silicon devices.

The formulas assume that Td and Id are small compared to T and I themselves. The second formula shows us that if the difference in temperature of the two transistors is 1°C (= 1K also) and the absolute temperature is 300K (27°C), then the difference in current from input to output is 300 times more sensitive to *differences* in temperature than to the actual temperature.

Experimental thermal oscillator

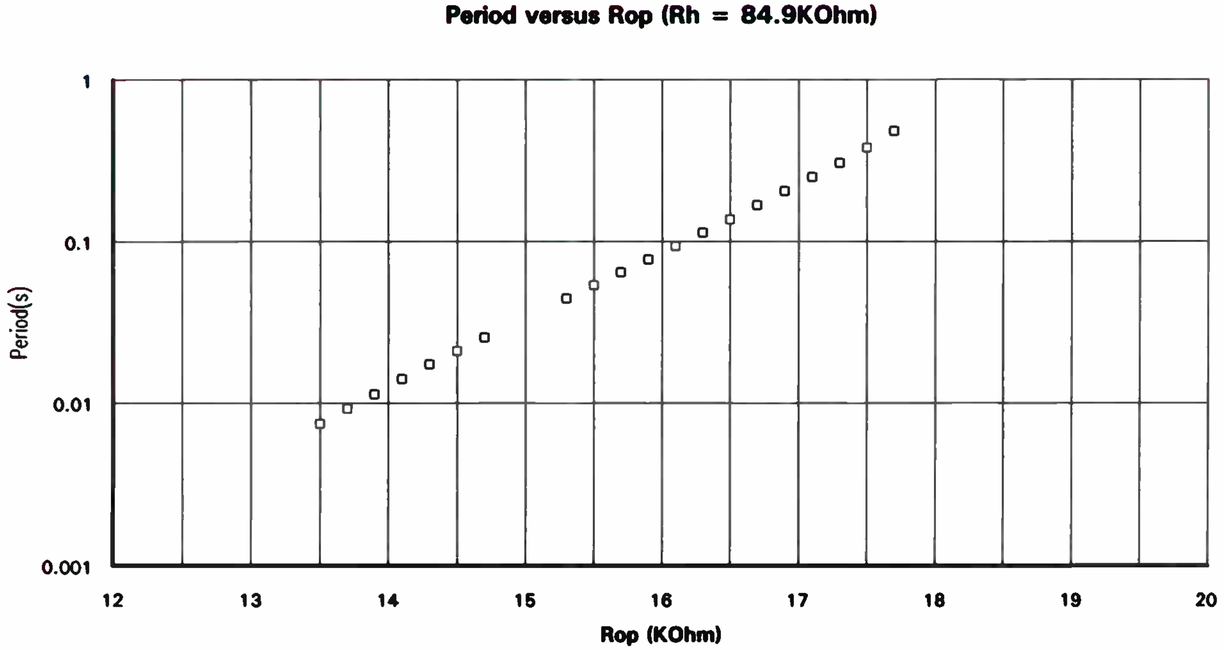


Fig.4

Q3 can sink, the voltage at the collectors of Q3 and Q6 will rise. As soon as this starts to happen the additional current introduced by Q4 is reduced. As this is happening, Q1 is starting to introduce an additional current into Q5, enabling Q6 to source even more current. The output soon snaps from low to high.

With the output in the high state, Q3 has the greater voltage across it; so it will now be warming up while Q6 is cooling. Q3 will continue to warm up until it can sink more current than Q6 can source. At this point the output will start to fall. Q1 will be switching off while Q4 is switching back on, and the output will snap back to the low state — which is where we started our explanation.

How it performs

So how does it go in practice, and how long does it take for these temperature changes to occur? I built the circuit shown with Q2, Q3, Q5 and Q6 off the circuit board and in a separate aluminium box. I made the interconnects between them with thin wire-wrap wire, to reduce thermal conduction and separated the devices by 15mm in every direction.

I also included a balance adjustment circuit as shown, to adjust out any mismatch between the transistors and the resistors RHA and RHB. With the switch closed the output was forced to half supply rail. The idea being that Q3 and Q6 have the same voltage across them and hence warm up equally. If one transistor wanted to draw more than the other, a current and hence a voltage would appear across R5. The polarity of this error voltage determines which of the two LEDs will be on. The control was adjusted until the LEDs were at the changeover point. The adjustment was done very slowly, allowing the transistor temperatures to resettle each time.

In retrospect this whole arrangement probably wasn't necessary, as the control stayed smack in the middle under each new operating condition.

With the adjust switch open, the LEDs indicate the output state. The impedance at the collectors of Q5 and Q6 is very high and hence the NAND gate is used as a buffer before connecting to a timer.

The two graphs of Figs.3 and 4 show how the period changed with Rh and Rop respectively. With Rop at 17.9k the actual oscillator is drawing about 1.3mA. With Rh at the same time being 100k, the additional current being injected is 110uA. This corresponds to a temperature change of about 5°C before the oscillator changes state. This happened twice in the 100ms period. So with moderately small amounts of power, things are happening at reasonable rates.

The shortest period that I recorded (and I've no reason to believe it shouldn't run faster) was 2.9ms, with Rop = 13.3k (less than 2mA) and Rh = 90.5k (about 1.5°C variation). This corresponds to a frequency of just on 350Hz. The circuit didn't perform well with time constants much over two minutes.

I'll be quite honest: what the graphs don't show is how the period changed from minute to minute. Three consecutive periods could vary by as much as 2% for long periods, and typically by 0.3% at any period.

Practical uses

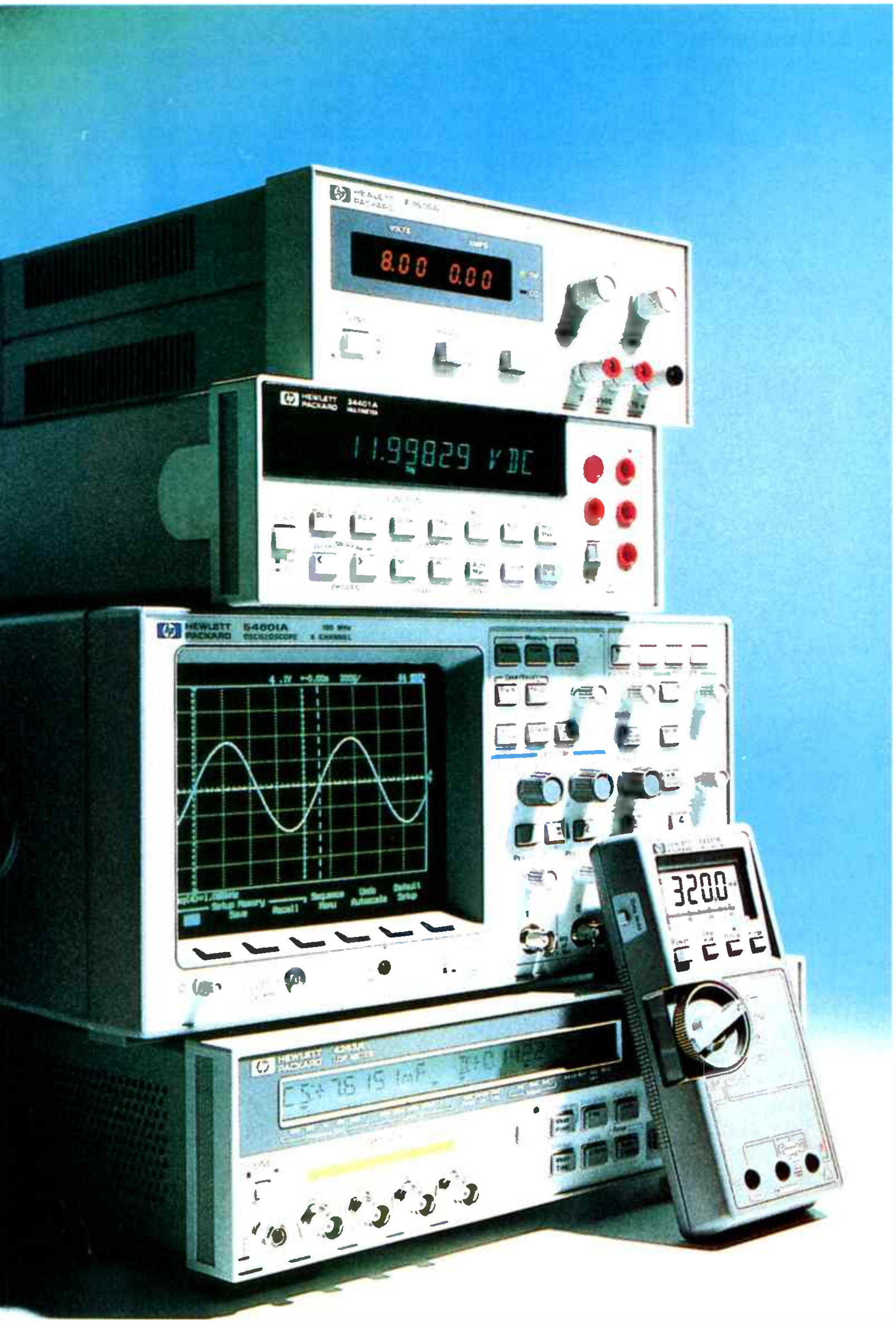
As for actual application in the real commercial world, there is only one glimmer I can see. Thermal oscillators of a similar sort, but rather working on the time it takes for a thermal wave to propagate, may find application in monolithic ICs. When the absolute tolerance on resistors in ICs is about 10%, and capacitors are poor and expensive in terms of space, it is hard to produce on chip oscillators with built in time constants that are at all accurate.

The arrangement of two current mirrors in Fig.2 may be useful for measuring air flow, or wind speed. As air flow carries away heat, the output transistors will not rise in temperature as much as they normally would. There should be many potential applications for this in the air-conditioning industry. ❖

About the author

Donald Kay has several years' experience in designing industrial and scientific systems. He now operates his own business in Adelaide, designing and supplying custom electronics equipment for industrial and professional clients.

Mr Kay can be contacted at Don Alan Electronics, PO Box 404, Brooklyn Park 5032; phone (08) 43 3957.



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Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Serial-parallel link

The CY233 LINC (Local Intelligent Network Controller) from Cybernetic Micro Systems provides a general mechanism for passing data between a serial network or computer port and local parallel devices, at a very low cost.

It operates in one of three modes. The most complex is LAN mode, which connects multiple serial devices into a network. Features include ring or bus network capability, selectable token support, half or full duplex operation. It supports 255 encoded and eight decoded addresses.

But the device can also be used in its simple mode, to connect any serial device, such as an RS232 port, to any parallel device. The host computer is also able to control multiple parallel devices or special parallel hardware.

The chip is a single 5V 40-pin device, with baud rates from 300 to 57,600 and a powerful expanded command set. Compared to LON technology, the CY233 LINC chip is claimed to offer a simple and effective alternative, at a fraction of the cost and with no licences or royalties required.

For further information circle 273 on the reader service coupon or contact Baltec Systems 26 Mayneview Street, Milton 4064; phone (07) 369 5900.

Integrated ADPCM codec

Motorola has released samples of its MC145540 ADPCM Codec, a mixed signal processing device from the MOS Digital-Analog IC Division which is particularly well-suited for digital cordless telephone applications — because of its wide operating voltage range, low power dissipation and feature set.

The MC145540 encodes analog speech signals to digital Adaptive Differential Pulse Code Modulation (ADPCM) at bit rates of 32, 24 or 16kbps, or Pulse Code Modulation (PCM) at 64kbps, and simultaneously decodes digital code back to analog speech signals. Additional applications include digital multiplexers, pair gain systems, and other communications equipment requiring low bit rate digitised speech.

The CMOS mixed signal processing 145540 ADPCM codec combines the relative advantages of analog and digital signal processing circuit techniques to provide a powerful, efficient system solution for applications requiring the digitisation and bit rate compression of speech signals. It meets the 32kbps ADPCM conformance requirements of CCITT Recommendation G.721 and the equivalent ANSI T1.301. This speech coding standard has been adopted for digital cordless telephone systems in Europe, Japan, Asia and North America.

Several circuit design innovations enable the device to operate over a wide power supply voltage range of 2.7 to 5.25 volts, while typically dissipating only 65mW at three volts. As a result, it's suitable for battery powered as well as AC powered applications. A serial control port provides microcomputer access to internal control and status registers.

For further information circle 272 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711.

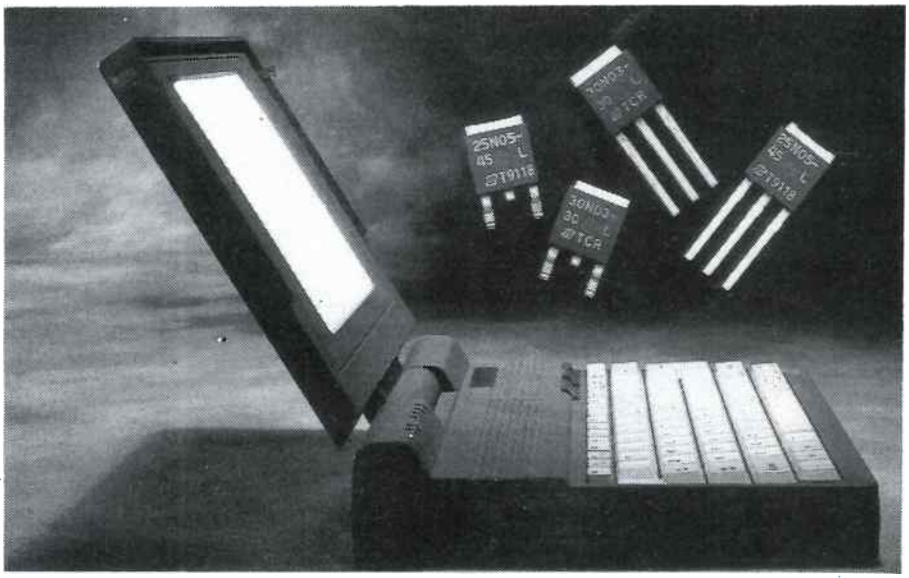
Low-Ron DPAK MOSFETs

Siliconix has released the SMD30N03-30L and the SMD25N05-45L — low on-resistance, logic-level, N-channel power MOSFETs in a DPAK package. The SMD30N03-30L is rated at 30V, with an on-resistance of 30 milliohms, while the SMD25N05-45L is a 50V MOSFET, rated at 45 milliohms. They are both very suitable for portable computer power systems.

The SMD30N03-30L can be used to replace Schottky diodes on the secondary side of power converters in a synchronous rectifier configuration. Using it can improve efficiency by 8% over Schottky diodes.

The SMD25N05-45L was designed for use as a switching transistor with the Si9112 PWM controller. Its logic-level specification is important for portable computer applications because the maximum gate-source voltage on the device will be the battery voltage — usually about 7.2V nominal, instead of the 10V at which MOSFETs are generally specified.

For further information circle 271 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766.



Micros with more RAM

Siemens' new 8051 compatible SAB 80C515A and SAB 80C517A microcontrollers offer respectively 1.25Kb and 2.25Kb of on-chip RAM. The firm claims that no other microcontroller of this type has as much integrated memory.

In addition, a 32Kb program memory has been integrated in the corresponding ROM versions, SAB 83C515A-5 and SAB 83C517A-5. For many applications this means a significant reduction in ex-

ternal components, enabling genuine single-chip solutions and thereby markedly lowering system costs.

The new members of the Siemens 8051 family use a maximum clock frequency of 18MHz, which increases CPU performance by 50%. In the SAB 80C517A, fast computation is supported by the integrated 32-bit multiply-divide unit (for example, division of two 32-bit/16-bit operands in 4us) and by the eight data pointers.

Both microcontrollers are equipped with integrated peripheral modules and 16-bit wide timers are incorporated for digital signal generation.

A new hardware power down (HWPD) mode is entered and exited, depending on the voltage present at a specific pin. In HWPD mode, the ports go to the tristate condition in order to reduce power consumption even further.

For further information circle 274 on the reader service card or contact Siemens Advanced Information Products, 544 Church Street, Richmond 3121; phone (03) 420 7345.

Three way graphics controller

Cirrus Logic has introduced the CL-GD6420, a single-chip graphics controller that gives notebook computer users three ways to display information. The chip allows high quality VGA-level (640 x 480

pixel) graphics on a notebook LCD, this same VGA-level graphics displayed on the LCD and an external CRT simultaneously, and Super VGA-level (up to 1024 x 768 pixel) graphics on an external high resolution CRT alone.

For the smallest sub system form factor, Cirrus Logic has integrated into the chip virtually all of the functions that must be performed by an LCD VGA controller, including host bus interface logic, LCD panel interface buffering, full LCD panel power sequencing logic, and a complete RAMDAC. An entire graphics control subsystem can occupy less than four square inches, making it ideal for high end notebook computer motherboard designs.

The CL-GD6420 offers a 'scaleable video memory' capability that lets it support up to 1MB of video memory in the form of two, four or eight 256K x four DRAMs. So pending on market focus, a manufacturer can match cost and performance levels to specific market segments. The flexibility of this design also makes upgrading easy.

In addition to producing 64 shades of gray on a monochrome LCD, the CL-GD6420 can directly drive a 512 colour active matrix LCD panel. The chip expands the basic colour selection possiblities of the panel from 512 colours to 185,000 colours of which — in accordance with the VGA standard — 256 can be simultaneously displayed.

For further information circle 275 on the reader service coupon or contact Alpha Kilo Services, PO Box 180, Lane Cove 2066; phone (02) 428 3122.

Isolated EIA-485 interface

The Newport NM485D is an electrically isolated dual differential driver and receiver, which offers an integrated design solution for minimising noise levels and maximising space availability on the PCB, thanks to its low profile 24-pin DIL 0.6" package.

A single +5V input supply powers all the functions either side of the isolation boundary within the NM485D, which requires no external components. Designed for balanced multipoint bus transmission at rates of up to 10Mb per second, the device provides two receive channels and two driver channels, which both have an active low enable.

The driver outputs provide limiting for positive and negative currents, and thermal shutdown has been designed in as protection against line fault conditions on the transmission bus lines. The isolation voltage between input and output is 1000V RMS and the operating temperature range is 0°C to 70°C.

Op-amp swings rail to rail

Maxim's new MAX407 micropower dual operational amplifiers offers more than a 15x reduction in supply current over industry standard micropower op-amps as well as an output voltage that swings to both supply rails. Supply current is less than 1.2uA per amplifier, which means that operating life is often limited only by a battery's shelf life.

In low voltage, battery-powered applications, an op-amp's ability to operate with a wide dynamic range from a single supply voltage as low as 3V is critical. The MAX407 operates from a single +2.5V to +10V supply, or a dual supply ranging from +/-1.75V to +/-5V. And the outputs swing rail-to-rail, while the input range extends from the negative supply rail to within 1.2V of the positive supply.

Unlike any other CMOS amplifiers, linearity is maintained under heavy load conditions due to a design technique that optimises output drive at low supply current. The MAX407 is extremely stable without external compensation while driving heavy loads in excess of 1000pF, and is capable of sourcing as much as 2mA (2000 times its supply current). An input bias current of less than 0.1pA makes it ideal for high source impedance applications such as pH probes, thermocouples and thermistor signal conditioning.

For further information circle 276 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

Very bright amber LEDs

Toshiba is to begin marketing an amber light emitting diode (LED) that can replace energy-consuming tungsten lamps in outdoor use in daylight. Claimed to be the first mass produced bright amber LEDs, the new devices are suitable for advertising displays, highway information displays and traffic signals.

Incorporating an Indium-gallium-aluminium-phosphide (InGaAlP) active layer in a new chip structure, the TLYA190P amber LED achieves a luminosity of six candela at a wavelength of 590 nanometres.

The substrate on which LEDs are mounted absorbs light emissions and decreases brightness. In Toshiba's new structure, a reflector consisting of a multi-layer semiconductor is installed above the substrate, cutting this light loss. The output of the new LED is 10 times as bright as the company's current amber-coloured device. ❖

NEW PRODUCTS

Portable PCM testing kit

The new portable test kit PMK-30 from Wandel & Goltermann provides an ideal combination of analog and digital instruments for making a range of essential measurements on circuits, multiplexers, switches and cross-connects up to 2Mbit/s, in PCM, data, GSM and ISDN networks.

The instruments are battery powered, and housed in a carrying case to make an economical lightweight solution for field testing applications. The case also has provision for an optional printer. The kit makes A-D, D-A and D-D measurements, both in-service and out-of-service. It has a comprehensive range of digital interfaces: G.703 co-directional, G.703 (HDB3AMI), V.24/RS232C and V.11/X.24 are all built-in. V.35 and V.36/RS449 interfaces are also available via optional cable adaptors.

For further information circle 244 on the reader service coupon or contact Wandel & Goltermann, 42 Clarendon Street, South Melbourne 3205; phone (03) 690 6700.

Cordless phones

Panasonic is launching cordless phones which ensure that conversations are as loud and clear as they are on regular telephones. To achieve such clarity, Panasonic has adapted technology that is used extensively in hi-fi audio equipment. Known as Dynamic Sound Focus (DSF), it filters out buzzing noises and boosts the voice signal to provide crisp, clear sound.

Top of the range model KX-T3836BA, in addition to being cordless, features a speaker phone on the base station, and can store up to nine telephone numbers for abbreviated dialling.

Its intercom facility is another handy feature, as are redial, recall and mute buttons. Also, the KX-T3836BA is configured to make use of relatively new Telecom services such as call waiting.

For further information circle 242 on the reader service coupon or contact Panasonic Australia, 1 Garigal Road, Belrose 2085; phone (02) 986 7629.

Fibre optic stripper

A small lightweight, low cost hand tool is now available for stripping buffer/cladding from fibre optic conductors, with consistent accuracy and reliability.

These tools have spring-loaded, self-centering jaws to maintain perfect concentricity. Three sizes of tools are available for 125 - 150um, 150 - 200um and 200 - 250um.

For further information circle 245 on the reader service coupon or contact Royston Electronics, PO Box 328, Mount Waverley 3145; phone (03) 543 5122.

Single-hole mount hardware

A number of new hardware items featuring single-hole panel mounting have been added to the Dick Smith Electronics component range. These include a mains-rated rocker switch and two sizes of concentric DC power inlet sockets.

The new P-7720 rocker switch is of the DPDT type and rated at 240V and 3A. It has an escutcheon with external dimensions of 20 x 30mm, with a rocker measuring 12.5 x 21mm, yet mounts via a single round hole 18mm in diameter. The switch uses a moulded plastic construction for safety, and is priced at only $3.95 (RRP).

The P-1648 and P-1650 are concentric DC input connectors for low voltage applications, and are designed to suit the standard line plugs having central female connectors of 2.1mm and 2.5mm respectively. Both types include switching contacts for the outer concentric contacts, for optional battery switching. Both types mount in a panel via a single round hole 12.5mm in diameter, and have a moulded plastic body and mounting nut for full isolation from a metal panel.

The P-1648 and P-1650 are both priced at $1.95 (RRP). Also now available from DSE outlets is a new line-type 2.5mm concentric socket, type P-1655.

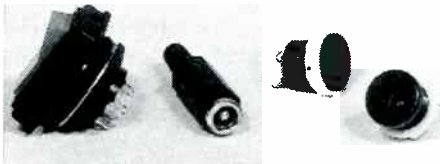
This is designed to allow making

300MHz DSO's offer 1M samples/ch

The LeCroy 9300 Family of portable digital oscilloscopes offer record lengths of up to one million points per channel. Two and four channel versions are available, each in three memory configurations: basic, 'M' (medium), and 'L' (long). The basic units have 10K record length per channel; the 'M' units have 50K per channel, and the 'L' units have 1M per channel. The entire 9300 family features 300MHz analog bandwidth, and independent 100MS/sec digitisers on all inputs.

Special features include fast autostep for repetitive signals, and a sequence mode which allows storage of multiple events in segmented acquisition memories. The long memory of these instruments make them suitable for radar, magnetic media, data communications and electro-mechanical applications.

For further information circle 241 on the reader service coupon or contact Scientific Devices Australia, 2 Jacks Road, South Oakleigh 3167; phone (03) 579 3622.



extension cables for plug pack power supplies, etc., in conjunction with the existing P-1645 or P-1646 2.5mm line plugs.

Cable TV spectrum analyser

The new 2714 Cable TV Spectrum Analyser from Tektronix simplifies and makes more repeatable RF spectral measurements, for cable TV and broadband LAN engineers and technicians.

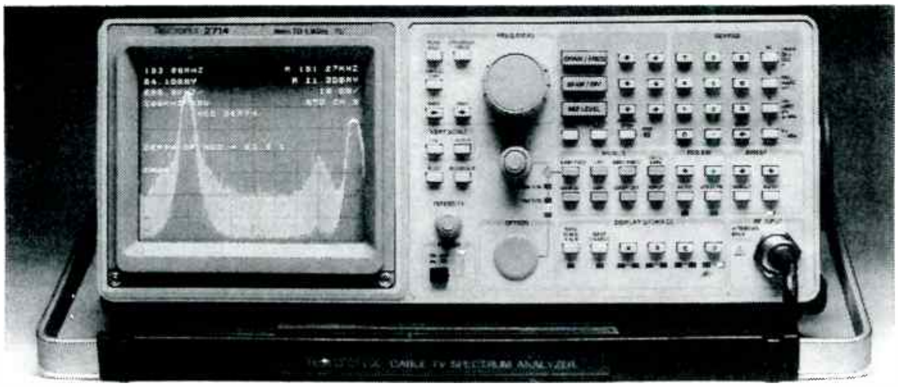
All commonly needed measurements, such as carrier-to-noise and hum/low frequency disturbance, are automatically made, by simply selecting the measurement from the onscreen cable TV menu.

An accompanying PC-based software package extends this capability to an even higher level with complete measurement configuration, data collection, and report generation features. This new level of automation allows new spectrum analyser users to collect extensive system performance data in the field.

Part of the 2714's value and performance comes from being designed specifically for cable TV and broadband LAN applications. The onscreen menu allows selection of firmware-based measurements and capabilities such as automatic positioning of visual and aural carriers; depth of modulation; system frequency response; and view baseband modulation (field and line) and demodulated video, etc.

Completing the picture is the PC-based software package that allows cable TV engineers to configure their own system channel tables and download them to the 2714 for easy tuning between channels. In addition, the software can be used to configure the 2714's automatic measurements into test sequences.

With its cable measurement capabilities, the 2714 is also a highly portable, general purpose spectrum analyser. It offers high sensitivity (to -90dBmV) for analysing weak signals and improved carrier-to-noise measurements. Its frequency accuracy (0.5ppm) is also high. The 2714's continuous greyscale analog display makes it easy to see spurious signals, demodulated signals, or modulation characteristics.



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NEW PRODUCTS

For further information circle 247 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066.

Ultra-slim fan

To complement the F70 (80 x 80 x 18mm) and F62 (62 x 62 x 15mm) series of fans, Micronel has released the F41 (41 x 41 x 12mm), the latest ultra slim fan in the series.

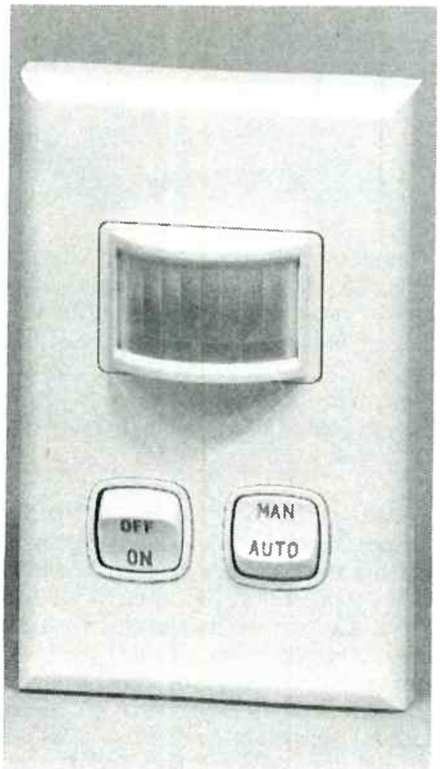
At minimum nominal power the F41 ultra slim fans are nearly noiseless, due to a new applied airflow technique, which causes almost a laminar airflow.

The main features of the F41 ultra slim fan are: housing and impeller of black glass-fibre reinforced plastic; and mounting with M3 screws or self adhesive gasket, with mounting possible in any orientation. As with the F70 and F62 series, voltage ranges available are 5, 12 and 24V DC, with two levels of air flow, 4200L/min and 5400L/min.

For further information circle 246 on the reader service coupon or contact RAE Industrial Electronics, PO Box 76, Thirroul 2515; phone (02) 232 6933.

Automatic light switch

Dick Smith Electronics stores are now stocking the HPM Industries



XL632 Automatic Light Switch, which incorporates a passive IR movement detector capable of operating the controlled lights when movement is detected. The unit was recently judged Best New Electrical Product by the AEEMA, at the recent Elenex trade show.

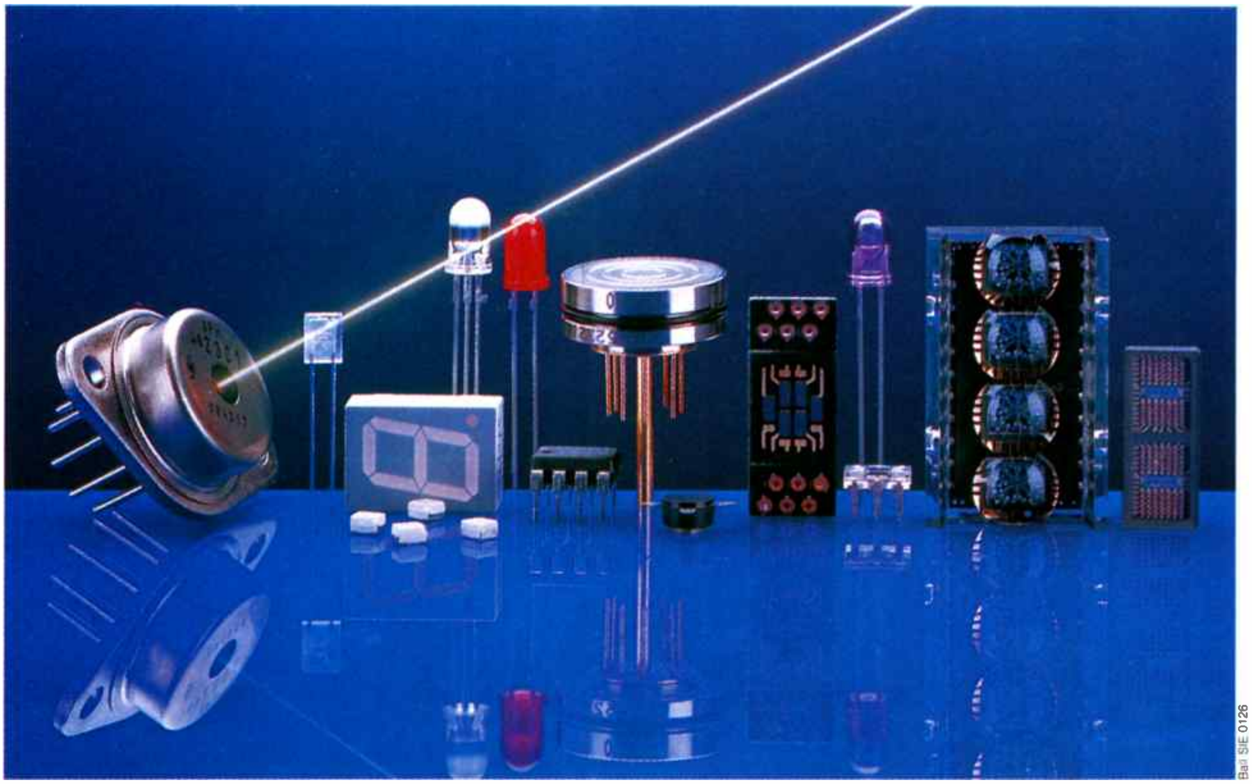
The XL632 can operate as either a conventional manual light switch or an automatic switch, as desired. In automatic mode it will detect movement within a 90° horizontal arc and a 12° vertical angle, and within five metres of the sensor. The sensitivity can be adjusted between 5 and 300 lux, to operate either at all times, or only at night.

In addition the unit offers the ability to adjust the time period that the controlled lights remain on — from as little as 10 seconds, up to 15 minutes. Maximum loading capacity is 300W, with a minimum load of 25W. Only incandescent lamp loads can be used.

The XL632 is very suitable for situations where 'hands free' operation of lights is required, and also for use in intruder detection and other security applications.

Priced at $69.95, the HPM Automatic Light Switch is available from all Dick Smith Electronics outlets as Cat. No. M-7035.

SIEMENS



In Opto-Electronics, one company remains a ray of light.

In 1875, Werner Siemens invented the selenium photo detector.

Since then, Siemens has remained at the forefront of opto-electronic technology, producing one of the most comprehensive product ranges in the world today.

This includes alphanumeric displays, programmable display devices, intelligent display devices, military displays, LED lamps, optocouplers, infrared emitting diodes and photodetectors, fiber optic products, lasers, interrupters and other opto-electric products that can be customised to your unique requirements.

Yet range alone counts for little, unless the quality of each individual product is beyond reproach.

Which is why Siemens manufactures every little LED and diode as if it were the only one we made.

Because we believe if you get the little things rights, the big things take care of themselves.

Phone (03) 420 7111 or fax us on (03) 420 7275 for more information.

Siemens
Components.

Little things make a big difference.

READER INFO NO. 26

Powerline filters

Critec has released an enhanced range of PLF series of Powerline Filters. The new models feature improved low pass filter performance and balanced, coupled inductors are used to produce good common and transverse mode response. Also, the 3dB attenuation point based on a 50 ohm source impedance now extends from 350 - 200Hz, dependent on model. The E-PLF10-2A is rated for AS1768-91 category A and qualifies as a 400V device, in respect to the let-through voltage.

The B series has enhanced surge absorption capability to cater for the multiple stroke lightning discharge. This type of lightning occurs in over 75% of events and can cause an MOV to absorb 10 or more repetitive pulses at 50 - 300 millisecond intervals. Because the accumulated heat generated in the MOV is known to cause premature failure, B series units are now rated up to 20kA single shot, and have been type tested to over 100 impulses at 3000 amp 8/20 rating with a 30 second repetition rate.

For further information circle 249 on the reader service coupon or contact Critec, GPO Box 536, Hobart 7001; phone (002) 73 0066.

Ceramic resonators

ACD, now distributors of Kyocera products, has a broad range of high quality ceramic resonators, covering both the kilohertz and meghertz frequency range. The high quality and extensive coverage of this product line allows optimum design of almost any oscillating circuits.

Ceramic resonators stand between quartz crystal oscillators and LC/RC oscillators in regards to accuracy, but are considerably smaller, require no adjustments, have improved startup times and are low in cost. Kyocera manufactures a large assortment of kHz and MHz band ceramic resonators, such as the ultra-compact lead type, built-in capacitor type, chip type and built-in capacitor chip type, with various styles and frequencies suitable for many applications.

For further information circle 243 on the reader service coupon or contact Advanced Component Distributors, PO Box 139, Bayswater 3153; phone (03) 762 7644.

Irons have fume extractor

OK Industries has released the SAI-640-X Micro (40 watt) and SAI-690-X (90 watt) irons, which are attachments for its SA-1000 soldering system. Safety and comfort are the major features of the irons. The SMMJ fume extraction pipe is fully adjustable for maximum efficiency, while flexible silicone tubing is heat resistant and ESD safe, when attached to the SA-1000's fume extraction installation.

For further information circle 250 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999. ❖

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Silicon Valley NEWSLETTER

Hyundai moves to Silicon Valley

In a blunt effort to boost its lack lustre performance in the critical US personal computer market, Hyundai has moved the entire headquarter operations of its US$400 million-a-year PC business from Korea to a new facility in the heart of Silicon Valley.

Along with the new site in San Jose, Hyundai's PC operations were also given new leadership, as the Korean company said it has hired Edward Thomas to head the division. Thomas is a 27 year old IBM veteran, who until most recently, headed the CompuAdd chain of computer retail stores.

Hyundai sold US$375 million worth of PC's in 1991, but it holds only a 2% share of the US$21 billion US market, or about US$40 million worth of US sales. Thomas vowed he will double the market share within one year. While doing business in Silicon Valley tends to be very expensive, Thomas conceded, Hyundai hopes the move there will allow the company to react quickly to the latest market and technology trends which usually start in Silicon Valley or in the US in general.

Texas to sell Cyrix 486 chip

In a move that may radically alter the high end PC microprocessor market, Texas Instruments has struck a new deal with Cyrix. In addition to making that company's own version of the Intel 486 processor, TI said the technology licensing agreement will allow it to also sell the 486 chip under its own name. TI will begin selling the 486 processor immediately.

The move shook up Wall Street, where shares of Intel and AMD traded sharply lower.

TI's 486 was designed by startup Cyrix which earlier announced the chip. Following TI's announcement that it would produce the chip for Cyrix, Intel has already filed a copyright and patent infringement suit against both Texas companies.

TI said it now plans to use the Cyrix 486 design as the basis for a whole line of 486 chips, ranging from high performance desktop versions, to low cost chips aimed at the low end of the PC market. At Advanced Micro Devices, company chairman Jerry Sanders said that Wall Street was over-reacting to the TI announcement and that his company is well positioned to face up to the additional competition.

T.J. Rodgers, outspoken president of Silicon Valley chip maker Cypress Semiconductor. Although known as one of the best run firms in the industry, Cypress has just had to lay off 200 people and shift some operations overseas, to boost sagging profits.

Perot wins European contracts

Perot Systems, one of the companies owned by billionaire and presidential candidate H. Ross Perot, has won two major European computer and communications integration and servicing contracts worth more than US$1 billion.

The contracts are with East Midland Electricity, a major UK power utility company, and with Europcar, the largest vehicle rental company on the continent. In the latter contract, Perot beat 20 other bidders, including some of the biggest names in the industry.

Perot Systems president Pat Horner said his company is eyeing Europe "as a strong area of future growth for us," adding that the company is in the midst of negotiating a number of similar deals with other companies in Europe.

Horner said that increasingly large European companies were reaching out to outside contractors to help them build new integrated computer and communications systems and networks.

Apple's 'Newton' PDA is near

Apple Computer appears to be readying itself for its first entry into the hectic consumer electronics market. On May 29, the company was expected to introduce a product developed under the code name 'Newton', at the Summer Consumer Electronics Show in Chicago. Newton will be an executive organiser measuring about 6 x 8 inches and controlled by a pen. It will cost between US$800 - 1000 at the retail level.

People familiar with the Newton product say it could be one of the most exciting new computer products to hit the market in years. For one, the Newton will operate under control of a new 'ARM' RISC microprocessor jointly developed by Apple, VLSI Technology and Acorn. That means the Newton would have a greater raw computing power than even Apple's most powerful Quadra Macintosh computers.

The Newton is expected to include special 'intelligent assistant' software designed to recognise even cursive handwriting (a technology Apple licensed last year from a Russian company). Other instructions can be initiated by tapping icons on the machine's display. The assistant software also automatically adds appointments to a calendar, dials phone numbers and dispatches fax messages.

Key to the functionality of the Newton is the novel 'neural network' approach Apple has taken in building the system. Using this highly futuristic artificial intelligence computer architecture design, the Newton, for example, will automatically place an appointment on its built-in calendar if the user simply writes a note saying: 'Meet with Mr Johnson next Monday.'

If the user writes 'Call Mr Johnson,' the Newton will instantly display the various numbers of file for that person and dial the one the user taps with his pen. By the

same token, the machine will dial the right fax number if the user writes 'Fax Mr Johnson.'

Newton will come with a built-in fax data modem and will also be able to communicate with desktop computers via infrared light over a distance of up to two metres.

The Newton will be produced for Apple by Sharp, and the Japanese company, under a recent licence agreement with Apple, will also produce its own version(s) of the machine. Apple's version will be targeted at the business market, while Sharp will offer its Newton to consumers. The two versions will look different and feature different icons and other display options. Availability is not expected until next year, as the company is still working on the plastic casing for the machine.

Intel to put XGA in chip set

Intel and IBM have announced a new agreement, under which Intel will licence IBM's new XGA graphics display technology. Intel will use the licence to build XGA into new PC chip sets it will market to computer makers worldwide.

To date, IBM has been struggling to get the PC market to adopt the XGA video display technology, despite the improvements it offers over VGA.

The pact with Intel could vastly accelerate the acceptance of XGA, which computer makers will be able to offer as standard in their machines without any major premium in component cost of their new computers.

Officials mum on looming trade conflict

The top US government official in charge of the US-Japanese Chip Trade Agreement recently took a tour of an advanced Silicon Valley chip production facility. But he disappointed industry executives, by refusing to talk tough on Japan's apparent failure to live up to the terms of the trade agreement.

Michael Moskow, the Deputy US Trade Representative, suited up in a 'bunny suit' and toured the advanced chip laboratory of Advanced Micro Devices in Sunnyvale. While praising AMD and the US industry for their efforts to regain international competitiveness, Moskow repeatedly refused to criticise Japan and talk about what steps, if any, the Administration plans to take if Japan does not live up to the terms of the trade agreement.

"We have expressed great concern to the Japanese about this issue. Members of the Japanese gov ernment have expressed their desire to fulfil their commitment under the agreement. We have no reason to think they will not fulfil these commitments. I think it is too premature to talk about possible options if they don't meet the terms," Moskow said.

Industry analysts said they were not surprised Moskow was not more forthcoming in his statements about the trade agreement. His visit to Silicon Valley was designed mostly as a symbolic gesture to show the Bush Administration has not forgotten about the industry and its problems with Japan.

Judge to reconsider Apple decision

The Federal District Court Judge who shocked Apple Computer by dismissing virtually its entire US$5.5 billion copyright infringement lawsuit against Microsoft, has agreed to reconsider his ruling.

Acting on a motion filed by Apple after his April 14 ruling, Judge Vaughn Walker said he will reconsider his decision that most of the claims in the Apple suite were not covered by copyright law, or were already covered by a 1985 technology licensing agreement between Apple and Microsoft.

Walker, however, told Apple's attorney that the Apple motion was highly unusual and that he was granting Apple's request "with great reluctance. I was sorely tempted to dismiss Apple's motion out of hand, and I think I would be on firm ground if I did," the judge said.

Second cellular data system planned

Two weeks after IBM announced a joint venture with nine major cellular phone companies, four other cellular telephone companies — including Pacific Bell on the US West Coast — said they will construct the first US wide cellular network.

Unlike the IBM network, which is designed for small companies and individual PC users, this system will be specifically built for United Parcel Service to link its 50,000 delivery trucks. When completed, UPS will be able to offer customers the first nationwide vehicle and package tracking system. Once proven in the field, the four companies are expected to further market the network to other large and small companies.

Both the UPS and IBM cellular data communications systems will have dramatic consequences for the way computers are used and people work.

With cellular adaptors attached to their notebook and other portable computers, people will be able to use their computer as both a cellular telephone and to remain in online contact with their office computers. They will be able to send and receive E-mail messages, faxes, and interact with their office computer from almost anywhere in the United States.

The four companies said they expect to spend some US$150 million to modify their existing cellular networks, to add the data processing capability.

Much like the IBM deal, the companies will use packet switching technology that will insert small 'packets' of data into cellular communications frequencies — often right in between burst of voice communications. Computers at central locations recognise the incoming packets and assemble them in the right order before moving the data on to their final destination.

"This is the first time there will be a nationwide cellular solution to a data problem," said a spokesman for PacBell Cellular. In addition to PacBell, the group includes GTE MobilNet, South Western Bell, and McCaw Cellular Communications.

With very few exceptions, most notably the Phoenix, Arizona area, the four cover the entire United States with cellular services. ❖

Cops catch two virus makers

Federal authorities in the state of New York reported the arrest of two Cornell University students, who were charged with creating a computer virus that is alleged to have infected computer systems around the world.

According to court records, the two students planted their virus inside three computer games for the Apple Macintosh computer that were stored at Cornell University's computer centre, and subsequently transmitted to a computer archive located across the US at Stanford University at Palo Alto.

From there, the games were duplicated by unsuspecting students and the virus began to spread across the US, the UK, Japan and other countries. Each time a user copied the game onto his computer's hard disk drive, the virus would destroy the computer's operating system software.

If convicted, the two students face jail terms of up to four years as well as substantial financial penalties.

ASP's 'Jetway' printer sharer

The Jetway printer sharer is a very compact, economically priced unit that allows up to eight personal computers to share a single printer. It uses RS-232C serial links from each computer, using low cost four-wire telephone cable, and can be configured for serial communication at up to 115,200bps — so that printing can be effectively just as fast as using a direct Centronics cable.

by JIM ROWE

Although local area networks or 'LANs' may be all the rage for linking the personal computers and other workstations in a modern office, they're not without their drawbacks. A full LAN, based on a technology such as Ethernet, can be quite expensive — involving a special dedicated controller/transceiver card in each machine, and relatively expensive cabling.

There can also be software complications, as each machine needs to have network management system software running, and often this can turn out to have compatibility problems with applications software.

Another disadvantage of LANs is that they tend to be susceptible to viral infection. If a virus is picked up by any one machine on the LAN, it can spread to all of the other machines long before its presence is detected. It's one of the disadvantages of having the machines linked together so intimately...

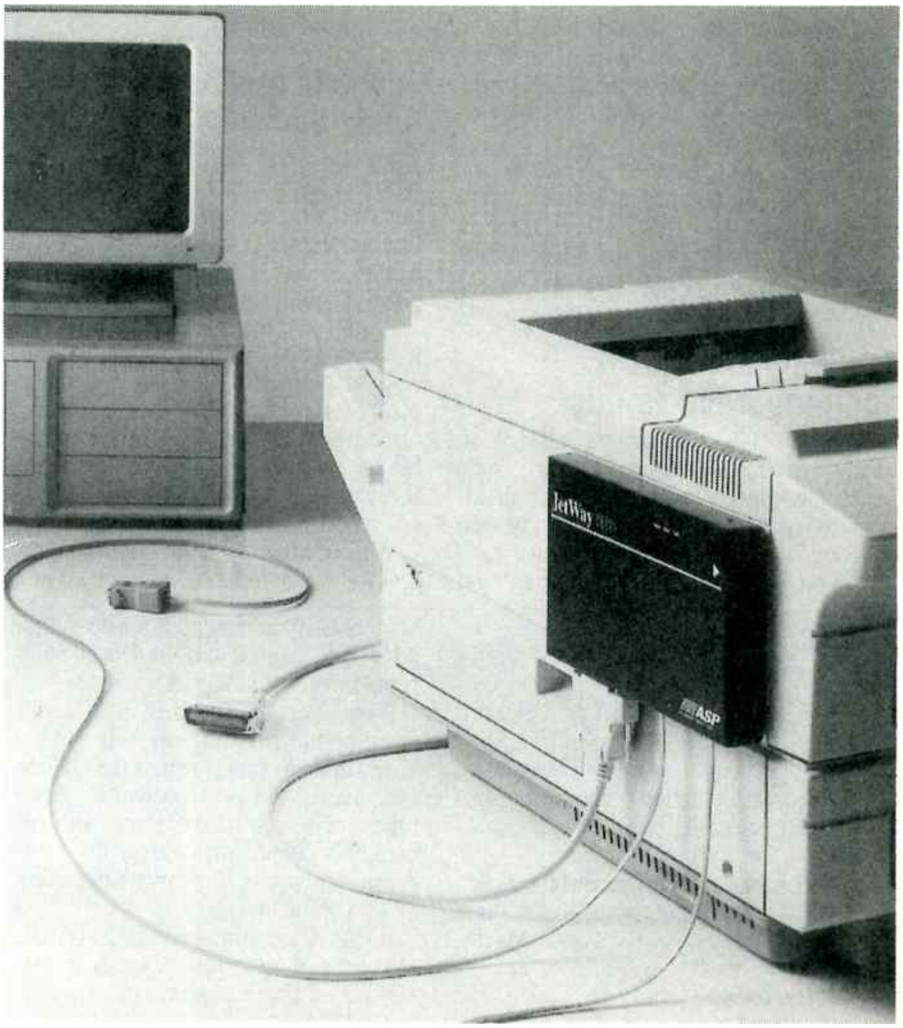
As it happens, a full-blown LAN often isn't necessary in order to achieve the main things that people want to do in their offices. In many cases, all that's really needed for much of the time is a way for all of the users to share a relatively expensive resource, such as a laser printer.

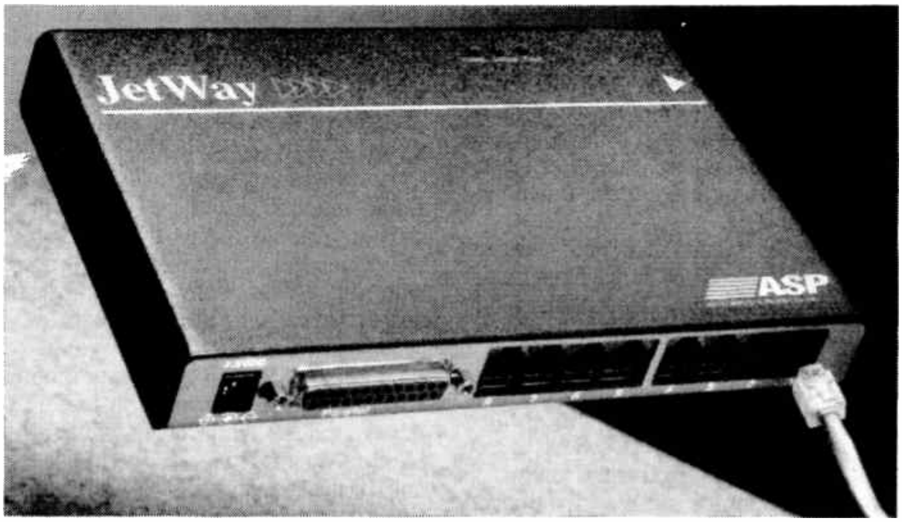
Take *EA*'s own little editorial office, for example. Everyone has their own PC, and there are a number of low cost dot-matrix printers to allow convenient printing of letters, memos and rough drafts of articles.

We transfer the finished articles between machines as files on floppy disks, and this is quite convenient as we're not doing it all that often (most of us only write one or two articles a month!).

But we all have to share the office laser printer, because they're too expensive for the company to be able to provide more than one. In our case it's a Texas Instruments PS35 'MicroLaser', with PostScript and 2.5MB of memory.

The laser is used not only by Production Editor Milli Godden and myself, for desktop publishing the magazine (using *Ventura Publisher*), but also by Rob Evans, Peter Murtagh and myself again for printing out PCB patterns (using





A close up view of the eight-port version of the Jetway, showing all of its connectors. At far left is the DC input, followed by the Centronics output and the eight serial inputs — which use compact RJ11 modular connectors.

Protel *Autotrax* and *Easytrax*), circuit schematics (using Protel *Schematic*) and diagrams (using *CorelDraw*). At times we also use it for printing out other things, like the results of simulations on *IsSpice* and *MicroCap III*. So at times the laser is kept pretty busy...

Up until recently, the laser was connected to Milli's computer, because she's the one who uses it most frequently. When the rest of us needed to print something out, we'd print the file to disk on our own machines, and feed it to the printer via Milli's computer — when she went to lunch, or was away from her desk for a few minutes.

It was a system that worked, but one that was not entirely convenient for everyone. It also tended to slow down the rest of us, when the monthly deadline was approaching and Milli was inevitably very busy.

All we really needed was a way to link all of our machines up to the laser, so that each person could print things out independently. A full LAN wasn't necessary — just a system that would let us do this, and at a low price so we could justify the further investment to management. I'm sure there must be many other offices with a similar need.

Well, it turns out that there *is* a low cost system designed to do this very job: the 'Jetway' printer sharer, from ASP Computer Products of Sunnyvale in California. It's sold in Australia by Sprinter Products, based in Manly NSW.

The Jetway comes in two basic models, one of which caters for up to four computers, and the other up to eight. In each case the links from each computer use serial communication, from standard RS-232C ports.

And although these links can be wired using standard low-cost telephone cable (such as the readily available 'two-pair', or the new flat-profile four wire cable), they can at the same time be configured for communication at up to 115,200bps. This is the maximum data rate available on the serial ports fitted to most of the newer PC's, and corresponds to around 11,500 characters per second — actually about *double* the transfer rate for most Centronics interfaces.

So the Jetway can be virtually 'transparent', apart from situations where two computers try to print files at the same time (in which case the 'loser' is delayed while the first file is printed).

The Jetway itself has a standard Centronics parallel port, to feed the shared print stream to the printer — it even uses a standard DB-25 output socket, so that a standard IBM-compatible printer cable can be used.

The serial input ports on the Jetway use compact 'modular' RJ-11 connectors, as used on virtually all of the latest telephones, answering machines and fax machines.

And Sprinter Products can provide matching serial cables of various lengths, to make it easy to connect each computer up. Needless to say they can also supply matching adaptors, to allow the RJ-11 cable connectors to be hooked up to standard DB-25 or DB-9 serial port connectors.

How do you get your computer's programs to print out via one of your serial ports, instead of the usual Centronics port? This is taken care of by a small utility program called *ASPMODE*, which is loaded by the main *JWSTART* program supplied with the Jetway, as part of your initial setup. *JWSTART* also loads another utility called *ASPBAUD*, to configure the desired serial port for any desired rate up to 115,200bps (DOS itself doesn't have provision to set the ports beyond 19,200bps). Either or both of these utilities can be called before you run your applications software, and ASP provides a simple batch file to do this.

There's also another program called *JWSETUP*, which is called by *JWSTART* during installation, to set up various configuration parameters inside the Jetway itself: the baud rate for individual ports, the automatic timeout period after a file transfer is interrupted, storage of any optional 'header' or 'footer' strings (which the Jetway can append to all print files, if you wish), and an optional 'number of copies' parameter, which applies only to the next print file received, for automatic multiple-copy printing.

All of these parameters except the last are stored within the Jetway in non-volatile memory, so that they're normally retained even when the power is turned off. However *JWSETUP* can be called at any time to modify the settings, if you wish. *JWSETUP* also customises the batch file that calls the *ASPMODE* and *ASPBAUD* utilities, as well.

In short, ASP seems to have gone to quite a lot of trouble to make the Jetway not only easy to connect up, but also convenient and flexible in use.

By the way the Jetway doesn't only work with IBM-compatible PC's, even though the above utilities are designed for this environment. ASP's literature advises that the Jetway is quite compatible with Apple Macintoshes, VAXes and HP3000 machines — in fact virtually any computer which can be arranged to print via an RS-232C serial port.

And any of these computers can be mixed in a single system, if you wish. Presumably ASP can supply any driver software than may be needed for these other computers.

Compact power

The Jetway itself comes in a compact and unobtrusive little box, measuring a mere 185 x 125 x 25mm. It weighs only around 1kg, and in fact ASP suggest that it can be attached to the side of the printer itself, using 'Velcro' strips (supplied). It runs from an external 9V/1A DC plug-pack supply, which is also supplied.

Inside the Jetway there's a compact PCB with a dedicated microprocessor (80C188), running under the control of a program in ROM. There's also a large proprietary PLCC chip, and a row of

eight sockets for RAM chips — each capable of taking either 256K x 4 or 1M x 4 DRAMs.

This gives the Jetway a potential buffer memory of anywhere between 256KB (the standard configuration) up to 4MB, simply by adding/substituting chips. Sprinter Products can in fact supply the unit with any of the possible RAM configurations fitted, for those who aren't confident about upgrading the memory themselves.

The PCB also has space for two 82C684 chips, which are quad serial port controllers, and matching sets of RS-232C interface transceiver chips. The main difference between the two versions of the Jetway seems to be that the four-port version has a single 82C684 and its matching transceivers, while the eight-port version has the full complement. Very neat!

Because the Jetway normally operates in a manner that is transparent to the user, there's only one 'control': a reset button, to allow the inbuilt micro to be 'put back on the rails' should it ever become confused. The button is recessed behind a small hole in the case, and can only be accessed using a pencil or similar pointed item — to prevent accidents.

When the reset button is pressed, the Jetway's micro is also triggered into performing a set of system diagnostic tests. At the end of the tests it sends a status report to the printer, for printing out.

In addition, there are three LED indicators that are used to display the Jetway's status during normal operation.

The green 'Power' LED glows whenever power is applied, to indicate that the unit is active; the amber 'Status' LED blinks when print data is being received from a computer, and glows continuously if the data is forced to remain in the Jetway's buffer (because the printer has refused to accept it, for some reason); and the red 'Fault' LED glows during power-up initialisation and diagnostic testing, but otherwise only glows if the Jetway develops an internal fault.

The Jetway comes complete with power pack, a floppy disk with the macthing software utilities and an A5-format user manual of about 54 pages.

The manual is clear and concise, and provides information not just on standard installation, but also on aspects of interest to 'advanced' users — such as downloading of job control commands.

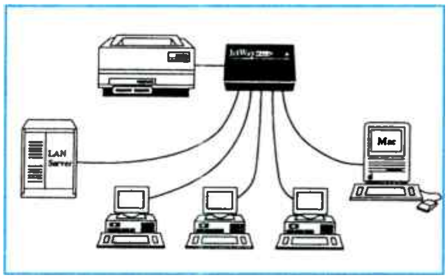
Trying it out

Sprinter Products very kindly loaned us an eight-port Jetway, complete with a set of cables, so we could try it out in our office. Initially we ran the cables in temporary fashion along the floor, using 'gaffer tape' to hold them down and avoid tripping.

Using the manual for guidance, we were able to load the Jetway's software into each computer without a hitch, and set both it and them up for correct communication.

ASP recommends that the *ASPMODE* and *ASPBAUD* utilities are simply added to your AUTOEXEC.BAT file, so that they're simply activated when each computer is turned on. We tried this approach initially, but soon found that for our purposes it had shortcomings.

Some of us wanted to be able to select between our dot-matrix printer and the laser, depending upon either the



The Jetway can be used to share a printer among a variety of computers, including both IBM compatibles and Apple Macs.

package we were running or the kind of printing to be done; having the utilities activated by AUTOEXEC.BAT doesn't give this flexibility.

We also found that some applications packages and/or operating environments (such as *Windows* or *Gem*) virtually reset the computer's serial port parameters, when you exit the program. This means that if you return to the same package, or another that needs to print via the Jetway, the computer will no longer be able to communicate with it.

In view of these limitations, we decided it was better to call the utilities each time you run any program that will need to be able to print via the Jetway. This can easily be arranged to occur automatically using batch files, and turns out to obviate virtually all of the problems.

Having done this, our machines all communicated with the laser very happily. In fact we were so impressed with the results, that we decided we had to have one!

In due course, we were able to convince management of the productivity benefits, and approval was given for us to purchase the Jetway that we were reviewing. It was only then that we struck a small snag.

The temporary cables laid along the floor were rather messy and unsightly, so we arranged for the company's electricians to run permanent wiring inside the office walls and above the suspended ceiling panels.

This gave a much neater result, but then we started getting printing troubles! It turned out that unless you had all of the computers that were hooked up to the Jetway turned on, it would 'hang' and flash its Status LED — not all the time, but intermittently.

After spending quite some time trying to track down the cause of these symptoms, we finally brought Sprinter Products into the picture.

They very kindly loaned us a second Jetway, and substituting this revealed that the original unit had been 'borderline', in terms of its susceptibility to noise pickup by the serial lines. This discovered, Sprinter arranged for us to retain the good unit, and return the original to them so that they could analyse the cause of the problem.

The replacement unit has now been working happily in our office for some weeks, and we're very happy with the results. The only thing we've found is that it doesn't really like long serial cables plugged into its ports, unless they're terminated by a computer at the far end.

The computer doesn't have to be turned on — just connected to the cable. Presumably its serial port then provides a reasonable termination, and prevents excessive noise pickup by the cable...

Summarising, then, we've found the Jetway a very nice little unit, and one which provides a very convenient way of sharing an expensive peripheral like a laser printer, among as many as eight personal computers.

The basic price for the four-port Jetway with 256KB of RAM is $579, plus sales tax where applicable. The equivalent price for the eight port version is $899 plus tax. Serial cables of various lengths, adaptors and memory up-grades are all available for additional cost.

Further information on the Jetway and other products in the ASP range of computer accessories is available from Sprinter Products, of Level 1, 22 Darley Road, Manly 2095; phone (02) 977 8155. ❖

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Serial I/O bus for chips and PC peripherals:

A look at I²C and the ACCESS bus - 2

Here is the second and final article describing the development and operation of the basic I²C bus and its new derivative, the ACCESS bus. To conclude our discussion of I²C we look at some of the demo modules and development aids that are available to help the designer; then we look at the ACCESS bus and how it differs from I²C.

by JIM ROWE

To make it easy for system designers to become familiar with the I²C bus and its operation, and to develop systems using it, Philips in particular has produced a number of demo modules and development aids.

These range from stand-alone boards which are primarily intended to demonstrate I²C, but can also be used as low cost evaluation/development systems, through to a hardware and software package which allows a standard IBM-compatible PC to be used as a very flexible development system and/or I²C system analyser.

As an example of the stand-alone demo boards, the picture shows the OM-1016. This is essentially a complete I²C system on a board, requiring only 9V/150mA DC from a plug pack or other supply, to operate.

It has four conductor strips running down the longer centre axis, distributing +5V, ground and the I²C clock (SCL) and data (SDA) lines to some 13 functional subsystem areas. This makes the board rather more complex than many real-world applications of I²C, but at the same time it demonstrates well how easily the bus can be used to link various commonly-used chips.

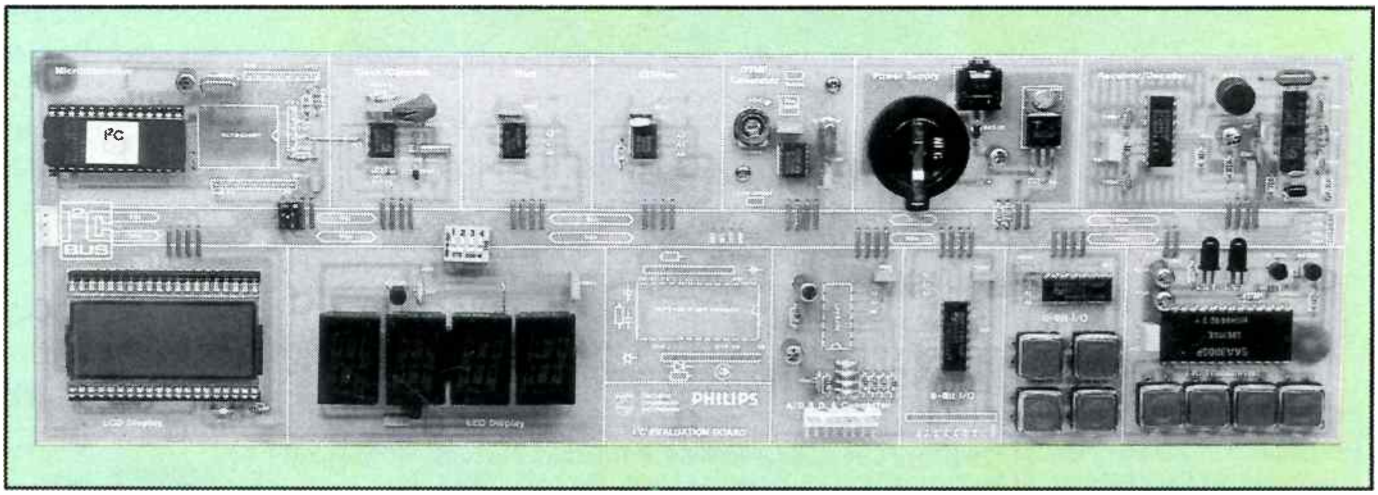
At the heart of the board, and positioned at the top left-hand corner, is a microcontroller based on a PCF84C00T microprocessor and a 27C64 ROM. These have the demo board's 'operating script', if you like, and thus know how to listen and talk to the various subsystems so that they can all communicate correctly.

Moving clockwise around the board, the other subsystems consist of:

(a) a clock/calendar, using a PCF8583 chip and associated components;
(b) a RAM, using a PCF8570 chip;
(c) an EEPROM, using a PCF8582 chip;
(d) a DTMF tone generator, using a PCD3312 chip and a TDA7050T (for audio output);
(e) an IR receiver/decoder, using an SAA3028, an IR photodiode and a TDA3047;
(f) an IR transmitter, using an SAA 3006 with four pushbuttons and a pair of IR LEDs;
(g) an 8-bit parallel input port, using a PCF8574 with four further pushbuttons;
(h) an 8-bit parallel output port, using another PCF8574;
(i) an A/D and D/A converter combination, using a PCF-8591;
(j) a four-digit seven segment LED display, using an SAA1064; and
(k) a four-digit LCD display, using a PCF8577 and an LTD226F-12.

There's also an unwired board area, which allows the user to wire in an 84C21/41/81. The basic circuitry for the complete board is shown in Fig.1.

As a demo system, the OM1016 is fine for showing how easily the I²C bus can link all of these standard chips and subsystems. But the board is also designed so that with a minimum of effort, it can



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also be used as a breadboard, to try out other circuitry based on I²C-compatible chips. Any of the existing subsystems can be disconnected from the central bus conductors, simply by removing some links; similarly other circuitry can easily be connected to the bus, via a maximum of four wires.

Philips also has available the OM4151, which is very similar to the OM1016 except that it is based on an 8051-type microcontroller. There's also a companion manual for both boards, known as the OM1018. The OM1016 sells for $175 plus tax, while the OM4151 is only $20 dearer.

In addition, Philips has available the OM1020, which is a demo board for I²C-based LCD drivers and displays.

At the more elaborate end of the spectrum, Philips also makes available the OM1022. This is a hardware and software package that effectively converts a standard IBM-compatible MS-DOS personal computer into a very flexible I²C development system and system analyser. It sells for $400 plus tax, including all software and manuals.

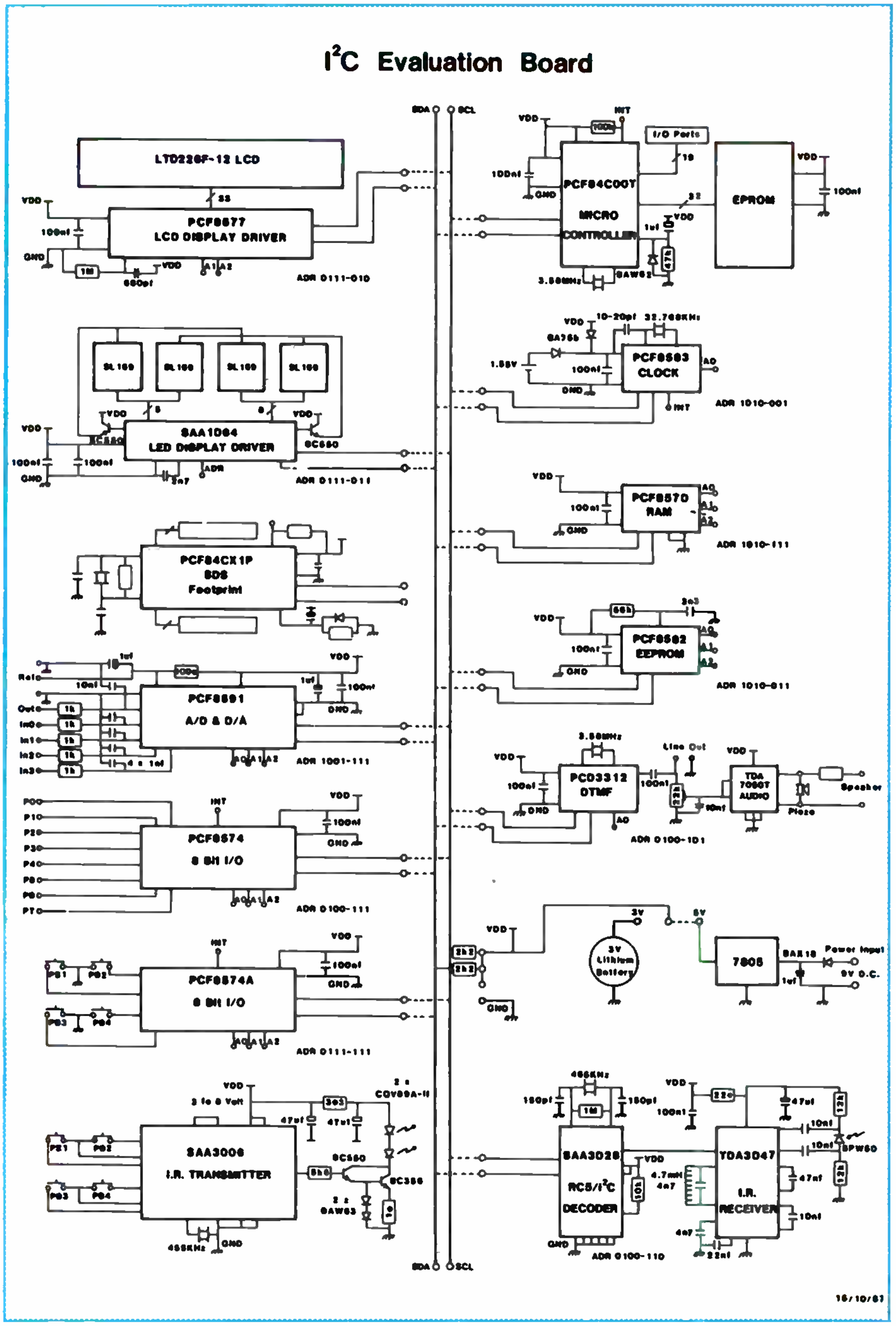


Fig.1: The circuit of Philips' OM1016 evaluation/demo board for I²C. The card itself is pictured on the opposite page; it demonstrates very clearly how I²C can be used to link many different chips on a PC board.

Simpler approach

While only the last of these development tools could be described as either complex or expensive, there's another way of 'dipping your toes in the I²C water' — and one that's even simpler and cheaper. This is by using a set of 'I²C Bus Control Programs' which are available to professional customers on request from Philips Components, and which again run on a standard IBM-compatible PC.

The programs are used in conjunction with an easily-made 'roll your own' hardware interface, which connects to the PC's Centronics parallel port and allows it to communicate with an I²C bus as the system's 'master' device.

The circuit for the hardware interface is shown in Fig.2, and as you can see it's exceedingly simple. Only one IC is required, a 74LS05 hex inverter. All that is needed, apart from your PC and this simple interface, is a +5V DC power supply — and you have a complete 'poor man's I²C development system'.

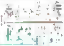
The matching Philips I²C Bus Control Programs come on a single 360KB floppy disk, and provide an easy-to-use package to control the I²C bus, examine the status of chips hooked up to it, send data to them and retrieve data from them, initialise the system and so on. The software is menu driven, and includes an inbuilt database with configuration information on each of the standard I²C chips.

As you can see, then, it's possible to start experimenting with the I²C system and developing your own circuits around it, with very little outlay. And more and more, electronic circuit designers are probably going to have to get familiar with I²C, because its advantages are becoming more attractive all the time — not just in terms of circuit simplification, but cost as well.

I hope the foregoing, together with the first of these articles, has given you a reasonable introduction to how I²C operates, and how easy it can be to use it. Now let's look at 'son of I²C' — the new ACCESS bus, developed by Philips/Signetics and Digital Equipment Corporation, as an elegant and yet low cost way to interface personal computers with peripherals such as keyboards, mice, scanners, modems and printers.

Gaining ACCESS

In September 1991, Philips/Signetics and the US computer firm Digital Equipment Corporation (DEC) jointly announced the ACCESS bus — a low cost serial I/O interconnection bus designed to connect up to 14 low speed peripheral devices to a standard work station or PC.



I²C ACCESS bus - 2

The new ACCESS bus is 'open', in the sense that Philips/Signetics and DEC are providing the protocol specifications free of charge; there are no licences or royalties. This is to encourage faster acceptance of the bus, and since the announcement, over 20 equipment manufacturers have indicated that they will support it. This suggests that ACCESS may well be destined to become an international standard for peripheral interfacing in low-end systems.

Features of the ACCESS bus include its 'daisy chain' configuration, which allows up to 14 peripherals to be interfaced to a single ACCESS serial port. The bus is also designed to allow 'hot plugging', whereby peripherals can be connected to and disconnected from the bus without removing the power or rebooting. Any device can be simply plugged in and used, without having to load device-specific driver software or adjust DIP switches.

Maximum data transfer rate on the ACCESS bus is 100 kilobits per second, or around eight kilobytes per second. This is more than sufficient for keyboards, joysticks, mice, trackballs, graphics tablets and printers, and even suitable for low speed graphics scanning devices. Maximum cable length is about eight metres, or 26 feet — again quite sufficient for many personal computer applications.

The ACCESS bus has four conductors: data, clock, +12V and ground. And essentially it's our old friend the I²C bus, effectively 'beefed up' or ruggedised to allow it to serve as a link between equipment, rather than just between chips on a single PCB.

The connector used for ACCESS bus interconnections is a modified four-pin telephone type 'modular' (RJ-22) connector, enlarged slightly to allow it to be shielded. Both Molex and AMP make the connector, known as 'SEMCONN' or 'SDL' respectively. The computer only needs a single connector, while peripherals should have two connectors wired in parallel, to allow further peripherals to be connected to the 'daisy chain'. But small hand-held devices are permitted to use a single connector, on the basis that a 'T' connector can be used to extend the bus.

The cable used for ACCESS interconnections is a matching four-wire shielded type, with low capacitance — less than 70pF/m for the SDA (data) and SCL (clock) conductors. By the way, the shielding on both cable and connectors of the ACCESS bus are to minimise RF radiation.

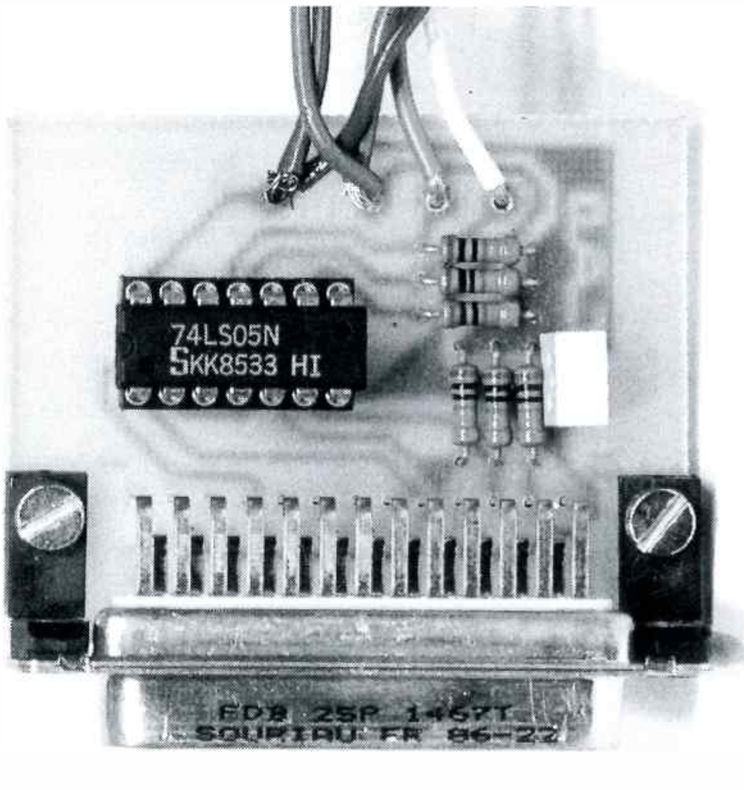
The additional +12V line on the ACCESS bus is used to supply power to the peripherals, and the computer's port is designed to provide a total of 500mA. Each device is expected to step down the +12V to +5V, to match the I²C bus requirements for the SDA and SCL lines. In addition each device must have a series resistor of at least 10 ohms at its +12V input, to limit inrush current during hot plugging.

Peripheral devices don't have to derive their power from the +12V line on the ACCESS bus, however. They can alternatively use their own power supply, but a power-up reset circuit must be provided so that the device's logic circuits are reset when it is connected to the bus, or when power is applied to the bus.

Electrically, apart from this additional +12V power line, the main other difference between ACCESS and I²C is that whereas I²C uses simple pull-up resistors for the SDA and SCL lines, ACCESS uses *active current sources* in the host computer's port circuitry. The current sources provide 3mA of current capability, and it is this which allows the ACCESS bus to operate on longer cables while still maintaining the original 1us rise and fall time specification of I²C.

In fact the ACCESS bus's cable length limit of eight metres is basically determined by cable capacitance. The nominal maximum capacitance is 700pF for the SDA and SCL lines, and typically an 8m cable will reach this figure when connector and terminating capacitances are taken into account. However the 700pF figure actually includes a 22% safety margin: the theoretical limit is 857pF, when the specified active pull-up current sources are used in the computer's ACCESS port.

Apart from these differences, the ACCESS bus operates electrically in almost identical fashion to the I²C system described in the first of these articles. The SDA and SCL lines are bidirectional, and use a wired-OR scheme. Clock pulses on the SCL line are used to strobe data on the SDA line, and each data interchange is controlled by the initiating 'master' device, which sends the address of the intended 'slave' in a header byte.



A close up of the simplest possible I²C interface for a standard personal computer Centronics port. It uses a single low cost IC, and can be built for around $10 — yet can be used with Philips' software for basic development work.

Modified protocol

There are a few more differences between ACCESS and I²C when it comes to the data exchange protocol, however.

For a start, all devices on the ACCESS bus are expected to be 'intelligent' — i.e., they need to have microprocessors or controllers which are capable of initiating a data transfer, as a 'master'. In fact part of the ACCESS bus specification is that all devices must be able to act as

either a master transmitter or a slave receiver, for any particular transfer. Unlike I^2C, there can be no master receivers or slave transmitters.

So with ACCESS there is no communication between peripheral devices — only between the computer and a peripheral, or a peripheral and the computer. And because the transmitter for any particular transfer is defined as the 'master' for that transfer, the receiving device automatically becomes the 'slave'.

The computer's ACCESS port has a dedicated microcontroller, which is used to perform the functions of protocol conversion and FIFO (first-in, first-out) buffering. The controller's main job is to perform all of the I^2C housekeeping — including device addressing and checksum generating/checking, freeing the computer's main processor and device driver from all except generalised data transfer functions.

ACCESS uses a modified version of the I^2C device addressing system, with bit 8 of the address byte set to 0 permanently to indicate that a master transmitter is initiating each transfer. This means that all ACCESS bus addresses are 'even'. The host computer is always assigned address 50 hex, and after a power-up or reset all devices adopt a default address of 6E hex. The 14 possible active device addresses are in the range 52 - 6C hex, and these are assigned to each device by the host computer's controller during either the power-up configuration sequence, or the 'dynamic reconfiguration' that takes place whenever a device is connected to, or disconnected from the bus.

The reason why only 14 possible addresses are allocated for ACCESS bus peripherals is to ensure that there is no conflict with I^2C addresses already allocated to standard chips such as RAMs, ROMs, PLLs and so on. This is necessary since many controllers, in both peripherals and host adaptors, will need to communicate with local chips as well as the ACCESS bus itself.

Although having only 14 possible bus addresses might seem a drawback for ACCESS, it's not as serious as it may seem because a *sub-addressing* system allows each device to have up to four logically separate peripherals, sharing the same I^2C controller and bus address. This gives a theoretical maximum of 56 possible peripherals, which should be more than enough for virtually any PC application.

Every ACCESS bus peripheral has to be able to identify itself, by transmitting a standard *identification message*. This consists of three left-justified 8-byte strings, and a 32-bit signed integer number. The strings are used to provide information on the peripheral: the *module_revision* (for example 'Rev_0.3 '), the *vendor_name* (e.g., 'Philips ') and the *module_name* (e.g., 'LDK501 '). The 32-bit number is used for device identification, and can be either a unique serial number (positive) or a pseudo-random number (negative).

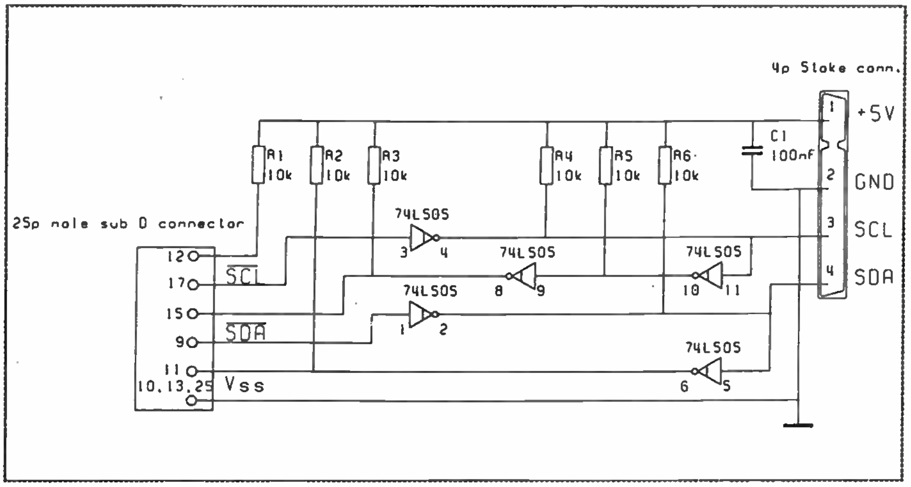


Fig.2: The circuit for the 'poor man's I^2C interface' for a PC Centronics port. As you can see, it uses a single 74LS05 hex inverter chip, six 10k resistors and a 0.1uF bypass capacitor. What could be simpler?

This last *ID number* is used by each device as a cross-checking key, to make sure that any message sent to its bus address is really intended for its reception. Unless a received message contains *both* its bus address and its ID number, the device doesn't respond. The only exceptions to this are when it receives either a 'reset' or 'identify yourself' command message.

But if all peripheral devices power up with the same default bus address of 6E hex, how does the host computer's controller separate them in the first place? That's a good question.

What happens is that at power up or later re-configuration, the host controller sends a reset message out to all device addresses. This forces all devices present to revert to the default address, if they're not already there. Then it sends out an 'identify yourself' command to the default address. Naturally all devices will try to respond, but the normal I^2C bus arbitration system will automatically force them to 'queue', so that their ID messages are sent one after the other — basically in order of their speed of response.

This allows the host controller to deal with each one separately, and re-assign it with a unique bus address. At the same time the host controller can retrieve further information from the device regarding its *capabilities*, to update its software driver configuration. Each device's capabilities information can be up to 64K bytes (normally stored in ROM), with data regarding the device's character set, resolution and so on. During normal operation, the host computer's controller will regularly request any inactive peripheral devices to identify themselves, by polling all assigned addresses plus the default address. If a device does not respond (perhaps because it has been unplugged), or a new device responds at any of the addresses, the host controller will automatically send a reset command to all active addresses, plus the default address. The complete ID, address assignment and capability updating sequence is then repeated, to ensure that the complete bus status is updated.

Incidentally, it's only *after* a peripheral device has received its unique bus address allocation from the host controller that it can send 'live' data back to the computer. Before that, when it's at the default address, it is only allowed to send back ID and capability information.

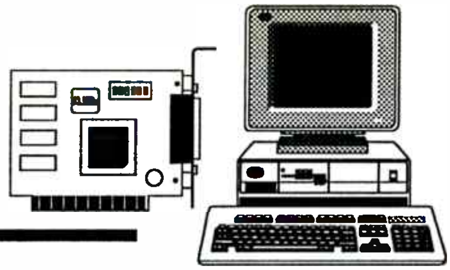
Summary

Hopefully, the first of these articles showed how useful the I^2C bus can be in providing an elegant and efficient way to pass low speed data between chips on a PCB. In the present article I've tried to show how its derivative the ACCESS bus provides a similarly neat and cost-effective way to achieve wider communication, between a personal computer and many of its peripherals.

It's likely we'll see quite a bit more of both I^2C and ACCESS, in the next few years.

Further information on both buses is available from Philips Components, which has offices in each state. ❖

Computer News and New Products



Lasers feature edge enhancement

Siemens has launched two laser printers from Mannesmann Tally, which incorporate all the standards of PCL Level 5.

They also use Mannesmann Tally's 'Edge Enhancement Techno logy' (EET) to detect and smooth jagged edges.

The first printer, known as the MT904 Plus (priced at $2398), examines pixels a line at a time for segment changes, to determine how to adjust the laser spot.

This gives a sharper finish to oblique and rounded shapes for both text and graphics. It has 1MB of memory as standard (expandable to 3MB) and will interface with parallel Centronics and both serial RS-232 and RS-422 connections.

The second new printer is the MT908 with a 32-bit RISC-based processor (priced at $3697). Featuring eight scalable fonts which can also be rotated, it allows users to exploit their creative potential to the full.

Users can print in landscape and portrait on the same page, rotate text and graphics, print white on black, and fill text with patterns or shades. With 1MB of memory as standard, the MT908 can be upgraded to a maximum of 5MB.

Both the MT904 Plus and MT908 have four resident emulations, including PCL level 5, as standard. Built into the command set of PCL level 5 is HPGL level 2, the inustry-standard plotter/graphics emulation.

For further information circle 164 on the reader service coupon or contact Siemens Advanced Information Products, 544 Church Street, Richmond 3121; phone 008 032 954

Eagle motherboards

Based in Melbourne, Eagle Systems International is a wholly Australian owned designer and manufacturer of computer components. These include motherboards for 386 (SXT and SXI) and 486 (DSX and DX2) configurations, which support the entire Intel range of CPU's.

New LCD projection panels

In Focus Systems has released four new LCD projection panels, range from the low-end black and white LCD panels for the price-sensitive education market, to high-end video projection systems for multimedia presentations.

The new products include the 7600XGA, with a 1024 x 768 resolution LCD projection panel. It has a 24,000 colour palette and is designed to maximise the amount of information displayable under Windows as well as project sophisticated graphics such as computer-aided design, 3-D modelling and medical imaging. The 7600XGA has a passive matrix panel.

The TVT3000 offers customers an active matrix LCD projection panel with 262,144 colours — the largest palette size available. It can run animation, multimedia applications like QuickTime, computer based video and live video at up to 30 frames per second. To run live video, the system requires a PAL to RGB converter.

The 7000FX+ is a passive matrix panel featuring a 24,000 colour palette with rich saturation, and the ability to display 640 x 480 resolution.

And finally the 1600GS is a low cost black and white, passive matrix LCD projection panel, which features 16 levels of grey scale for representing the colours most commonly used in software today. It also features 640 x 480 resolution. Targeted specifically at the price-sensitive eduction market, the 1600GS is compatible with most Apple and IBM computers used in school systems today.

All four new products feature built-in loop-through so the user can see the image in the monitor and projection screen simultaneously; on-screen set-up menus; and push button rear projedtion mode to facilitate set up of a sophisticated rear projection presentation. All except the 1600GS include a remote control for image adjustments.

For further information circle 166 on the reader service coupon or contact Electroboard, 275 Alfred Street, North Sydney 2060; phone (02) 957 5842.

Eagle Systems also design and manufacture a wide range of high grade PCBs, including a full range of VGA cards, LAN cards and LAN stations.

For further information circle 165 on the reader service coupon or contact Eagle Systems, 70 Keys Road, Moorabbin 3189; phone (03) 355 0133.

Low cost LANs

Procon Technology is now offering customers a range of low cost network solutions.

The Murrumbeena Network System (MNS) starter kit provides two network cards, 10 metres of cable and MNS software for just $360 inc. tax. This system may expand to nine users, over a maximum cable length of 50 metres. For longer distances the TFT network card is available. Using standard telephone cable over distances of 300 metres, with excellent reliability, this system costs $495 inc.tax.

The advantage of MNS over other networks is the ease with which the hardware and software can be installed — just plug in the cards, connect the cable, and run MNSSERVE on the server and MNSWORK on the workstation.

MNS is ideal for home users who wish to back-up information on a second computer system and to share a printer between systems.

Educational institutions would also find MNS suitable for the classroom — the instructor can use the server (the computer can still be used to run DOS applications, as MNSSERVE runs in background), allowing a single copy of software to run on all computers in the room, and for all computers to share a single printer.

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Continuous form 16ppm laser

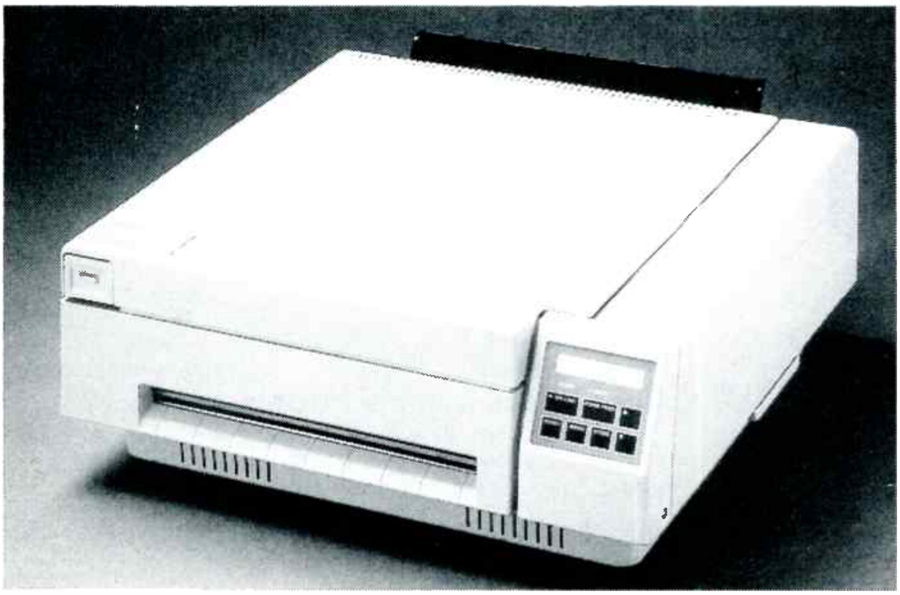
Facit has released its Model D7160 laser printer, which features high speed 16 page/m throughput on continuous forms media. The printer uses a high-performance RISC-based graphics controller to provide industrial labelling and graphics capability such as bar codes and variable size characters.

The D7160 can also be used as a high speed low cost alternative to line printers, with an equivalent throughput of 1024 lines/minute.

The printer emulates IBM Proprinter and QMS Magnum Code V, Text Mode (Line Printer), and features optional IBM Twin-Ax/Co-Ax interfaces. This makes it compatible with a wide range of computer systems and a direct replacement for many line printers.

Print capabilities include variable size characters, 40 bar code types, auto-incrementing of number fields, and much more. A free WYSIWG software for label creation is also available. Logos, forms and other graphics can be downloaded and stored in the printer. The D7160 also prints on a wide variety of media, such as polyester, vinyl, mylar and tag stock, in format widths ranging from 11.4 to 25cm, and unlimited length. A straightthrough paper path with self centring tractors ensures reliable feeding.

For further information circle 163 on the reader service coupon or contact Elmeasco Instruments, PO Box 30, Concord 2137; phone (02) 736 2888.



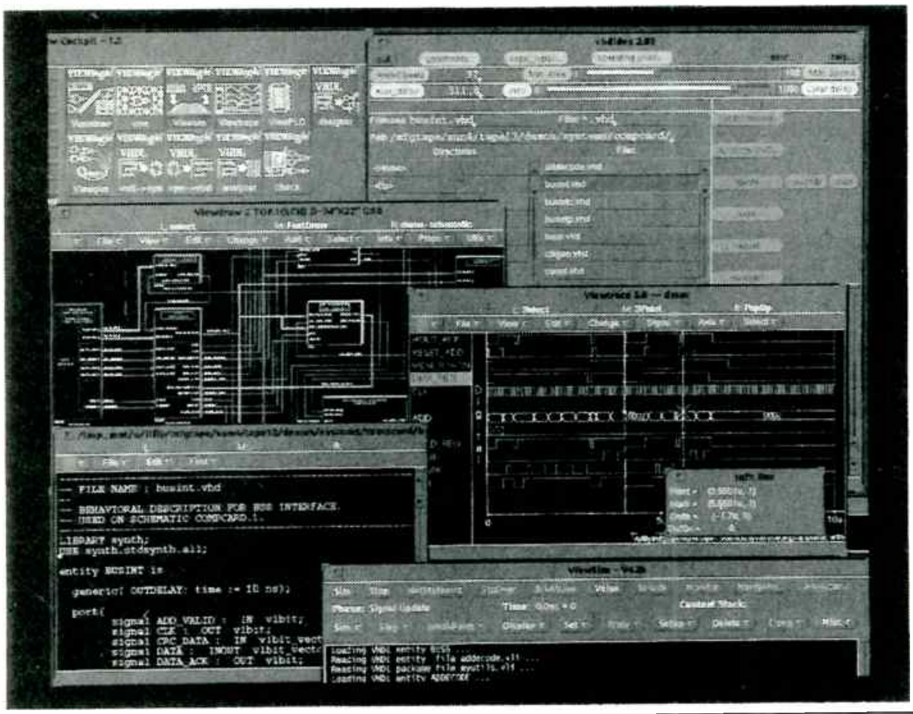
Tools for design automation

Viewlogic Systems has released Powerview, a family of high performance, UNIX-based design automation tools and a modular framework. Powerview enables electronic engineers, for the first time, to mix and match tools from multiple sources easily, so they can design complex electronic components more quickly and cost effectively.

Powerview is claimed to be the first commercial offering based on the proposed electronic design automation (EDA) standardards being developed by the CAD Framework Initiative (CFI). CFI is an industry body comprised of prominent EDA users and vendors, including Viewlogic, working to standardise critical aspects of design automation technology.

It also incorporates industry-standard user interfaces, such as OpenLook and Motif and supports VHDL, EDIF and other industry standards. The adherence to these standards and Viewlogic's commitment to providing an open design environment is claimed to make it the most open and flexible design environment on the market.

"With the announcement of Powerview, Viewlogic is delivering what engineers have wanted for years — the ability to integrate multiple vendors' and their own tools into a unified design environment, while precisely meeting their design engineering needs," said Gene Robinson, Senior Vice President of Sales and Marketing. "Design engineers are tired of having to choose between tools that offer the best performance for a particular task, and tools that work well together. Now they can have both."



Powerview offers high flexibility for design entry, allowing designers to choose the forms of entry that most closely fit the task. Designs may be entered via VHDL, ABEL, truth tables, state diagrams and tables or functional block diagrams, in addition to schematics.

Designs can also be entered through the waveform editor and a new graphical VHDL entry tool. Whether designing at the behavioural, structural or gate level, the package provides the optimum design entry environment for system, ASIC, IC, FPGA, PLD, analog and mixed signal design.

Powerview's simulation environment, Viewsim, combines VHDL simulation and debugging with mixed analog and digital simulationof complex components and systems.

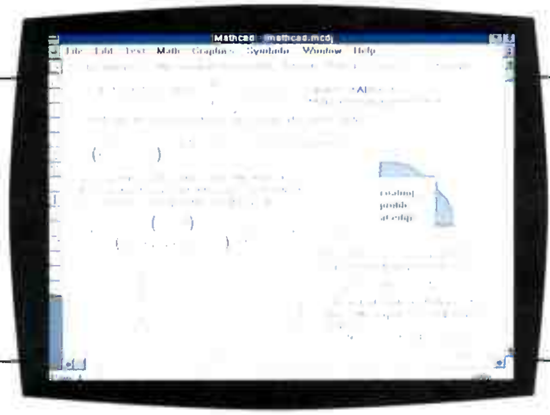
Analog and mixed signal capabilities are added through extensive integration of industry standard SPICE simulators.

All Powerview tools run on UNIX-based Sparcstations from Sun Microsystems Inc, and are data compatible with Viewlogic's Workview tools for MS-DOS-based computing platforms.

Versions of Powerview for use on UNIX-based engineering workstations from other manufacturers, including Hewlett-Packard Company and Digital Equipment Corporation, are currently under development.

For further information circle 168 on the reader service card or GEC Electronics Divisions, 1/38 South Street, Rydalmere 2116; phone (02) 638 1888.❖

Calculations.



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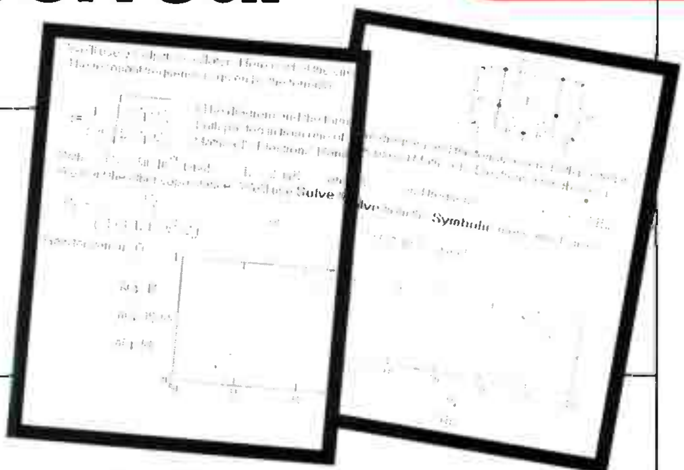

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12V OPERATED LASER WITH A KIT SUPPLY

Save by making your own 12V laser inverter kit. This combination includes a He-Ne visible red laser tube and one 12V universal laser power supply kit — MkII. This inverter features easy construction since the transformer is already assembled and will drive all the 0.2-15mW tubes efficiently. Universal 12V supply plus a used 2-3mW tube or head **$99**

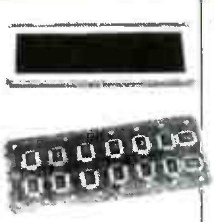
One extra tube or head $30 extra. Only with initial purchase.
(Item No. 0105X)

Universal Supply Kit plus a new 1mW tube **$129** (Item No. 0105)

Universal Supply Kit plus a new 5mW tube **$189** (Item No. 0106)

Universal Supply Kit plus a new 10mW tube **$299** (Item 0107)

LARGE LCD DISPLAY MODULE



Brand new large Hitachi LM215XB display, as used in some laptop computers. Yellow-green LCD reflective type, 480 X 128 dot display, effective display area of 242 X 69 mm, has 14 LSI ICs mounted on the rear of the PCB. Includes four pages of data sheets. Limited stock at a small fraction of their real value. **$39** ea.
(Item No. 0132)

MAINS OPERATED LASERS

Consider this mains operated laser for discos, laboratories, photography, holography, medical use, etc. We supply a brand new laboratory quality He-Ne visible red laser tube, with its matching encapsulated (240V AC) power supply. **$179**
(Item No. 0112)

2-4mW tube with its mains supply **$240** (Item No. 0113)

8-10mW tube with its mains power supply **$390** (Item No. 0114)

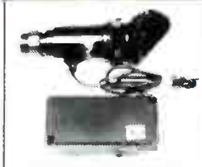
Other combinations may also be available: Ring.

PASSIVE NIGHT VIEWER

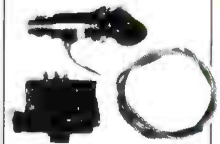
These custom made viewers will produce useful images with starlight illumination only. Can be IR assisted, in rare situations where this may be required: In these cases low power IR LEDs, IR lasers, or low power torches fitted with an IR filter can be employed. The viewers employ an ex-military 18mm fibre optically coupled second generation image intensifier. They also have automatic gain control, to protect against possible excessive lighting levels. Limited availability at a super price **$1800**
(Item No. 0145)

Note that we may also have in stock some second generation tubes similar to the ones used in these viewers, but with some blemishes. These will be priced between $500 and $700. Ring.

NIGHT VIEWER BARGAINS



A very small telescopic monocular IR viewer. The assembled scope has high quality military grade optics, and employs a prefocussed IR image converter tube. This tube has a useful response from 600-1300 nM, thus also making it useful when working with IR LEDs, and IR laser systems. The scope has provision for a coaxial E.H.T. connection, and is supplied with a power supply kit, that features a ready assembled inverter on a small PCB. The power supply easily fits into a small plastic case, and can be fitted with a belt clip: Also supplied! At a very small fraction of its real value! **$269**
(Item No. 0121)



We can also supply the same monocular viewer with its original power supply. Powered by a single 1.5V C type battery. In this case all that is needed is connecting the scope to the power supply unit via a coaxial cable, which is also supplied. **$289**
(Item No. 0122)

I.R. BINOCULAR VIEWER

High quality military binocular IR viewer. Self powered, and originally intended to be mounted on a helmet. Focus is adjustable from 1 metre to infinity. Requires some IR illumination. Powered by one single 1.5V battery. Original fibreglass carry case provided. Limited stock. **$649**
(Item No. 0125)

Can easily be re-built as a hand held binocular IR viewer.
Note that the $649 units are in "as new" condition. We may have some units that need a little cleaning at lower prices. Ring.

SOLAR PANEL GIVEAWAY

Brand New high quality US made, amorphous glass Solar Panels. Dimensions: 150 X 150 X 2.5mm. In normal sunlight they deliver a full 1 Watt whilst charging 6V-8V batteries! Can be connected in series, in parallel, or series / parallel, to increase the voltage, and/or current capacity. For example, in average sunlight, two of these panels connected in series will deliver approximately 150mA of charging current, into a floating 12V (14V) battery: 2 Watts! Four panels can be connected in series parallel to deliver 300mA into a floating battery: 4 Watts! Compare the prices! All the panels have a weather protection film on rear, and the terminating clips are provided.
INCREDIBLE PRICING: **$10** ea.
or 10 for **$85**
(Item No. 0130)

PROJECTION LENS

Brand new large precision projection lenses, which were originally intended for big screen TV projection systems. Will project images at close proximity, onto walls and screens and it has adjustable focussing. Main body has a diameter of 117mm and is 107mm long. The whole assembly can be easily unscrewed to obtain three very large lenses: two plastic and one glass. The basis of the cheapest large magnifier or projection system? Experimenters delight at ONLY **$28**
(Item No. 0137)

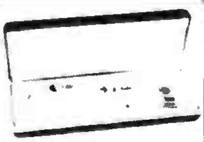
SINGLE CHIP MICRO COMPUTER

In the form of a telephone display. Based on an NEC uPD7503G single chip micro computer. Apply power to the unit and the display will show date and time (Xtal controlled oscillator on board) but this is only a small part of the micro computer's features: 4 bit single chip micro computer, 4 bit parallel ALU, 8 bit serial interface, 4096 X 8 bit words of ROM, 224 X 4 bit words of RAM, 23 general purpose I/O lines, 24 line segment outputs and 4 lines common outputs for driving LCDs, instruction set enables direct memory addressing, can be battery operated (3.5-6V), extremely low battery consumption: less than 1mA whilst operating, less than 10uA in standby. Connection to the phone display can be made by simply pushing wires into the socket provided. One complete 15 page set of instructions on the uPD7503G and a circuit diagram of the phone display will be provided with each order for one or more of the phone displays. ONLY **$15** ea.
OR 5 for $60
(Item No. 0133)

LASER GUNSIGHT

Small black anodised metal body. Removable pressure switch. Vertical and horizontal adjustments. Battery life more than 10 hours continuous. 5mW 670nM class IIIA laser. Range is about 150m, some would claim three times more. Shock tested to 2000g. One year warranty.
ONLY **$299**
Price includes one rifle or pistol mount
(Item No. 0108)

VISIBLE LASER DIODE POINTER-PEN

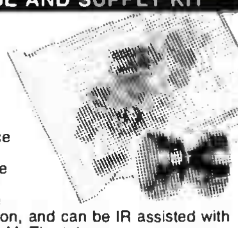


Suit teachers, doctors, businessmen, and other professionals. Improve and enhance all your presentations. Not a kit, but a complete commercial pen sized laser pointer at an incredible price!
ON SPECIAL AT
$180
Small pen sized body. Runs on two small AAA battery. Battery life: 2-10 hours. Visible 5mW red (670nM) laser. Projects a visible red spot at more than 50 metres. As used for medical treatment by doctors and acupuncturists.
(Item No. 0101)

NEW CRO TUBES AND VALVES

CRO tubes: 1" electrostatic deflection type number CV1522 **$35.** 3" spiral PDA electrostatic deflection type numbers DP-10-6 and 4VP7 **$44.** Mercury vapour rectifier valve type 866A/866 **$5.** Pentode valve type 6C6 **$5.** All items are new limited stock items and are supplied in their original cartons. Enquire about reduced quantity prices.
(Item No. 0136 + item details)

PASSIVE TUBE AND SUPPLY KIT



We sold out of these tubes within two days of publication of the Mini Night Viewer in Oct. 91 E.A., but have now located a further small quantity. These first generation tubes produce a very high resolution picture because they use fibre optic windows, will produce a useful picture with moonlight illumination, and can be IR assisted with IR illumination: 800-900nM. The tubes are used and may have very minor blemishes. For the tube and a high voltage inverter only. **$299**
(Item No. 0124)

For further reading on Night Viewers see: *Electronics Australia* (E.A.) May 1990, E.A. Sept. 1990, E.A. Oct. 1991. *Australian Photography* Dec. 1991.

VISIBLE LASER DIODE HEAD

Save, by making your own laser pointer, laser gun sight, medical treatment laser, etc. Produces a well collimated beam. Designed to be powered directly from a 3V battery, or from higher voltages, if a simple constant source is added. Simple circuit included. 5mW (670nM). At an incredible introductory price of: **$135**
For the head only.
Add $8 for the extra "bits" needed to make a complete laser diode pointer. Case, switch, alkaline batteries, and battery holders.
Everything you need to make a complete, self contained, visible laser pointer or gunsight.
(Item No. 0103)

OATLEY ELECTRONICS

FOR SPECIALISED ELECTRONIC ITEMS, COMPONENTS AND KITS

PO BOX 89, OATLEY, NSW 2223
Telephone: (02) 579 4985 Fax: (02) 570 7910
Certified p&p: $6 in Aust. NZ (Airmail): $10

READER INFO NO. 34

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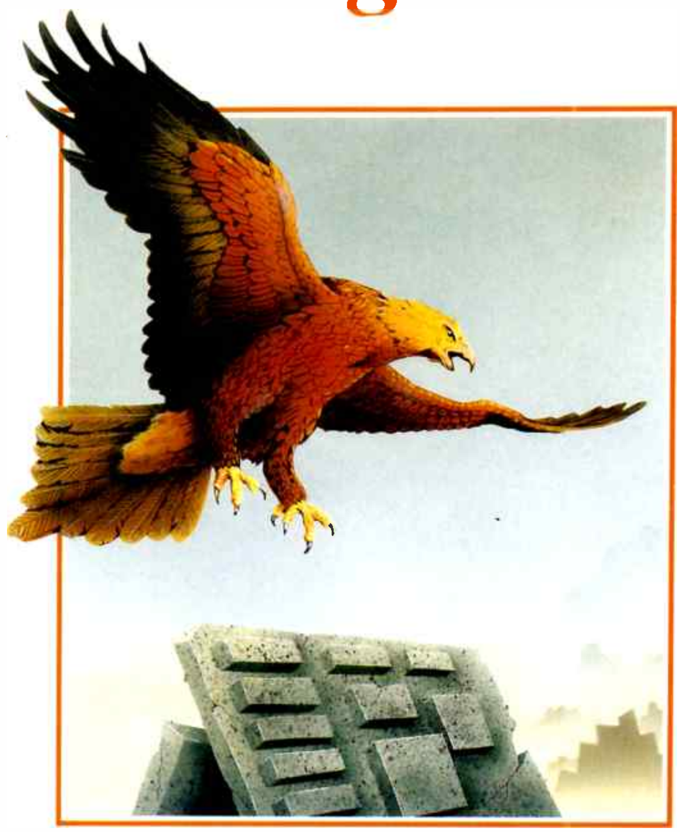
The *Eagle* Flies Highest.



No doubt, your demands are really quite simple. You want a computer that runs flat out all the time, doesn't break down, talks to all kinds of other systems, works as a network or standalone, and thinks the way you do.

By that we assume you want it to work as hard and as fast as you do, have the same stamina that you do, and keep going until the job is done, just like you do.

During the two year development of the 486 DX2-50, we have had just two obsessions, awesome speed and absolute reliability. Unlike some of our competitors, these obsessions were not mutually exclusive.

With the release of the Eagle 486 DX2-50 we have achieved our objectives. Naturally one of the key elements was the selection of the processor. We needed a chip that was fully capable of supporting the system we had designed.

Intel was the only choice.

The Eagle 486 DX2-50 is now a reality. It is so good, and the price is so competitive, that we are exporting it to Europe. Good for Eagle, good for Australia, not too bad for Europe either.

You can purchase this system complete, or just as a board, case and power supply kernel. Users, dealers, EDP Managers and Systems Integrators and Installers are invited to call for further details.

If our experienced sales force can't help you, (which is extremely unlikely), then the people who designed and built the system certainly can.

Nobody knows more about it than we do.

Fly High.

Eagle 486 DX2-50 LANDMARK SPEEDS

Landmark V2.0	CPU	167.5 mHz
Landmark V2.0	FPU	397.4 mHz

EAGLE ALSO MANUFACTURES:

* 386 SX Integrated Motherboards.
* 486 SX20 through to 486 DX2-50.
* Super VGA Cards.
* 386 Lan Stations.

and our latest release,
The Integrated Lan Station (ILS) with VGA Lan Connectors, IDE, Serial X 3, Parallel Port, 32 Meg Ram (Incorporating the Intel 386 SL chip set), all built into a super new slim line case.

intel inside

READER INFO NO. 36

DEALER and O.E.M. ENQUIRIES WELCOME

EAGLE SYSTEMS

Eagle Systems International Pty Ltd
ACN 004 518 123
70 Keys Road,
Moorabbin, 3189
PH: (03) 555 0133
Fax: (03) 553 2572
AH: (03) 878 1961