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"It was clear and detailed with a crisp and attractively positive presentation. Dynamic range was wide and the player produced vivid stereo with clearly localised images."
JIMMY HUGHES, HI FI ANSWERS MAGAZINE (U.K.) ON THE PD91 REFERENCE SERIES C.D. PLAYER.

"I am forced to note that the sheer goodness of the Pioneer revealed starkly the inconsistent engineering standards at the BBC and other broadcast organisations."
ALVIN GOLD, WHAT HI FI MAGAZINE (U.K.) ON THE F91 REFERENCE SERIES AM/FM TUNER.

"The fidelity, lack of distortion and even the low frequency performance belied the size of the speakers, their cost and their miniscule proportions. The quality of sound was right on par with my reference speakers and I was more than impressed."
LOUIS CHALLIS, ETI (ELECTRONICS TODAY INTERNATIONAL) ON S55T LOUDSPEAKERS.

"I used it to fill a restaurant with sound for a lively office party and accepted accolades on the sound quality all night."
PAT HAYES, ETI (ELECTRONICS TODAY INTERNATIONAL) MAGAZINE OF THE Z770 "MIDI" SIZE HI FI SYSTEM.

"Pioneer's Z990 should be on the short list of anyone looking for a midi system."
CHRIS GREEN, AUSTRALIAN HI FI MAGAZINE ON THE Z990 MIDI SIZE HI FI SYSTEM.

"I see it appealing both to the audiophile wanting a good "purist" machine for sound quality reasons, as well as to the more general user."
JIMMY HUGHES, HI FI ANSWERS MAGAZINE (U.K.) ON THE PD9300 (PD71 IN AUSTRALIA) REFERENCE SERIES C.D. PLAYER.

"This player is a high quality example of the genre. Build and finish are first rate, and the lab performance was superb. Impressive in many ways, it can be recommended with confidence."
MARTIN COLLOMS, WHAT HI FI MAGAZINE (U.K.) ON THE PD6300 C.D. PLAYER.

"Given that it's a good idea having two trays, Pioneer has achieved this enhancement very elegantly and with surprisingly little additional hardware."
JIM ROWE, ELECTRONICS AUSTRALIA MAGAZINE ON THE AWARD-WINNING PDZ72T TWIN TRAY C.D. PLAYER.

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C.E.S.A. (AUSTRALIA) AWARD TO THE PDZ72T TWIN TRAY C.D. PLAYER.

"Replay of PAL encoded discs gave superb results. It was virtually impossible to tell it from a normal broadcast picture and was miles better than standard VHS tape."
RICH MAYBURY, WHAT HI FI MAGAZINE ON THE CLD1400/CLD1450 COMBINATION C.D./C.D. VIDEO PLAYER.

"Many people will be surprised that it is a cassette based machine at all, so nearly is it in danger of transcending the natural limitations, and so authoritative is its style of delivery."
HI FI CHOICE MAGAZINE (U.K.) ON THE CT91A CASSETTE DECK.

"The CT656 is a distinguished entrant in the market for budget three head designs. It can be confidently recommended."
HI FI CHOICE MAGAZINE (U.K.) ON THE CT656 CASSETTE DECK.

"Pioneer have just launched a player which sets a standard by which others will be judged."
GRAHAM S. MAYOR, WHICH COMPACT DISC? MAGAZINE (U.K.) ON THE PD91 REFERENCE SERIES C.D. PLAYER.

"Pioneer have done well to put together such a package for this price and the only real problem is to find good enough programming to exercise its virtues."
CHRIS BRYANT, HI FI CHOICE MAGAZINE (U.K.) ON THE F91 REFERENCE SERIES AM/FM DIGITAL TUNER.

"This tuner was free of digital nasties and benefitted from a pleasantly quiet background."
PAUL MILLER, WHAT HI FI MAGAZINE (U.K.) ON THE F225L AM/FM DIGITAL TUNER.

"The Pioneer's impressive specification and build were confirmed by the listening tests."
WHAT HI FI MAGAZINE (U.K.) ON THE CT335 CASSETTE DECK.

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Electronics Australia

June 1990

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE – ESTABLISHED IN 1922

The World of MEGA SOUND!

PA systems have come a long way in the last few years, in both power and fidelity. Here's a look at the kind of megasystems used for today's live outdoor concerts. (Page 10)

You'll find this month's ETI in the centre of the book, facing page 74. Highlights include a feature on automated test equipment; Les Cardilini's review of Yamaha's new CD players with single-bit DACs; a look at the new Bose noise-cancelling headset, by Louis Challis; and a story by Kester Cranswick on Apple's new portable computer.

On the cover

Setting the scene for this month's features on test instruments, Tracy Douglas is shown trying her hand at measuring the response of an RF probe – part of a project that we'll begin describing next month. (Photo by John Fryz)

Features

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Projects and Technical

News and Comment

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LETTERS TO THE EDITOR

Phone 'tapping'

I am writing to bring to your attention recent changes to the law relating to telephone interception devices.

It is already an offence against section 7 of the Telecommunications (Interception) Act 1979 (Commonwealth) for an unauthorised person to intercept, or to do any act or thing that will enable a person to intercept, a communication passing over a telecommunications system. The changes will supplement this offence by making it an offence, except in certain circumstances, for a person to manufacture, advertise, offer for sale, sell or possess an apparatus or device if the person knows or ought reasonably to have known that it can be used to enable a person to commit an offence against section 7 of that Act. The offence covers both assembled and unassembled devices.

The offence will not apply unless the device could reasonably be regarded as being designed for the purpose of using it in connection with an act of interception. It will not be an offence to manufacture, advertise, offer for sale, sell or possess such an apparatus or device for the purpose of interceptions authorised under the Act, or to manufacture, sell or possess an apparatus or device for export. Other exceptions are set out in the Regulations. The new offence, which is found in section 85ZKB of the Crimes Act 1914 (Commonwealth), provides for a substantial fine or possible imprisonment.

J R Dick,
Senior Assistant Secretary,
National Security Branch,
Attorney-General's Department,
Parkes, ACT.

Sony headphones

Thank you for doing a product review on Sony's MDRR10 headphones.

In this letter, I hope to answer your inquiry on the driving impedance recommended for use with MDRR10.

You asked whether the MDRR10's should be driven from the usual reasonably constant-current circuit, or driven from a low impedance, relatively constant-voltage circuit, like a loud speaker? (From page 34, February issue).

Our reply is that the driving circuit impedance does affect the performance of headphones. However, MDRR10 performs well regardless of the type of driving circuit impedance used. The reasons are two fold. First, because the damping factor of MDRR10 is higher than the speaker systems. Second, because Sony engineers have always been aware when engineering headphones of the wide range of output impedance of amplifiers, special care was taken to put the sound within the scope aimed for regardless of the type of driving circuit impedance used.

Rather, Sony recognises that sound performance of MDRR10 will be affected more by the quality of the amplifier.

Sony engineers have found that the possibility of getting better performance is higher when a low impedance headphone jack is used.

I hope that answers your inquiry. If you have any further questions, please kindly contact myself.

T. Terazawa,
Sony (Australia),
North Ryde, NSW.

WIA broadcasts

Thank you for a most interesting report on the broadcast facilities of the NSW division of the WIA, in the March edition. However, the story has a small number of errors which I wish to correct.

By the way, use of the term 'ham' is deprecated by the WIA, due to its negative connotations, and I note that on the opposite page you use the more correct term 'Amateur'.

The order of news articles is not quite correct. 'Silent Key' notices are presented first, before the divisional news, and other events such as sales seminars etc. are presented along with the divisional news. WICEN news is also mentioned after the IPS report. This format has been used for some time, following a number of arrangements, and seems to be the most popular.

Following the morning broadcast, a summary is recorded onto an answering machine, accessed by dialling (02) 651-1489 outside of broadcast hours. This is for the benefit of those who missed both broadcasts. The text is also uploaded to the divisional packet radio bulletin board for further distribution, and also uploaded to an Australia-wide computer network ASCnet.

Although Jeff Pages VK2BYY was responsible for much of the recent work, the efforts by the rest of the Dural Committee cannot be ignored, such as the installation of the AM HF transmitters.

The preparation of the broadcast roster is actually carried out by an assistant, Steve VK2KXX, whose help is invaluable.

Although the 80m morning AM transmission has been temporarily dropped in favour of 30m, the evening SSB transmission still remains on 3.595MHz.

To speed up the callbacks in the morning, a third person takes 2m repeater callbacks, on 147MHz, and traditionally this is the task of the broadcast officer.

Finally, the building also houses the divisional beacons, covering 10m, 6m, 2m, 70cm and 23cm, with others being planned.

By the way, Ray Biddle's callsign (caption to the photograph on page 117) is VK2DB, not VK2ZDB.

Thank you once again for an interesting presentation of the NSW divisional broadcast, albeit only slightly marred by the above errors and omissions. I will be happy to supply any further information you may desire.

David I.Horsfall VK2KFU,
VK2 Broadcast Coordinator.

Tesla papers

I am wondering if you can help me. I am trying to get copies of Nichola Tesla's 'Works, Lectures, Patents and Articles: Inventions, Researchs and Writings of Nicola Tesla', here in Sydney.

I have tried the NSW Library, but the books are missing. I went to the Library of the University of NSW, but they have nothing in stock on Tesla.

I would be grateful if any of your readers know where I could go in Sydney to get copies on the above subject matter.

Barry F. Curtiss,
8/8 Cowper Street,
Randwick, NSW 2031.

Feel free to send a letter to the Editor if there's something you believe that *EA's* readers should know. If we agree we'll publish it, but we do reserve the right to edit those that are too long, or potentially libellous.

EDITORIAL VIEWPOINT

Stronger than ever, we look to the future

As you've probably noticed already, this month's issue is even fatter and heavier than usual. That's because it's now essentially *two* magazines in one: we've been joined by our next-largest competitor, *ETI*.

I'm sure most of our readers are aware that for nearly six years now, *EA* and *ETI* have been 'stable mates', owned by the same publisher yet still competing in healthy and vigorous fashion. In doing so we've been continuing a tradition of friendly rivalry that began back in 1971, when *ETI* first appeared on the Australian electronics publishing scene. For over 19 years it has given readers a strong and lively 'alternative choice' in electronics reading, and established itself as the undisputed 'No.2' publication in the field.

It's been a continuing source of pride that our company has been able to maintain *EA* and *ETI* in the first and second positions in this market, despite the entry of various other publications – many of which are now defunct.

But electronics is a rapidly evolving and changing technology, and all electronics publications must evolve with and adapt to the resulting changes if we are to continue providing the greatest possible benefit to you, our readers and advertisers. As part of this process, Federal Publishing has now decided to merge the two titles together, to provide you with the magazine best equipped to meet your needs for the future.

Our aim with the new enlarged *Electronics Australia with ETI* is to combine the best elements of both titles, to produce a magazine that is not only the biggest, but also the brightest and most informative in its field. We're certainly going to be putting a lot of effort into achieving this goal, and with our newly enhanced resources I believe we're in an excellent position to do so.

For *EA's* existing readers, the change will bring many benefits, not the least being more extensive and timely coverage of computer technology and consumer electronics. *ETI's* readers will also find many of their familiar writers, reviewers and features – plus all of *EA* as a bonus!

So Australia's two leading electronics magazines have merged, to become even bigger and stronger. I hope you'll stay with us, because the future looks more exciting than ever.

Jim Rowe

What's New In HOME ELECTRONICS

Hi-band 8mm camcorder from Sony

The story of video is one of a constant search for picture excellence and this search is about to open a new chapter with Sony's introduction of the world's first Hi8 camcorder, the CCD-V900.

The Hi8 video system is achieved by a shift in the luminance recording carrier which raises the lines of horizontal resolution to more than 400, plus a wider frequency deviation that provides a better video signal to noise ratio. The luminance carrier frequency is 7MHz, up 2MHz from standard 8mm. Similarly, the frequency deviation on Hi8 video is 2MHz, compared with 1.2MHz on standard 8mm.

The greater than 400 lines of horizontal resolution in playback is also achieved by the use of new metal evaporated Hi8 tape. Through its improved electromagnetic characteristics ME tape offers a 5dB improvement in video output and carrier to noise ratio.

The essential differences between ME and conventional tape is that ME tape is composed of metal thin film, which does not contain additives such as a binder or curing agent. The 0.2 micron thick magnetic layer is formed through vacuum oblique evaporation with the introduction of oxygen. The magnetic materials used are mainly Co and Ni, which build up with a curved columnar structure. The magnetic layer is one-fifteenth the thickness of conventional coated tape.

A new precision 2/3" charge coupled device is the high technology source for Hi8 recordings, and used in the CCD-V900. This CCD has 495,000 pixels (gross), 440,000 of which are effective for the creation of sharp detailed images. True RGB colour processing is said to provide unrivalled colour fidelity.

The CCD-V900 has an auto iris feature to control exposure in varying lighting conditions, plus a new four mode auto white balance system. The four modes are: continuous adjustment, hold and two preset modes for indoor and outdoor lighting conditions. Freeze frame, slow motion and frame by frame advance are built in special effects which make it easy to see details of the recorded images with the camcorder's variable speed electronic shutter.

Also built in is a two-page digital superimpose with scroll/reverse capability, allowing pictures, illustrations and handwritten or printed titles to be superimposed while recording. Titles can be scrolled and/or image reversed from bottom to top for an added professional look.

The CCD-V900 camcorder is available from the Sony Dealer network at a RRP of $3699.

For further information, contact Sony, 33-39 Talavera Road, North Ryde 2113 or phone (02) 887 6666.

S-VHS mixer with frame synchroniser

Panasonic's latest 8-bit digital production mixer, the WJ-MX12, features an internal frame synchroniser to eliminate the need for a TBC, and offers S-VHS capability via separate Y/C input/outputs.

It also provides digital effects such as freeze, strobe, painting and mosaic, a colour border wipe and a full function in-built colour corrector.

The appearance of soft edge and wipe patterns have been vastly improved due to an increase in frequency response from 3MHz to 5.5MHz. The signal to noise ratio on the video signal has also increased to 48dB from 46dB, while the Y/C sampling frequency has been upped to 14.3MHz (Y) and 3.58MHz (C).

The mixer also incorporates analog effects such as fade, mix, super, impose, as well as 17 wipe patterns to keep up the variety in production.

There are four audio inputs on the WJ-MX12: two stereo main, one stereo auxillary and a mono mike input, which can be combined and are available from two line level stereo outputs.

For further information, contact GEC Video Systems, 2 Giffnock Avenue, North Ryde 2113 or phone (02) 887 6222.

Top end ribbon speaker systems

Ribbon speaker technology has been used in loudspeaker design since the ribbon tweeter was first patented in Germany in the early 1990's. However, earlier attempts to design a full range ribbon (20Hz to 20kHz) speaker system met with only limited success, and in 1981 Apogee became the world's first and only manufacturer to offer a full range ribbon system.

The American Apogee range consists of five models.

The Stage model stands 91cm high and weighs 27.2kg. It is a two element system, able to be configured for mono or bi-amp operation. Nominal impedance is 3 ohms. The Stage is covered by a two year warranty and has a recommended retail price of $5895.

The Calibre Signature stands 122cm high and weighs 32kg. It is again a two element system that can be driven for mono or bi-amp applications. SPL is quoted at 110dB. The Calibre Signature is covered by a two year warranty and has a recommended retail price of $7995.

The Duetta Signature is 152cm high and weighs 43kg. It is a two element full range system, with a nominal impedance of 4 ohms and capable of an SPL level of 115dB. Recommended re-

tail price is $11,995 and it is covered by a two year warranty.

The Diva is 182cm high and weights 68kg. It is a three element system (woofer, mid range and treble) with a nominal impedance of 3 ohms. SPL is quoted at 118dB (peak). The Diva has a recommended retail price of $23,995 and is covered by a three year warranty.

The Diva DAX has the same specifications as the Diva. However, it comes complete with the DAX (Dedicated Active Crossover) and represents a major saving as opposed to ordering the DAX and Diva separately. Recommended retail price is $27,995.

For further information, contact Audio Connection, Suite 1, Old Town Centre Plaza, Bankstown 2200 or phone (02) 708 4388.

Compact 3-speaker system from Bose

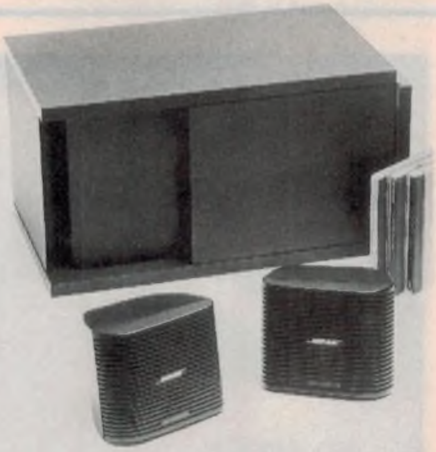
Two sculptured injection moulded wedges are the only visible components of the latest three-piece home loudspeaker system from Bose.

These small wedge-shaped enclosures, along with an unobtrusive bass module, are claimed to produce a lifelike and spacious stereo sound with the bass, power handling and dynamic range of a much larger system.

Called the AM-3 the new music system brings the benefits of the critically acclaimed Bose Acoustimass technology to an even smaller, more affordable system.

Sound waves in an Acoustimass system are launched into the room by two moving air masses rather than by the vibration of a driver cone. The claimed result is pure sound, reduced cone motion, and low distortion.

The Acoustimass 3 bass module was a 5-1/4" driver and measures only 20 x 20 x 35cm with a weight of only 6.5kg, while the curved wedge-shaped enclosures measure 8.75 x 11.25 x 11.25cm



and weigh only 500g. Operating in the range above 200Hz, each speaker contains a single long-throw 6.25cm wide range transducer specially designed by Bose. Each drive is fully magnetically shielded, to allow close positioning to video monitors if desired.

For further information, contact Bose Australia, 11 Muriel Avenue, Rydalmere 2116 or phone (02) 684 1022.

'Floor' hifi systems from Pioneer

Pioneer Electronics Australia has released its new range of Avante hi-fi-floor systems.

Three audio hi-fi models offer a full range of music source functions, starting with the Avante Z-770, through the middle market with the Avante 6300, and culminating with the sophisticated, superbly featured Avante 9300.

The Avante Z-770 comprises a 35 watts per channel amplifier, five band equaliser with spectrum analyser, multi-program timer and full function 'SR' remote control, full logic double auto reverse cassette deck with music search, AM/FM tuner with 24 pre-sets, fully automatic turntable, two-way, three-element speakers and choice of twin play or multi-play CD player.

The Avante 6300 has 125W per channel while the premier model, the Avante 9300, comprises a fully integrated amplifier with 130 watts per channel, and three-way speaker system with 16" bass drivers.

For further information, contact Pioneer Electronics, PO Box 295, Modialloc 3195 or phone (03) 580 9911.

Fax machine for the home

The Canon Homefax is black, stylishly designed, lightweight and portable and requires no special installation. Simply plug it into the telephone socket and send a fax message.

It will be sold through K-mart stores and other consumer outlets, retailing for $1250.

Homefax is intended for the self employed and for business executives who often have to work back at the office waiting on local and overseas fax messages. It includes an automatic document feeder that takes up to five A4 size documents, and multi-function pulse/tone phone.

Further information from Canon Australia, 1 Thomas Holt Drive, North Ryde 2113 or phone (02) 887 0166.

Laptop video TV system

Hitachi's LC50 is a compact portable VHS video recorder that also incorporates a flip-up 5" high definition LCD colour television. All the standard video functions such as timer recording, on-screen display, search mode and still pause are incorporated into the video section with the addition of long play mode.

Other features include electronic tuning with memory for up to 20 channels, in-built aerial or external connection and convenient sleep and wake up timers. Audio signals can be quite simply monitored through the in-built speaker or via the two earphone sockets located on the side of the unit.

The VT LC50EM will have a suggested retail price of $3500, including all necessary accessories.

For further information contact Hitachi on (03) 555 8722.

Twin speed copier

Toshiba's BD-5910 introduces a new concept in photocopying development. By simply pressing a button it is possible for the operator to increase the copy output rate from the standard 22cpm (A4) to 30cpm (A4), with the newly developed twin speed technology.

When multi copies are required, switching up to 30cpm results in a productivity increase of some 36%. Another significant benefit which results from selecting the 30cpm mode is a toner saving of up to 50%.

Besides twin speed, the BD-5910 offers all the functions of an advanced copier. Automatic exposure control, present enlargement and reduction with zoom range 65% to 154%, useful options such as reliable automatic document feeder, 10 and 20 bin sorter and 1000 or 1500 sheet large capacity paper feeders.

For further information, contact Toshiba (Australia), PO Box 350, North Ryde 2113 or phone (02) 887 6054.

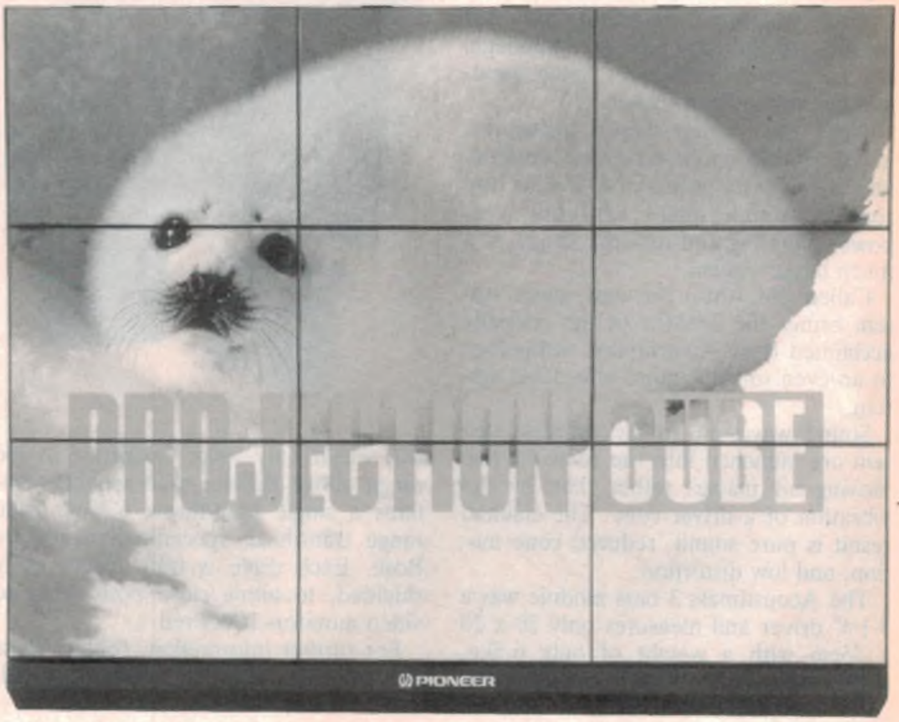
Projection cubes

Pioneer's Projection Cube System is most suited for showrooms and large lobbies. Unlike the other CRT projection systems which leave wide visual voids between screens, the projection cubes are closely packed with only .5" gap between screens.

As a result of improved screen design, there is less reflection. Each projection cube provides a full 40" screen, which may be used in a stand alone configuration or freely combined to form a gigantic projection area of up to four units high and virtually limitless length.

The projection cube has 520 lines of horizontal resolution, auto white balance and dynamic black level correction. With improved brightness and contrast, colours are more highly saturated. The tube is cooled using a glycol compound which also functions as a lens.

For further information, contact Pioneer Electronics Australia, 178-184 Boundary Road, Braeside 3195 or phone (03) 580 9911.



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- *PM 3365A 100 MS/s sampling simultaneously on both channels, plus repetitive sampling at up to 100 MHz, 100 MHz analog bandwidth, 4 memory registers, extra signal - processing modes, Digitally Delayed Timebase, GPIB/IEEE - 488 or RS232 - C interface options.*
- *PM 3355 Fast 250 MS/s sampling simultaneously on both channels, 60 MHz analog bandwidth, 4 memory registers, fast - action 'intelligent cursors', Digitally Delayed Timebase, GPIB/IEEE - 488 or RS232 - C interface options.*
- *PM 3375 Fast 250 MS/s sampling simultaneously on both channels, plus repetitive sampling at up to 100 MHz, 100 MHz analog bandwidth, 4 memory registers, fast - action 'intelligent cursors', Digitally Delayed Timebase, GPIB/IEEE - 488 or RS232 - C interface options.*

For further information please contact your local Philips Test & Measurement Organisation:

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READER INFO No. 2

ADVANCED TECHNOLOGY MADE TO MEASURE

For this outdoor concert by John Farnham, the engineer has arrayed the full range speaker boxes to give a precise coverage pattern. Sub-woofers are stacked on the level below.

The World of MEGA-SOUND!

For a fete or sporting event, sound reinforcement may consist of a single microphone, a modest amplifier and a few 'PA' horn speakers barely covering voice frequencies. But for today's large-scale outdoor performances of 'live' music, the requirements and solutions are on a vastly different scale...

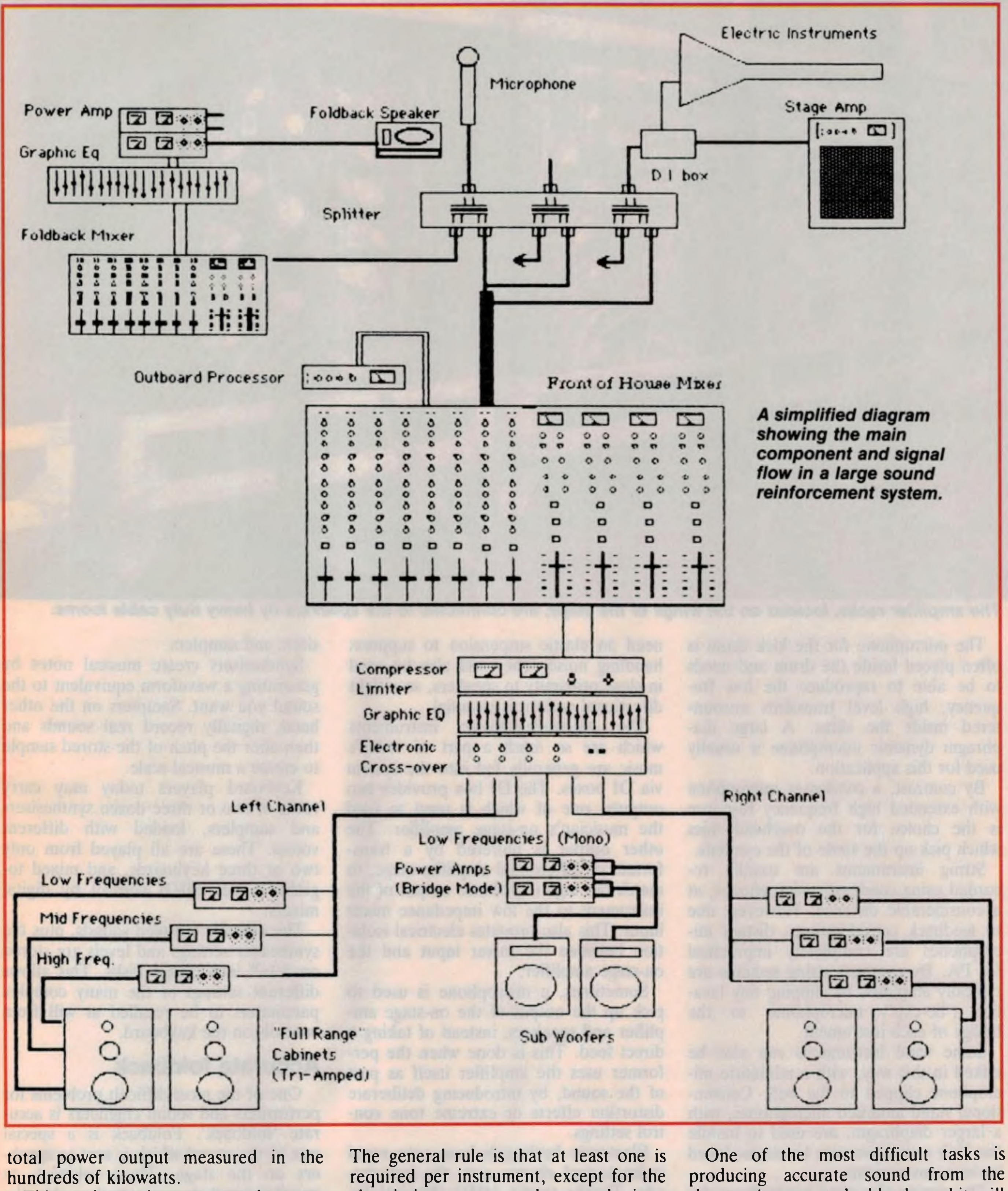
by DEREK J. POWELL

Everyone who professes an interest in things electronic will, sooner or later, be roped in to installing, adjusting, operating or fixing a PA system.

The average School of Arts or church hall sound system, with maybe a couple of microphones, a mixer, amplifier and speakers, usually is simple enough to be easily assimilated. But have you ever wondered exactly what goes into a really BIG public address system?

It's a long, long step from 'school hall' sound to a Concert Sound System such as a major international performer would use on tour. A peek behind the scenes of a major production would reveal that while many of the principles are the same, the scale of their application can be truly mind bending.

Sound reinforcement systems probably reached their peak in size and power during the 1970's. During this era, international rock groups like the notoriously over-the-top 'Grateful Dead' would use up to 25 tonnes of speakers, driven by amplifiers with a



A simplified diagram showing the main component and signal flow in a large sound reinforcement system.

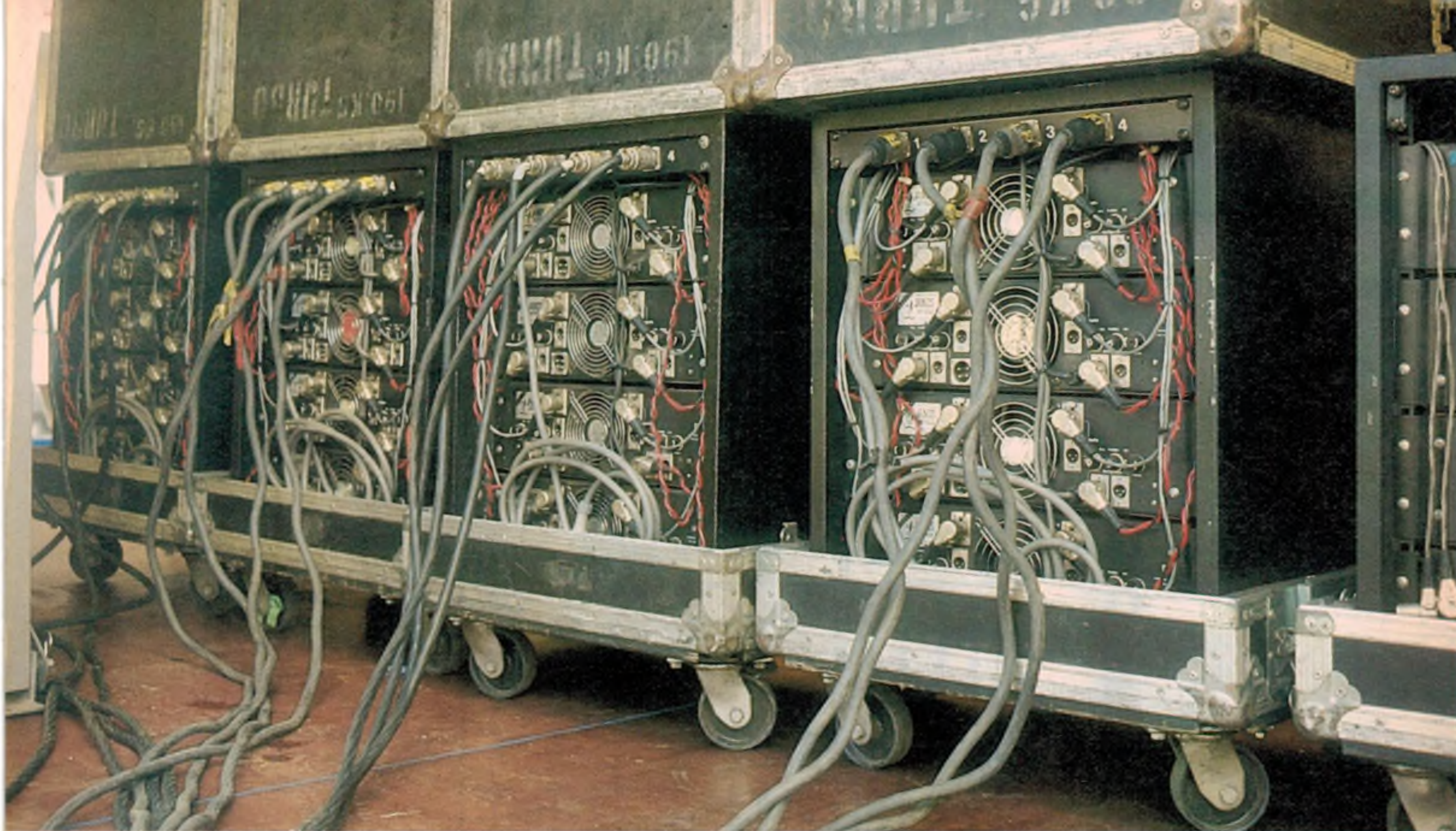
total power output measured in the hundreds of kilowatts.

Things have become much more realistic since then, but big venues still demand big PA. Let's look at the various elements that go into these Mega-Sound systems, to see how they come together.

The first link in the reproduction chain is, of course, the microphone. The general rule is that at least one is required per instrument, except for the electric instruments such as synthesisers and so on, which are patched into the mixer either directly, or via a 'DI' (direct injection) box.

Each instrument has its own characteristics, and each will require a slightly different technique – and possibly a different type of microphone.

One of the most difficult tasks is producing accurate sound from the drums. A concert double drum kit will require 15 or more microphones: two for the bass (kick) drums, six for the toms, one or two on the snare drum, one on the high-hat cymbals, then probably four more for the crash and ride cymbals – plus two overhead microphones for the overall ambience.



The amplifier racks, located on the wings of the stage, are connected to the speakers by heavy duty cable looms.

The microphone for the kick drum is often placed inside the drum and needs to be able to reproduce the low frequency, high level transients encountered inside the skins. A large diaphragm dynamic microphone is usually used for this application.

By contrast, a condenser microphone with extended high frequency response is the choice for the overhead mics which pick up the sizzle of the cymbals.

String instruments are usually recorded using condenser microphones, at a considerable distance. However, due to feedback considerations, distant microphones are completely impractical for PA. By contrast, string sections are typically amplified by clipping tiny lavalier ('tie-clip') microphones to the bridge of each instrument.

Some wind instruments can also be miked in this way, with a miniature microphone clipped to the bell. Conventional stand mounted microphones, with a larger diaphragm, are used to handle the high sound pressure levels produced by brass instruments.

The choice of a vocal microphone depends a great deal on the style of the vocalist concerned, but several factors need to be considered.

The microphone should have a good blast filter, to protect against breath 'popping'. As they are usually hand held, the pick-up elements of vocal mics need an elastic suspension to suppress handling noise. They will also be used in close proximity to speakers, so a tight directional pattern is essential.

The electric/electronic instruments which are so much a part of today's music are generally fed into the system via DI boxes. The DI box provides two outputs, one of which is used to feed the musician's on-stage amplifier. The other output is buffered by a transformer or differential amplifier stage, to match the high impedance output of the instrument to the low impedance mixer input. This also provides electrical isolation between the mixer input and the on-stage amplifier.

Sometimes, a microphone is used to pick up the output of the on-stage amplifier and speakers, instead of taking a direct feed. This is done when the performer uses the amplifier itself as part of the sound, by introducing deliberate distortion effects or extreme tone control settings.

Electronic keyboards have seen rapid technological change over the last decade. Thanks to the MIDI (Musical Instrument Digital Interface) connection standard, a single keyboard can control an almost unlimited number of sound sources.

The current trend in keyboard sounds is away from the simple organ circuits of oscillators and filters, and to synthesisers and samplers.

Synthesisers create musical notes by generating a waveform equivalent to the sound you want. Samplers on the other hand, digitally record real sounds and then alter the pitch of the stored sample to create a musical scale.

Keyboard players today may carry racks of two or three dozen synthesisers and samplers, loaded with different voices. These are all played from only two or three keyboards, and mixed together under MIDI control by digital mixers.

The digitally sampled sounds, plus the synthesiser settings and levels are stored on 3-1/2" inch floppy disks. This allows different settings of the many complex parameters to be recalled at will from controls on the keyboard.

Accurate foldback

One of the most difficult problems for performers and sound engineers is accurate 'foldback'. Foldback is a special mix of the sound which is sent to speakers on the stage. These foldback or monitor speakers are aimed so that the performers can hear themselves (and each other) during the performance.

Without foldback it is difficult for the drummer, say, to hear the other instruments – and especially singers – on a large stage. Worse than that, the delayed sound from the audience area

The foldback console, in this case a 40-input Yamaha, and located so that the operator has easy access to the stage.

speakers reaching the performers can easily cause them to get out of time with each other.

To overcome these problems, speakers are located close to each performer and a special mix of all instruments is sent to them.

Foldback should not be confused with *feedback*, which is the uncontrolled oscillation or howling which occurs when the sound from the speakers is picked up and re-amplified by the microphones. However, as high levels of sound are required in the same area as the microphones, avoiding feedback effects in the foldback system is a major problem.

To make matters more difficult, each performer may require a different mix of the various instruments in their monitoring speaker. The drummer, for example, may need predominantly bass guitar and lead vocal, so that he can clearly pick up his cues. The lead singer, by contrast, may want to hear harmony vocals and keyboards as well as his own voice and guitar.

Up to a dozen separate foldback feeds, each with its own amplifiers and speaker systems and each with a different mix of instruments, may be called for on a complex production.

To effectively deal with the problems of providing accurate foldback, a separate mixer and two or more crew mem-

The front of the house mixer, with three racks of outboard signal processing equipment.

Part way through rigging the microphones. Although the cables are not connected, eight microphones are in position, each directed to just one drum.

bers are usually dedicated to this task. The monitor mixing console must be capable of developing many separate 'mix sends' (composite signals), and is usually specially designed for the purpose.

As the monitor mixer is usually located close to the stage, while the 'front of house' mixer will be towards the rear of the audience area, it is usual to split the output of each stage microphone and line level source. The splitter box is often a set of transformers, each with two secondary windings so that electrical isolation is maintained between the two output feeds. One feed from each source is routed to the monitor mixing console, while the second is sent to the front of house mixer.

A complex show will use a spectrum analyzer and noise generator to measure any peaks in the frequency response between microphone and foldback speakers. Peaks must be eliminated because they are a source of feedback. One-third octave graphic equalizers are used to correct for an uneven frequency response.

Mixing the sound

Multicore microphone cables, typically with eight or sixteen separately shielded pairs, link the stage splitter box with the 'front of house' mixer. This console is located in the main audience area, so that the operator can hear the sound as the majority of the audience will experience it.

The front of house mixer is the heart of the sound system. Most large acts will use at least a 32-channel mixer, and sometimes 40, 56 or more channels are called for.

The mixer will have provision to group numbers of channels together under a single sub-master control. This allows for the drums say, or a string section, which each may use a dozen microphones, to be varied within the overall mix using just one volume control (fader).

As well as comprehensive equalisation controls on each channel, the mixer will provide patch points to connect external signal processors in line with each input channel. Compressors and limiters, which control dynamic range, are often connected in line with a particular instrument or vocal channel.

A compressor is akin to a fast-acting automatic gain control. Compression makes the output more uniform, but also alters the character of the sound, giving it a 'harder' quality which is better able to cut through a complex mix.

Several different types of signal processors are available to the front of house mixer. These are usually mounted in racks, adjacent to the mixer itself, connected by a cable loom. These processors, collectively referred to as 'outboard gear' comprise compressors and limiters; specialized equalizers; and digital effects such as phasing and reverberation.

A growing trend is to use digital signal processors, which may combine the functions of several types of outboard equipment. The control settings of this equipment can be memorised on floppy disk and recalled remotely under MIDI control. In this way, an operator can set up complex effects for each song involving reverberation, equalisation, compression or other special effects across a number of channels. All of the parameters can be stored and then recalled instantly by a MIDI controller when required.

By using MIDI, studio effects which previously took a great deal of time to achieve in a recording session can be preset and executed in a live environment.

Power to the people

From the mixer stereo outputs, the signal is routed via peak limiters to the active crossover units. These divide the signal into three or four frequency bands. From there, distribution amplifiers feed the racks of power amplifiers located near the speakers.

Most large PA systems of a few years ago used arrays of individual enclosures for the bass, midrange and treble. Today, the tendency is to use composite 'full range' speaker boxes, plus separate subwoofer enclosures.

Even 'full range' boxes will be two- or three-way designs with separate amplifier feeds to the bass, mid and treble components.

These enclosures are designed to acoustically reinforce each other in a precise way, when stacked or hung in arrays. Each enclosure has a particular dispersion pattern and is aimed to cover one section of the audience. It is impor-

Continued on page 147

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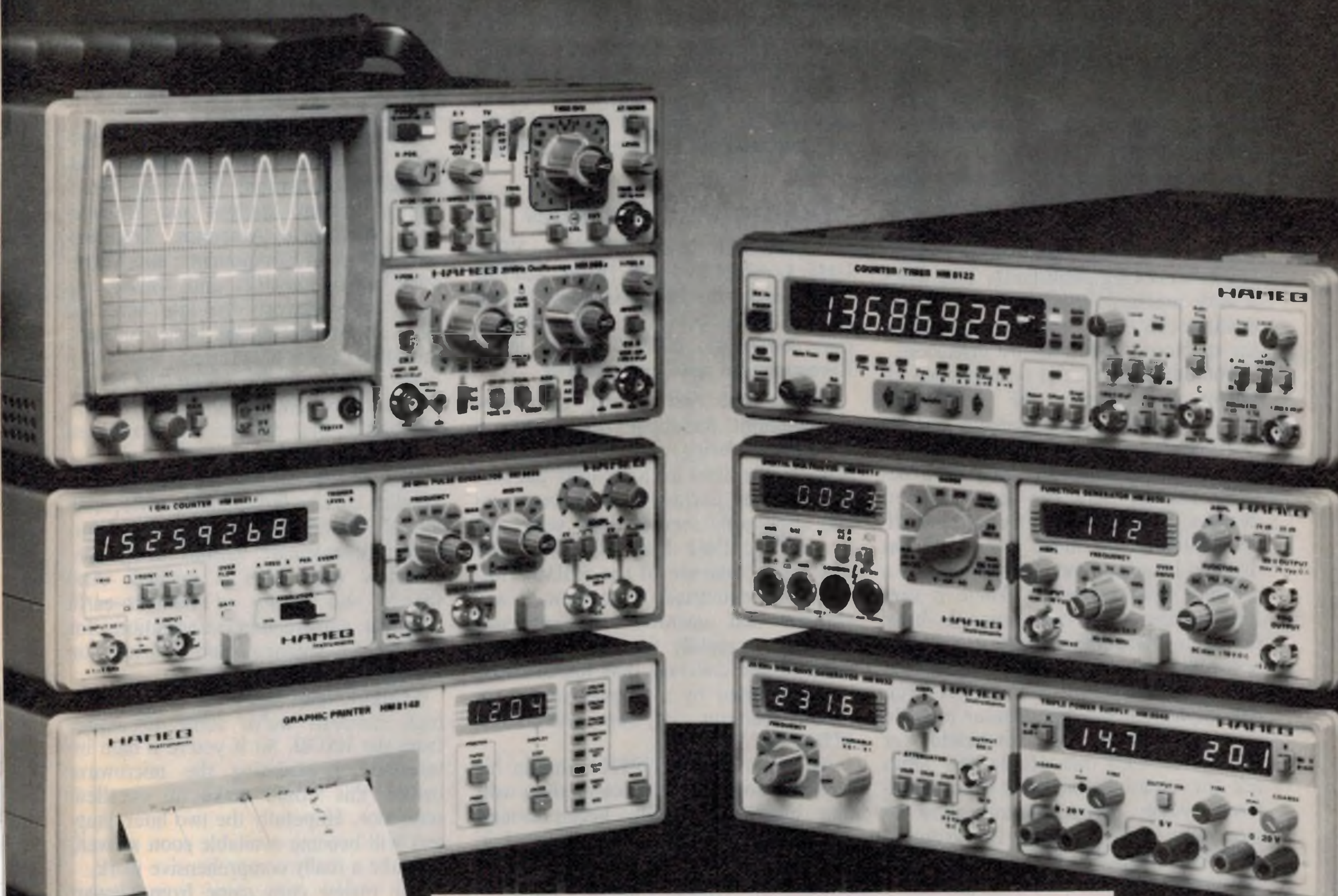

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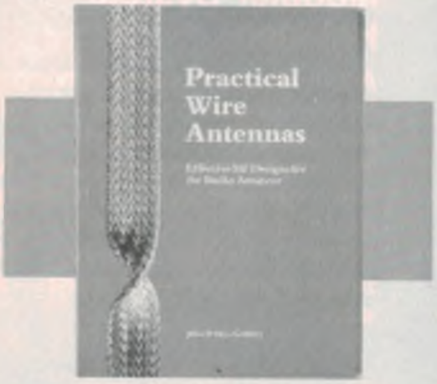


HF antennas

PRACTICAL WIRE ANTENNAS, by John D. Heys, G3BDQ. Published by the Radio Society of Great Britain, 1989. Soft covers, 245 x 185mm, 100 pages. ISBN 0 900612 87 8. Recommended retail price $28.00.

A further publication for the radio amateur – we're certainly getting quite a few of them lately, to the exclusion of almost everything else! (Aren't there any others being published?) This one's a very practical little volume, though, dealing with almost the opposite end of the spectrum to the one just discussed.

The emphasis here is on achieving efficient and effective HF propagation and reception using relatively simple and low-cost wire antennas, as opposed to the multi-band beams that have become popular over the last couple of decades. The author has been using HF wire antennas for many years, and has distilled his experience with them into a practical reference work. There is very little maths, and only enough basic theory to allow the newcomer to amateur radio to understand the principles.

As he points out, it is nowadays virtually impossible for the amateur to build a state-of-the-art HF transmitter or transceiver, and one of the few areas left for experimental work is with antenna systems. Wire antennas allow almost any interested ham to carry out this kind of experimentation, and with a minimum of outlay.

The seven chapters are headed Halfwave Dipoles; Centre-fed Antennas using Tuned Feedlines; End-fed Long Wires; Transmitting Loops; Marconi Antennas and Ground Systems; a Gallimaufry of Antennas; and Antenna Matching Systems. Virtually all of the antenna designs presented have been built and tested by the author personally during his 42 years as an active ham, and they represent just about every known type of wire antenna with the except the trapped multi-band dipole, regarding which he has misgivings.

The text is well written and easy to read, and is well augmented by illustrations. So all in all, it should be of great value to anyone working at HF and keen to experiment with this kind of antenna.

The review copy again came from Stewart Electronic Components, of 44 Stafford Street, Huntingdale 3166 (PO Box 281, Oakleigh 3166), which can supply copies by mail for the price quoted, inclusive of packing and postage. (J.R.)

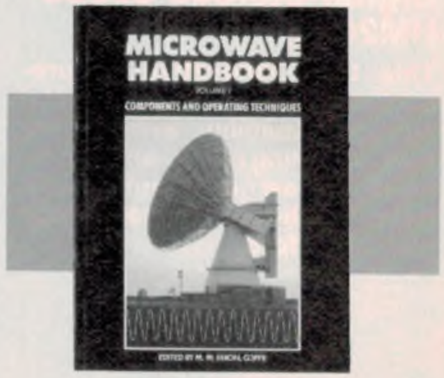
Microwave techniques

MICROWAVE HANDBOOK – VOLUME 1, edited by M.W. Dixon, G3PFR. Published by the Radio Society of Great Britain, 1989. Soft covers, 243 x 183mm, over 200 pages. ISBN 0 900612 89 4. Recommended retail price US$70.

This is the first volume of a new three-volume handbook on microwave techniques being produced by the RSGB. The need for a separate publication devoted exclusively to microwaves was apparently seen over 10 years ago by the late Dain Evans G3RPE, who was then Chairman of the RSGB's Microwave Committee. Even then, it was realised that microwave activity was growing so rapidly that it would soon need greater coverage than has formerly been provided by a chapter or two in recent editions of the well-known *VHF/UHF Manual*.

As Mike Dixon G3PFR notes in his preface, work on the present three-volume handbook actually began around 1981-2, but only reached full speed in mid-1985 when the committee decided to make a determined effort.

The new handbook is the RSGB's first attempt to provide a separate microwave handbook for radio amateurs, and a lot of authors have apparently been involved. Each has handled a different section, in order to expedite the work yet make it as comprehensive and as up to date as possible. But despite this, there's no obvious variation in style or overlapping of treatment, at least in this first volume.



Subtitled 'Components and Operating', it consists of six chapters in all, headed Introduction; Operating Techniques; System Analysis and Propagation; Microwave Antennas; Transmission Lines and Components; and Microwave Semiconductors and Valves. As these titles suggest, the aim here has been on introducing the basic concepts, in rather more detail than was previously possible in the *VHF/UHF Manual*. And after looking through it, my impression is that this has been achieved very nicely.

The text is written in the RSGB's familiar concise-but-readable style, with lots of reference tables, graphs and formulae to calculate various design parameters when this is needed. And there's also plenty of down-to-earth practical construction information, for things like antennas and transmission line splitters, etc.

In short, then, it's quite up the usual high standard we've come to expect from the RSGB. So if you're a ham interested in exploring the microwave bands, this would make an excellent reference. Hopefully the two later chapters will become available soon as well, to make a really comprehensive work.

The review copy came from Stewart Electronics Components, of 44 Stafford Street, Huntingdale 3166 (PO Box 281, Oakleigh 3166), which can supply it by mail order for the above price, inclusive of post and packing. (J.R.)

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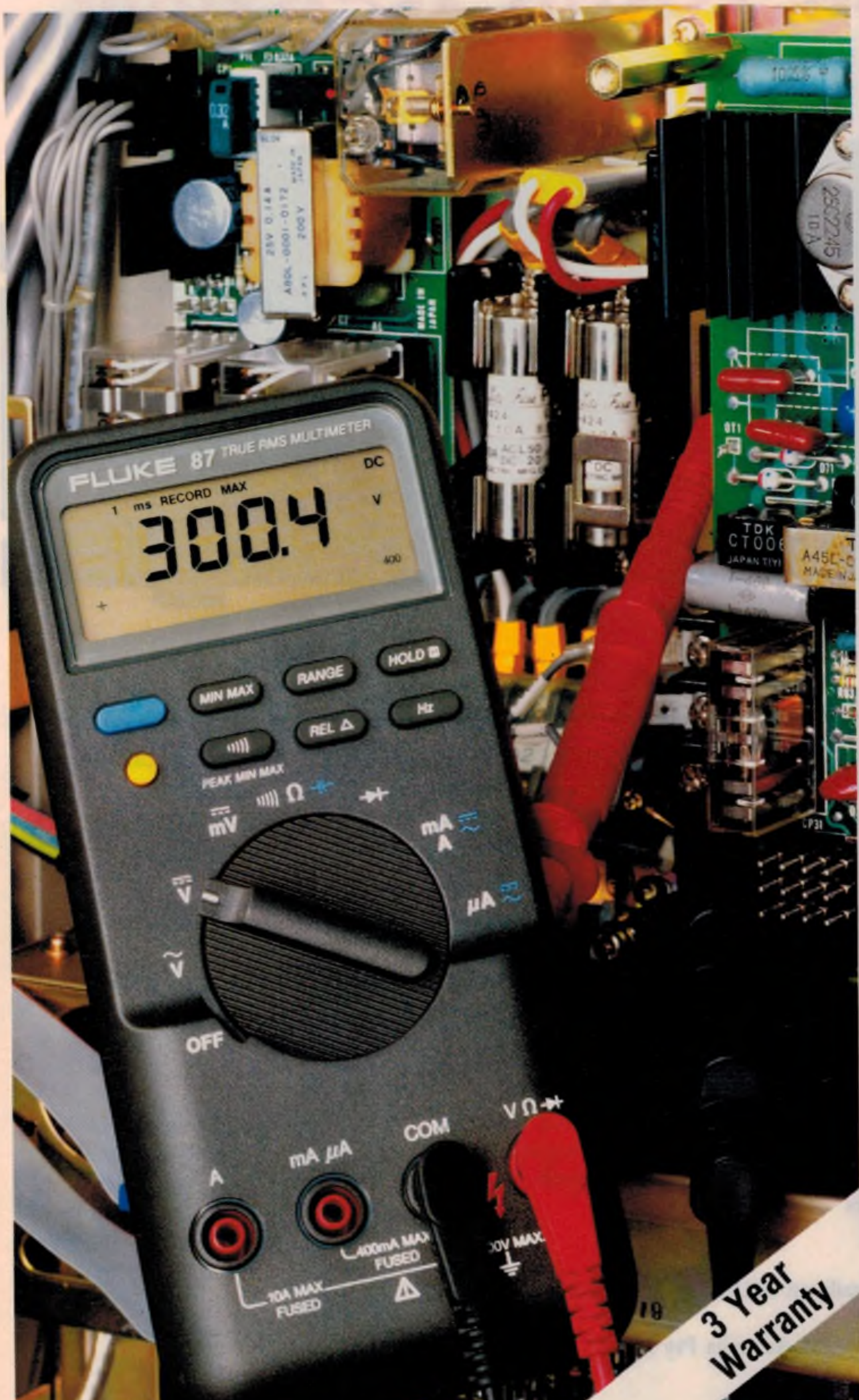

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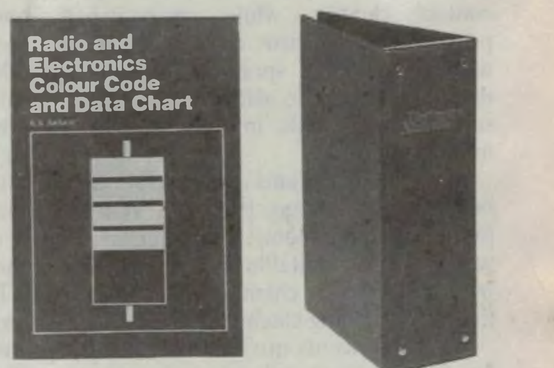

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Chemicals for use in Electronics

Except for the most experienced service technician, many of us may be baffled when confronted with a problem which could be easily solved with the use of the right kind of chemical. Here's an updated look at the range of chemicals available for use in electronics, with a look at how they're used.

by WINIFRED VINCENT

The kind of chemicals available for use by an electronics service technician or hobbyist is by no means limited to solder flux and flux remover. In fact a wide range of chemicals available today make assembling and troubleshooting of electronic equipment a lot easier.

Apart from chemicals to improve the quality and reliability of electrical contacts there are also compounds to ensure the thermal efficiency of heatsinks, and freezer sprays to assist in tracking down intermittent faults – to name only a few.

Potentiometers and switches can often benefit from a judicious spray with a contact cleaner, while newly-etched printed circuit boards can be protected with a coating of spray-on lacquer/solder flux. There are also a variety of insulating compounds, in both drying and non-drying form.

Moisture expellants are useful both before and after any part of a PCB or piece of equipment is immersed in water, while a suitable fire extinguisher with non reacting chemicals will be very handy if anything catches fire.

While lubricants are generally needed for moving parts, special chemicals are needed for applications such as tape head cleaning, to prevent damage to the tapes.

In the July 1971 issue of *EA*, we published a survey article on chemicals for electronics written by Philip Watson. Reading through this, I realised that it was about time that we updated the information supplied there.

At that time products containing trichlorotriflouroethane (Freon), now commonly known as CFC, seemed to be very attractive because of this chemical's low surface tension, non-flammability and inertness towards printed circuit materials and components. However today, the production and use of CFCs is banned in many countries because of concern for the Earth's ozone layer, and an alternative has to be found soon.

Many of the companies that were listed in 1971 are not in business anymore and some of the remaining are cautious about advertising their products, waiting to see what the Australian Government is going to say about putting CFCs to limited use. Since it is a controversial subject and in any case I am not a chemist, I would like to stay out of this; however in view of the importance of this aspect, a few comments need to be made.

Maxwell Chemicals is using trichlorotriflouroethane and trichloroethane as solvent/propellant in its electronic cleaning products. Electrolube is using monochlorodifluoromethane and trichloroethane in its products, while Richard Foot is using hydrocarbons and trichloroethane as solvent/propellants.

Trichlorotriflouroethane has the best compatibility with most of the plastics used in electronics; even the thermoplastics are safe with this. When using the other solvents it is best to test with a sample of plastic before using on the circuit. The hydrocarbons in addition pose the problem of fire hazard and explosion, when applied near a live circuit or if the circuit is turned on while the fumes are still present.

There have been reports of service technicians having nasty accidents when using hydrocarbon-based freezer sprays in conjunction with hot-air blowers, for tracking down intermittent circuit faults using the 'heat it up – cool it down' technique. There is a suggestion that in finely-divided mist form, the hydrocarbon propellant can ignite/explode even from contact with hot air; a naked flame may not be necessary.

At present the situation regarding freezer sprays in particular is therefore rather unsatisfactory. A spray based on trichlorotrifluoroethane is environmentally unfriendly, while one based on a hydrocarbon may well be highly user unfriendly!

In general, when you buy a particular chemical product, it is important to read the label carefully and make sure that (a) it will do what you want it to do; and (b) it will protect the user and the circuitry. In the following sections I will mention what qualities to look for in chemicals used for various purposes.

Moisture expellants

Water is an electrical conductor and whenever an electrical component comes in contact with water, normal operation is generally disturbed; hence some means must usually be found to displace the water and replace it with an insulator.

Moisture expellants replace the water molecules and form a coating around the component. This is possible mainly because of their low surface tension when compared to water. In some cases the protective layer will remain, while in other cases it will evaporate quickly – but hopefully after the water!

Electrical components such as transformers, chokes, motors and similar devices can often be salvaged after dunking in water, if they are immersed in a bath of moisture repellant. EHT circuitry and similar components in TV receivers are also easily treated with expellants in spray-on form, when affected by damp conditions.

In the absence of CFCs, we will be left with petroleum products to do this job and will be left with the risk of fire, especially when trying to to get the water out of a car's ignition system or any other high voltage device. Hence the importance of reading the manufacturer's label carefully, to see whether the product is flammable or not.

Contact cleaners

Most of the moisture expellants can also be used as contact cleaners. Yet a good purpose-designed cleaner will dissolve the grease and dirt and when applied under pressure, remove the solid particles held under and evaporate quickly. Various manufacturers are coming up with products that also leave a protective coating after the cleaning is done.

Contact cleaners are often needed with potentiometers, switch contacts, TV tuners etc. If the basic cause of the problem is dirt, cleaning can be a long term solution. But if the cause is wear, cleaning will provide only a temporary solution – the only real solution will be to order and fit a replacement part.

For harsh cleaning, paste cleaners are also available. Solvent impregnated cleaning pads are available for cleaning connectors before assembly and during servicing.

Aerosol cans containing pure compressed inert gas are also available, and can be used for removal of dust and airborne contamination from very delicate or inaccessible areas of electrical and electronic equipment.

Cleaning chemicals in aerosol cans should be used with the extension tubes supplied, to avoid spraying the other components. Some contact cleaners are not plastic compatible. Also, while using aerosol cans, avoid tilting them by more than a 45° angle to the vertical – this tends to allow the propellant gas to escape without the chemical, and may result in wastage due to the propellant becoming exhausted prematurely.

High purity solvents used for cleaning delicate electrical/electronic assemblies such as circuit boards, edge connectors etc. can also be used for cleaning computer disk drive read/write heads and tape heads in videos and tape recorders. These generally come under a separate category.

Lubricants

Standard oils or greases may be used on fixed or moving contacts, edge connectors, turret tuners, plug sockets, switching devices, potentiometers, fuses, small regulators, slip rings, slider/rotary controls, rocker/push-pull edge connectors, switch gear and butting contacts.

Specialised electro-mechanical lubricants have low contact resistance, good thermal conductivity and wide temperature ranges and are compatible with most of the plastics. If you have any questions about any plastic, contact the technical advisory department of the dealer or the manufacturer.

Before the lubricant is applied, hardened dirt and tarnish should be removed by rubbing with leather, cloth or canvas impregnated with lubricant or cleaning solvent. General cleaning can be done with electronic cleaning solvent. Contact cleaning strips can be used for initial cleaning of contacts which are subject to arcing in normal operation.

There are multi-purpose maintenance fluids which will dewater, penetrate, lubricate and protect from rust and corrosion – but remember, almost all of these chemicals come without warranty.

Tape head cleaners

Tape heads tend to become contaminated by a build-up of oxide and binder particles from the tape itself. To clean the heads properly, a cleaning agent should wash away the contaminating particles and not leave behind any solvents to damage the binder on a tape that is used afterwards. Naturally quick drying solvents are used, and most of the time lint-free applicators and brushes are used rather than a spray.

It is better to follow the manufacturer's guidelines about tape head cleaning. Most of the time a specific kind of cleaner will be recommended for a particular kind of recorder. There are a variety of kits available, some coming with a tape to polish the head.

Special chemicals and kits are available for cleaning compact discs. Your video supplier or the closest electronics parts shop should be able to supply these, accompanied by appropriate instructions for use.

Insulating compounds

There are both non-drying and drying varieties of electrically insulating compounds. The non-drying compounds are used with high voltage electrical connections and ignition systems to inhibit leakage and corona. These are generally silicone grease compounds; they do not harden with age and have excellent water and moisture repellent characteristics.

Even though foreign particles tend to adhere to these substances, this is considered harmless. After excessive contamination they are cleaned off and a fresh coating is applied. This kind of insulating compound is available in aerosol form as well as in bulk.

The drying kinds of insulating compound are referred to variously as silicone lacquers, plastic sprays, protective coatings etc. The coatings dry within hours and remain water repellant and flexible. The lacquer variety can also act as a soldering flux when servicing is

Chemicals

TABLE 1: SOURCES OF CHEMICALS FOR ELECTRONICS

FIRM	MOISTURE EXPELLENTS	CONTACT CLEANERS	LUBRICANTS	TAPE HEAD CLEANERS	NON-DRYING INSULATING COMPOUND	DRYING TYPE INSULATING COMPOUNDS	PC BOARD CLEANER	PRINTED CIRCUIT LACQUER	FREEZER	HEAT TRANSFER COMPOUND	ANTI-STATIC	COMPUTER CARE PRODUCTS	PHOTO RESIST	ADHESIVES
ALTRONICS	ELECTROLUBE PERMAGUARD	ELECTROLUBE EML ECS & CCS	ELECTROLUBE SOB EML		ELECTROLUBE SCO	ELECTROLUBE PAJ	ELECTROLUBE PCC	ELECTROLUBE CPL	ELECTROLUBE FRE	UNICK	ELECTROLUBE AFC	ELECTROLUBE AIR DUSTER	ELECTROLUBE PRA	SILASTIC & KRAZY
ARISTA		ARISTA NS221 & NL222	ARISTA NL222 & LC223	ARISTA VH310 BT300 VHC8, VHC-C VCS1					ARISTA HR225			ARISTA FDC & DUST REMOVER		ARISTA SUPER GLUE SG2
DICK SMITH ELECTRONICS	CRC 2-26	ELECTROLUBE EML ECS & CCS	ELECTROLUBE SOB SGB EML & EMPL	ELECTROLUBE VID	ELECTROLUBE SCO	ELECTROLUBE HPA & PAJ	ELECTROLUBE PCC	ELECTROLUBE CPL	ELECTROLUBE FRE	ELECTROLUBE HTC & HTS	ELECTROLUBE AFC & ASA	ELECTROLUBE AIR DUSTER	ELECTROLUBE PRA & ERN	SUPER GLUE SILASTIC CONTACT ADHESIVE
DOW CORNING			SILICONE BASED LUBRICANTS		SILICONE COMPOUNDS	POTANTS/ ENCAP SULANTS CONFORMAL COATINGS				HEAT SINK COMPOUND				RTV
JAYCAR		'RF' ELECTRONIC CLEANING SOLVENT No. 1	ARISTA LC223				'RF' ELECTRONIC CIRCUIT BOARD CLEANER	'RF' CIRCUIT BOARD CLEANER	'RF' FREEZING SPRAY	UNICK		ARISTA DUST REMOVER		SILASTIC
LOVELOCK LUKE		FREON TF		FREON TF FREON TMS			FREON TF FREON TMS							
MAXWELL CHEMICALS	MAXSOLVE 200	SS113	SS4A	SS113	SS21				SUREFREEZE					
RICHARD FOOT	'RF' PROTEK	'RF' ELECTRONIC CLEANING SOLVENT No. 1		'RF' ELECTRONIC CLEANING SOLVENT No. 1			'RF' ELECTRONIC CIRCUIT BOARD CLEANER	'RF' CIRCUIT BOARD LACQUER	'RF' FREEZING SPRAY	'RF' HEAT SINK COMPOUND		'RF' ELECTRONIC CLEANING SOLVENT No 1		
ROD IRVING ELECTRONICS	FORMULA "66"	ELECTRONIC SUPER CLEAN	ELEC CONTACT CLEANER & LUBE			INSULATING VARNISH & PRINTED CIRCUIT COATING	FLUX REMOVER		FREEZING SPRAY	UNICK			PCB PHOTO RESIST	
SELLEYS	RP7		RP7											ARALDITE SUPER GLUE SILICONE
SUBA ENGINEERING	ELECTROLUBE PERMAGUARD	ELECTROLUBE EML ECS & CCS	ELECTROLUBE SOB SGB EML & EMPL	ELECTROLUBE VID	ELECTROLUBE SCO	ELECTROLUBE HPA & PAJ	ELECTROLUBE PCC	ELECTROLUBE CPL	ELECTROLUBE FRE	ELECTROLUBE HTC & HTS	ELECTROLUBE AFC & ASA	ELECTROLUBE AIR DUSTER	ELECTROLUBE PRA & ERN	ELECTROLUBE GPA
TANDY ELECTRONICS			LUBE GEL & PRECISION OILER	CLEANING KITS										INSTANT BONDING ADHESIVES
3M												HEAD CLEANING DISKETTES & CK-90 KIT		
TIC DISTRIBUTORS	ELECTROLUBE PERMAGUARD	ELECTROLUBE EML ECS & CCS	ELECTROLUBE SOB SGB EML & EMPL	ELECTROLUBE VID	ELECTROLUBE SCO	ELECTROLUBE HPA & PAJ	ELECTROLUBE PCC	ELECTROLUBE CPL	ELECTROLUBE FRE	ELECTROLUBE HTC & HTS	ELECTROLUBE AFC & ASA	A F COMPUTER CLEANING PRODUCTS	ELECTROLUBE PRA & ERN	ELECTROLUBE GPA

done on the component. After servicing is done the component should be re-sprayed.

Before the insulating compound is applied, the area to be covered should be cleaned of any contamination, otherwise corrosive material will get trapped underneath the insulation and may do damage to the circuitry.

PCB cleaner

Generally a suitable organic solvent will be needed to remove grease, perspiration and other residues from a printed circuit board before soldering, and to remove the rosin-based fluxes after soldering. There are products which will do all these, but since they are organic, they could affect some of the thermoplastics.

Some cleaners can affect aluminium components, by removing the aluminium oxide protective coating. One should determine how critical this is in each application, before applying.

PCB lacquers, coatings

A finished printed circuit assembly will generally benefit from being cleaned and sprayed with lacquer to protect the circuit material from moisture and oxidation. This lacquer also will act as a flux whenever servicing is done. This kind of coating is available in spray-on form as well as in bulk for dipping and brushing.

Sometimes a better quality of coating will be required to protect the circuit against industrial fallout, salt spray etc. Silicone and acrylic-based insulating coatings have a high order of water repellancy. There are acrylic and transparent modified silicone resin *conformal coatings* available to meet the defence and aerospace industry requirements. These also can be soldered through.

Before the application of conformal coating, the complete PCB should be dried – possibly by vacuum dessication. There are gels which will remove conformal coating in local areas. Peelable coating mask is available to protect some components and areas that require further processing during conformal coating.

Freezers

Refrigerant gases are used to test components which exhibit intermittent faults. If the fault is due to heating, it should go away when cooled. Some manufacturers add lubricants which insulate the components from the ice (frost) that forms on top, and hence cool them better. The degree of cooling depends on the kind of gas used.

A fractured track on a printed circuit will sometimes show the fault visually, when cooled with the freezer, due to the contraction and parting. There is a claim that dry joints will cure themselves when a frost appears on the joint. However this will not work if there is a protective coating.

Component damage from overheating during soldering can be eliminated by cooling the component using the freezer prior to soldering. If it is necessary to cool a component for any length of time, a piece of plastic foam should be wrapped around the component and then saturated with freezer.

Thermal compounds

A typical application for a thermal transfer compound is where power transistors, diodes, SCRs or other high power devices must be mounted to a

heatsink. Here the requirement is generally for good heat conduction combined with electrical insulation – i.e., high thermal conductivity with poor electrical conductivity.

Heat transfer compounds are made of silicone oil or other synthetic fluids filled with powdered metal oxides, to provide good heat conduction. They come in syringes, cartridges and bulk packages.

For best result, these compounds should be applied thinly and evenly to both surfaces which are to be mounted together – e.g., the base of the transistor and the heatsink radiator. The idea is to have the compound filling all of the space between the two; any trapped air bubbles will lower the thermal conductivity.

Anti-static sprays

Static charge buildup can be a nuisance in computer rooms, studios, laboratories and some hi-tech factory situations. There are anti-static sprays that can be used liberally in such rooms. Anti-static spray helps prevent dust, unpleasant shock and fire hazards.

Anti-static foam cleanser can be used on plastics, metal, glass and synthetic surfaces. Computer screens and keyboards warrant such a cleanser. Spray the foam on a lint-free cleaning pad and apply on keyboards etc. There are special 'lint-free wipes' available for this purpose. Avoid spraying chemicals directly at the computer or the accessories.

De-mineralised water is used for anti-static protection during fibre-optic cable connection.

Computer care

Apart from using the above mentioned anti-static products, one can use the cleaning kits supplied by some manufacturers. There are special floppy diskettes available which can clean the disk drive read/write heads within seconds.

It's a good idea to keep anti-static cleaning solution and lint free wipes handy around the computer area. There are reports of many 'computer failures' turning out to be due to grime, and responding after a thorough cleaning of the system.

Photoresist

For those who are interested in making their own printed circuit boards, there are positive as well as negative photoresists available. The instructions as to how to use those come with the products themselves. You will need to buy the developer and the etchant as well.

For simple circuits, direct etch resist applicator pens are available. Also silver conductive paint is available for printed circuit design and repair. Such conductive paint will be handy if one recognises a need for slight alterations, after the etching is done.

Adhesives

Often there is a need to hold a component in a fixed position, during or after assembly. There are many kinds of adhesives that will do this job, varying from the quick setting type to the slow drying flexible type.

Quick setting 'super glue' is handy in holding small objects together with a long lasting result. It is a fast-setting cyanoacrylic acid ester based adhesive. However this type is not suitable for use on polyethylene, polypropylene or teflon, and will not permanently bond glass or materials containing alkaline elements.

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READER INFO NO. 5

Chemicals

This kind of adhesive is also too brittle for holding large objects in a vibrating environment. Super glue is water resistant, but not water proof. Generally the effectiveness of the glue depends on the preparation of the surfaces before bonding; smooth and well fitting surfaces give good results. There are solvents that can dissolve these glues.

For larger gap-filling applications, epoxy resin adhesives such as 'araldite' are used. These are two part epoxy resin adhesives – part A is the resin and part B is the hardener. These range from quick setting to slow setting, attaining the full strength after several hours.

The surfaces should be cleaned with oil free solvents, and for best results smooth surfaces should be roughened by mechanical abrasion.

For vibrating environments and for components that could require replacement, a flexible type of adhesive is indicated. These come as acid cure or neutral cure silicone. It is advisable to avoid the acid cure kind for use on electrical circuits, which invariably have metallic contacts. Flexible silicone compounds can be cut and peeled off and are compatible with rubber and plastics. It is advisable to do a test before trying new products on your equipment.

There are also caulking compounds, which are really non-drying insulating compounds. Most of the adhesives can serve the purpose of an insulator as well. It is their dielectric breakdown strength that determines where they can be used. So if they are used for insulation at low voltages, this does not mean that the same can be done at high voltages.

Fire extinguishers

Fire extinguishers reduce the temperature of the combustible material and also displace the surrounding air by non-flammable gas. In electrical fires the last thing one would want to use is water. For electrical fires a refrigerant type of gas is used.

Since electrical fires are likely to happen in a workshop whether you are using chemicals or not, it is best to keep a fire extinguisher suited for electrical fires.

In conclusion

There are many chemicals available to help the electronics worker and hobbyist. However it is important to choose these products carefully. One should take care to find out whether they provide the right kind of propellant/solvent for the job concerned, to ensure that your equipment and its components are not damaged – and that you yourself are not injured.

If the manufacturer or dealer is unable to supply information about the product's flammability, toxicity, compatibility with various plastics and rubbers, etc., it may be safer to avoid the product concerned.

On the subject of toxicity, it is important to make sure that the working area is well ventilated when using any chemical products. Most experts also suggest that you don't eat, drink or smoke while using chemicals.

Table 1 shows some of the major current Australian suppliers for a selection of electronics-related chemical products. This table is by no means exhaustive, but it should at least provide a starting place for most of the common products.

Finally, I wish to thank Joe Dadic of Suba Engineering and Caroline Smart of TIC distributors and all the companies shown on the table for their assistance in preparing this article, generally by sending information on their products.

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P19032....................$9.95

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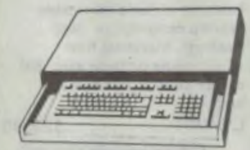

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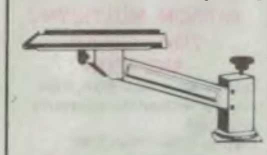

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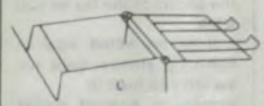

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- Conveniently stacks paper printout in document tray automatically
- Made of plastic coated steel
- Suitable for most printers
- Excellent value at this price
- 80 COLUMN

C21054...................$24.95
- 132 COLUMN

C21056...................$34.95

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- Made of moulded plastic
- Suitable for most printers

C21058 80 column $79.95

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- AC DC 0 - 500 Volts
- 10mm thickness & 80g light weight for easy operation
- Dimension & weight = 108 x 54 x 8mm and 60g approx

Q11264......................$69

MULTIMETER (YF-3000)

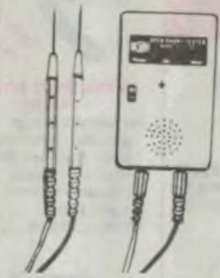
- Large display 3 1/2 digit 0.5" height LCD for easy readout
- AC DC 0 - 1000 Volts
- Auto/manual range select easy to operate
- Automatic low battery" - + " display for battery indication
- Memory-comparative function available for allowance within ±5% f.s
- Warning sound for overload and conductance
- Dimension & Weight = 170 x 80 x 33mm, 260gram approx
- Data hold function for easy readout

Q11268....................$110

MULTIMETER (YF-2100)

- Large display 4 1/2 dgt 0.5" height LCD with maximum reading of 19999
- AC DC 0 - 1000 Volts
- Automatic polarity."-" display for negative input
- High over-load protection for all ranges
- Over load display, the highest digit "1" or "-1" alone glows
- Power consumption 20mW approx.
- Dimension & weight = 162 x 86 x28mm and 200g approx

Q11266....................$199



SHORT TESTER

- Instantly shows the open/short position of PCB
- It can test whether PCB or solid wire open/short by Buzzer

Q11276.................$22.95

LOGIC PULSER (LP-540H)

- Can be used directly to inject a signal into logic circuits without removing IC
- Compatible with TTL, DTL, RTL HTL, MOS and CMOS

Q11274.................$42.95

DIGITAL METER (YF-120)

- Autoranging operation
- Data-hold for easy readout
- Full range protection
- 0-500 volts AC-DC
- 0-20 MΩ
- Dimension & weight =133 x 29 x 17mm and 60g approx

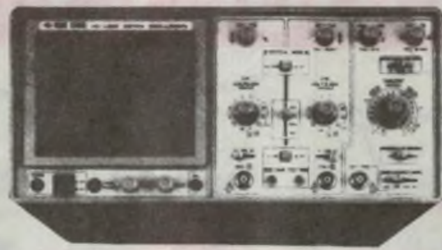
Q11270................ $59.95

LOGIC PROBE (LP-2800)

- Useful for TTL or CMOS has high and low indicator leds and also with pulse memory.
- This is a very handy tool for the hobbyist or serious technician for tracing those hard to find faults on logic boards.

Q11272................ $19.95

NEW CRO'S



20MHZ DUAL TRACE OSCILLOSCOPE

CRT DISPLAY
- 150mm rectangular

VERTICAL DEFLECTION
- Deflection Factor: 5mV to 20V/ Div on 12 ranges in 1-2-5 step with fine control
- Bandwidth DC: DC to 20MHz (-3dB)
  AC: 10Hz to 20MHz (-3dB)
- Operating Modes: CH-A, CH-B, DUAL and ADD (ALT CHOP L202 only)
- Chop Frequency: 200KHz Approx
- Channel Separation: Better than 60dB at 1KHz

TIME BASE
- Type: Automatic and normal triggered in automatic mode, sweep is obtained without input signal
- Sweep Time: 0.2μ Sec to 0.5 Sec/ Div on 20 ranges in 1-2-5 step with fine control and X-Y
- Magnifier: X5 at all ranges

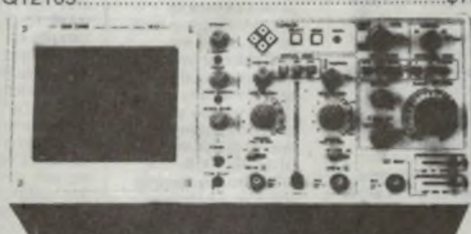
CRO Probe to suit $39.50 each - Cat. Q12201.

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

HORIZONTAL DEFLECTION
- Deflection factor: 5mV to 20V/ Div on 12 ranges in 1-2-5 step with fine control
- Frequency Response: DC to MHz (-3dB)
- Max Input Voltage: 300V DC + AC Peak of 600Vp-p
- X-Y Operation: X-Y mode is selected by SWEEP TIME/ Div switch
- Intensity Modulation Z Axis: TTL Level (3Vp-p~50V) + bright, - dark

OTHER SPECIFICATIONS
- Weight: 7Kg Approx
- Dimensions: 162(H) x 294(W) x 352(D) mm

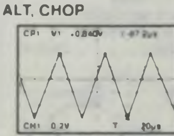
Q12105..$750



40MHZ READ-OUT OSCILLOSCOPE

CRT DISPLAY
- 150mm rectangular

VERTICAL AMPLIFIER (CH1 and CH2 Identical)
- Operational Modes: CH1, CH2, ADD, DUAL, ALT, CHOP
- Sensitivity: 5mV-5V/ Div 3% in 1-2-5 steps
  1mV-1V/ Div x5% x5MAG
- Bandwidth DC: DC to 40MHz (-3dB)
  AC: 5Hz to 40MHz (-3dB)
- Rise Time: Less than 8.7nS



Ex: Readout Display

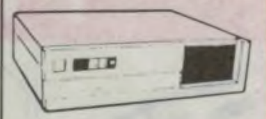
HORIZONTAL AMPLIFIER
- Operating Modes: X-Y operation CH1-X axis, CH2-Y axis
- Sensitivity: 5mV-5V/ Div- 3% in 1-2-5 steps
- Input Impedance: 1MΩ -2%, 25pF-3%
- Bandwidth DC: DC to 1MHz (-3dB)
  AC: 5Hz to 1MHz (-3dB)

CRO Probe to suit $39.50 each - Cat. Q12201

TIME BASE
- Sweep Method: AUTO, NORM, SINGLE
- Sweep Time (A): 0.2μs-0.5S/ Div-3% in 1-2-5 steps (X1 only)
  (B): 0.2μS-0.5mS/ Div-3% in 1-2-5 steps (X1 only)
- Magnified Sweep: 10 times-5%, Max 20ns
- Linearity: -3% or better

Q12107..$1,695

CASES



IBM* XT COMPATIBLE CASE WITH AT* STYLING

Features security key switch, 8 slots, and mounting accessories
Size: 490(W) x 145(H) x 400(D)

X11091......................$99

BABY AT* STYLE COMPUTER CASING

Small footprint. Features security key switch, 8 slots and mounting accessories
Size: 360(W) x175(H) x405(D)mm

X11093......................$99

rie

ROD IRVING ELECTRONICS

SYDNEY: 74 Parramatta Rd, Stanmore 2048
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Fax: (02) 519 3868

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Phone: (03) 663 6151

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Order Hotline: 008 33 5757
(Toll free, strictly orders only)
Inquiries: (03) 543 7877
Telex: AA 151938
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ORDER HOTLINE 008 33 5757 (TOLL FREE)

STRICTLY ORDERS ONLY

LOCAL ORDERS & INQUIRES (03) 543 7877

RATES

$1- $9.99	$3.00
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$25- $49.99	$4.50
$50- $99.99	$6.00
$100- $199	$6.00
$200- $500	FREE
$500 PLUS	FREE

The above postage rates are for basic postage only. Road Freight, bulky and fragile items will be charged at different rates.

Errors and omissions excepted. Prices and specifications subject to change.

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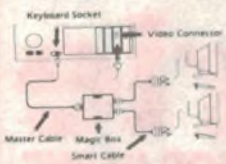
VISA MasterCard

ROD IRVING ELECTRONICS

LOOK...NEW PRODUCTS

AIR IONS GENERATOR

No need for air freshners with our Negative Air Ions Generator.
Just plug it into the cars cigarette lighter and it releases negative air ions into the vehicle....making a fresh driving environment. Odors, smoke and dust are eliminated and a fresh feeling prevails. The product is also good for the respiratory and blood systems.
A15072.....$49.95



PC- SHARE

The PC- SHARE Magic Box enables two user workstations (monitor & keyboard) to be connected to one PC.
SPECIFICATIONS:
- Magic box - 20mm X 100mm X 20mm
- Master cable - 600mm
- Smart cable - 2, 4, 10, 40 mt.
- Maximum distance between desks - 80 metres
- Power supply - none required
- Compatible computers - PC, PC-XT, PC-AT 286, PC-AT 386, PS/2 Model 25, PS/2 Model 30.
- Compatible operating systems - Supports MS-DOS, OS-2, MS-WINDOW, UNIX, PICK etc.
- Monitors - monochrome, CGA, EGA, RGB.
- Keyboards - PC-XT or PC-AT type
- Leads sold seperatly.

X19088.....$299

PRINTER BUFFER

PB - 42P PRINTER BUFFER
The printer buffer is for offices or schools which have high volume data to process. Its a time saver. It accepts data from your computer and stores the data in its memory, then feeds the data to your printer at its own speed so that your computer is free for other work.
X19160.....$595

TOUCH MOUSE

A STATIONARY BREAK THROUGH !!!
Now you can use your fingers instead of your mouse.
MODELS: ATM- 110 Touch Mouse for IBM PC/ XT/ AT and compatible's.
Operates under Microsoft / mouse system mode.
FEATURES:
- User's finger movements on the 58 X 48mm front panel of the touch mouse control the on screen cursor movement.
- With no ball, the touch mouse requires no desk space for movement.
- No pad to get dirty and take up desk space.
- One finger can do all the users drawing.
- Compatible with all existing mouse software.
- RS- 232 serial port
- Especially suitable for laptops, the touch mouse saves on desk space.

X19960.....$149.00

TRIPOD VIDEO CAMERA STAND

Collapsible three legged floor stand for video and 35mm camera's with centre leg to prevent sudden camera drop.
The platform can be tilted sideways or angled to the front or the back and has a securing bolt and locking pin for keeping the camera secure. It is also easily removed so it can be permanently secured to the video camera. When it is needed it can be speedily re- attached to the stand with the aid of a quick release lever system.
- Removable panning arm
- Fully geared elevator system
- Quick release snap leg locks.
- Rubber feet scew up to reveal spikes for usage on soft sorfaces
- Black semi gloss aluminium frame.

A15598.....$199.95

10 AMP CAR NOISE SUPPRESSOR

Heavy duty automotive electrical noise filter
- Reduces alternator whine and impulse noise.
- Will take up to 40 amps.
- Used for stereos, and equalisers, CB's, etc.

A12102.....$19.95

CONSUMER PREMISES EQUIPTMENT PROTECTOR

USE:
- For protection for fax's, computers, computer's with modem connections, telephone's, telephone answering machines.

PROTECTION:
- The unit uses a combination of both M.O.V.s and gas arrestor circuitry to prevent damage to home and office machinary which can amount to several hundred dollars costly repairs and down time.
- Approved by the Australian Dept of Minerals and energy.
- Approval # N11361

X10089.....$64.95

240VAC MAINS SURGE PROTECTOR

Atmospheric dicharges that cause power spikes and surges often occur in the IC's mains reticulation system sometimes causing severe damage to appliances, computers, HI- FI systems etc.
Protection of any device can be achieved by simply inserting the PAC15 into the power point and pluging the appliance into the front of the PAC15. Built in MOV circuitry absorbs any spikes or surges that enter the PAC15 through the AC power system before they reach the appliance.
An amber light shows you that the unit is in proper working order. If a surge or spike enters the MOV it will break the circuit and the amber light will not appear.
This means that the PAC15 has prevented the appliance from being damaged.
X10091.....$29.95

MAGIC EYES

(HANDS FREE LIGHT)
You don't have to take your glasses off. Great for checking circut boards, inside dark placer, motor cycle repairs, camping, fishing. Anywhere you need your hands to be free.
A15062.....$19.95

S14049 7W BC.....$34.95
S14051 11W BC.....$34.95
S14052 15W BC.....$34.95

S14053 12W BC.....$42.95
S14054 18W BC.....$44.95

FLOURO GLOBES!

DID YOU KNOW THAT SOME AUTHORITIES IN AMERICA NOW SUPPLY FLOURO GLOBES FREE OF CHARGE?
IT IS CHEAPER TO GIVE AWAY THE GLOBES THAN FACE THE POLLUTION AND FINANCIAL COST TO BUILD NEW POWER STATIONS.
IF THE SUPPLY AUTHORITIES RECKON THEY CAN SAVE MONEY THEN SO SHOULD YOU.
HOW?
EACH FLURO GLOBE PRODUCES 5 TIMES THE LIGHT OF A NORMAL GLOBE SO YOU NEED ONLY BUY A 20 WATT FLURO TO REPLACE THAT 100 WATT GLOBE. YOU SAVE MONEY BY USING POWER AT ONLY 20% OF THE PREVIOUS RATE.
IMAGINE CUTTING YOU LIGHTING BILL BY 80% !
THOSE CHEAP GLOBES POP ALL THE TIME AND THEY APPEAR TO COST MORE EVERY TIME YOU BUY THEM. WHEN YOU HAVE TO CLIMB ON CHAIRS OR UNDO FITTINGS TO CHANGE THEM YOU REALISE THE COST IS NOT JUST AT THE CHECK-OUT.
THE FLURO GLOBES LAST AT LEAST 8 TIMES AS LONG AS YOUR NORMAL GLOBE, YOUR TRIPS UP THE LADDER AND THE CALLS FROM YOUR CHILDREN OR ELDERLY PARENTS WILL COME LESS FREQUENTLY.
BUT PERHAPS THE BIGGEST SAVINGS IS IN OUR FUTURE. IF WE ALL USE LESS POWER, WE NEED DIG LESS COAL, USE LESS WATER WASHING IT, AND LESS ENERGY TRANSPORTING IT AND ULTIMATELY LESS DE-STRUCTION OF OUR ENVIRONMENT.
SO NOW YOU CAN SAVE ON YOUR LIGHTING BILLS AND BE LIKE EVERYONE ELSE AND CARE A LITTLE MORE FOR YOUR ENVI-RONMENT.
TAKE YOUR STAND NOW AND INSIST ON FLUROGLOBES FROM ROD IRVING AND TELL YOUR POLITICIANS WHAT YOU ARE DOING AND WHY. PERHAPS THE MESSAGE WILL GET THROUGH AND THEY WILL ALSO SEE THE LIGHT...

PLIERS AND CUTTERS

MICRO BENT NOSE PLIERS

For delicate or high precision electronic work. Stainless steel head with plastic insulated handles.
Length: 10cm.
T12040.....$9.95.....$4.95

TRANSISTOR NIPPERS

Specially designed for cutting copper wire in small gauge and for delicate and intricate high precision work in electronics.
It also has plastic insulated handles.
T12070.....$8.95.....$4.95

MICRO LONG NOSE CUTTING PLIER

Very fine point for delicat work in very confined spaces.
Size: 125mm
Finished: polished head with plastic insulated handles.
T12060.....$13.95.....$4.95

MICRO CUTTING PLIERS

Great for detailed cutting. These have a stainless steel head and pkastic insulated handles.
Length: 90mm
T12050.....$9.95.....$4.95

BENT NOSE PLIERS

It has a long tip angled at 45° for complicated or delicate work.
Stainless steel head with plastic insulated handles.
Length: 10vm
T12046.....$9.95.....$4.95

HALF ROUND NOSE PLIERS

Plastic insulated handles with stainless steel head
Length: 10cm
T12044.....$9.95.....$4.95

PORTABLE SOLDERING IRONS

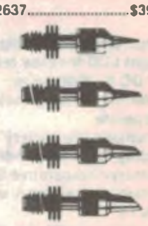
PORTASOL PROFESSIONAL

- 4 tools in one- Blow torch, Hot blow or hot knife.
- No cords or batteries
- Heavy duty, tip temperature adjustable up to 400c
- Equivalent to 10- 60 watts
- Hard working. Average continuous use 90 minutes
- Refills in seconds
- Powered by standard butane gas lighter fuel.
- Range of easily replaceable screw tips included
- Includes metal stand for when the soldering iron is working
- Cap features built in flint for ignighting
- Includes snap case for storage

T12639.....$88.95

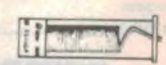
PORTASOL SOLDERING IRON

T12637.....$39.95



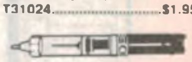
PORTASOL TIPS

T12605 4.8mm.....$12.50
T12606 3.2mm.....$12.50
T12607 2.4mm.....$12.50
T12608 1.0mm.....$12.50



SOLDER PENCIL

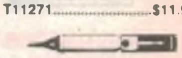
Approximately 5 meters of 1.2mm resin cored solder in handy dispenser
T31024.....$1.95



ECONOMY SOLDER SUCKER

- Light weight
- Sturdy construction
- East to remove tip
- Excellent value for money

T11271.....$11.95



DELUXE DESOLDERING PUMP

- Powerful suction
- Light weight
- Non conductive
- Composite long life tip
- One of the best in the business
- Length 210mm

T11261.....$34.95

DELUXE PUMP REPLACEMENT TIP

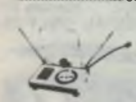
T11263.....$4.95

YES! PRODUCTS FOR EVERYONE!

ROD IRVING ELECTRONICS

INDOOR ANTENNAS

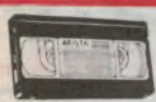
SPIROMATIC ANTENNA
Indoor spiral type (assembled) for use in good signal areas of VHF channels 0 - 12. Comes with 12 metre, 300 ohm cable, fitted with spade terminals.
L15040 .... $9.95



THE ULTIMATE INDOOR ANTENNA
- Built in mixer for UHF, VHF, FM.
- Wide frequency band from 40 MHz to 890MHz.
- Directional fine tuning with variable inner loop
- Easy mount and will even hang on the wall
- 75 ohm with coaxial cable and plug

L15038 .... $39.95

VIDEO ACCESSORIES

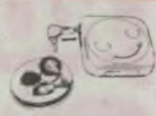


VHS VIDEO HEAD CLEANERS
New "wet ,dry, wet" system cleans and dries all parts which come into contact with the magnetic tape. Fluid is applied directly on to cloth cleaning tape prior to use. It uses clean tape for each cleaning operation. Low drag for use in sensitive mechanisims.
A11456 .... $16.95

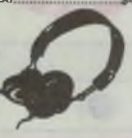
ONSIGHT VIDEO AND AUDIO/ VIDEO MONOTORING SYSTEMS
Depending on the cameras placement , you can see and, or hear if your child is awake, see or talk with people at the front door, or see if someone is in the pool and keep an eye on them.
With the cameras built in intercom, the VM200 onsight lets you converse with the people in the room where the camera is mounted.
Optional camera's, monitors and switches allows you to monitor several locations at once.
A15080 Video $489
A15085 Video Audio.... $589

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

HEADPHONES



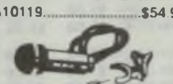
MINI STEREO EARPHONES
Impedance: 32 ohms
Sensitivity: 96dB
Freq. Response: 40 - 10,000 Hz
Cord length: 1.2m
A14006 .... $4.95



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

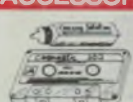
MICROPHONES

DUAL IMPEDANCE UNI DIRECTIONAL MICROPHONE (ECM502D)
Impedance: 600/ 50K ohms
Frequency response: 20 - 20KHz
Sensitivity: Lo - 68dB, High - 57dB
Cord/ Plug: 4.5 metres, 6.35mm plug
Battery: 1.5V UM3 / AA
Type: Electret condensor
Dimensions: 20 X 210mm
A10119 .... $54.95



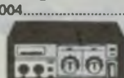
TIE TACK WIRELESS UNI DIRECTIONAL MICROPHONE (ECM550)
Tunable: 88 - 108MHz
Freq. Response: 50 - 16kHz
Field Strength: 15UV / 100m
Cord / Plug: 5 mt / 3.5mm plug
Battery: 1.5V (LR- 44)
Type: Electret condenser
A10127 .... $37.95

AUDIO ACCESSORIES



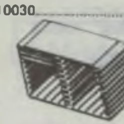
AUTOMATIC CASSETTE HEAD CLEANER
- Cleans head (rec / pb) with mechanical action.
- Also cleans capstan and pinch roller at the same time
- Includes bottle of cleaning fluid.

A10004 .... $3.95



PUBLIC ADDRESS AMP (PAE15)
AC/ DC use PA amplifier with built in chime and siren Also contains brackets.
A14450 .... $149.95

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



COMPACT DISC STORAGE
- Holds 10/ 20 compact discs in their cases
- Interlocking modular design allows verticle and horizontal interlocking
- Discs slide into place horizontally making titles easy to read
- Wall mount or free standing
- PIC- 20 Discs

A10032 .... $28.50

COMPACT DISC CARRYING CASE (CD30)
- Soft sided case
- Holds 30 compact discs
- Convenient, adjustable strap

A10036 Holds 30.....$34.95
A10035 Holds 15.....$19.95

CASSETTE CARRYING CASE
- Soft sided case
- Design like that of the CD cases
- Holds 30 boxes or 48 unboxed

A10038 .... $24.95
- Holds 60 boxed or 96 unboxed

A10040 .... $39.95

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

ALARMS & SIRENS

PHOTO ELECTRIC SMOKE DETECTOR
- Uses no radioactive substances
- Activated by visible smoke, no false alarms caused by chemicals or wind
- Operates from 12V DC, N/O circuit for control panel
- Built in piezo siren for alarm and low battery warning
- Red LED blinks when armed
- Built in test circuit
- 9 - 12V DC output under alarm condition. 9V battery back up
- Size: 168mm diameter, 42.5mm high

S15076 .... $64.95

TELEPHONE ACCESSORIES

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

Y16042 .... $29.95

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

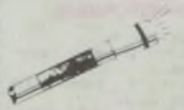
Y16019 .... $34.95

TORCHES

ARLEC SUPER TORCH
A sophisticated rechargable torch ideal for use in and around the home, the car, the boat, etc.
- Powerful built in Nicad batteries
- Reflector head swivel through 90 degrees
- 3 position switch gives on/ off and dim
- Indicator lamp when recharging
- Charges from mains electricity or from car battery

Supplied complete with:
- SEC approved battery charger
- Plug and cord for car lighter socket
- Handy charging bracket with fixing screws

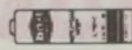
A15055 .... $43.95



ALUMINIUM TORCH
- High strength corosion resistant aircraft grade
- Durable anodised abrassion resistant finish
- Non- slip knurled grip
- Adjustable light beam angle
- Keyring tail cap
- Spare bulb -inside tail cap

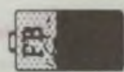
mini size- 87mm long
A15066 .... $9.95
pocket size- 150mm long
A15068 .... $11.95

NICAD BATTERIES



AA SIZE NICAD
Normal voltage: 1.2V 450m AH.

	1-9	10+
S15020	$3.95	$3.75



C SIZE NICAD
Normal voltage 1.2V 1,200m AH
charging: 120mA, 15hrs.

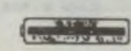
	1-9	10+
S15021	$9.95	$8.95

D SIZE NICAD
Normal voltage 1.2V 1,200mAH
Chargig: 120mA, 15hrs

	1-9	10+
S15022	$9.95	$8.95

9V SQUARE TYPE NICAD
Nominal Voltage: 9V 100mAH
Charging: 14hrs at 10mA
Note: equivalent brands may be supplied

	1-9	10+
S15023	$24.95ea.	$23.95ea.



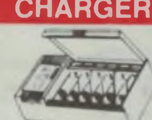
AAA SIZE NICAD (2 PACK)
Nominal voltage: 1.2V 180mAH
Charging: 18mA maximum, 15hrs

	1-9	10+
S15026	$11.95	$10.95

NR-N SIZE NICAD (2 PACK)
Nominal voltage: 1.2V 150mAH
Charging: 15mA, 15hrs

	1-9	10+
S15027	$11.95	$10.95

BATTERY CHARGERS



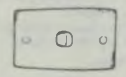
NBC-2 BATTERY CHARGER
Nickel cadmium battery charger for charging up to six batteries similtaneously.
- Charges UM3, UM4, & UM5 nicads
- Charging circuts are automatically selected depending on the physical size of the battery and the charger
- Charging time 10 - 14hrs
- 240V AC mains operated
- Requires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

M23523 .... $22.95

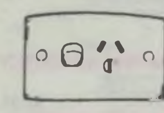
ELECTRICAL ACCESSORIES

DUAL ADAPTOR
P18020 .... $4.50

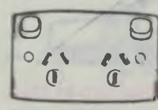
ARCHITRAVE SWITCH
P18026 .... $5.95



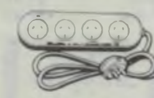
WALL MOUNT SWITCH
P18027 .... $8.95



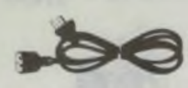
SINGLE POWER POINT
P18028 .... $9.95



DOUBLE POWER POINT
P18030 .... $11.95



4 OR 6 WAY POWER OUTLETS
With overload protection
4 way
P18040 .... $12.95
6 way
P18042 .... $19.95



EXTENSION LEADS
240V, moulded plastic plug to socket.
3 metre
P18046 .... $5.95
7 metre
P18047 .... $9.95
20 metre
P18048 .... $19.95

ROD IRVING ELECTRONICS
MELBOURNE:
48 A'Beckett St,
Phone: (03) 663 6151

NORTHCOTE:
425 HighSt,Melb
Phone: (03) 489 8866

SYDNEY:
74 Parramatta Rd,
Stanmore , NSW.
Phone: (02) 519 3134

CLAYTON MAIL ORDER
56 Renver Rd,
Phone: (03) 543 7877
Hotline: 008 33 5757
Fax: (03) 543 2648

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SAVINGS+RANGE+SERVICE =ROD IRVING ELECTRONICS!

ROD IRVING ELECTRONICS

RS232 WIRING ADAPTOR BOX
- Male to female
- 25 Detachable plug on leads
- 2 mini jumpers
- Ideal for experimenting or temporary connections

Cat. X15665

Only $19.95

CAR ANTENNA BOOSTER
- In-line instalation
- 12V boosts 100%

Cat. A12073 $7.95

CHROME LED BEZELS
9mm hole, available 3 colours

Cat No	Description	Price
S14030	Red	$1.20
S14032	Green	$1.45
S14034	Yellow	$1.45

HEATSINK COMPOUND
Heatsink compound is applied to the base and mounting studs of transistors and diodes. It maintains a positive heatsink seal that improves heat transfer from the device to the heatsink, thus increasing overall efficiency.

Cat. H11800 (10g) $2.00
Cat. H11810 (150g) $14.95

CODE KEY PAD
- Telephone type digital keypad
- Four digit, changeable code
- Over 5000 possible combinations
- Power consumption: 5mA standby, 50mA alarm
- Two sector LED and 1 arm LED
- Wrong number lockout
- 12V DC operation
- Relay output
- Panic button
- Normally open tamper switch
- Dimensions: 145 x 100 x 37mm
- ACP3 compatible

Cat. A13014 R.R.P. $79.95
SPECIAL, ONLY $69.95

MINIATURE BUZZER
5-15V White or black

Cat	1-9	10+
C15062	$2.50	$2.25

2¼" MINI SPEAKERS (57mm)

Cat No.	1-9	10+
C10610	$1.95	$1.75

CRYSTAL LOCKED WIRELESS MICROPHONE AND RECIEVER
MICROPHONE SPECIFICATIONS:
Transmitting Frequency: 37.1MHz
Transmitting System: crystal oscillation
Microphone: Electret condenser
Power Supply: 9V battery
Range: 300 feet in open field
Dimensions: 185 x 27 x 38mm
Weight: 160 grams
RECIEVER SPECIFICATIONS:
Recieving Freq.: 37.1MHz
Output Level: 30mV (maximum)
Recieving System: Super heterodyne crystal oscillation
Power Supply: 9V Battery or 9V DC power adapter
Volume control
Tuning LED
Dimensions: 115 x 32 x 44mm
Weight: 220 grams

Cat. A10452 R.R.P. $113
Our price, $99

ULTRASONIC TRANSDUCERS
Designed to transmit at 40kHz (L19990) and receive at 40kHz (L19991) with up to 20V I/P on the transmitter. These units can't be heard and so are ideal for TV remote controls, water level detectors, burglar alarms, motion detectors and information carriers as they can be either pulsed or used in the continuous wave mode.
Full specifications below for design purposes.
Maximum Input Voltage: 20V rms
Centre Frequency (kHz): 40 ± 1.0
Sound Pressure Level 10V RMS: 110dB min.
Sensitivity (dB/v/ubar) min.: -65 min.
Bandwidth (kHz):
Transmit: 4.0 (at 100dB)
Receiver: 5.0 (at -73dB)
Impedence:
Transmit: 500
Receiver: 5000

Cat. L19990 (Transmitter) $4.95
Cat. L19991 (Receiver) $4.95

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

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

X15700 $94.95

FOOT SWITCHES
- Momentary or on off models to choose from
- Cord length 2.5 metres
- 6.3mm plug

A17000 Momentary operation
A17005 Push On Off operation
each $19.95

SUPER SPECIALS

PANEL METERS GALORE!
We have a great range of panel meters at great prices!

Cat No.	Description	Price
Q10500	MU45 0-1mA	12.50
Q10502	MU45 50-0-50uA	12.50
Q10504	MU45 0-100uA	12.50
Q10510	MU45 0-5A	12.50
Q10518	MU45 0-1A	12.50
Q10520	MU45 0-1A	12.50
Q10525	MU45 0-20V	12.50
Q10530	MU52E 0-1A	14.50
Q10533	MU52E 0-5A	14.50
Q10535	MU45 VU PMetre	14.95
Q10538	MU65 0-50uA	16.95
Q10540	MU65 0-1mA	16.95
Q10550	MU65 0-100uA	16.95
Q10560	MU65 0-20V	16.95

TOGGLE SWITCHES

Cat No.	Descript	1-9	10+
S11010	S.P.D.T.	$0.90	$0.80
S11020	D.P.D.T.	$1.10	$1.00

CENTRONICS GENDER CHANGERS
- Female to Female
- Saves modifying or replacing non mating Centronics cables
- All 36 pins wired straight through

Cat. X15663 **Male to Male**
Cat. X15661 **Male to Female**
Cat. X15664 **Female to Female**

Normally $33.95
Only $24.95

QUALITY 3mm LEDS

Cat. No.	Col	1-9	10+	100+
Z10140	Red	$0.15	$0.12	$0.10
Z10141	Grn	$0.20	$0.15	$0.12
Z10143	Ylw	$0.20	$0.15	$0.12
Z10145	Ora	$0.20	$0.15	$0.12

QUALITY 5mm LEDS

Cat. No.	Col	1-9	10+	100+
Z10150	Red	$0.10	$0.09	$0.08
Z10151	Grn	$0.15	$0.12	$0.10
Z10152	Ylw	$0.15	$0.12	$0.10

ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A, Cat. M12155	$9.95	$8.95
2156 240V 6-15V 2A, Cat. M12156	$14.95	$13.95
2840 240V 9V CT, Cat. M12840	$5.95	$4.95
2851 240V 12-6V CT 150mA, Cat. M12851	$5.95	$5.50
2860 240V 15V CT 250mA, Cat. M12860	$5.95	$4.95
6672 240V 15-30V 1A tapped, Cat. M16672	$14.95	$13.95

ELECTRET MIC INSERTS
With pins for easy board insertion

Cat. C10170

1-9	10+	100+
$1.20	$1.00	$0.90

WIRE WRAP IC SOCKETS
These quality 3 level wire wrap sockets are tin-plated phosphor bronze.

Cat.No.	Description		1-9	10+
P10579	8	pin	$1.50	$1.40
P10580	14	pin	$1.85	$1.70
P10585	16	pin	$1.95	$1.80
P10587	18	pin	$1.95	$1.80
P10590	20	pin	$2.95	$2.70
P10592	22	pin	$2.95	$2.70
P10594	24	pin	$3.95	$3.50
P10596	28	pin	$3.95	$3.50
P10598	40	pin	$4.95	$4.50

MINIATURE HOBBY VICE
- Lever operated suction grip base for instant mounting and portability
- Mounts on smooth non-porous surfaces
- Ideal for holding components and other small light objects

Cat. T12458 $6.95

PC BOARD HOLDER
Better than an extra pair of hands! a must for all PCB work

Cat. T12444 $9.95

FLASHING LEADS
Red, 5mm

	1-10	10+
Z10159	$1.10	$1.00

MOSFET SPECIALS

	1-9	10+
2SJ49	$7.50	$7.00
2SJ56	$10.00	$9.50
2SK134	$6.90	$6.50
2SK176	$9.50	$8.90

8087 CHIPS
Genuine Intel chips with manual and data sheets packed in boxes!

8087-3	(4.77MHZ)	$175
8087-2	(8MHZ)	$265
8087-1	(10MHZ)	$395
80287-6	(6MHZ)	$295
80287-8	(8MHZ)	$395
80287-10	(10MHZ)	$495
80387-16	(16MHZ)	$795
8038720	(20MHZ)	$895
80387-25	(25MHZ)	$1,095

MEMORY

	1-9	10+
1 M/B 80NS	$24.95	$22.95
4164-15	$4.95	$4.50
4164-12	$5.95	$5.50
41256-15	$7.50	$7.00
41256-12	$8.50	$8.00
41256-10	$9.50	$9.00
41256-08	$9.90	$9.50

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
LOCAL: 543 7877

DATA TRANSFER SWITCHES
If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.
- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector

2 WAY RS232 X19120 ONLY $39
4 WAY RS232 X19125 ONLY $59
2 WAY Centronics X19130 ONLY $49
4 WAY Centronics X19135 ONLY $59

DB25 CONNECTOR SPECIALS!

		1-9	10+
P10884	DE9P	$1.00	$0.70
P10885	DE9S	$1.00	$0.70
P10890	DE9C	$1.00	$0.80
P10891	DA15S	$1.00	$0.80
P10892	DA15C	$1.00	$0.80
P10894	DA15P	$1.00	$0.80
P10902	DB25C	$1.00	$0.80
P10900	DB25P	$1.00	$0.80
P10901	DB25S	$1.00	$0.80

MIDRANGE HORNS
Use these quality, all metal, Piezo tweeters for great top end sound in your band speakers, disco sound system, etc. Rated at 30 watts RMS in a system they will handle over 100 watts RMS.
Two sizes to choose from:
Size: 4 x 10½
Impedance: 8 ohms
Rating: 30 watts RMS
Response: 1.5kHz - 14kHz
Dimensions: 102 x 267 x 177mm
Cat. C92082 Normally $49.95
This month only $39.95

Size: 3 x 7
Impedance: 8 ohms
Rating: 30 watts RMS
Response: 2kHz - 15kHz
Dimensions: 76 x 177 x 145mm
Cat. C92084 Normally $29.95
This month only $24.95

SUPER HORN TWEETER
- Requires no crossover and handles up to 100W!
- Sensitivity: 100dB/0.5m
- Frequency Response: 3kHz-30kHz
- Impedance: 8 OHMS
- Size 96mm diameter

Cat. C12102 Normally $12.95
SPECIAL, ONLY $9.95

SAVE $2!

10W HORN SPEAKERS
White durable plastic, 8 ohms

Cat. C12010 Normally $11.95
SPECIAL, ONLY $9.95

UTILITY BOXES
Plastic boxes with aluminium tops and available in four sizes. Very popular for projects and very economical!

H10101	150x90x50mm	$ 3.25
H10102	195x113x60mm	$ 4.50
H10103	130x68x41mm	$ 2.75
H10105	83x54x28mm	$ 1.95
H10110	120x65x38mm	$ 2.95
H10112	120x65x38mm (Metal top)	$ 2.95

9 PIN TO 25 PIN CONNECTOR ADAPTORS
The perfect solution! Features gold plated pins

X15668 DB9 Plug to DB25 Socket
X15669 DB9 Socket to DB25 Plug
each $8.95

FREE STANDING, FOLD UP MAGNIFIER
An economically priced "hands free" magnifier, lets you take care of all those tricky fine detailed jobs so often encountered in electronics, or any of many other practical uses such as home, work, hobbies etc.

Cat. T10020 Normally $14.95
SPECIAL, ONLY $12.95

UNIVERSAL BATTERY CHARGER AND TESTER
Save money on expensive batteries with this universal battery charger. Features include meter tester, and provisions for D, C, AA, AAA, N, button and cell batteries, 9V and 6V (square types). Comes complete with detailed instructions.

Cat. M23533 $29.95

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

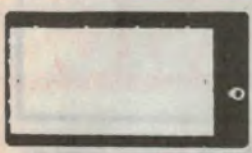
Size	Desc.	1-9	10+	100+
AA	450 mA H	$2.95	$2.75	$2.50
C	1.2 A H	$9.95	$9.50	$8.95
D	1.2 A H	$9.95	$9.50	$8.95

GIFT VOUCHERS AVAILABLE!

WE HAVE OVER 6,000 ITEMS AVAILABLE

ROD IRVING ELECTRONICS

GENERAL COMPONENTS



BREAD BOARDS

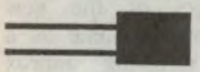
This inexpensive rang of modular interlocking units enables a quick, easy way of experimenting with new circuits and ideas. There are two main units consisting of a terminal strip or distribution and a Central plug-in unit.

· 100 holes
P11000..................$2.75

· 640 + 100 holes
P11007................$14.95

· 1280 + 100 holes
P11010................$26.95

· 2560 + 700 holes
P11018................$69.95



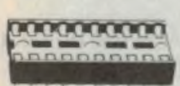
RECTANGULAR LEDS

	1-9	10-99	100+
RED	20c	15c	12c
GREEN	20c	15c	12c
YELLOW	20c	15c	12c
ORANGE	20c	15c	12c

GOLD INSERT LOW PROFILE IC SOCKETS

- Gold machined pins
- Extremely high quality
- Anti-wicking
- Ideal for professional use or where field service components is required.

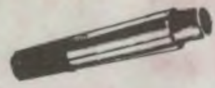
Cat.no	Description	1-9	10+
P10620	8 pin	$1.20	$1.10
P10624	14 pin	$1.60	$1.40
P10626	16 pin	$1.90	$1.80
P10628	18 pin	$2.00	$1.90
P10630	20 pin	$2.20	$2.00
P10632	22 pin	$2.40	$2.20
P10634	24 pin	$2.60	$2.40
P10640	28 pin	$2.90	$2.70
P10644	40 pin	$2.95	$2.75



LOW PROFILE IC SOCKETS

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

Cat. No.	Description	1-9	10+
P10550	8 pin	$0.20	$0.18
P10560	14 pin	$0.25	$0.20
P10565	16 pin	$0.25	$0.20
P10567	18 pin	$0.40	$0.35
P10568	20 pin	$0.40	$0.35
P10569	22 pin	$0.40	$0.30
P10570	24 pin	$0.40	$0.30
P10572	28 pin	$0.50	$0.40
P10575	40 pin	$0.50	$0.40



CANNON TYPE CONNECTORS AT SPECIAL PRICES !!

	1-9	10+
3 pin line male		
P10960	$3.90	$3.35
3 pin chassis male		
P10962	$3.90	$3.50
3 pin line female		
P10964	$3.90	$3.50
3 pin chassis female		
P10966	$4.95	$3.95

12V DC FANS

80 x 80 x 25.4mm
12V DC, 1.7 Watt, 0.14 Amps
T12469................$12.95
10+ fans only $11.95 each

MICE

QUICK MOUSE

MICROSOFT* COMPATIBLE!

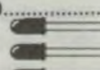
- Auto-selection and auto-transfer between mouse system system PC mouse mode and Microsoft serial mouse mode
- Microsoft Serial Mouse and Mouse System compatible
- Super high tracking speed: 600mm/sec
- Super high resolution: 200 D.P.I. (0.12mm/dot)
- Silicon rubber coated ball
- Optical rotary encoder

X19952................$79.00

WITTY MOUSE

- Three buttons, user definable
- Silicone coated steel ball
- High resolution movement of 195 dots/inch. Smaller table space and less hand movement required
- Optical rotary encoder
- Max. tracking speed: 200m/sec
- Mouse resident firmware
- Size: 116 x 66 x 34mm
- Mouse Driver Software included, allowing you to install with all popular software packages. Also included is the handy Pop-up menu software that allows the user to integrate the mouse with the keyboard, DOS, and other popular software packages

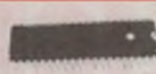
X19950......................$59



FLASHING LEADS

· Red, 5mm

	1-10	10+
Z10159	$1.10	$1.00



THIS MONTHS INCREDIBLE IC'S SPECIALS

	1-9	10+
4002	29c	25c
4007	20c	18c
4012	20c	18c
4014	75c	70c
4018	75c	65c
4022	35c	30c
4034	1.30	1.10
4035	75c	60c
4040	60c	50c
4047	65c	60c
4071	25c	20c
4075	25c	20c
4081	25c	22c
4098	60c	50c
4510	70c	60c
4511	75c	70c
4515	80c	70c
4516	80c	70c
4518	75c	70c
4520	75c	70c
4526	80c	70c
4536	2.50	2.00
4556	50c	40c
MM5369	2.50	2.20
40175	50c	40c
7402	50c	40c
7405	50c	40c
7409	40c	35c
7410	45c	40c
7425	50c	40c
7426	30c	25c
7427	50c	40c
7430	50c	40c
7437	60c	55c
7438	30c	25c
7446	50c	45c
7447	50c	45c
7473	60c	55c
7475	60c	55c
7476	60c	55c
7493	50c	45c
7495	65c	60c
7497	1.20	1.00
74125	60c	55c
74126	60c	55c
74145	75c	70c
74150	1.00	90c
74155	60c	55c
74157	60c	55c
74161	60c	55c
74164	60c	55c
74174	60c	55c
74175	50c	45c
74283	75c	70c
74290	50c	45c
74100	30c	25c
74F32	30c	25c
74F109	42c	35c
74F153	25c	20c
74F157	80c	70c
74F181	2.50	2.20
74F194	1.00	80c

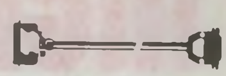
OFFER ENDS JUNE 30 1990

CRYSTALS

1/2 PRICE OFF ALL CRYSTALS

Y11000	1MHz	$11.50
Y11003	1.8432MHz	$7.50
Y11005	2MHz	$6.90
Y11007	2.3040 MHz	$6.50
Y11008	2.4576 MHz	$6.[illegible]
Y11009	2.7648 MHz	[illegible].90
Y11010	3MHz	[illegible]90
Y11015	3.5795[illegible]	[illegible]
Y11018	3.93[illegible]	[illegible]
Y11020	[illegible]	[illegible].90
Y11022	[illegible]	$3.90
Y11023	[illegible]MHz	$4.90
Y110[illegible]	[illegible] MHz	$4.90
[illegible]	[illegible]75 MHz	$4.90
Y11[illegible]	4.9152 MHz	$6.90
Y110[illegible]	4.9562 MHz	$4.90
Y11030	5MHz	$4.90
Y11033	5.0688MHz	$4.90
Y11042	6.144 MHz	$4.90
Y11050	8.00 MHz	$4.90
Y11055	8.86723MHz	$4.90
Y11070	12.00 MHz	$4.90
Y11072	14.318 MHz	$4.90
Y11080	16.00 MHz	$4.90
Y11085	18.432 MHz	$4.90
Y11090	20.00 MHz	$4.90

LEADS



PRINTER LEAD

- Suits IBM* PC/XT, compatibles
- 25 pin "D" plug (computer end) to Centronics 36 pin plug

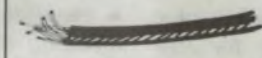
· 1.8 metres
P19029.................$14.95
· 3 metres
P19030.................$19.95
· 10 metres
P19034.................$39.95

CABLES

FLAT GREY RIBBON CABLE

- Flat cable for IDC connectors
- m = metre

	1-9m.	10+m.	100+m.
W12614 · 14 way	$1.90m	$1.80m	$1.20m
W12616 · 16 way	$1.90m	$1.80m	$1.20m
W12620 · 20 way	$2.50m	$2.20m	$1.50m
W12624 · 24 way	$2.90m	$2.70m	$1.70m
W12626 · 26 way	$3.60m	$3.30m	$2.20m
W12634 · 34 way	$3.90m	$3.60m	$2.30m
W12636 · 36 way	$1.90m	$1.80m	$1.20m
W12640 · 40 way	$4.90m	$4.00m	$2.80m
W12650 · 50 way	$5.50m	$4.90m	$2.90m



COMPUTER CABLE

- Six conductor shielded computer interface cable
- m = metre

	1-9 m	10+ m	100+ m
W12670 · CIC6	$1.30m	$1.10m	$1.00m
W12672 · CIC9	$1.60m	$1.50m	$1.20m
W12674 · CIC12	$2.50m	$2.20m	$1.90m
W12676 · CIC16	$3.50m	$3.20m	$2.50m
W12678 · CIC25	$3.90m	$3.40m	$3.00m

METEX 4500H MULTIMETER

10A, 4 1/2 digit multimeter with digital hold, transistor tester and audible continuity tester.

CHECK THESE FEATURES...

- Readout hold
- Transistor Tester
- 4 1/2 digit x 1/2"(H) LCD
- Audible continuity tester
- Quality set of probes
- Digital readout hold
- Built in tilting bail
- Instruction manual
- hFE test
- Diode Tester
- Vinyl case

Q91560 Normally $175
Special, only $159

FREE 100 PAGE CATALOGUE PLEASE CALL IN AND PICK ONE UP

METEX 3530 MULTIMETER

Compact, rugged, battery operated hand held 3 1/2 digit multimeter.

Features

- 1/2" high contrast LCD
- Automatic over-range indication with the "1" displayed
- Automatic polarity indication on DC ranges
- Capacitance measurements to 20uF
- Diode testing with 1 mA fixed current
- Audible Continuity Test
- Transistor hFE Test

SPECIFICATIONS

Maximum Display: 1999 counts 3 1/2 digit type with automatic polarity indication
Indication Method: LCD display
Measuring Method: Dual-slope in A-D converter system
Over-range Indication: "1" Figure only in the display
Temperature Ranges: Operating 0-C to +40-C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat. Q91540 Normally $139
SPECIAL $109

NEWS HIGHLIGHTS

AUST TRIAL OF CT2 CORDLESS PHONES

Australia is now seeing the latest development in personal communications, courtesy of British Telecom, with a pocket-sized phone that can be used in the office, home and on the street. The first trial of this technology to take place in Australia is being conducted by Qantek, the information technology arm of Qantas, at the new Cairns International airport.

The new lightweight, digital cordless phones supplied by British Telecom are claimed to have already gained wide acceptance in the UK. Known as CT2 (for Cordless Telephone Mk2), the tiny phones are the latest step in personal communications for all. They can be used as a cordless telephone, handling incoming and outgoing calls in the home or connected to a PABX in the office. But in addition they can also be used as a mobile phone for making outgoing calls whilst on the street.

The user needs to be within 200 metres of a Telepoint 'station' to make a call. Telepoints will be distinguishable by bright signs and will be located in convenient places where people need to make calls, such as shopping centres, stations, airports, city centres, business areas, pubs, restaurants, high streets and carparks.

To make a call, a business man for instance, would enter his own personal identification number, unique to his handset. The Telepoint system can then recognise him as a valid customer, whereupon he receives dial tone and can make a call to anywhere in the world. He can be billed to either his home or office address.

The key advantages of the new phones are their size (the same as a pocket diary and weighing approx 130gms) as well as their low cost, compared to other mobile systems.

At present Austel is examining whether Telepoint services should be allowed in Australia, and they are expected to report their findings to government shortly. In the meantime, Austrel have allowed British Telecom to trial the service at Cairns airport in conjunction with Qantek.

PAY TV COULD TAKE OFF FASTER THAN VCR'S

Pay TV could attract more than one million subscribers in Australia in its early stages as a result of a perceived poor quality in commercial channel programming. Additionally, the introduction of Pay TV would have major impacts on other forms of home entertainment, primarily commercial television viewing and the purchase and hire of pre-recorded video cassettes.

These are among the key findings of a new study, *A demand study for Pay TV: A consumer perspective*, by the information marketing consultancy, BIS Shrapnel. The study has found:

- A very high level of general awareness of pay and cable TV;
- A generally favourable reaction to the concept, with the most favourable reactions in Sydney and Melbourne;
- A clear pattern of the level of expenditure which households are willing to pay to receive a pay TV service; and
- A range of additional services, such as home education and home banking would be popular.

NEWS BRIEFS

- The 15th ***Australian Conference on Optical Fibre Technology*** and the 7th ***Optical Fibre Sensors Conference*** will be held from 2-6 December 1990 at the Sydney Convention and Exhibition Centre. For further information, contact the Institution of Radio and Electronics Engineers on (02) 327 4822.
- ***Kingfisher International*** has moved to a new address: 860 High Street Road, Glen Waverley 3150.
- The next ***Melbourne Audio Engineering Society*** convention will be held from 20-22 August 1991 at the Moonee Valley Function Centre. For further information, phone (03) 885 5088.
- ***Hewlett-Packard Australia*** has appointed Bill Hilliard as managing director, following the ill health of Malcolm Kerr, who will return to the company on full recuperation.
- The third ***International Electronic Component Exhibition*** for Asia will be held from 4-7 April 1991 in Hong Kong. For further information, phone (02) 251 2855.
- ***Control Supplies*** is a distributor of industrial control products from Furnas Electric and Nordic Electric of the USA, Tempatron of the UK and CDC, AECO and Thermosystems of Italy. The company is located at 138 Richmond Road, Blacktown 2148, or phone (02) 671 2177.
- David Combe has joined ***Amtex Electronics*** as National Product Manager after a two year work holiday in the US.
- ***Toshiba Corporation*** has appointed Mobex as its sole Australian distributor for all consumer products except commercial air conditioners.
- ***IRH Components*** has been appointed Australian distributor for the semiconductor products of both Teccor Electronics and Siliconix.
- ***Datacraft Computer Protocol*** has appointed Ian Lyons as the State Manager for South Australia, while in Melbourne, Gerald Glover has been appointed as the General Manager of another subsidiary, ***Australian Computer Manufacturers***.

AUST SONAR SYSTEM USES HP PROCESSORS

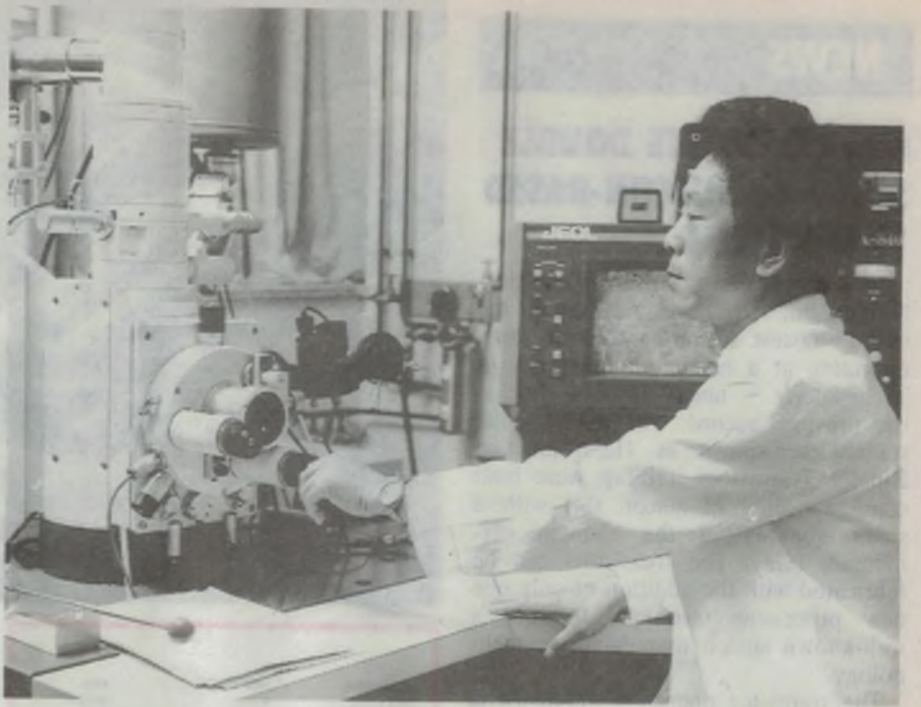
The Royal Australian Navy has commissioned a new sonar system for Australia's Oberon class submarines, which is believed to be unique to Australia.

Sonartech, a Sydney based signal processing company, is producing the sonar and selected Hewlett-Packard HP9000 computer processors as the heart of the system.

The Defence Science Technology Organisation (DSTO) undertook the initial concept development and prototype design several years ago, at which time they called upon HP to provide engineering support to facilitate interfacing and board level modifications. After successful sea trials of the prototype sonar, the technology base was transferred to Sonartech who have re-engineered the system. Significant performance improvements were achieved by using the latest developments in the HP9000 series of processors.

The system, known as Ping Intercept Passive Ranging Sonar (PIPRS), intercepts acoustic signals emitted from (enemy) submarine and surface ship sonar systems as they attempt to detect a submarine and fixes the location of the signal source. This allows the submarine to gather vital information on the transmitting vessel and take appropriate action well before the sonar echo can be detected.

Dr Tony Collins, Managing Director of Sonartech, said it was hoped that this unique signal processing system could be exported to selected foreign navies which use suitably equipped submarines. "At this stage the system is installed on three Australian submarines and other boats are expected to be fitted with PIPRS over coming years."



MM CABLES SUPPORT CONDUCTIVITY RESEARCH

In a continuing commitment to research, Metal Manufactures Ltd is sponsoring the first Chair in Superconductivity at the University of New South Wales.

In addition, MM Cables Division is supporting an additional three years of the superconductivity research project that Professor Dou and his team have been working on since 1987. This brings Metal Manufactures financial contribution to this area of research to $650,000, which amounts to 25% of the total Australian expenditure on superconductivity.

"The probability of a commercially viable high temperature ceramic superconducting material and the possibility of this being realised in the next few years presents another exciting challenge for MM in the 1990s", said Mr Peter Macdonald, Group General Manager MM Cables.

One of the great problems with ceramic conductors is their brittleness. This problem can be overcome by the fabrications of metal/ceramic composites, where the metal's malleability compensates for the ceramic's brittleness. Unfortunately these ceramics react with nearly every metal with which they come into contact. The UNSW team has discovered and patented a method of safely processing the ceramic together with silver. The ceramic can be encapsulated in a silver tube, which can then be drawn into a smaller size and rolled into a flat tape.

The silver-clad bismuth-based superconducting tape made by the researchers at UNSW is capable of carrying 12,000 A/sq cm at 77K, which is comparable with the very best results recorded worldwide in this field. This wire has been coiled into a three centimetre diameter and carried over 2000 A/sq cm over a length of one metre.

These rapid developments have further intensified the pace of international competition. In the USA and Japan, even bigger consortia have now been formed between universities, national laboratories and industries.

Professor Dou is confident that the research team at the University who were in on the initial crest of research and development will continue to remain among the leaders.

TRANSATLANTIC SATELLITE TO USE B-MAC SYSTEM

Scientific-Atlanta's proprietary B-MAC satellite transmission technology will secure the transatlantic video transmissions of BrightStar, the transatlantic international satellite service for PTTs, commercial broadcasters and private users.

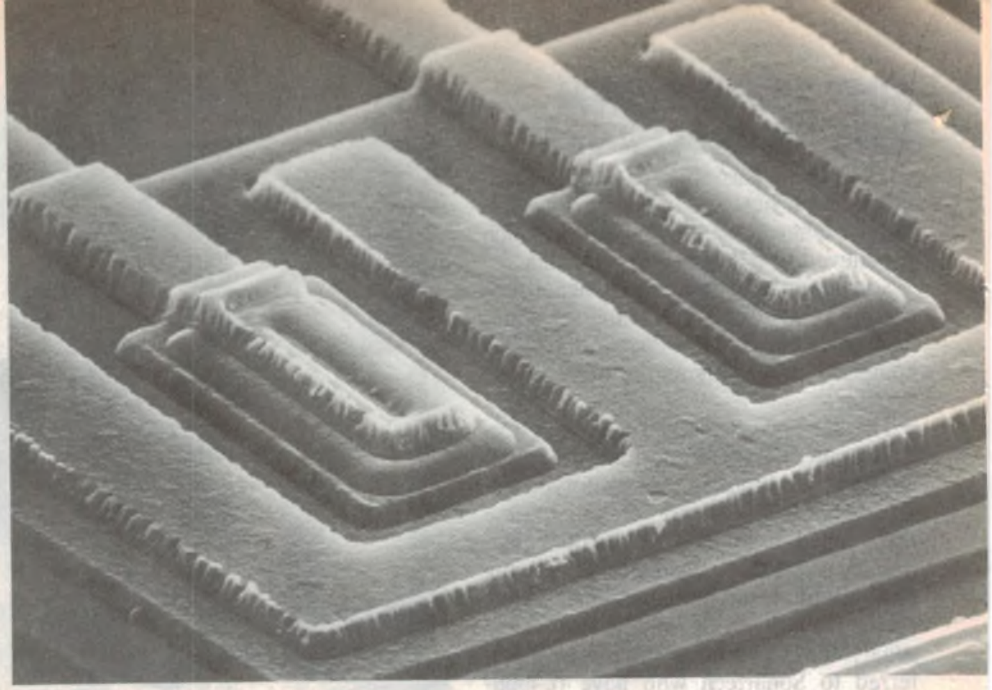
BrightStar has standardised on the B-MAC encryption standard, with the purchase of Scientific-Atlanta's recently introduced 625-line compact encoder. B-MAC technology provides simultaneous transmission of hard-scrambled video, six digital audio channels, a utility channel and on-screen teletext.

BrightStar, a provider of turnkey satellite services with major transmission facilities in Washington DC New York, London, Paris and Frankfurt, will use the B-MAC technology to provide a wide range of transatlantic and continental scrambled video services. Applications will include news backhaul as well as private business television broadcasts.

The company is investing over US $2 million in an additional 24-hour west-to-east channel providing Ku-Band transmission direct to Europe.

According to BrightStar General Manager John Milman, Scientific-Atlanta's B-MAC was chosen after a study of different methods, and was selected on its merits of "...high security and excellent signal performance."

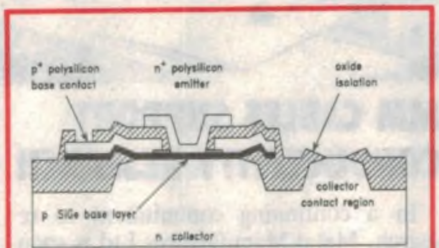
IBM SCIENTISTS DOUBLE SPEED OF SILICON-BASED TRANSISTORS



IBM scientists in Yorktown Heights, NY, claim to have fabricated the world's fastest silicon-based transistors, operating at a maximum frequency of 75 gigahertz – nearly twice as fast as the previous record. The experimental transistors, known as Heterojunction Bipolar Transistors (HBTs), were built using an alloy of silicon (Si) with a small quantity of the element germanium (Ge). The transistors can be fabricated with the addition of only one new processing technique to today's well-known silicon manufacturing technology.

The transistor operating frequency is one factor in determining the speed of computer chips. Although substantial work is needed to develop these transistors fully, this IBM achievement represents a significant advance in Si-based chips for use in high-speed computers.

The HBT, first invented in the fifties, has superior speed and lower power consumption relative to conventional transistors. Although high performance HBT devices have been fabricated in a variety of materials, primarily compound semiconductors like gallium arsenide, they have only recently been fabricated in silicon. Si-based HBTs are important because they can provide a significant performance improvement for high-speed computers.



In a SiGe HBT, the SiGe layer is used to enhance the electrical properties of the transistor's critical region. Earlier attempts to produce such devices with SiGe alloys have failed because the large size of the Ge atom relative to that of the Si atom makes it difficult to mix properly the two materials. Despite these difficulties, SiGe alloys can be formed by epitaxial processes which deposit a controlled ratio of Si and Ge atoms layer by layer.

IBM's record-breaking transistors were fabricated by depositing SiGe alloys with a special process called Ultr-High-Vacuum/Chemical Vapour Deposition (UHV/CVD) which was invented at IBM. In this method, deposition occurs at lower temperatures and in a far cleaner environment than existing growth techniques. Low temperature deposition is required to keep the larger Ge atoms in place, while the VHF conditions are needed to eliminate the incorporation of contaminants which easily ruin the material quality. After the deposition of the transistor's initial structure, the IBM rsearchers employed a specially designed fabrication process to avoid damage to these delicate, ultra-thin (0.05 micron) layers.

RAMTRON, NMBS TO DEVELOP 4Mb DRAMS

Ramtron Corporation has announced expansion of its October 1988 DRAM co-development alliance with NMB Semiconductor (NMBS) Company of Japan.

Under the terms of the follow-on multi-million-dollar agreement, the two companies are co-developing a second generation of high-speed CMOS 4-megabit (4Mg) Dynamic Random Access Memories (DRAMs).

The new 4-Mb DRAMs, which feature 40ns maximum access times, a low power standby mode with extended refresh times and space-saving 300 mil packaging, will be sold worldwide exclusively by NMBS' recently formed joint venture with Intel Corporation, the world's market leader in microprocessors. The new 4-Mb DRAMs are expected to be made commercially available during the second half of 1990.

Commenting on the significance of the agreement, Richard Horton, Ramtron's president, said, "This new 4-Mb DRAM co-development program, which follows the November 1989 design completion of our first generation 50ns DRAMs now entering production in NMBS' semiconductor fabrication plant in Tateyama, Japan, significantly increases the potential for greater worldwide sales and market share for our 4-Mb DRAM products."

Mr Horton continued, "The very high operating speed of these 4-Mb DRAMs will allow systems designers to directly interface zero-wait-state main memory to advanced high-performance microprocessors, in many cases eliminating the need for SRAM-based cache."

NEW ELECTRODE BOOSTS BATTERY

Scientists at Lawrence Berkeley Laboratory in California have invented a radically new positive electrode that should allow them to produce a solid-state battery with more power, longer lifetime and shelf life than any battery now on the market or under development.

The new lithium batteries also promise to be cheaper in that they use less expensive materials. They can be made for all types of uses, from the sustained low power demands of a watch, to the high power demands of electric vehicles.'

And, because they are solid-state and contain no liquid, they cannot leak. They could be on the market within two years.

DISPLAYS FOR RAN SEAHAWK CHOPPERS

Thomas Electronics of Australia recently commenced delivery of cockpit display screens to Rockwell Collins Avionics of Cedar Rapids, Iowa USA, for the RAN's new Seahawk helicopters.

The initial order is for 16 helicopters, with follow-up orders likely in the near future. The first eight helicopters were built by Sikorsky in the United States. The remaining eight units are now being assembled by ASTA in Melbourne.

The seahawks will primarily be used on the Navy's six FFG's and the proposed Anzac Frigates, to provide these ships with powerful anti-submarine capability. To achieve this function, the Seahawks have an advanced combat data system – integrating the information received from a number of sensors, including radar and sonar buoys.

All tactical information is displayed on the two central cockpit displays which utilise 12" high brightness CRT's designed for viewability under all ambient light conditions. Additional 5" CRT screens display navigation information for each pilot.

BRITISH BREAKTHROUGH IN LARGE SCREEN LCDs

Scientists at the British GEC electronics group's Hirst research centre claim they have overcome the major problems that until now have barred the way to giant colour liquid crystal displays.

The researchers have just won a major award for the development of high-performance, polysilicon, active-matrix LCDs with fault-free components. GEC says the technology involved overcomes difficulties that have impeded progress towards high-information-content, large-area LCDs with the colour, greyscale, and video capabilities needed for applications that until now have been the exclusive preserve of cathode-ray tubes.

The key to this success is what is known as 'active-matrix addressing', in which each pixel of the display is controlled by its own thin-film transistor. This active-matrix array of transistors is deposited inside the display on the actual glass plates from which the display is fabricated.

Progress to successful products has been impeded by the problem of finding a suitable semiconductor. Although earlier work in Japan had used amorphous silicon as the semiconductor, GEC found that polycrystalline silicon or 'polysilicon', offered several major advantages. The company also discovered that transistor-quality polysilicon can be deposited at glass-compatible temperatures of 630°C or less by chemical-vapour deposition at low pressure. Conventional polysilicon deposition equipment was radically redesigned for low-cost bath processing of large glass substrates.

ULTRASONIC TAPEMEASURE

A new ultrasonic tapemeasure for professionals, called SupaRule, is now available on the Australian market. Designed and manufactured in Ireland, the unit provides a degree of accuracy and a range of features hitherto not available on electronic tapemeasures.

The accuracy of the SupaRule has been tested by Assistant Professor Roy R. Frank of the University of Illinois, who found that the unit has an accuracy range of 99.45% to 99.99%. This accuracy, which can be more precise than the manual method, has been achieved by allowing automatic compensation for any temperature variation.

As well as measuring distances, the SupaRule can determine areas and volumes by using an easy to operate memory function. Distances can be measured in metric and/or imperial in a range of 271mm (1") to 25m. Distances longer than 25m can be calculated by aggregation through the 'Add-on' function.

For further information, contact Hertz Electronics on (02) 32 3029.

BRISBANE HOME ELECTRONICS SHOW

Queenslanders will be able to see the latest advances in electronics when the Triple M FM104 Home Electronics Show opens in Brisbane this month, 22nd - 24th June.

The Home Electronics Show is planned to cover every square metre of space at the Exhibition Building, RNA Showgrounds, and will feature open display areas as well as purpose built sound-proof demonstration rooms for hi-fi and video demonstrations.

Products highlighted at the show include the latest hi-fi products, video and television, car stereo, personal computers, music products and photographic gear.

A feature of the show will be 20 fully enclosed sound demonstration rooms, housing some of the best hi-fi and video equipment in the world. According to organiser Rob Woodland, the demonstration rooms should provide a pretty good indication of how a product will sound in a lounge room environment.

Interviews unearth differing opinions:

Opportunities for women in electronics – 2

Here is the second of our news editor's articles exploring the current career opportunities for women in the electronics industry. She continues with further profiles of women who have 'made it' in the industry, including those who are now running their own contracting firms.

by WINIFRED VINCENT

Dr Ria Follett obtained her BSc in Computer Science from Sydney University in 1974, and a PhD in Artificial Intelligence from the University of New South Wales in 1979. While still a graduate student she formed her own company, which later became Scientia-Whitehorse Ltd. After working at Marconi Avionics in the UK for two years, she returned here and rejoined Scientia-Whitehorse as Technical Director – her current position. Her area of specialisation is Artificial Intelligence and Medical Software.

Even though Dr Follett denies that she is an electronics person, she has good understanding of the hardware side of computers as well as the software. She is married to an electrical engineer, and repairs instruments and makes devices during her spare time. She says that her husband supports her in working long hours and going on business trips, etc.

Dr Follett has worked in an advisory capacity on Industry and Government bodies (e.g., the Australian Science & Technology Council). On one occasion she went to Japan to evaluate their software systems and capabilities, and says that the Japanese were not at all concerned that she was a woman. She is a member of Australian Computer Society and of the Expert Systems Group. She has also been Chairman of the Software Industry committee. She has published papers on Maintenance Management and on Artificial Intelligence.

Ria Follett sees electronics as different from other engineering fields in that it requires high level of intelligence and mathematical ability, but less physical exertion. At her company she runs a software development team, developing both custom systems and products. She is never self-conscious about the fact that she is a woman. On one occasion she took her baby daughter to a meeting with IBM executives and they did not mind it at all, since the baby was sleeping throughout the meeting.

Dr Follett believes that women should achieve in their own right, so that they earn the respect of other groups, rather than demanding special treatment. She thinks affirmative action is unnecessary, because women can enter any field they like on their own merit.

Ria Follette

Nerida Perkins obtained her Bachelor of Engineering (Electrical) from NSW Institute of Technology (now the University of Technology) nine years ago. She did her studies while an engineering trainee with AWA. Like other trainees she was rotated around AWA's Telecommunications, Data Communications and Defence sections and acquired experience in testing, drafting, designing, processing and purchasing. She specialised with the Telephone Switching group.

After nine years with AWA she joined Time Office Computers and did software design. Later she joined GPT and did software design for a system called Time Division Cross-Connect, for Telecom's data switching exchange. She took maternity leave from GPT when she became pregnant, but did not go back to work for them after her daughter was born; instead she and her husband started their own company, Van Woerkom & Associates.

Now she is working part-time, contracting to GPT and designing software for a project she previously worked on. Although she is not directly involved in electronics, for the level at which she is designing software a background in electronics is essential. Her career ambition is to build up the family business and to consult on software design methodologies.

Nerida is a member of the Institute of Electrical and Electronic Engineers and the IEEE Communications society. She has been active with the Section and Chapter committees. She says the fact that her father was a TAFE teacher in Electronics helped her develop her interest in electronics. She too met her husband at work, and is grateful to both her parents and husband for the encouragement and support they've given her in pursuing her career.

Electronics is an 'invisible' field, Nerida believes, when compared to other branches of engineering, because

Louise Appel

Judith Hopper

although people see the telephone, TV, computer etc., they generally can't see the engineering effort behind them. For that reason electronics is simultaneously 'simple' and 'difficult' to the average person. Nerida says that generally people take their telephone for granted but think anyone who can understand what goes on inside it is a magician.

At J.N. Almgren

Judith Hopper is a Project Manager with J.N. Almgren (JNA). She got her BSc in Biology, Computing and Electronics from Macquarie University five years ago, and has worked for both IBM and AWA. Her areas of expertise are in software engineering and project management.

Nerida Perkins

Judith has an unusual combination of qualifications. She has a Pathology Technician Certificate from Sydney Technical College, and she worked for North Shore Hospital in the Microbiology Laboratory for four years before going to university. While at AWA she wrote applications software for a videotex package, and later managed projects involving arrival and departure displays for Ansett airlines terminals, and a voice annunciator for Adelaide's railway system.

What she likes most about her job is the mixture of hardware and software in a single project. The projects involve electronic communications – multiplexers and modems. She does not think electronics needs to be introduced at an earlier age in schools, for it may lead to 'over specialisation'.

There are 20 people working under Judith and they all have good rapport with each other. Judith does not believe in women's support groups, and says that she is capable of handling any situations as they arise. Her future career ambition is engineering management.

Rupa Chandran is a graduate engineer with JNA. She is from Malaysia and obtained her BE in Electronics Communications from the Bangalore University, India, last year. At the time of the interview it was nearly six months since she had joined the company.

Rupa is involved in the maintenance of data communication equipment, which involves both software and hardware. She agrees that electronics requires less physical labour when compared to other engineering fields such as civil, mechanical or chemical. To her, the most interesting aspect of electronics is solving a problem and getting something to work.

Rupa was a member of the IEEE student body at the university and has published papers on Cache Memories and Algorithmic State Machines. She was also a member of the amateur radio club (callsign RMC232), and is going to get an international licence. She has built radio equipment, as well as repairing a TV and other domestic appliances.

Rupa believes that she is serving humanity by working in this field, even though that was not the main reason she chose electronics as a career. Her career ambition is going into project management.

Louise Appel is a work-in-progress Materials Co-ordinator with JNA. She is currently studying at North Sydney Technical College – in the second year of an electronics course. She joined JNA only recently, and finds that the people she works with are the least prejudiced and most supportive of those she has encountered.

Her experiences seem to me to reflect the kind of problems women face at the trade level. Let me start her story in the right sequence.

Louise was a creative artist, with an appropriate university degree, whose interests shifted more and more towards the audiovisual area. She found herself depending more and more on electronics technicians, who didn't always have answers to her questions. So she went and enrolled for the electronics trade course at Sydney Technical College, three years ago.

After completing only three semesters of that course, she realised that something was wrong. She tried to get a job as a trainee technician and some companies would not even give her a forwarding address, to send in her application. Finally one company hired her as a storeperson. Within that company they mentioned the likelihood of her becoming an assistant production manager, even though she wanted to become a technician first.

After spending one year with that company, Louise thought that with three semesters of electronics and one year work experience, there would surely be a company out there which would hire her as a trainee technician. But she discovered to her dismay she was wrong.

The supervisor of the technical staff at an Engineering Department of a major university told her that the person she would work under, if she were hired, had 'set ideas' and therefore it was unlikely that she would be hired.

Learning of this story, I contacted the department head concerned, who expressed regret for his supervisor's statements. He undertook to make sure that such incidents would not happen again. In view of this admitted instance of discrimination, one may perhaps be forgiven for being somewhat skeptical about his assurances that they still picked the 'best' applicant.

At JNA, Louise is getting a lot of encouragement about her career pursuit. At the moment she inspects parts which have left the store and have become work-in-progress; parts that don't meet QA specs are dealt with at this stage, along with shortages. She also accepts and inspects returned manufactured goods, submitting them for testing. She has also assisted the test engineers, and attends production meetings to draw the attention of the relevant parties to any problems or discrepancies they need to know about.

Louise's career ambition is to become an electronics technician, and later an engineer. Her interests are not limited to electronics only – in fact, at the time of our discussion she was rebuilding a motor cycle.

At universities

Emine Daldal works as a Technical Officer at the Department of Electrical Engineering and Computer Science of the University of New South Wales, and had been there for nearly six weeks at the time of our interview. In fact, she has a degree in Electronics Engineering from the Middle East Technical University in Turkey, and she is a member of the Institute of Engineers (Australia).

Emine is not bitter about the fact that she is currently not working as an engineer, because she believes she needs to brush up on her English. She would also like to take some more courses at the university, to bring her up to date with new developments in software engineering. Her area of specialisaion is process control and instrumentation.

Soon after her graduation seven years ago, Emine went to work for the Electronics Instrumentation and Control factory in Turkey, as a calibration and test engineer. She calibrated analog and digital temperature meters, scanners, and frequency counters.

A year later Emine joined another Turkish firm, Electromechanical Instruments, as a research and development engineer in electronic control instrumentation. There she worked on projects relating to process control instruments such as a DC power supply, digital temperature meter and industrial type controller, conductivity/salinity meter, pH meter and a speed controller for sugar centrifuging. She has also organised courses and seminars for process engineers and technicians, dealing with automation in sugar processing.

Emine says that at the time of her graduation in Turkey, about 10% of the engineering students were female. Although she didn't grow up with electronics as a hobby, she has always been comfortable with mechanical things because her father was a mechanic with special interest in repairing trucks. She thinks today the girls and boys in Turkey have more opportunities for electronics-related hobbies, because the government has relaxed import restrictions.

Dr Branka Vucetic is a Senior Lecturer at Sydney University. She obtained her BE in 1972 and PhD in 1982, from the University of Belgrade. She says that in the early 1970's, around

Rupa Chandran

Emine Daldal

25% of the engineering students in Yugoslavia were female. Dr Vucetic joined the academic staff of Sydney University in 1986; her areas of specialisation are communications and error control coding.

When I asked her whether she thought that there were growing opportunities for women in Australia's electronics industry, Dr Vucetic's response was fairly negative. But she pointed out that currently there aren't too many opportunities for men either, the way the industries are going. Her belief is that a growing number of our engineers are going into sales, instead of doing 'real engineering'. Nevertheless she sees no reason why there shouldn't be a higher proportion of women in electronics, since women have the same abilities as men.

Dr Vucetic has written more than 50 papers in journals and conference proceedings, covering the topics of digital communications, error control coding and channel modelling. She has also published some original algorithms. She holds membership of the Institute of Electrical and Electronic Engineers (IEEE) and the Australian Association for Education in Engineering. She particularly enjoys research, and her career ambition is continuing with her research.

Dr Vucetic has noticed that female students do not do as well in the practical 'laboratory work' as in theoretical subjects. She thinks that the introduction of electronics and computing at an earlier age in schools could help remove this disadvantage, by dispersing the fear or unfamiliarity that many girls seem to have regarding electronic equipment and computers. She also postulates that inadequate preparation at schools could be one of the factors for the low percentage of women in engineering.

Her own children are too young to show any interest in electronics, but she has already got them interested in mathematics and computers. She believes that schools, universities and society as a whole should change their attitudes – not simply to make the work environment more enjoyable for women, but also to allow society to make greater use of them as a resource.

Before coming to Australia, Dr Vucetic worked as a research engineer with the Communications and Electronics Institute for three years, and as a lecturer with the University of Belgrade for eight years.

Dr Teresa Buczkowska is a Senior Lecturer at the University of Technology, Sydney (UTS). She obtained her

Branka Vucetic

Teresa Buczkowska

BSc and MEng from Warsaw Technical University in Poland in the late 1950's, and her PhD from Ahmadu Bello University, Nigeria in 1970. She has also worked in Kenya and Nairobi, coming to Australia in 1976.

Dr Buczkowska has written a book on digital systems and networks, and also edited the *Proceedings of Pacific Region Conference on Electrical Engineering Education – 1988*. She is Vice President of the Institution of Radio and Electrical Engineers (IREE), is a member of the Communications Group Committee of IEEE and was President of the Australian-French Association for Specialists (AFAS). She is also the Research and Seminar Committee member of the Pacific Telecommunications Council (PTC).

Dr Buczkowska believes there will always be a demand for electronic technicians, and that women should certainly enter that area as well. She says that like other engineering fields, electronics requires cooperation involving a team, but unlike many fields it is usually confined to a laboratory or factory. She believes that in many cases the administrative staff of various organisations will need to change their attitudes, for the work environment of women to improve.

Although she hasn't encountered any discrimination from her own colleagues, Dr Buczkowska says she would be willing to help other women who have, and to assist them in getting fair treatment. She is a member of a women's support group at the UTS, called FORUM.

Even as a teenager, Dr Buczkowska was interested in new developments in semiconductors and satellites. Nowadays she repairs and builds equipment during her spare time. Her qualifications in telecommunications and electronics are useful not just for teaching, but also for her consulting work. As part of her work in industry she spent several years in the computer industry.

Dr Buczkowska has written many papers on her primary field of expertise, and in addition she has a patent for the development of a novel, state of the art, microprocessor-based exercise machine she co-invented. There is another patent pending, the details of which she is reluctant to disclose.

Dr Buczkowska's husband is also a professional engineer and an academic. Even though their daughter has chosen a different career as a management consultant, she is happy to acknowledge gaining a lot from her mother's knowledge and professional attitudes to life. Dr Buczkowska's own career ambition is to become a full professor.

AWA Communications

Madeleine Rowles is a design engineer who started off as a cadet seven years ago with AWA Communications. She completed her BE (Electrical) at the University of Technology, last year. Her specialty is digital communications equipment.

Madeleine says that as a part-time student she wasted a lot of time trying to contact lecturers, and that some difficult subjects took up much more time than those in other courses. Working and studying did not leave much time for friends, yet her interest in music helped her keep contact with the outside world. Madeleine, her husband Neville and friends play music at weddings, and she uses her electronics knowledge to make equipment to support their musical activities. At the moment she is working on an 8-input mixer.

Careers for Women

Asked what it is about electronics that she particularly enjoys, Madeleine says it's seeing her designs working. She also likes the way electronics combines practical hands-on work with physics and mathematics.

Even though she did not grow up with electronics as a hobby, Madeleine made up for this lack of experience by the factory/testing/drawing office work she did during the first half of her course. She believes that girls as well as boys should be taught electronics at an earlier age at schools.

Madeleine says that those in factory and clerical jobs tend to ask "So you want to do a man's job, eh?". She says that this kind of remark does not come from other professionals. She thinks that if more women are seen to acquire knowledge of, and skills in electronics, there will be decreasing opposition to the entry of further women wanting to pursue this career.

Perhaps surprisingly, Madeleine has found that older factory workers have been more sympathetic and supportive than young engineers and office workers.

At AWA, Madeleine is involved in designing, modifying and updating various subsystems of their communications products. She worked on the switching power supply and alarm circuitry for a 2Mbps primary multiplexer, and designed a 4-wire Omnibus interface card to allow digital conferencing amongst sites having either terminal or drop-insert multiplexers.

Madeleine has also designed a 2-wire subscriber interface circuit to extend a 2-wire exchange circuit over the 2Mbps link. Next she will be designing part of a 7kHz programme sound project, to provide high quality telephone channels.

Women form 50% of the potential talent pool, Madeleine points out, and sometimes they bring different insights into planning and applications. She says that electronics is the fastest changing engineering field, and although broad in scope, with many available choices, it also has many areas requiring narrow specialisation.

Like myself, Madeleine believes that electronics can play a role in helping people in third world countries. She tended to agree that if this aspect of electronics received greater emphasis, perhaps more girls would choose it for their career.

Madeleine thinks her electronics education is in some ways too general, and that there is so much to learn on the job. Yet she realises that like most university education, her degree is really just a licence to go out and continue learning.

Madeleine Rowles

In summary

I believe the profiles that I have given in these articles are representative of the many women currently working in the Australian electronics industry. And because in the main they all present stories of successful achievement, I hope they give encouragement to girls who may be interested in pursuing electronics as a career.

To these girls I would say yes, there are many more opportunities in electronics than there were, even though there are still not as many as we could wish. Electronics can be just as rewarding a career for women as for men.

Incidentally I could not contact *all* of the female engineers and technicians in Sydney that I wanted to, because in the case of some working for a few major firms, I could not get past the personnel department. One company in particular was worried that they might lose their valuable engineers and technicians, as a result of them being 'advertised' in our articles. Even though this fear of 'poaching' blocked our access to their employees, at least it was good to know that they cherish their technical staff!

About a third of the women I interviewed indicated that they experienced prejudice or discrimination from either classmates, colleagues, lecturers or potential employers. I have avoided mentioning all of the details, in an effort not to make these articles too gloomy. And the fact remains that in spite of all the obstacles, all of the ladies I talked to either have achieved, or are achieving so much. It seems to me that society as a whole should feel proud of their achievements.

A few of the women engineers I spoke to believe that affirmative action is humiliating, degrading, demeaning etc. Most of these women are in software engineering, and it may be that it is easier for women to succeed in this relatively new field. Perhaps there is less prejudice evident, and hence less perceived need for affirmative action.

It does seem likely to be easier for other women to enter software engineering in future, because these women are already doing well and employers are not going to doubt women's abilities.

Some of the women hardware engineers I talked to also didn't seem too keen about affirmative action, but it's hard to tell if this is significant. Female hardware engineers are still relatively rare and/or just starting their professional careers, so perhaps we are yet to find out how they tackle prejudices. The fact that some employers are hiring women as hardware engineers is surely a good sign.

Like the women I interviewed in researching for these articles, I'm certainly grateful for the positive changes that have been achieved so far, in the area of women's education and training. However I do believe that further changes will probably only be achieved by bringing to the attention of both the public and the relevant authorities any undesirable situations that exist in educational and work places. We may not change anything immediately, but hopefully a 'workable' solution can be found later, possibly for the next generation.

I have tried contacting the universities and technical colleges, to get figures on whether the number of female students in electronics is increasing. They have not responded as yet, but I understand that the intake numbers of female students in engineering fields have increased.

The technical colleges claim to be encouraging more female students to enrol in electronics courses. However like many employers, they seem to be blaming women for not showing more interest in technical areas.

Perhaps it's just that not enough girls have been made aware of the opportunities that exist in electronics, and of the satisfying careers for women as electronics engineers and technicians. Hopefully the present articles will help in this regard, appearing as they are in Australia's premier electronics magazine.

Incidentally it's my belief that not only electronics, but all of engineering is really a 'caring' field, because it is ultimately geared towards a better structured future. Use of electronics for war and destruction should not deter women from entering this field, because the positives outweigh the negatives – particularly if we have more women involved. A field like biomedical engineering is a good example, where there's enormous potential for a 'caring' engineer to help alleviate suffering all over the world.

We all agree that electronics does not require exceptional physical strength and that lifting and moving can always be done with the help of others. Men in electronics rely on team work, and in that sense women are no different.

Some of the women I interviewed expressed the concern that they receive insensitive comments and insufficient help from administrative staff – who are predominantly women. Perhaps it isn't just women in technical roles who have experienced this problem, but men as well.

From my own experience administrators often have little understanding of electronics or other technical fields, and can tend to see a 'technical type' as someone who is difficult to deal with, and best kept working away in the 'back room'. All of the women I interviewed seemed to agree that the more understanding of electronics by women in general, the greater will be the psychological support for those choosing it as a career.

Finally, I believe we should analyse and understand why more and more electronics engineers – both female and male – are going into sales rather than staying in engineering. *EA*'s editor Jim Rowe says it's because design engineers are simply not paid as much as their counterparts in sales, and he may be right. But this is surely bad for the future of our industry, because it's a chicken and egg situation, where the lack of quality engineers will not allow the industry to grow.

The only positive course seems to be boosting our emphasis on education. Introducing electronics at an early age in high schools will help create better quality engineers of both sexes, who are better able to cope with the rapid changes.

As one of my interviewees suggested, we will have to be careful about over- and premature specialisation, where other important skills are sacrificed. Only schools can determine the balance of the curricula; but if they want to experiment with electronics education, they'll have plenty of supporters! EA

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READER INFO No. 6

When I Think Back...

by Neville Williams

The rise and fall of thermionic valves or 'tubes' – 2

The initial 25-odd years of the present century saw 'wireless' emerge as a practical means of communication and entertainment, but widespread demand from about 1930 onwards triggered a virtual explosion in technology, requiring valves far removed from the lamp-like diodes and triodes of Fleming and De Forest.

In the late 1920's came a big industry push to get away from the tedium batteries, wherever possible, and to produce receivers for full AC mains operation. It called for a complete revolution in valve design and manufacture.

It was easy enough to rectify and filter AC for the HT (plate) supply, but not for the valve filaments. Nor could the filaments of existing valves be operated satisfactorily from AC. Several volts of AC applied across the filament would be much the same as having a large 50Hz voltage superimposed on the grid/filament bias. It would be treated and amplified by the valve as an input signal.

While the effect could be cancelled, in part, by suitably centre-tapping and earthing the filament supply, the temperature of the delicate valve filament – and therefore its emission – would still vary over each individual half-cycle. This caused the electron stream to be modulated at 100Hz, creating an intolerable hum in the loudspeaker.

AC powered valves

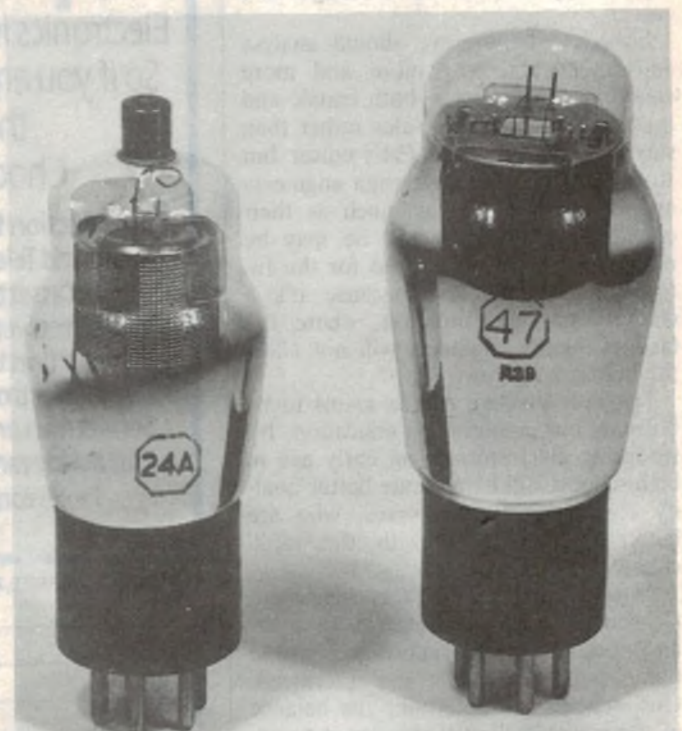
The industry's initial response to this problem, circa 1927, was a notably conservative one: the American type 26, a triode much like the traditional 01-A except that it was fitted with a rugged filament rated at 1.5V and 1.05A. The purpose of the low operating voltage was to minimise signal injection into the grid/filament circuit; secondly, the stout, heavy current filament was meant to exhibit high thermal inertia, thereby reducing the temperature variation over each successive half-cycle.

With critical setting of the earthed centre-tap on the transformer filament winding, the 26 triode worked reasonably well in all stages of typical contemporary TRF (tuned radio frequency) receivers – except the detector, where the hum problem demanded a more radical solution.

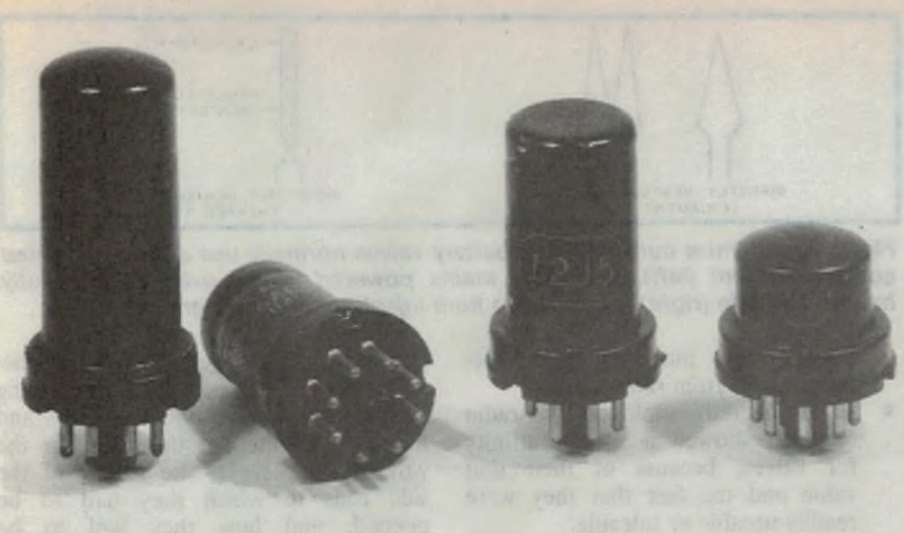
Fortunately one was forthcoming, in the form of the indirectly heated cathode: a thin metal tube coated externally with an emissive oxide (Fig.3). A separate heater element was located inside the cathode sleeve, but electrically insulated from it by ceramic end bushes or sleeve or by a heat tolerant slag (e.g., aluminium silicate).

In fact, the idea had been patented by Messrs Freeman and Wade of Westinghouse as early as 1921, but not commercially developed. It was taken up later by the McCullough and Kellogg companies in the US circa 1925, and used to produce double-ended, indirectly heated replacements for the 01-A.

The idea was that a set of the new McCullough/Kellogg tubes could be plugged directly into an existing battery set, their original function being preserved by having the cathode sleeve connected internally to the now otherwise dormant filament pins. The new heater, brought out through the top of the bulb was energised via a supplementary overhead harness, fed from an external low voltage 'filament' transform-



Two classic AC powered receiving valves from the late 1920's – early 1930's era. At left is a 24-A RF amplifier tetrode, with a type 47 power output tetrode at right. Together with the type 80 rectifier, they formed the heart of many Australian radio sets of that era.



Examples of the first 'all metal' 8-pin octal based valves which first appeared in America around 1935. Later octal valves had a glass envelope.

er. By also substituting a commercial 'eliminator' for the B-batteries, the old battery set could thus become all-AC operated!

Taking the longer view and faced with the need for an indirectly heated detector to go with their type 26 triodes, RCA produced the 27 – an otherwise traditional triode with insulated cathode and a 2.5V/1.75A heater – fitting it with a 5-pin plug-in base. In so doing, they signalled the mass production of AC mains powered receivers.

Fairly obviously, the evolution of valves to this point had hinged largely on the incandescent filament/cathode and the problem of ensuring a sufficiently copious electron stream for a manageable current drain. Less lamp-like constructional methods had also emerged but, in terms of amplification factor, transconductance and plate resistance, triodes like the 26 and 27 (226 and 227) differed little from the original 201.

Tetrodes & pentodes

Apart from the line-up of 26's as RF and AF amplifiers and a 27 as detector, the initial wave of mains powered receivers likewise departed little from the circuit concepts that had previously been developed around battery valves. But that phase was shortlived, and the only receivers of that type I encountered personally were those that subsequently accumulated in the factory basement as trade-ins.

In the present climate of nostalgia, those hum-prone 26/27 discards would probably be worth a lot more now than they were then!

Designers soon made it clear that they preferred indirectly heated valves for all sockets and, what's more, that they'd had enough of the chronic instability of triodes as RF amplifiers – a by-product of their high internal grid-plate capacitance.

Research in both Europe and America had produced battery valves with an extra grid, placed between the control grid and the plate. Operated at a fixed positive potential somewhat below that on the plate and bypassed to ground, it served as a passive electrostatic shield between the two critical electrodes. (See Figs. 4 and 5). By bringing one of the connections – normally the grid – out through the top of the bulb, the capacitance between the connecting leads could also be minimised, reducing the overall grid-plate capacitance by a hundred times or more.

Reacting to this demand, valve manufacturers released a number of mains type 'screen-grid' (or *tetrode*) RF amplifiers, the best known in Australia being probably the 24-A (or 224) released in 1929 as a companion valve of the 27 triode. Two years later, the 'variable-mu' type 35 (235) appeared, with very similar characteristics except that a variable-pitch control grid made it possible to adjust the signal amplification over a very wide range by varying the bias (Fig.5).

From type to type

During 1931/32 a flood of locally produced mains receivers was released onto the Australian market using one or two type 35 valves as RF amplifiers, a 24 or 27 as detector, a 45 power output triode or a 47 power tetrode, and an 80 rectifier. About the same time, however, a highly practical version of the superheterodyne type circuit began to gain favour and appeared on the market with a comparable valve complement.

By the time I entered the industry in early 1933, those valves, too, had been superseded and replaced by the '50' series, also using 2.5V heaters but fitted with slimmer envelopes and boasting improved performance. At the same

TETRODES, PENTODES & DIODE TRIODES

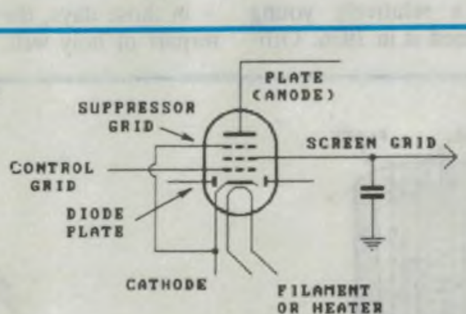


Fig.4: A basic triode, as in Fig.2, contains a filament or a heater/cathode combination, a control grid and a plate (or anode). In a screen-grid (or tetrode) valve, an extra grid is placed between the control grid and plate. Operated at a fixed positive potential, usually somewhat lower than the plate, and bypassed to earth, it serves as a passive electrostatic shield between grid and plate. By thus reducing the grid/plate capacitance, it makes it possible to achieve high gain in RF amplifier stages without instability and oscillation.

The signal handling capability of a tetrode valve can be further improved by inserting a *suppressor* grid between the screen and plate. Operated at earth or cathode potential, it prevents slow-moving 'secondary' electrons, dislodged from the plate by the incoming 'primary' electron stream, from being attracted back to the screen.

Some multi-element valves also provide one or two small diode plates, adjacent to one end of the filament or cathode sleeve, so that signal detection can be provided within the same envelope, along with a signal-dependent voltage to provide automatic gain control.

Other typical multi-element valves contain twin triodes, separate triode and pentode sections, or complex electrode structures intended for specialised roles such as frequency changers in superheterodyne receivers.

time, the tetrodes had become *pentodes*, with a third 'suppressor' grid inserted between plate and screen to refine the overall dynamic characteristics (Fig.5).

As it happened, the 2.5V series had one serious limitation: their unsuitability for use in automotive receivers – operating commonly, in those days, from 6-volt systems. RCA and others had provided for this market with the 36-39 series, but in the mid 1930's they released 6.3V versions of the 2.5V series, suitable for either mains or automotive use.

If that wasn't enough, they came up with yet further equivalents, available in both glass and all-metal construction, using the IO (international octal) base and with either 6.3V heaters, or 12.6V to suit the new generation of 12V cars.

There were parallel developments in the design of receivers for country areas. The Americans offered the 30-34 series, combining operating economy with reasonable ruggedness, but with only modest performance specifications.

The European 'golden' series boasted state-of-the-art design, with far better specifications, but quite unequal to the rigours of transport from European factories to the living rooms of Australian rural homes.

The uniquely Australian 2.0V/120mA series provided a much better combination of economy, performance and reliability and were widely used in the early 1930's for both battery and vibrator powered receivers – filling the breach until the appearance of the all-glass 1.4V miniatures.

A whole story could be written around these developments, but the long and short of it simply was that consumer radio revolved almost totally around valves.

- The status, price and presentation of a receiver depended on the number of valves: 4 – economy; 5 – standard; 6 or more – up-market.
- Having nominated the valves, a designer would reach for the data books and design the circuit accordingly.
- The age and merit of trade-in receivers was determined largely by the valve complement.
- Valves featured large in troubleshooting, with servicemen needing to carry and account for a full range of replacement types. Owners, hoping to save the cost of a service call, bought large numbers of replacement valves from radio shops.
- Light-fingered employees in radio factories showed a special affinity for valves, because of their unit value and the fact that they were readily useable or saleable.

Fig.3: To minimise current drain, battery valves normally use a directly heated coated filament (left). But most mains powered valves used an indirectly heated cathode (right), to minimise hum injection into the signal path.

I must confess to considerable culture shock when I moved out of this overall environment into the AWV factory in Ashfield, Sydney – to be surrounded by thousands of valves in every stage of manufacture. A hitherto exclusive, high-tech product was suddenly revealed for what it really was – bits of wire, metal and glass, created and assembled by automatic machines and by the deft fingers of process workers, equally 'programmed' to perform specific tasks.

Valves had been produced in small numbers in Australia since the early 1920's, principally by AWA under licence to RCA. Large scale manufacture began in 1933, following the setting up of the Amalgamated Wireless Valve Company in the previous year. Philips established their own valve factory in 1936 at Hendon, SA, while STC became involved in valve manufacture in 1939, mainly to meet specific needs of the PMG's Dept (now Telecom) and, later, the Australian Defence Forces.

Valve production

AWV was still a relatively young company when I joined it in 1936. Officially, the valves were being manufactured to RCA specifications, covering such things as the number of turns and the winding pitch of the grids for the various valve types, the nature of the side rods to which they had to be peened, and how they had to be trimmed to fit the pre-punched mica support washers.

In practice, the specifications had to be amended to suit materials and production facilities available to AWV, and to effect possible economies in the context of shorter production runs.

My first job in the company was to identify such amendments from engineers' and supervisors' personal notebooks and to generate official AWV specification sheets for master filing. It was a task that, for me, dispelled much of the early mystique associated with valves.

I discovered, for example, that a 'variable-mu' or super-control characteristic could be obtained without resorting to a special variable pitch control grid (Fig.5). An aperture created by snipping specified half-turns from a standard grid would let sufficient electrons through at high bias levels, to produce much the same 'remote cut-off' characteristic!

A little further down the track, I was to become involved in the derivation and publication of valve characteristics – in those days, the technological counterpart of holy writ. As mentioned ear-

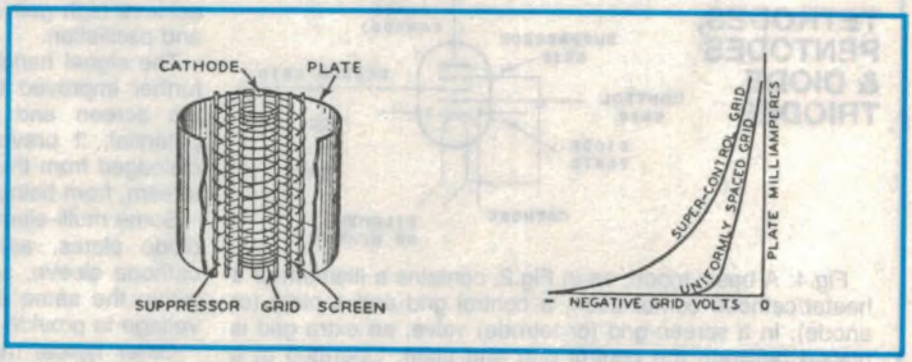


Fig.5: At left is the electrode structure inside a pentode valve. The grid winding pitch was normally uniform, but a variable gain or 'super-control' characteristic (right) was achieved by varying the control grid pitch over its length, as shown.

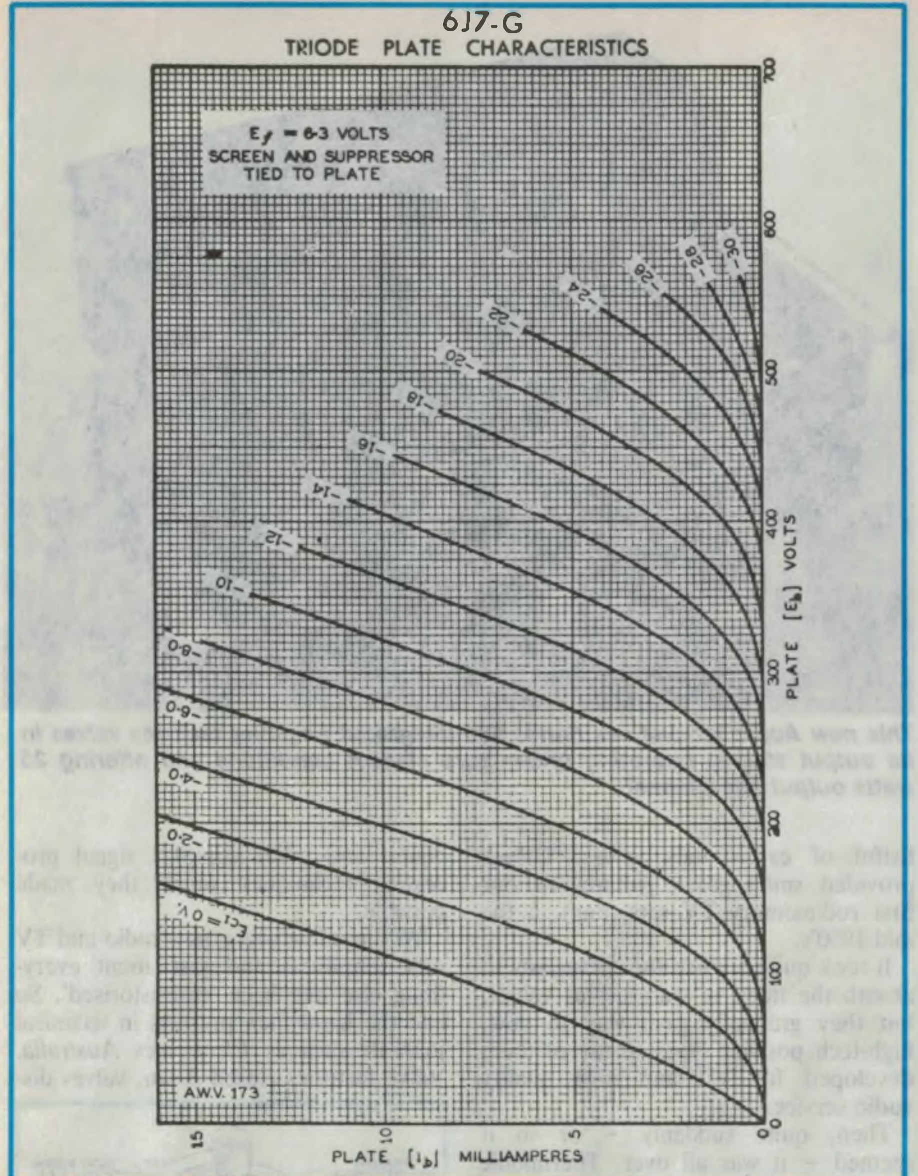


Fig.6: The plate family of curves for a triode-connected 6J7-G. They differ very slightly from earlier curves for the equivalent 6C6 triode.

lier, equipment designers, great and small, would closely study the published data, work out sums on their slide rules involving voltage, current and resistance, and generate the precise circuitry for each successive stage.

Producing valve data

To derive, verify or expand basic valve application data, the AWV lab was equipped at the time with permanent tabletop test set-ups involving adjustable heater, grid and HT supplies, each one monitored by lab-quality voltage and current meters with large, mirrored scales and housed in traditional polished, dovetailed wooden boxes.

Used also to check developmental versions and production samples for quality control, the equipment was then under the watchful eye of the late Ron Tremlett, who subsequently joined the Philips group, becoming President of the IREE (Aust) in 1964-65. (Sadly, most of the aforesaid equipment was destroyed in a major fire which gutted the AWV factory in the early '40s).

When deriving tabulated data and characteristic curves for particular types, the tests were not performed on just any valve. Like most other fabricated products, valves were/are subject to manufacturing tolerances and exhibit a spread of characteristics, not normally apparent to everyday users but certainly evident on instruments.

To derive or examine basic performance data, tests were always performed on what we described as 'bogey' valves – selected from production samples for salient characteristics near the centre of the tolerance range. This was to reduce the likelihood of predictable conflict with data already published.

For plate family curves in particular (Fig.6) the measurements were also made in a sequence, which covered low-current readings first, working progressively upwards into the higher current regions and minimising the on-time for readings above the maximum rated dissipation. The reason for so doing was to minimise structural heating and artificial ageing effects on the cathode.

In due course, the figures would be transferred to graph paper by a technical draftsman – at the relevant time the writer – and examined for graphical discontinuities, to expose possible reading errors or anomalous curves. They would also be checked against other curves and published data to ensure that there was no discrepancy in spot readings of electrode current, or with basic characteristics as deduced from the slope and position of the individual curves.

Ultimately, the curves would be inked in and published – ostensibly applicable to all valves bearing the same RMA type number. To the extent that valve data acquired a reputation for consistency, worldwide, I can only assume that the respect for standardisation and uniformity in AWV was matched in other companies working to American RMA conventions.

One other thing I remember vividly from my stint in the AWV lab: Every day or so, sample valves from each production batch would be handed to Ron Tremlett. He would document and check each one and then plug them into special life test racks, for exposure to full rated operating conditions for 1000 hours or more. Set up at one end of the lab, the heat from those racks was a bonus in winter but just the reverse during a Sydney summer.

On completion of the life test, the valves would be re-checked to ensure that they were within acceptable tolerances, and then discarded. They would later be methodically smashed, along with other test and developmental samples, so that they could be subtracted from production totals and would not attract government excise charges.

I must confess that, to an enthusiast from way back, the deliberate destruction of perfectly useable valves was sacrilege of the highest order – and a source of personal agony!

The memory of all those 'busted bottles' became even more haunting during the war that followed soon after, when new valves became a scarce commodity, especially for hobbyists.

Valves for a 'song'

But then, in the 1950's, the hobby market was suddenly flooded with a huge array of valves that became available through war disposals and stock clearance, by factories re-organising for peacetime production.

Who, from that generation, can forget cartons full of all-metal 6H6 twin diodes? Or 6N7 twin triodes? Or 6AC7 and EF50 high-gain RF pentodes? And 6L6 'beam-power' output valves, or their ubiquitous 807 glass equivalents for use in transmitters?

It was around that time that I bought several type 800 UHF power triodes for next to nothing, and built around them a 100W 6-metre UHF transmitter. It called for a 1000V plate supply, but that was no great hassle, assuming one could find a high voltage ex-disposals transformer. Type 866 mercury vapour rectifiers and their high vacuum counterparts like the 836 were also available very cheaply.

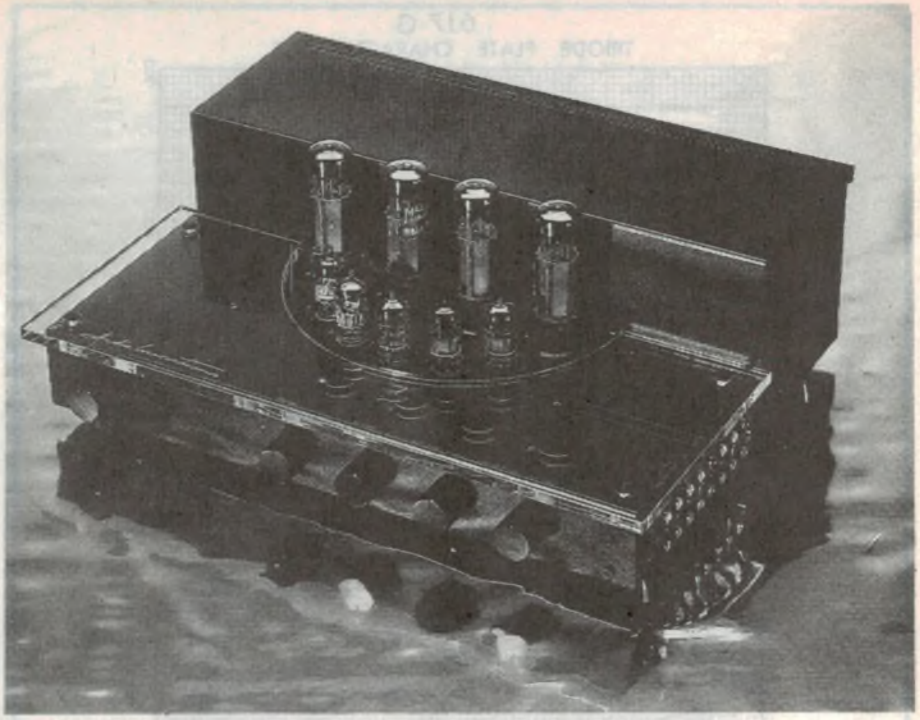
For the HF bands, I built a transmitter around the magnificent old 803 RF power pentode, capable of 150-odd watts output in class-C telephony or 200 watts CW. I bought a couple of them ex-disposals for a proverbial 'song'. For two songs and a bit of luck, in those days, one could pick up its up-dated successor the 813.

And, of course, there were the cathode-ray tubes, intended originally as spares for radar and other military equipment. Because these took up a lot of valuable storage space, dealers were glad to get rid of them. As some readers may recall, many of them ended up in home-built oscilloscopes, along with a fistful of ex-disposals valves. Others provided small green pictures in our first rudimentary TV sets, built in the mid 1950's.

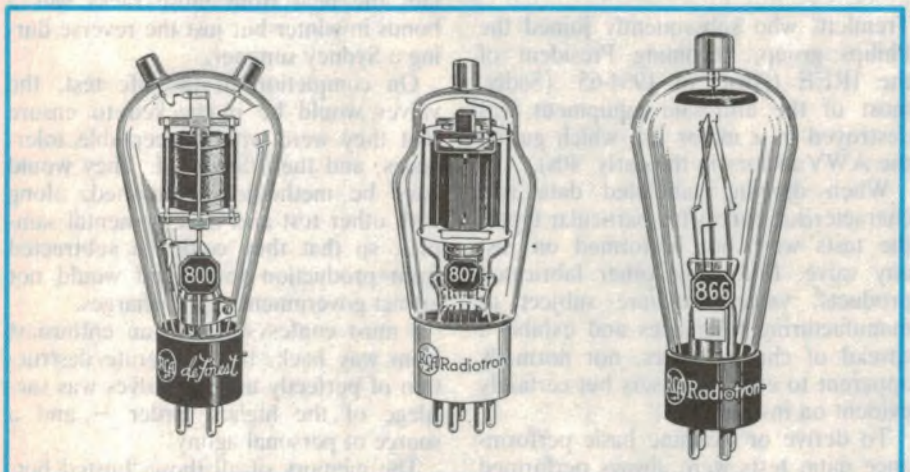
It took quite a while for enthusiasts to absorb the flood of war surplus valves, but they gradually gave way to new, high-tech postwar types, many of them developed for TV and high quality audio service.

Then, quite suddenly – or so it seemed – it was all over. Thermionic valves and their attendant circuitry had given way to solid-state devices, and to digital and other complex signal processing techniques which they made possible.

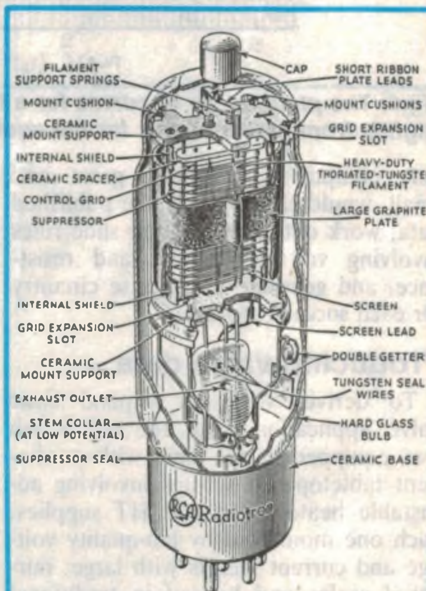
Within a few years, new radio and TV sets, amplifiers and just about everything else had been 'transistorised'. So had the handyman projects in technical journals such as *Electronics Australia*. Valve factories closed down, valves dis-



This new Audio Innovations Series 500 integrated amplifier features valves in its output stages, operating under pure class-A conditions and offering 25 watts output per channel.



Left to right: The type 800 HF power triode, used by amateurs in 50MHz transmitters; the 807, virtually a 6L6 beam power tetrode redesigned for RF service; and the 866 high voltage mercury vapour rectifier.



STRUCTURE OF TRANSMITTING PENTODE RCA-803

The writer's postwar transmitter was based around an 803 power pentode, with a solid graphite plate.

appeared from dealers' shelves and servicemen had to learn a whole new bag of solid-state tricks.

My last glimpse (as a visitor) inside the AWV factory was in the early 1970s, at Rydalmere, a few kilometres from the original site at Ashfield.

As before, rows of process workers were busily spot welding the electrode assemblies ready for the 'sealex' machines. Elsewhere, the power valve section was assembling transmitting type valves for broadcast and TV stations and other professional users.

With an eye to the future, another smaller line was producing small-signal transistors, against the day when they might – just might – make inroads into the valve industry.

At the rear of the building, they were assembling monochrome picture tubes while, at the same time, taking the first tentative steps towards a possible changeover to colour.

Add the machine shop and metal working facilities, the applications lab, the bulk store and despatch facilities, the management office and staff amenities and it was quite a setup.

But just a few weeks after publication of my article on Fritz Langford-Smith I received a letter from Frank Stroud, who joined AWV in 1934 on the original Ashfield site and retired from Rydalmere at the other end of his career. He framed and answered the question as to what finally happened to that hitherto successful enterprise.

With the cessation of valve and picture tube manufacture, he said, a tiny remnant of the Company ended up as the Special Valve Production Section of AWA.

Involving just seven or eight people from the original power valve section, they were occupied in building and rebuilding transmitting valves such as the 4CX5000 and 4CX10000, the 3J160 and 6166A. They would cut them open, fit new filaments, replace and/or realign the grids, then re-seal and re-exhaust them for a further period of service.

But, according to Frank, even that operation is no more, having been closed down at the end of 1989. For Frank, the only tangible reminders of the old Valve Company are in the personalities of valve engineers Jack Shaw, Don Frazer and Doug Sutherland – whom he sees from time to time at meetings of AWAVA - the AWA Veterans Association. (Current President is Reg Vine, who can be contacted on (02) 624 8974)

In truth, however, valves are remembered and mourned on a far wider plane than those whose whole career once depended on their manufacture.

Out there in suburbia is an enthusiast cult devoted to the reclamation of old-time valve radios, which yesterday's hobbyists and servicemen still find sufficiently large and comprehensible to work on.

Like steam locos, valve radios seem to have a personality all their own!

What's more, cult members find common cause with certain hifi buffs who insist, rightly or wrongly, that valve amplifiers exhibit an essential 'sweetness' of tone that they believe has thus far eluded their more highly specified solid-state successors.

Even as I write, a brochure has landed on my table extolling the virtues of a new Audio Innovations Series 500 amplifier. The valves on which it depends, according to the letter, are ranged in a semi-circle on top of the unit, for all to behold!

For me, that turns the clock back over 60 years, to when my father laboriously replaced the bakelite panel on the family wireless with plate glass, allowing all and sundry to contemplate the shiny valves inside while they enjoyed the program.

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READER INFO No. 7

FORUM

Conducted by Jim Rowe

An intriguing letter that turned out to be a nasty hoax!

Luckily the vast majority of letters sent to us from readers are genuine – but that certainly wasn't the case with one that turned up a couple of weeks ago. What makes this kind of incident worrying is that I really only discovered the fraud by sheer accident!

It's an interesting story, in more ways than one, as you'll see shortly. But before we look at it, I'd like to quote and briefly discuss another letter (quite genuine), from one of our young readers with a very legitimate concern – not exactly about matters electronic, but an area that I suspect you'll still find of interest.

The reader is Ian Dodds, who unfortunately omitted to give his address. But here's his letter, which although quite brief expresses his concern with admirable clarity:

The topic which I'd like you to discuss is aluminium and health.

Mum brought up the topic one night, saying that the use of aluminium has been said to be linked to Alzheimer's Disease, and that this has supposedly been proven scientifically.

She has a strong opinion that this is true, but Dad and I find it hard to believe as aluminium is obviously widely used in pots and pans, and in medicines – e.g., stomach antacid powders.

Why is it that, if we are advised to stop using aluminium utensils, no such advice has been given to stop using aluminium foil?

I do not know about other readers, but I have definitely not heard of this issue in the media. I would like to hear your views and opinions on this topic, and maybe those from other readers.

Thanks for your letter, Ian. This kind of thing does tend to be a bit of a worry, doesn't it? Sometimes it seems that almost everything we eat, drink, or work with in today's developed countries will give us either cancer or some other dread disease – especially if it's in any way enjoyable...

Seriously, though, my understanding is that your Mum is right. There have been a number of stories in scientific journals such as *New Scientist*, reporting evidence for some kind of link between aluminium and Alzheimer's disease.

As far as I can recall, though, at this stage the exact link is not at all clear; a lot more work needs to be done. There's also a suggestion that Alzheimer's disease can only be contracted by people with a certain genetic predisposition, so that it may well be that only the people with this predisposition will turn out to be sensitive to aluminium in their food.

I also seem to recall that because aluminium is normally covered in a thin but dense layer of relatively inert oxide, the amount of aluminium which enters food from aluminium pots and pans is normally very tiny indeed. The main exception is when highly acidic foods like rhubarb are boiled up in an aluminium pan, allowing the acid to attack the oxide.

So wrapping cold food in aluminium foil, having aluminium foil caps on milk bottles and cooking your snags in an aluminium frying pan may yet turn out to be safe enough – even if your family may have a genetic predisposition to Alzheimer's. It may simply be wise to cook your rhubarb in a stainless steel or pyrex glass pan.

Of course this whole area of various metal traces in our food is only just starting to get the kind of scientific attention it really deserves. Another area that probably needs more research is the way most of our homes now use copper water pipes – which almost certainly results in us all receiving a much higher level of copper in our diet, than in the old days of galvanised iron pipes. And I believe that excessive copper has been linked to all kinds of nasty health problems, including mental illness.

Anyway, Ian, you and your family are right to be concerned about aluminium. But my advice would be not to toss those pots and pans away just yet, until the full story is known. But perhaps your Mum could stew the rhubarb in a stainless steel pot in future, just in case!

Incidentally if there are any readers out there with more information about the possible dangers of aluminium, by all means write in. I don't want to crowd out more electronic topics, but it's an interesting area. Aluminium has been such a useful metal for electronics – it'll be a bit sad if we learn that it has hidden dangers.

But now let's turn to our interesting, yet worrying, case of the letter that wasn't at all what it seemed. In recent months we've had pieces on computer viruses and 'Trojan Horses'; this was a case of a 'Trojan Letter'.

The arrival

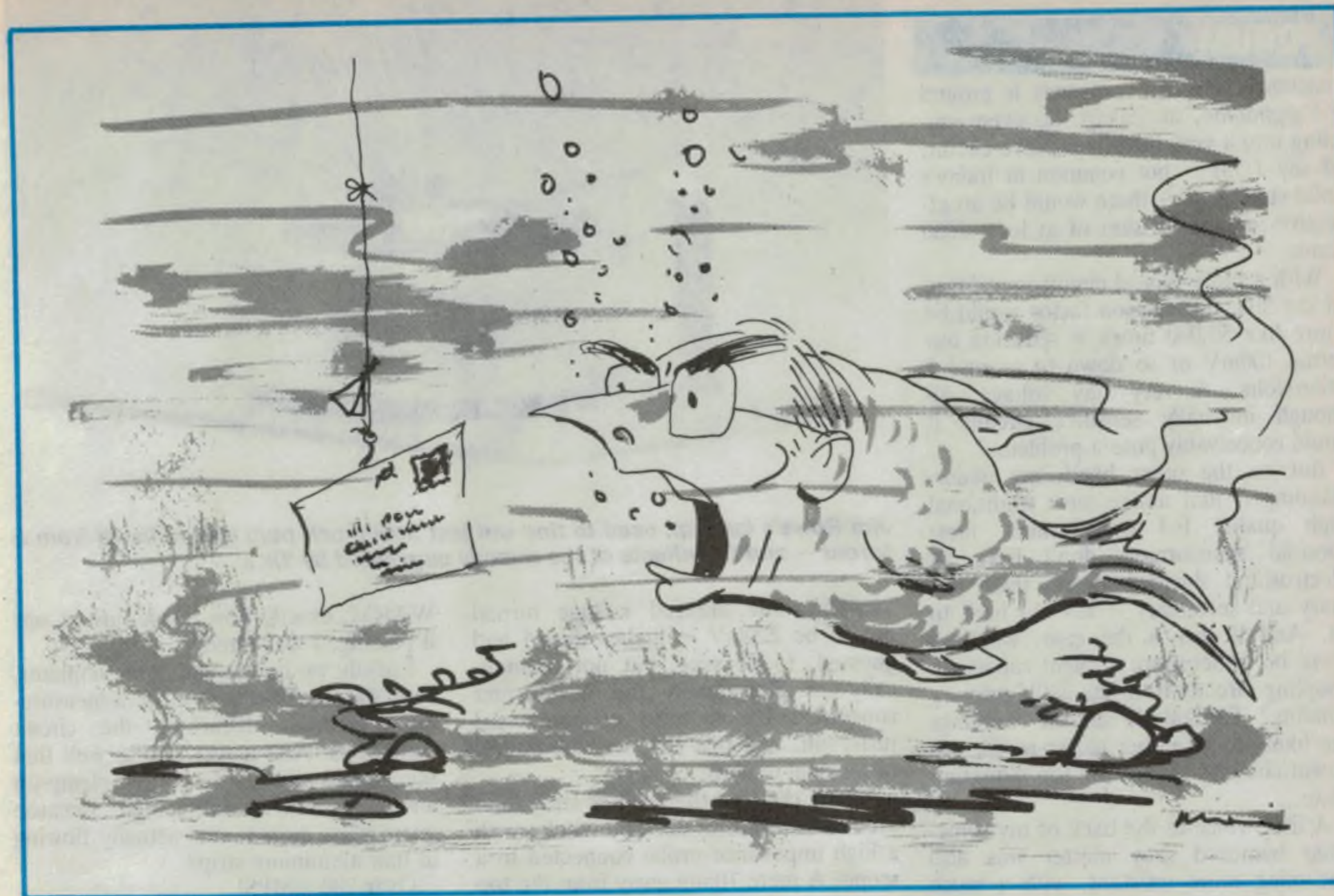
It began quite innocently. A letter turned up with a contribution for our 'Circuit & Design Ideas' section, ostensibly from Dr X, a scientist at one of the local research organisations. This in itself wasn't particularly remarkable, as quite a lot of scientists and academics read the magazine, and quite often send in contributions.

It was the content of the letter's contribution which attracted my initial attention, not its apparent source – although the more I considered the former, the more puzzling it became in the light of the latter.

Basically the contribution involved a suggested technique for reducing the hum radiation from toroidal power transformers. It was quite brief, so I may as well quote it:

Toroidal power transformers are becoming popular due to their low profile, ease of mounting and – most importantly – their low external magnetic field. What is often not realised, however, is that a toroid can quite unnecessarily radiate an ELECTRIC field.

Toroidal transformers are usually mounted against a chassis with a steel plate and a bolt through the centre. It is these components which cause the trou-



ble. Since the bolt passes through the toroid, it is in effect a half-turn, and will have a voltage induced in it. This is of course connected to the mounting plate, an ideal source of capacitive coupling into nearby circuits.

Normally this is not a problem, since the induced voltage is in the order of a few millivolts. But if one is striving for the best possible noise performance from a sensitive circuit, then the plate should be separately earthed.

This should be done with very heavy wire or braid, since the source of the offending voltage is a relatively low impedance. The following drawing shows the idea.

That was it – I've reproduced the original sketch, to show you exactly what was being suggested.

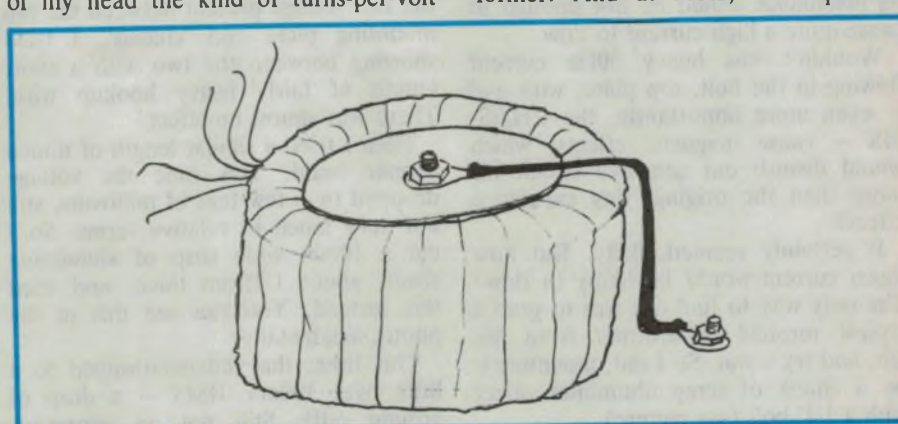
As you can see, there was enough valid theory and commonsense in there to make it all sound fairly plausible. If I hadn't been reasonably alert, I might have put it into the 'CDI' file without further thought, for publication at an early opportunity. But somehow, distant alarm bells starting ringing...

Fact and fiction

It's true, of course, that a toroidal transformer's mounting bolt *does* effectively form a half-turn secondary, and will thus have induced in it a small voltage. And it's also true that this will cause the circular mounting plate to 'float' at the same induced AC voltage, with respect to the chassis. But if the induced voltage was in fact only a few millivolts, as Dr X claimed, would this really be likely to produce any significant problems due to capacitive coupling?

It didn't sound very likely. I'd never actually gone through the exercise of designing a toroidal power transformer, and as a result I didn't know off the top of my head the kind of turns-per-volt figures that are typically used. But assuming it was not too different from conventional E-I cored transformers, with typically around 4 – 5 turns per volt, this suggested that the induced voltage in the bolt would be something in the order of 100 – 125mV.

The likely coupling capacitance between the top mounting plate and any sensitive circuitry nearby would probably be less than a couple of picofarads, I would guess, bearing in mind that one wouldn't normally mount such circuitry in close proximity to any power transformer. And at 50Hz, the capacitive



The sketch enclosed by 'Dr X' with his contribution for CDI, showing how to reduce hum coupling from a toroidal power transformer.

reactance of a 2pF capacitor is around 1.5 *gigaohms*, or 1500M. So even coupling into a very high impedance circuit, of say 1.5M – not common in today's solid state gear – there would be an effective voltage division of at least 1000 times.

With a more typical circuit impedance of say 30k, the division factor would be more like 50,000 times – reducing our initial 100mV or so down to around 2 microvolts. A very tiny voltage, although in *really* sensitive circuits it could conceivably pose a problem.

But on the other hand, my understanding is that unlike most traditional high quality E-I transformers, most toroidal transformers don't have an electrostatic shield between their primary and secondary – it's too hard to fit. And if this is the case, wouldn't there be rather *more* straight capacitive coupling directly from the 240V primary winding? Particularly as the windings are likely to be rather closer to the adjacent circuitry than is the top mounting plate...

A little voice in the back of my somewhat bemused grey matter was also becoming more insistent, with a much more fundamental doubt: if our sensitive circuitry was going to be disturbed by a hundred or so millivolts, capacitively coupled via a few measly picofarads, what would be the impact of Dr X's suggested cure?

After all, his suggested fitting of an earthing wire would form a complete circuit around the toroid, and would therefore effectively provide a 'shorted turn' – or at least a 'shorted half-turn'. And although the voltage developed across the bolt was only low, surely his advice that the shorting wire should be of stout wire or braid would mean that its impedance would be low enough to cause quite a high current to flow.

Wouldn't this heavy 50Hz current flowing in the bolt, top plate, wire and – even more importantly, the CHASSIS – cause magnetic effects, which would disturb our sensitive circuit far more than the original tiny capacitive effect?

It certainly seemed likely. But how much current *would* be likely to flow? The only way to find out was to grab a typical toroidal transformer from the lab, and try it out. So I did, mounting it on a chunk of scrap aluminium sheet with a 1/4" bolt (see picture).

First of all I applied the power, and used a DMM to check the AC voltage between the top mounting plate and the 'chassis'. The induced voltage turned out to be 220mV – higher than I had guessed, to be sure, but not dramatically so. Presumably the transformer concerned has a ratio of about 2.3 turns/volt, and this may well be typical of toroidal designs.

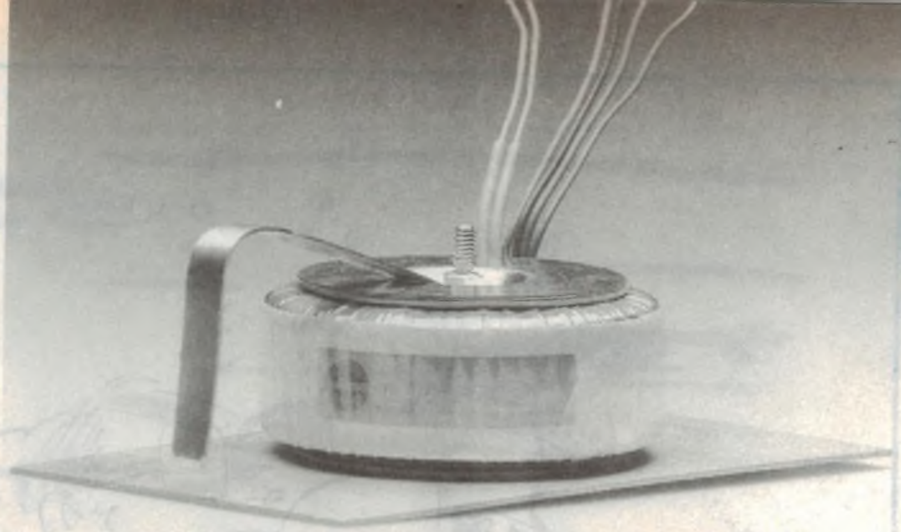
Next I checked the level of stray field around the transformer as a whole, with a high impedance probe connected to a scope. A mere 10mm away from the top mounting plate, the probe was picking up only a couple of millivolts; very low indeed. Yet the same distance away from the windings, down the side of the transformer, it picked up around 75mV – much more.

So as I'd guessed, the capacitive coupling from the top plate was actually quite minor, in comparison with that from the windings. One of the little disadvantages of a toroidal transformer, unfortunately.

But how about the solution suggested by 'Dr X' – did it help matters? With the DMM and scope both monitoring the AC voltage present between the top mounting plate and 'chassis', I tried shorting between the two with a short length of fairly heavy hookup wire. There was almost no effect.

Then I tried a similar length of tinned copper braid. This time the voltage dropped by a few tens of millivolts, still not very much in relative terms. So I cut a 10mm wide strip of aluminium sheet, about 1.25mm thick, and tried this instead. You can see this in the photo, incidentally.

This time, the voltage dropped to a little over 100mV RMS – a drop of around 6dB. Still not an enormous drop, in terms of its effect on the capacitive coupling. But in the process, the aluminium strip was getting rather WARM; exactly how much current *was* it passing, I wondered?



Jim Rowe's lash-up, used to find out just how much hum was radiated from a toroid – and the effects of the remedy suggested by 'Dr X'.

Luckily we have a clamp-on ammeter, so it wasn't difficult to make a measurement without disturbing the circuit conditions. And it was just as well that the ranges provided on the clamp-on ammeter went up fairly high. Because guess what current was actually flowing in that aluminium strip?

Over 200 AMPS!

Even the short length of braid turned out to draw about 25 amps, which is still quite a sizeable current to have flowing around the loop and through the chassis. Especially when it had negligible effect on the voltage present on the top mounting plate – that mounting bolt certainly represents a low impedance source of 220mV AC!

So summarising, 'Dr X' was perhaps right in suggesting that there can be a problem with the capacitive field around a toroidal power transformer, if very sensitive circuits are to be located in its immediate proximity. But he was basically wrong in attributing the problem to the voltage induced in the mounting bolt, and supposedly coupled via the top plate. In reality, the field from the windings is considerably higher.

And as for his suggested solution, of a shorting wire or strap, that is very definitely NOT the right answer. Not only does it *not* significantly reduce the capacitive field, but it can create a much bigger potential problem – by causing extremely high currents to flow in the bolt, mounting plate and chassis!

Which left me even more puzzled than ever. Surely a highly qualified scientist such as Dr X would have realised all this? Or was he very busy on a big project, and hadn't had time to give the matter much thought?

The thought also occurred to me that he might have been aware of it himself all along, and had sent in the item as a joke or booby trap – hoping that Jim Rowe would make a fool of himself by publishing it. But this hardly seemed likely, because he'd sent it in with a signed cover letter. If we published the item in the usual way above his name, he'd end up looking just as silly as we would...

Rather than puzzle about it any further, I decided to ring the research organisation involved, and try to talk to him directly. Assuming there was a Dr X, of course; another possibility was that the whole thing was a hoax.

But as it happens Dr X did exist, and I was soon talking with him. The only problem was, he hadn't sent in the item; in fact he knew nothing about it. And he was pretty angry, because it wasn't the first time that something like this has happened.

Apparently the research organisation concerned has someone with either a very warped sense of humour, or a nasty grudge against certain of the staff members – including Dr X. Every so often, this person cooks up a fake technical note or design idea, and sends it off to any likely magazine or journal, over the name of Dr X or one of the other scientists. He even forges their signature, to make everything look genuine and above board.

What a charming person! Apparently Dr X and his colleagues have been trying to pin down the person concerned, and they're pretty sure who it is. But the culprit is very shrewd, and so far has covered his tracks too well.

Needless to say I assured Dr X that I wouldn't either disclose his own name, or give any clues as to the organisation concerned. They want to sort things out themselves, and I wish them well. But I wanted to publish the basic story, both because it's interesting technically and because of the way it turned out to be a deliberate and carefully planned hoax.

Sooner or later, I'm sure the impostor will give himself away. Frankly, I hope they fire him. Most people enjoy a joke, but deliberately setting out to damage someone's professional reputation is no joke; it's pretty nasty.

I'm only glad that my suspicions were aroused by this particular little item, and we didn't publish it in the normal way. And needless to say I'll be looking at all future CDI contributions even more closely than usual, until I hear that our nasty little hoaxer has been caught.

Still, it made an interesting story for this column, if nothing else!

Oh – I almost forgot. If the hoaxer's suggestion of a shorting strap isn't the right solution to the problem of capacitive hum coupling from a toroidal transformer, what is?

Well, the simplest answer is to fit an earthed shield plate between the transformer and your sensitive circuitry, if it has to be located close by. Or if the circuitry must be all around the transformer, you would have to fit an earthed shield box around the entire transformer.

The earthed plate or box will act as an electrostatic shield, preventing the troublesome capacitive coupling. And providing you don't let it make contact with the mounting bolt or top plate, it'll do this without causing any problems of its own.

Incidentally the shield doesn't have to be made from a heavy gauge of metal. It can be quite light; even the foil on a piece of blank PC board laminate will do. But it *must* be connected to circuit ground.

Protection query

And as a final item this month, there's an aspect we didn't consider in our recent look at directional interconnecting cables, OFC speaker cables and other hifi exotica.

Neville Williams, our emeritus Editor-in-Chief, has sent me a cutting from a recent *Sydney Morning Herald*, with an article by David Frith on loudspeaker protection devices. The article essentially extols the virtues of these devices, including a passive unit known as the Allison Power Shield. This apparently fits in series with one of the speaker leads, and disconnects the speaker from the amplifier when it senses a potentially damaging overload condition.

Fair enough, you may say. Really good hifi speaker systems are very expensive, and something that can protect them against damage must therefore be a 'good thing' – right?

But consider this. A passive overload protection device like this must essentially consist of a non-linear resistor, whose resistance is supposedly near-zero at normal levels of speaker drive current, yet suddenly switches to a high resistance when the current rises to a pre-determined 'danger level'.

Now you might be able to produce such a perfect two-state resistor in theory, but you normally can't do so in practice. So unless the Allison people have discovered some hitherto undiscovered way to change the laws of nature, it's likely that their device doesn't change state suddenly, but over a certain *range* of current levels. It's also very likely that it will be neither a perfect short circuit at low current levels, nor a perfect open circuit when it 'switches off'. In short, it's likely to have significant resistance at low currents, and a fairly high degree of non-linearity over much of its operating range.

As Neville points out, this leads to the obvious question: with hifi enthusiasts spending so much money and effort on reducing speaker cable impedance to the absolute minimum, and on removing every skerrick of 'distortion' supposedly introduced by things like interconnecting leads and plugs, doesn't it seem rather inconsistent to be deliberately introducing a known non-linear resistor in series with your speakers?

It sounds pretty crazy to me. But what do *you* think?

Incidentally this criticism wouldn't apply nearly as much to the kind of protector which uses a peak detector circuit controlling a relay. These aren't likely to introduce any significant non-linearities, although the relay contacts will inevitably introduce a small amount of additional resistance. EA

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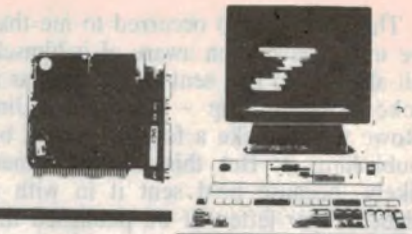


Low cost data acquisition

Priority Electronics has released the PCL-812 enhanced multilab card. The low cost multifunction analog/digital I/O card offers five of the most common measurement and control functions on a single board, when used with an IBM/PC/XT/AT or compatible.

Its versatile functions include 16 analog inputs, 2 analog outputs, 16 digital inputs, 16 digital outputs and a programmable interval timer.

Software supplied with the PCL-812 supports Basic, Basica and Microsoft Quickbasic languages. For C language and Pascal, a separate utility disk is available. The hardware is supported by other popular third party packages inincluding PC-LabDas, UnkelScope, Labtech Control, Labtech Acquire, Labtech Notebook and DADISP.

For further information, contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191 or phone (03) 521 0266.

SCSI floppy disk drives

Verbatim has announced two new high capacity SCSI flexible disk drives that combine the low cost and ease of use of a standard floppy drive with greatly improved storage capacity. The new 10 Plus and 20 Plus drives offer an unformatted storage capacity of 12MB and 24MB respectively, in the 5.25" format is up to 55 times that of a standard IBM DOS diskette, while the data transfer rate is up to 10 times faster than a regular floppy drive.

Both are in the standard drive form and have integrated SCSI (Small Computer Standard Interface) controllers. The 20 Plus model also reads disks written by the 10 Plus.

Special subsystem sets allow the drives to be used with the following systems:

- IBM PC/XT/AT, IBM P52, model 30
- IBM PS2, models 50/60/70/80
- Apple Macintosh Plus, SE, II
- Atari 520 ST, 1040 ST, Mega ST

For further information, contact Verbatim, 42 River Street, South Yarra 3141 or phone (03) 341 1361.

Electrostatic pen plotters

Hewlett-Packard has introduced the HP 7600 series electrostatic and HP Draftmaster pen plotters. HP has based these products on an advanced graphics language, HP-GL/2, and announced that all future HP plotters will include this language.

The HP7600 series electrostatic plotters provide fast, quality output – drawings with 406 dots-per-inch resolution and typically in less than a minute; unattended plotting – an automatic media cutter for both monochrome and colour plots; sophisticated output – with HP-GL/2 and HP's raster commands, users can create plots with 2048 colours, gray scale, screened vectors (patterned lines), and merged vector and raster data; and a wide range of media choices – paper, vellum, translucent media, and clear and matte polyester film.

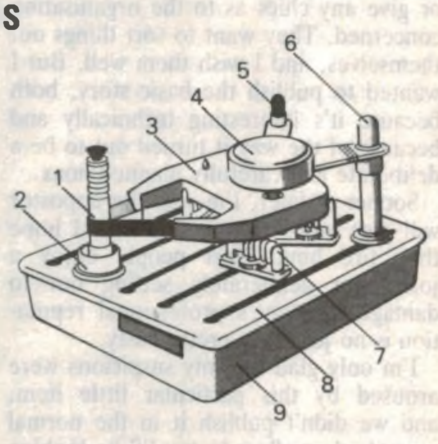
The new HP Draftmaster penplotters provide better access to the PC while the plotter is in use; more reliable pens; maximum acceleration of 5.7g and maximum pen velocity of 110cm/second; and superior line quality of resolution .00025mm.

For further information, contact your nearest HP office or phone (008) 033 821.

Re-inker for printer ribbons

The traditional practice of discarding used printer ribbons is costly and wasteful. By re-inking it is possible to extend the useful life of ribbons by upto 50 times or more.

A very wide range of fabric printer ribbons used on impact printers like PC printers, typewriters, telex machines and even cash registers can be re-inked using the MAXIPRINT inker. The Inker's components can be adjustably positioned on the baselid to accommodate the many different shapes and sizes of commercially available ribbon cartridges.



In contrast with the messy ink reservoir system used on other inking devices, the disposable ink cartridge system used on the MAXIPRINT makes the inking of ribbons easy, quick, clean and convenient. The ink cartridges are available in packs of six.

For further information, contact Ribern, 1/7 Conder Street, Burwood 2134 or phone (02) 744 3500.

Compact desktop laser

The compact Sharp JX-9500 laser printer weighs only 15kgs and is designed to sit on a desktop. Its dimensions are 340mm wide by 360mm deep and 267mm high.

Offering six page-per-minute print speed and 300dpi resolution, the JX-9500 provides outstanding print quality over a wide range of desktop publishing, spreadsheet and word processing applications.

The JX-9500 emulates five other leading printers including the HP Laser Jet II, Epson FX80, IBM Graphics Printer, IBM Pro Printer and Diablo 630, maximising the machine's printing flexibility.

For further information contact Sharp Corporation Australia, PO Box 827, Blacktown 2148 or phone (02) 831 9111.

24-pin printers

The LQ-850+ and the LQ-1050+ are the latest in Epson's line of advanced 24-pin impact dot matrix printers.

Features include 'Smart Park' advanced paper handling; fast printing of 300cps in high speed draft and 98cps in letter quality; two built-in letter quality fonts, Roman and Sans Serif, for the production of high quality documents; convenient selectype control, allowing direct selection of the printer's major functions; and special effects printing includes emphasised, double strike, underline, enlarged, super/subscript and italic.

Options include single and double bin cut sheet feeders, a pull tractor unit, a film ribbon cartridge, a multi font module (7407) and the 81xx series of interfaces.

For further information, contact your nearest Epson dealer or phone (02) 436 0333.

New laptop computers

NEC's latest laptop releases provide heavyweight power in a lightweight laptop computer, and are claimed to provide features usually found only in deskbound computer systems.

They can be integrated into most computer networks or used as standalone systems.

NEC's first colour laptop, the Prospeed CSX weighs only 8.3kg yet offers a powerful alternative to desk-top systems.

It features an 80386SX microprocessor, running at 16MHz, to support Windows 386, OS/2 and other 386 applications, and can be expanded up to 100MB.

The Prospeed 286 is based on an Intel 80286 microprocessor running at 16MHz.

It has an internal memory capacity of 1MB as standard and can be upgraded to 5MB. A choice of either 20, 40 or 100MB hard disk drives are available.

The Prospeed 386 Laptop could be best described as a portable, modular workstation. Based on the 80386 microprocessor running at 16MHz, it can run advanced DOS applications and Micro-

soft's Window/386.

It weighs only 7.9kg and includes 2MB of 32-bit 100 nanosecond RAM, expandable to 10MB; paper-white CTN/monograph display which supports VGA text mode, EGA and CGA resolution graphics, and high resolution graphic programs; and RS232, parallel printer, video, RJ11, battery ports and docking station connector.

For further information, contact NEC Information Systems Australia, 99 Nicholson Street, St Leonards 2065 or phone (02) 438 3544.

Enhanced 300dpi laser printer

Hewlett-Packard has announced its third generation laser printer, the HP Laserjet III.

The new printer provides eight-page-per-minute throughput, uses the HP PCL 5 printer language, and is compatible with and replaces the HP Laserjet II.

The HP Laserjet III produces text and graphics with smoother edges, sharper points, and cleaner line intersection. This is accomplished through an HP-developed technology called HP Resolution Enhancement which adjusts the position and size of the dots. These adjustments smooth the start-step effect inherent in 300 dots-per-inch printing.

This innovative technology resides in an application-specific integrated circuit (ASIC), designed and manufactured by HP. The ASIC intercepts the data and looks at each dot in relationship to neighbouring dots. Dots are then moved to the left or right or printed smaller to produce smoother, sharper and cleaner text and graphics.

HP Resolution Enhancement produces no speed degradation and requires no software support; information is processed as fast as the video signal passes through the ASIC.

For further information, call HP on (008) 033 821.

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COMPUTER PROTECTOR

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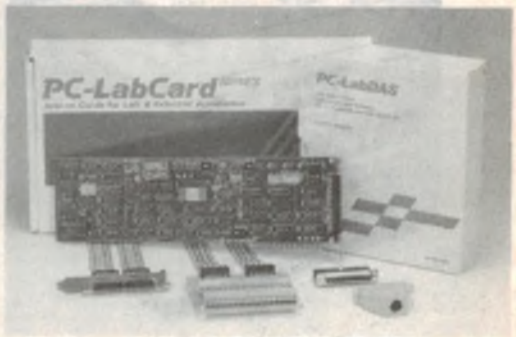
READER INFO No. 9

LabCard for IBM compatibles



PCL-718 from Advantech's PC-LabCard series is a multifunction data acquisition card for IBM PC/XT/AT or compatibles. It has broad applications in industrial and laboratory environments, like data acquisition, process control, automatic testing, signal processing, transient analysis and factory automation.

When integrated with a PC and suitable software package, the PCL-718 can emulate many traditional instruments like a digital oscilloscope, X-Y recorder, strip chart recorder, transient recorder, data logger and programmable controller etc. In addition to the A/D, D/A, digital input, digital output and timer/counter functions, provision is made for transferring high speed data through the use of Direct Memory Access (DMA).

The 12-bit A/D conversion can be initiated by software, by the internal timer or by an external trigger pulse. The converted data may be collected through a software command, an interrupt service routine or the use of one of the two DMA channels.

The PCL-718 is supported by external daughter boards such as a screw terminal board, relay output board, photocouple isolated digital input, solid state relay output, amplifier and multiplexer and industrial wiring kit. A utility software diskette, containing high level command routines and sample programs is furnished with the card.

For further information, contact Control Dynamics, Suite 6, 260 Main Street, Lilydale 3140 or phone (03) 735 1188.

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READER INFO No. 10

HOT TIPS
ON SOLDERING IRONS

ADCOLA RS30 Soldering Iron
- 12 watt mains powered
- Well balanced design
- Long-life Triclad 3mm tip

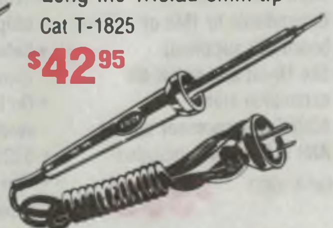
Cat T-1820

$39.95

ADCOLA RS50 Soldering Iron
- 16 watts mains powered
- reliable heavy duty element
- Long-life Triclad 5mm tip

Cat T-1825

$42.95



ADCOLA RS60 Soldering Iron
- 21 watts mains powered
- lightweight, super-slim barrel!
- anti-seize 6.5mm tip

Cat T-1835

$48.95

ADCOLA DR30 DUOTEMP
- Normal and Push-button Boost temperature settings!
- 21 watts on boost
- Can be fitted with a variety of specialist tips

Cat T-1830

$59

2 Tip Replacement Packs
- To suit the ADCOLA irons

Cat T-1860/-1862/-1864

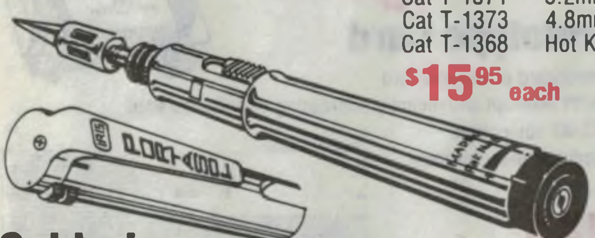
$19.95

5 Tip Replacement Packs
- To suit the ADCOLA irons

Cat T-1861/-1863/-1865

$49

PORTASOL Butane Soldering Iron
- Fits in your pocket!
- 60 minutes continuous use on high
- 10 to 60 watts temperature control
- totally portable



Replacement Tips

Cat T-1372	1.0mm
Cat T-1369	2.4mm
Cat T-1371	3.2mm
Cat T-1373	4.8mm
Cat T-1368	Hot Knife

$15.95 each

PORTASOL 'Pocket' Soldering System
- 10-60 watts power
- Butane powered- refills in seconds
- Averages 90 minutes continuous use
- 4 tips including knife & blow torch
- Case with clip-on iron stand

Cat T-1374

$69

Replacement Tips

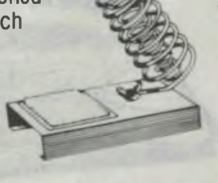
Cat T-1375	1.0mm
Cat T-1378	2.4mm
Cat T-1379	3.2mm
Cat T-1381	4.8mm
Cat T-1376	Hot Knife
Cat T-1377	Blow Torch
Cat T-1382	Hot Blow

$15.95 each

Soldering Iron Stand
- Suits most medium sized irons
- Stable die-cast base
- With sponge holder & sponge
- Can be attached to your bench

Cat T-1303

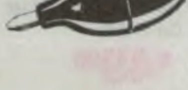
$9.95



Desoldering Bulb
- The fast way to remove solder!
- Sucks the molten solder off your work
- Use in reverse for blow cooling

Cat T-2581

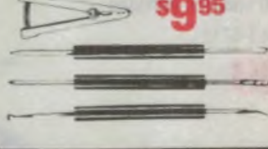
$5.95



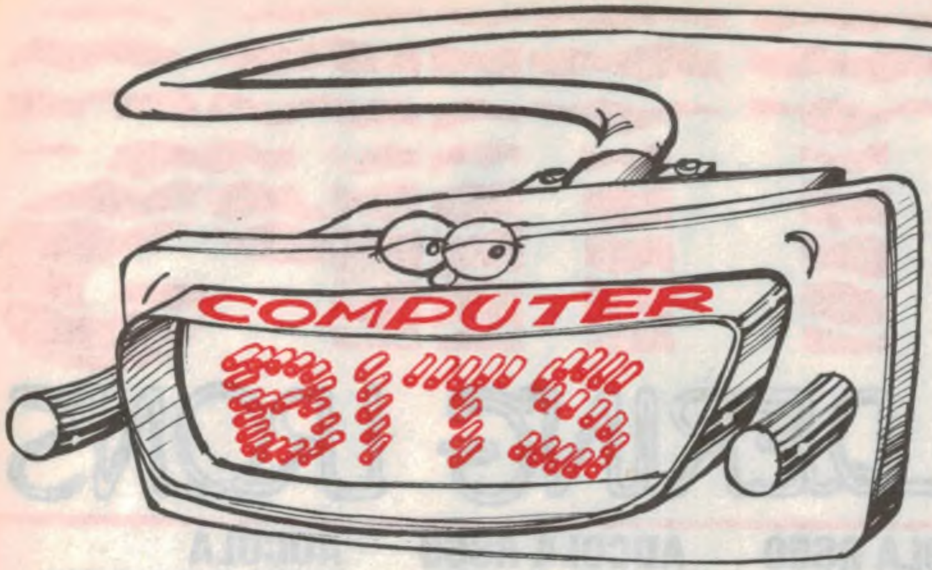
Soldering Aid Set
- Fine point & slotted end probe
- Scraper end & wire brush probe
- Angled scriber and scraper probe
- Aluminium heatsink

Cat T-2606

$9.95



DICK SMITH ELECTRONICS

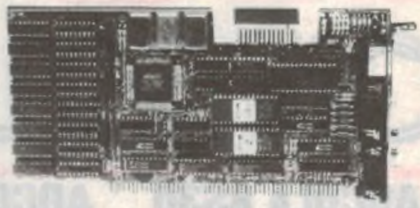


Super VGA Graphics Adaptor

- 256k on board expandable to 512k
- XT or AT compatible
- Can emulate EGA, CGA, and Hercules cards
- One of the most inexpensive VGAs around!

8-bit version Cat X-2018 **$249**

16-bit version Cat X-2019 **$299**



Mini XT Motherboard

- Fits into any desktop IBM compatible XT
- 8.9MHz clock speed
- Unbelievably small!
- 8 expansion slots
- Socketed for 640k on board (0k supplied)

Cat X-1001 **$149**

80286 AT Motherboard

- 12MHz clock speed
- Expandable to 1Mb or 4Mb on board (0k supplied)
- Six 16-bit and two 8-bit expansion slots
- 80287 co-processor socket
- AMI BIOS ROMs included

Cat X-1002 **$399**

20MHz 'Neat' AT Motherboard

- With 'NEAT' (New Enhanced AT) chip set
- Selectable 8, 10, or 20MHz clock speed
- On board support for LIMS EMS - version 4.0.
- 80287 co-processor socket
- Five 16-bit and three 8-bit expansion slots
- Expandable to 8Mb using SIP & DIP modules (0k supplied)

Cat X-1003 **$699**

RS-232 Breakout Box

- A complete in-line tester that makes serial connections a breeze

- 25-pin male to female connectors
- Jumper pads and wires included
- 24 in-line isolating switches
- Eight bi-colour LEDs for line testing

Cat X-2654 **$49.95**

The DSE Solder Station

- A professional Soldering Station at a hobbyist price!
- Variable temperature control from 200-500°C
- Temperature meter for exact control
- Includes lightweight iron holder and cleaning sponge

Cat T-2000 **$135**

RS-232 Loopback Tester

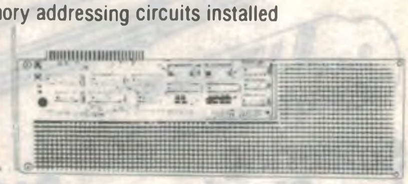
- Conducts data verification by returning output data back into your computer
- 4 LEDs let you know what's going on by monitor lines 2-3, 4-5, 6-20, and 15-17

Cat X-2651 **$19.95**

Prototype Card

- Veroboard expansion card
- With interrupt and memory addressing circuits installed
- XT/AT compatible
- Comprehensive manual

Cat X-2034 **$149**



3 in 1 Modular Tool

- It's a Drill, Soldering Iron, and Screwdriver all in one!
- Modular components snap onto rechargable battery pack
- Comes with assorted drills, screwdriver bits, and solder accessories
- AC charger included

Cat T-5712 **$99**

Computer Service Kit

- All you need to rip your computer to pieces is right here!
- IC inserter & IC extractor
- 3-claw holder & needlenose pliers
- Phillips & flat-head screwdrivers
- Reversible torque screwdriver
- Nut drivers & tweezers
- Handy zippered case

Cat T-4839 **$49.95**

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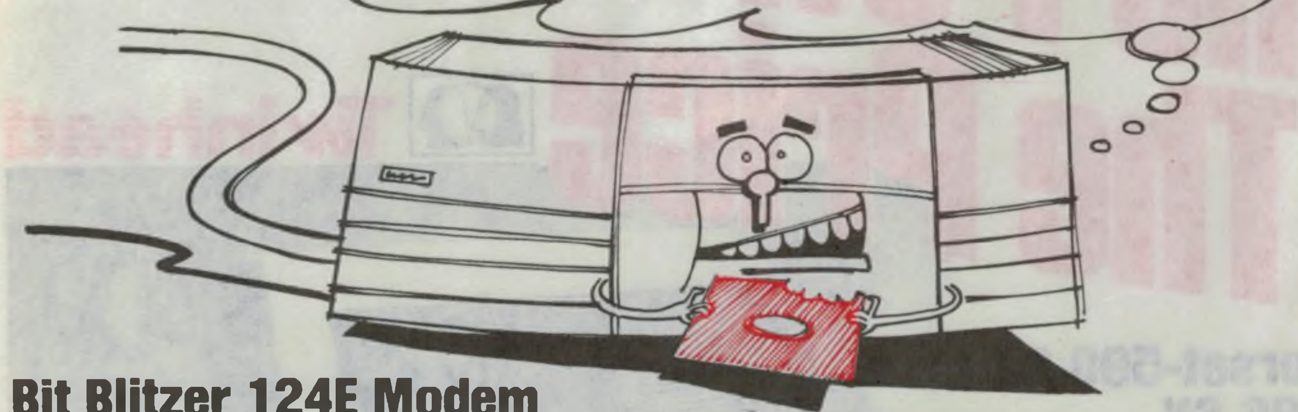
COMPUTER BYTES!

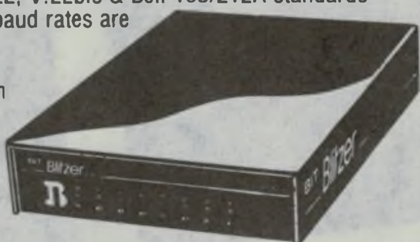


Bit Blitzer 124E Modem

- Low power reliable Modem
- Meets CCITT V.21, V.22, V.22bis & Bell 103/212A standards
- 2400, 1200, and 300 baud rates are software selectable
- Hayes AT compatible
- Sturdy metal case with built-in speaker

Cat X-3309

$399

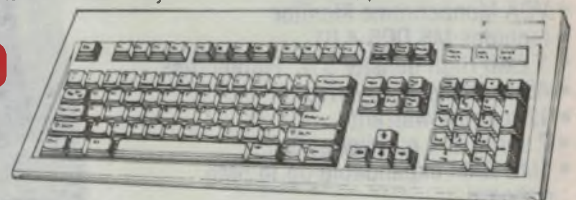


AT Style Keyboard

- Put an end to all that fumbling with combined numeric and cursor keys!
- 101 keys including 12 function keys
- Feels great too- with ALPS key switches for accurate, positive touch

Cat X-3821

$129



Apple II And Macintosh Cables

Cat X-2690 Modem Cable

- Connects RS-232 modems or printers to your Apple or Mac
- DB-25 male to 8-pin male mini

Cat X-2691 Printer Cable

- Connects RS-232 devices to your Apple or Mac
- DB-25 male to 8-pin male mini

Cat X-2692 Din Printer Cable

- Connects ImageWriter and LaserWriter printers to your Apple or Mac
- 8-pin male mini DIN plugs both ends

Cat X-2693 Adaptor Cable

- DE9 female to 8-pin male mini DIN
- Allows you to use standard cables with your Apple or Mac

$19.95 each

Quality DSE Disks

- Our expanded range includes High Density versions of both 5¼" and 3½" disks in packs of 10.
- Now in our handy new flip top containers

Cat X-3501	5¼"	DS/DD	$19.95
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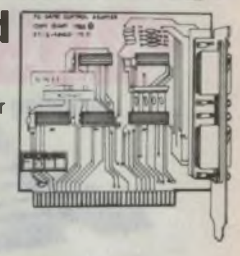
Cat X-3517	3½"	DS/DD	$29.95
Cat X-3511	3½"	DS/HD	$49.95

Twin Port Joystick Card

- IBM compatible games card
- A breeze to fit and use
- Now you don't have to take turns. Play against your opponent in real time!

Cat X-2040

$39.95



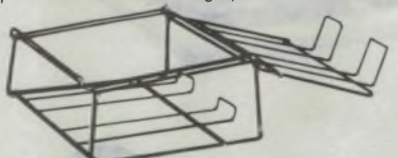
Printer Stands

Cat X-3814 Moulded plastic stand with paper store. Adjustable width for any width printer. **$14.95**

Cat X-3812 Wire stand with paper store for wide carriage printers **$29.95**

Cat X-3811 Standard size wire stand with paper store

$24.95

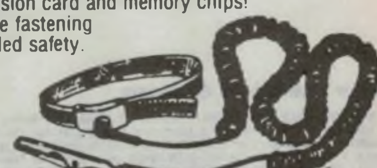


Anti-Static Wrist Strap

- A must for when installing expansion card and memory chips!
- Coiled ground lead and adjustable fastening
- High value series resistor for added safety.

Cat X-2042

$19.95



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Superset-590 SX 80386 SX Technology

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- Includes MS.DOS 4.01
- 1.2Mb High density 5¼" Floppy disk
- 40Mb 28ms Hard Drive
- 12 months warranty
- 2 serial & 1 parallel ports
- 1Mb RAM expandable up to 5Mb onboard.
  Supports Shadow RAM.
- 4 free 16 bit expansion slots
- AT style keyboard
- 80387SX Maths Co-processor socket
- Latest surface-mount technology throughout

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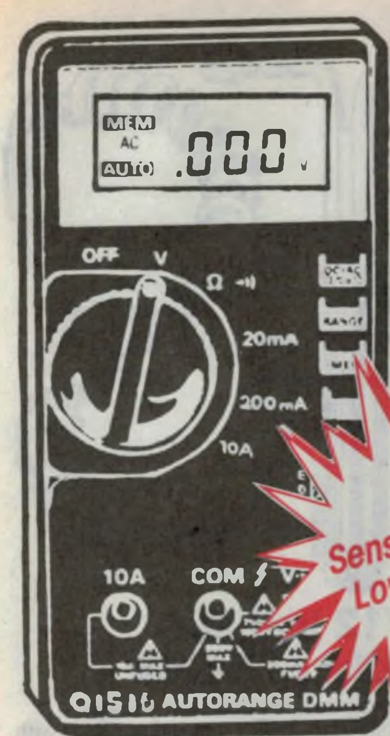


Sensational Low Price!

AUTO Ranging Digital Multimeter

A full featured DMM at this price? It could only be from Dick Smith Electronics!

- Autoranging & auto polarity
- Transistor testing
- Audible continuity testing
- Data hold
- Fast 1/2 second cycling
- High level overload protection

Cat Q-1516 **$109**

Ranges:	
Vdc	0.2, 2, 20, 200, 1000V
Vac	2, 20, 200, 750V
DC current	20mA, 200mA, 10A
AC current	20mA, 200mA, 10A
Resistance	200, 2k, 20k, 200k, 2M, 20M
Trans. check	Hfe
Continuity	buzzer

Multimeter Cradle With Belt

A lightweight cradle for the Q-1516 Digital Multimeter that comes with its own belt. Use it on the benchtop or clip it to the belt for 'go anywhere' action.

Cat Q-1522

$9.95

Temperature Probe Adaptor

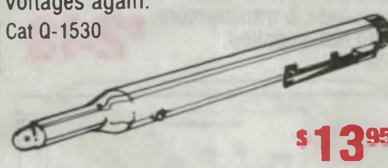
Now your multimeter can measure temperature too! Simply plug into your meter and set it for DC volts. The probe supplied operates from its own battery and has a range of -50°C to 260°C.

Cat Q-1430 **$59.95**

AC Voltage Probe

Here's a probe you should never be without! It senses anything above 60 volts right through the insulation. Now you'll never get caught out by dangerous AC voltages again.

Cat Q-1530



$13.95

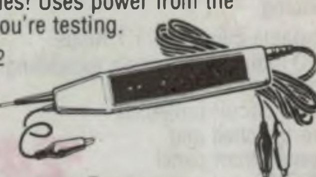
3 — State Logic Probe

Don't tie up your multimeter just for logic tests! With this logic probe you'll be reading logic states the easy way.

- Adjustable threshold for TTL or CMOS
- Pulse or hold mode
- No batteries! Uses power from the circuits you're testing.

Cat Q-1272

$35.95

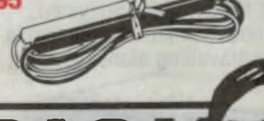


Banana Plug Leads

900mm test leads with standard probes and 4mm fully insulated banana plugs.

Cat Q-1912

$3.95

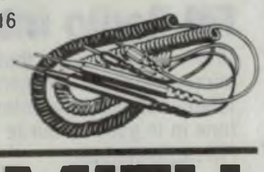


Coiled Test Leads

End the hassle of endless leads cluttering up your workbench with these retractable leads.

Cat Q-1916

$7.95



Light Duty Jumper Kit

Colour coded 10 piece jumper lead set with small insulated alligator clips.

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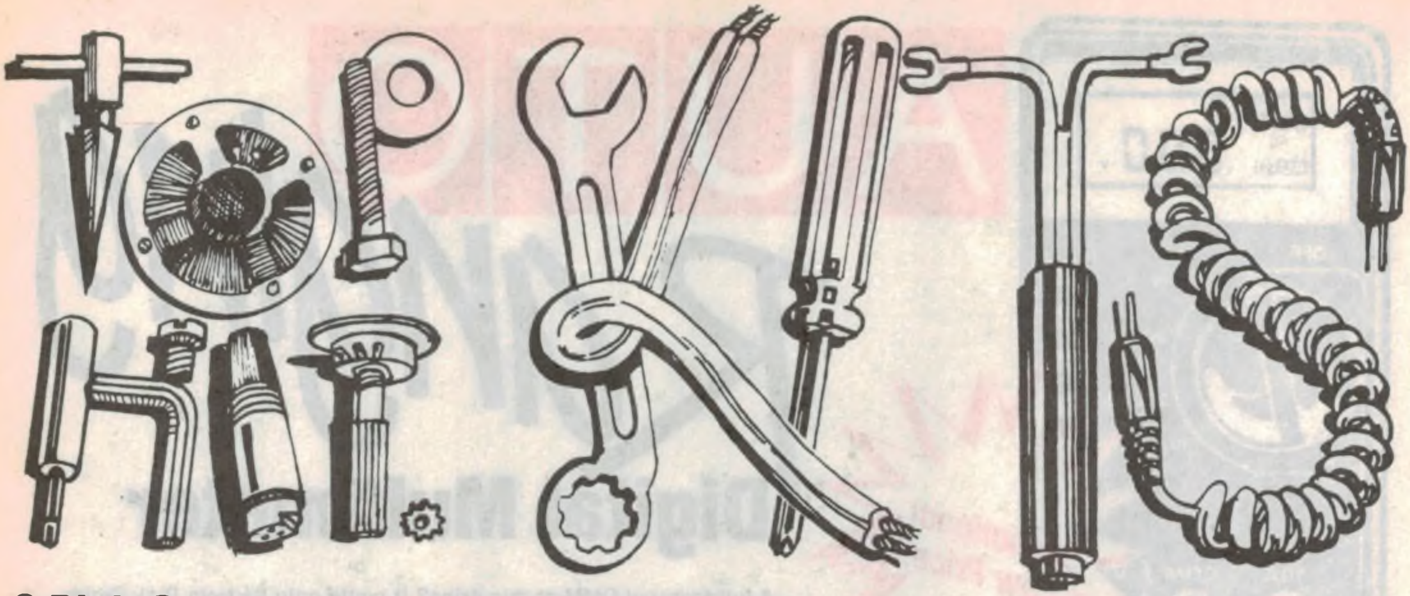

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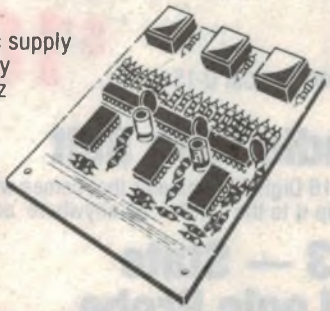

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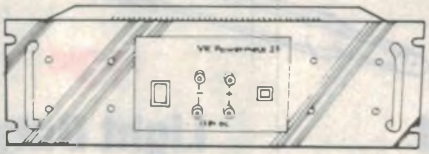

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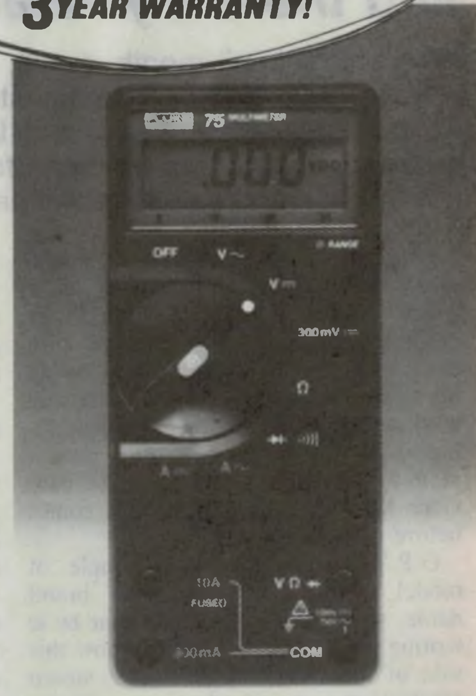

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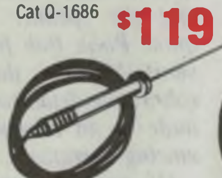

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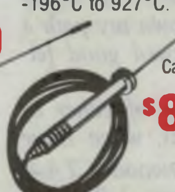

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The Serviceman

A mysterious speaker fault, and the 'dirty' heads that weren't...

It's contributors' month again, and this time we open the account with an entertaining story from across the Tasman. To my knowledge, this is the first New Zealand contribution we've ever had, and it comes from a 'mature age' gentleman (one of my mob!) who we will call G.P.

I love G.P.'s sense of humour, which shows up best in the covering letter which came with his contribution. After outlining his lifelong association with electronics, he mentions that following his retirement, he does a little servicing work at home 'mainly to avoid gardening, but also to earn a little pocket money'. Oh how I wish I could convince Mrs Serviceman that work comes before gardening!

G.P.'s story mentions a couple of model numbers but only one brand name, so we can't be certain that he is writing about models that we know this side of the water. Nevertheless, stereo receiver/amps are much of a muchness wherever they are found, so it doesn't really matter if we can't exactly identify the gear he discusses.

This is how he tells his story:

Q. Why am I sitting here writing?

A. The coincidence of Jim Rowe's request for 'Serviceman' contributions in December's EA, the presence on my bench of a job totally lacking the esoteric problems and the elegant solutions that so often characterise the columns of 'Serviceman'. Who could compete thus anyway?

Hopefully, this story emphasises the need for close communication between serviceman and client – a need which has certainly not been ignored by 'Serviceman' over the years.

My introduction to this client, who I will call Dave, came about a year ago when he handed me an MT30 stereo receiver with a thoroughly masticated speaker lead and an uncomplimentary reference to the scruffy-looking mutt seated at his feet.

Needless to say, the replacement of a few discrete components in the left channel output stage, plus the preparation of a new speaker lead were neither very time-consuming nor expensive, so Dave and the dog walked off down my path a day or two later, in renewed good fellowship.

After this I saw nothing of either of them for about six months, when Dave appeared clutching a Sherwood CTA-4 (made in Korea) receiver. "Blowing 1.6A mains fuses, one after the other!" he said. I refrained from asking him why he had replaced more than one fuse, and told him I would have a look at the receiver.

I remembered to enquire about the dog and the MT30 previously repaired. He told me the dog had lost its taste for speaker leads and he had traded the MT30 on this new stereo, shortly after I had repaired it.

Putting the machine on the bench, I connected it to the mains via my trusty 'Varitrans' (or 'Variac' in Aussie English! – Ed.), *enabling me to offer the offending appliance an alternating voltage adjustable from 0 to 260V at the turn of a knob. This is one of the most-used instruments to have bench space in my workshop.*

I found that at just 60V, the input current had risen to 1.5A. Reason enough after checking power-supply components, to remove the output chip, an STK4191. I dislike this sort of job intensely, being old enough to remember how easy it was to change a 6V6. (Amen to that! Don't we all? – Ed.)

Anyway, a new chip soldered in and bolted to its massive heatsink soon restored the receiver to normal. It remained to have the speakers brought in for a thorough check. After all, something had blown the output chip!

However, when I got the speakers on the bench I could find no fault with either – so, reluctantly, I connected them to the receiver. Perfect!

But even after running the gear for several hours, I still felt uneasy as Dave took it away. I tried to impress on him the need to bring it all back should any out-of-balance occur between channels.

Well, he did come back in about three months with the output chip again demolished. And the speakers? One measured 4 ohms resistance, with a good 'plink-plonk' as the meter probes were applied and removed. The other made only 2 ohms, with a barely audible click.

I removed the cone from this second speaker and enclose photographs of it and the speaker chassis although, to quote Pooh Bah from Gilbert and Sullivan's 'Mikado', they are "...merely corroborative detail to give artistic verisimilitude to an otherwise bald and unconvincing narrative".

Of course, another chip and another speaker again put things right, but I wonder if Dave was being totally truthful when he told me he never ran his stereo at high volume?

I don't know at what temperature voice coils are designed to run but the varnish from this one can be seen as radial smudges around the gap, where its vapour has condensed. And it was, surely, the evaporation of this varnish that resulted in the momentary shorting of some turns which took out the first chip.

After that, it was simply a matter of time till half the voice coil fell to pieces, with the second catastrophic result.

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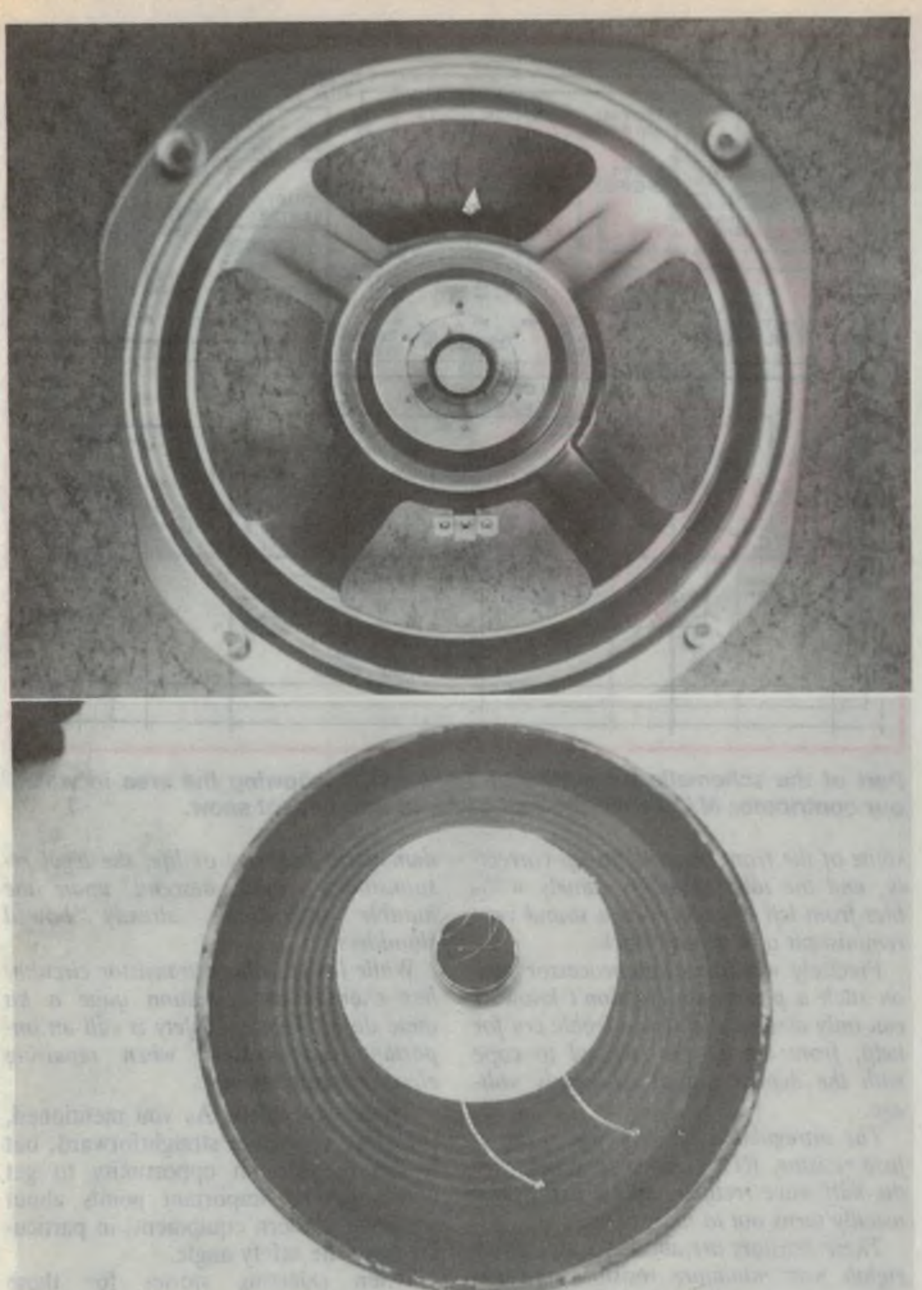


Here are G.P.'s pictures of the remains of his customer's speaker. Note the radial smudge marks around the voice coil gap – vapourised varnish!

full volume and an electro-acoustical efficiency of 3%, that poor voice coil was dissipating nearly 39 watts. No wonder the varnish boiled off! Perhaps some erudite reader could comment on how 100 watts or even more could be dissipated in the voice coil of a single speaker in, say, a car door?

Anyway, Dave has gone, more than happily, and I have had my thinking about the younger generation and their need for LOUD music brought up to date.

Before Dave departed, I tuned in the NZ Concert Programme (FM Stereo) where they happened to be playing a fine and lively rendering of the overture to 'Barber of Seville'.

Setting it at a level one might have enjoyed anywhere in the stalls, I turned to find Dave, hands over ears, saying "No, no! I never have it as loud at that!" My suggestion that it might have been acceptable had the performers been 'Heavy Metal' went down like a lead balloon.

Thanks, G.P. – I know just how you feel about 'Heavy Metal'. It beats me how 5 watts of Beethoven can bring down the wrath of teenage heaven, while 200 watts per channel is never enough to do justice to the latest remix from 'Jungle Joose' or whoever is the latest pop hero!

As for the dissipation in speaker voice coils, it would be interesting to hear from someone who can explain without getting too involved in complex maths. I do know that some high power speakers use a jelly-like liquid to help with cooling the voice coil.

Now we come back from the Shaky Isles to a story from C.B., of Dromana, Victoria. C.B. spends his days working on video cassette recorders, so it's not surprising that he has a VCR story or two to tell in these pages. Here is his latest effort:

A few weeks ago I told the story of a Sharp VCR with wobbly sound and the problems I had in finding the cause. Bearing in mind the fact that one has to make a living, you need an occasional straightforward job to help pay the bills.

In this case the machine was a National NV-370 VCR, a solid machine with a history of reliable operation. The customer was at a loss to describe the fault; the best he could manage was "The TV works OK when you wire straight to it, but stops when you wire it in."

I've had some experience with interpreting very non-technical descriptions of fault conditions, but this time I was as confused as the customer.

The obvious solution was to plug it in and see for myself.

The VCR itself lit up more or less as expected. When a tape was loaded and played it appeared to behave itself. The interest began when a TV was connected via the antenna output cable.

The replayed picture was in black and white for the top quarter of the screen, fading to solid white at centre screen; the bottom quarter was solid black. When the tape was stopped and the VCR tuner was active the screen was the same. Strangely, the sound remained unaffected.

It didn't take long looking at a pattern like that to realise that the fault had to be related to mains frequency hum in the power supply.

One unusual aspect was the screen pattern had only one light/dark bar. For 100Hz hum displayed on a 50Hz television system, the pattern should have two bars per picture.

The power supply circuit diagram provided the answer. The unregulated 18 volt output is only half wave rectified, so poor filtering on this line will produce 50Hz ripple.

The 2200uF filter capacitor (C1102) was the obvious contender. I extracted the capacitor and fed it to my capaci-

tance meter. Sure enough it had lost most of its microfarads.

The area around the negative lead was showing some dried leakage (liquid, not electrical), which I assumed to be errant electrolyte and a very gentle tug pulled the lead away completely.

Replacing the electrolytic cured the problem. The only remaining jobs were mechanical servicing: clean the heads and tape path, check the back tension brake, check the tape guide alignment and check the idler.

The idler assembly in this model transmits mechanical drive from the capstan motor, via a rubber belt and nylon roller, to the supply and takeup reel bases.

It's a very common configuration for driving the reels and is used in many different VCRs.

Because it relies on friction, the idler wheel is surrounded by a rubber tyre. With age this tyre either perishes, or hardens to the point where it loses the ability to transmit drive. This results in either poor rewind, or two rather less obvious symptoms.

One is where the customer complains that when play is pressed, the machine starts up OK and sometimes shows a picture, but then it just stops. This is lack of idler drive to the takeup reel. When in play mode, the system control microprocessor constantly looks for pulses from the takeup reel sensor. If they don't show, it shuts down the play operation to avoid tape damage.

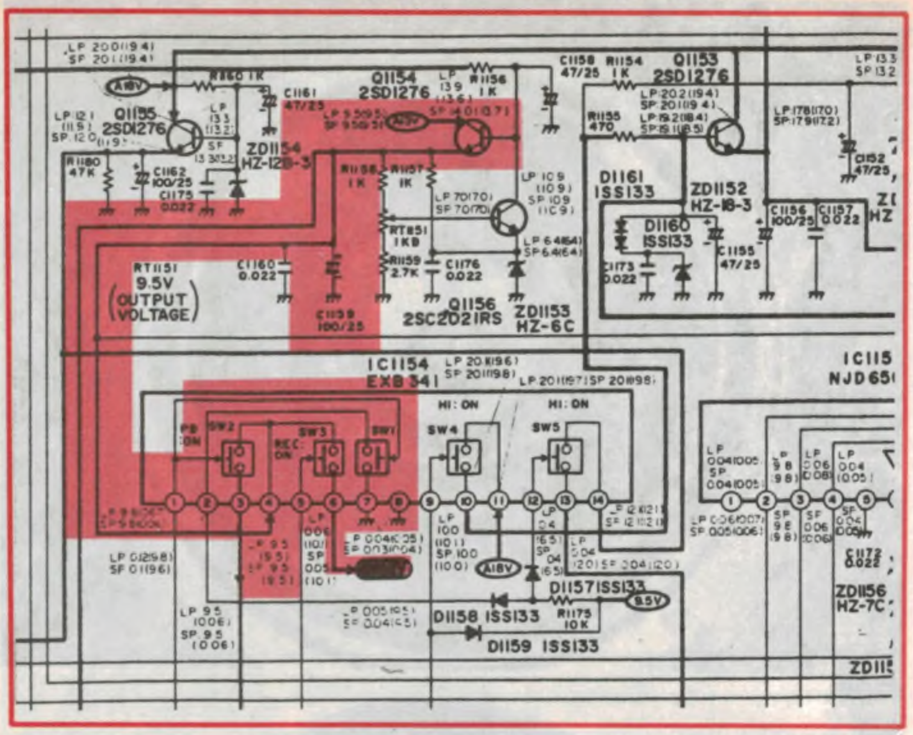
The other situation is lack of drive to the supply reel. Normally the supply reel is driven backwards in the 'stop' mode, to collect the excess tape when the guides retract the tape from the video head.

Typically with this problem the customer arrives with a couple of cassettes in hand. They look sad, with mangled shards of tape issuing from the front. The customer also looks sad – but then, they always do.

The idler tyre will be found to be full of perishing cracks!

While the machine in this story was still operating in this condition, it obviously wouldn't have lasted much longer. I cleaned all the surfaces the idler runs against, and fitted a new idler assembly. If the job had been left as was, the machine would have been back for service very quickly. Customers don't always appreciate how much a competent serviceman can save them, through preventative maintenance.

Another easily recognised fault occurs in the power supply of this same model. When the machine is switched on, only some of the front panel lights up correctly, and the idler assembly lamely wobbles from left to right, with a sound very reminiscent of a ticking clock.



Part of the schematic for a Hitachi TV-20E VCR, showing the area in which our contributor M.C. found the real cause of intermittent snow.

Precisely why the microprocessor puts on such a performance I don't know. I can only assume that it is a feeble cry for help, from an IC too stressed to cope with the deprivation of its supply voltage.

The unregulated 18 volt supply has a fuse resistor, R1101, fitted in series with the half wave rectifier, and it is this that usually turns out to have blown.

These resistors are about the size of an eighth watt miniature resistor, and encased in bright yellow plastic. They come in a variety of values, for use with different currents. In normal operation they run slightly warm and will fail under gross overload, or under slight overload over an extended period of time. They are used extensively and are very handy little devices. In large and complex circuits they provide good protection and often prevent a minor failure becoming an expensive catastrophe.

If that suggests that I always replace them with the correct type, you are right. Despite the added delay in obtaining the part, I believe that the customer is entitled to have their equipment returned to them in original condition, with all the protection circuits fully functional.

There is of course another aspect to this problem. If at a later date a piece of equipment catches fire and causes major damage to property or life, the legal responsibility could descend upon the humble technician's already bowed shoulders.

While lower voltage transistor circuitry has changed the situation quite a bit these days, electrical safety is still an important consideration when repairing electronic equipment.

Thank you, C.B. As you mentioned, the story was quite straightforward, but it did provide an opportunity to get across several important points about servicing modern equipment, in particular from the safety angle.

When selecting stories for these pages, we usually choose ones that exhibit what might be called a 'professional approach' to servicing. Luck always plays some part in solving problems, of course, but good fortune only comes after an accurate assessment of the symptoms and careful choice of likely areas for investigation.

The opposite to the professional approach could be called the 'poke and prod' method, wherein the serviceman(?) doesn't really know what he's about, but solves the problem with more good luck than good management.

The tale that follows really falls halfway between the two systems. Our contributor had an incomplete knowledge of the equipment he was working on, but his skill in other areas of electronics helped him to pull off a really tricky repair.

The story comes from Mr M.C., of Moonee Ponds in Victoria. I'll let him tell the story in more or less his own words, then make my comments later. Here's what M.C. wrote:

I work in the computer industry, but I have repaired a few televisions and other domestic appliances for friends and relatives.

This story involved a Hitachi model VT-20E video cassette recorder, a stereo model which has four heads on the revolving drum. This makes head replacement very expensive indeed, and accounts for why the owner abandoned the unit when my serviceman colleague diagnosed worn heads.

My friend passed it over to me, as he had no use for the machine. It was understood that if I wanted to spend enough money on a repair, then I could keep it. As I did not own a video recorder I jumped at the chance to get a good machine at something less than retail price.

I asked a few questions as to the nature of the fault and learned that it was only worn heads. As far as my friend could determine, every other function was working normally. It seems that the machine would suffer from 'dirty heads' and the owner would clean them with a common type of head cleaner. After this treatment, the machine would work perfectly until next time. Then the procedure would have to be repeated.

Once on the bench, I removed the cover and the drum shielding in order to gain access to the heads. On close inspection I found that one of the heads appeared to have a small chip out of it – probably due to the over-frequent cleaning that I suspect the heads had suffered.

I connected the machine to a monitor and inserted a pre-recorded tape to see just how the it performed. The sound was normal but there was no sign of picture at all, just a screen filled with noise.

At this point I rather sadly conceded that the machine really did need a new head/drum assembly. So I purchased one (at great expense I might add!) and carefully fitted it into the unit.

After rechecking my work, I played the pre-recorded tape and was devastated to find that it was behaving exactly as before – sound but no picture.

I left the tape running while I sat looking at the screen, and feeling most miserable with it, when I noticed a subtle change in the pattern. The random noise began to resolve itself into what could best be described as a lack of horizontal hold symptom.

Soon, it drifted into a picture with noise, then into a perfect picture. Then suddenly I realised that the machine really had a thermal problem, and I switched off to let it cool down for an hour or so.

When I switched on again and restarted the tape exactly the same fault occurred – noise followed by a perfect picture some five minutes later. By this time I was quite excited. Grabbing the can of freezer spray, I started attacking the semiconductors on what I imagined to be the servo board.

I chose the servo board to begin with, because it seemed to me that it was the speed of the drum rotation that was causing the 'cold' symptoms such as loss of sync etc.

Freezing all the semiconductors proved fruitless, so I started on the capacitors – spraying each in turn until I got to C1159, a 100uF 25V electro. As soon as the freeze got to it, the picture began to loose sync and finally became noise. A quick reheat with the soldering iron soon restored a first class picture.

I don't know what this particular capacitor does, as I do not have a circuit diagram. But it seems to be indirectly connected to RT1151, a trimpot which has an effect on the tape and drum speed.

Although I sprayed the capacitors, I did not expect to come up with anything on this line as I have found many faulty capacitors in other equipment, but none that were ever heat sensitive.

It occurred to me that this must have been the original problem and that cleaning the heads prior to use, as the original owner had done, merely allowed time for the capacitor to heat up, thereby producing a good picture.

And so I fitted a new capacitor and verified correct operation. But out of curiosity, I replaced the original head assembly; it produced a reasonable picture, although it was showing signs of a bad head – that is, colour smearing and the occasional sync loss at the top of the picture.

So after all that, my guess is that a fifty cent capacitor caused the owner to ruin the heads by over-cleaning. How misleading symptoms can be!

Thanks, M.C. I'm inclined to consider that as one of the most confusing problems one could come up against. I hope no one ever tells the original owner. He'd be hopping mad to know that he had ruined an expensive video for no good reason.

Still, he wouldn't be the first owner to grind away unnecessarily with a 'head cleaner'. I have one customer who uses his cleaner regularly every week, whether the heads need cleaning or not. He trades in his machine every time a new model appears, so worn heads don't worry him. But they worry *me*, because his sets turn up as 'used' models, and I often have to service them for the new owners.

Now, for my comments on M.C.'s story.

Firstly, the regular occurrence of 'dirty heads' should have alerted someone to the likelihood of an electrical rather than a mechanical fault.

Video heads don't get dirty every time the machine is switched on. This might happen once, but twice is too much of a coincidence. Head fouling usually occurs while the machine is running, and often after a section of damaged tape has been passed around the drum.

Secondly, it is not common for both heads to be fouled by the same amount at the same time. Usually one head is less dirty and reproduces some kind of a picture, which the other, dirtier head overlays with streaky noise.

So a total lack of picture, repeated every time the set is switched on, points more to a loss of demodulated video than to loss of RF output from dirty heads. Admittedly, both states show similar effects but other clues help to sort one from the other.

Thirdly, when M.C. saw the picture returning, he noted the lack of horizontal sync and attributed it to a speed change in the drum. I believe he was mis-reading the symptoms.

Whenever the drum slows down, the picture will drop into diagonal, off-sync lines, just as M.C. notes. But not until the drum has almost stopped spinning does the video information turn into noise. I'm sure M.C. would have mentioned any sign of the drum coming to a halt.

In fact, loss of horizontal sync as described by M.C. is indicative of the combination of a slightly misplaced horizontal hold in the monitor and a weak video input. I suspect that if M.C. had made a slight adjustment to the horizontal hold of his monitor, he would have been rewarded by the sight of an upright, synchronised picture emerging slowly from the misty noise.

Without delving too deeply into the circuitry of this machine, it seems that M.C. was really working on part of the luminance chain, albeit indirectly.

In fact, C1159 is a bypass on the main 9.5 volt supply rail, regulated by Q1154. The rail in turn passes through an electronic switch in IC1154, where it is toggled between record and playback on

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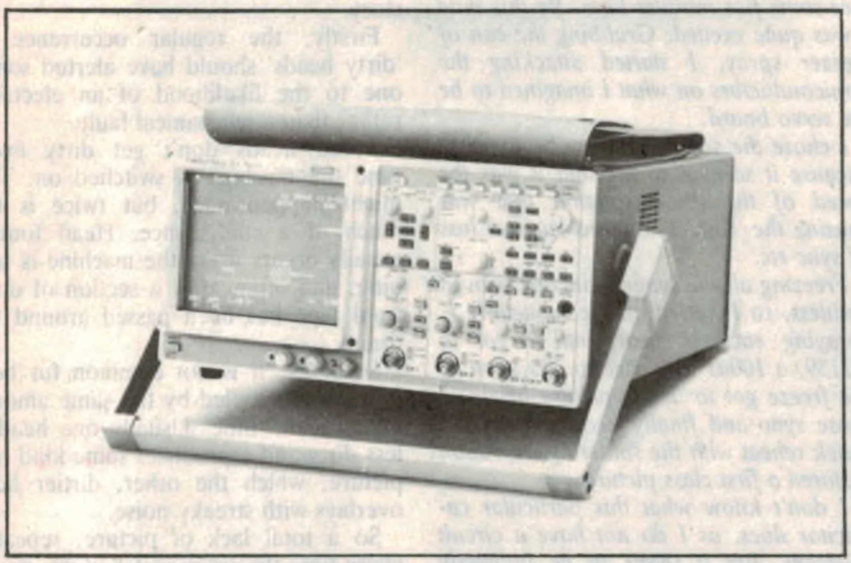

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READER INFO No. 12

the Y/chroma board.

In the fault condition, the 9.5V rail was probably low, thus limiting the output of the playback video circuitry. RT1151 is the 'Set 9.5V' trimpot, so it's not surprising that it had some effect on drum and capstan speed, as mentioned in M.C.'s story.

My fourth comment is on the nature of the fault as finally revealed. M.C. comments that he has never struck heat sensitive capacitors. He's lucky! I have found dozens of electros in this state, particularly around the vertical output stages in colour TV's.

I don't know what the heat sensitive mechanism is, or how it would affect the problem in this story. I should think that an intermittent open circuit within the cap would be either on or off, depending on the nature of the heat sensitivity. Yet in this case, and in others I have struck, the capacity seems to increase (or decrease) slowly with time. It's almost as though the heat was forming (or deforming) the dielectric layer each time the set was switched on.

Finally, I should point out that the foregoing comments are not meant as a criticism of M.C. or his servicing procedures. He did the best he could with his limited knowledge and facilities. He was also very lucky.

The important thing about the story is that it shows up the need to read the symptoms very carefully, and to consider them in the light of both theory and past experience. EA

Fault of the Month

Philips 14CT2006 etc.
(CTXA-1S chassis)

SYMPTOM: No sound. Voltages around output IC 7181 (TDA 2611AQ) are all wrong, but some are more wrong than others. Audio output on pin 8 of SIF chip 7164 seems to be OK, but nothing reaches the power chip.

CURE: C2177, a 22nF 50V ceramic cap has gone leaky and shorts the signal to ground. Out of circuit the cap measures 50 ohms between terminals.

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

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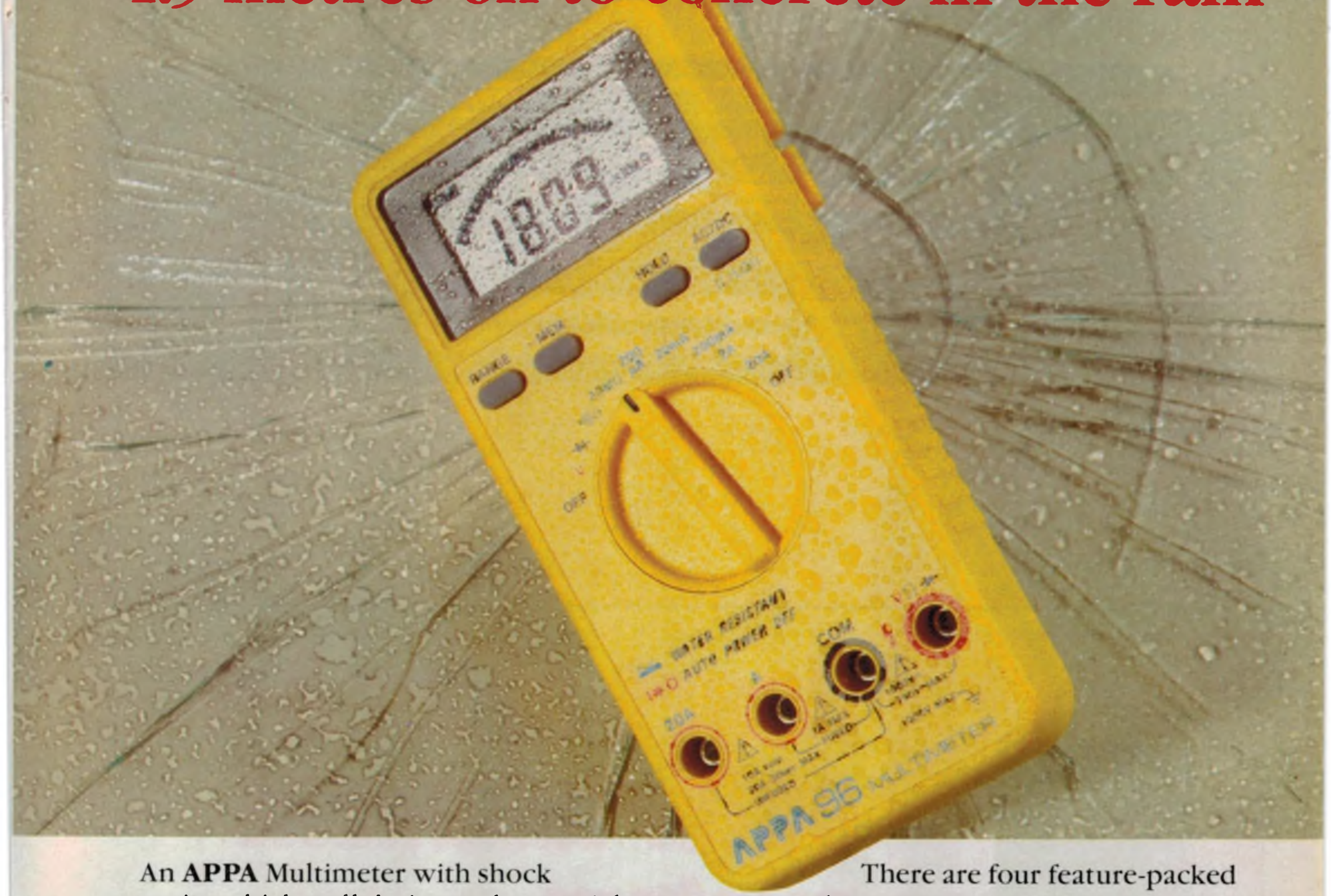

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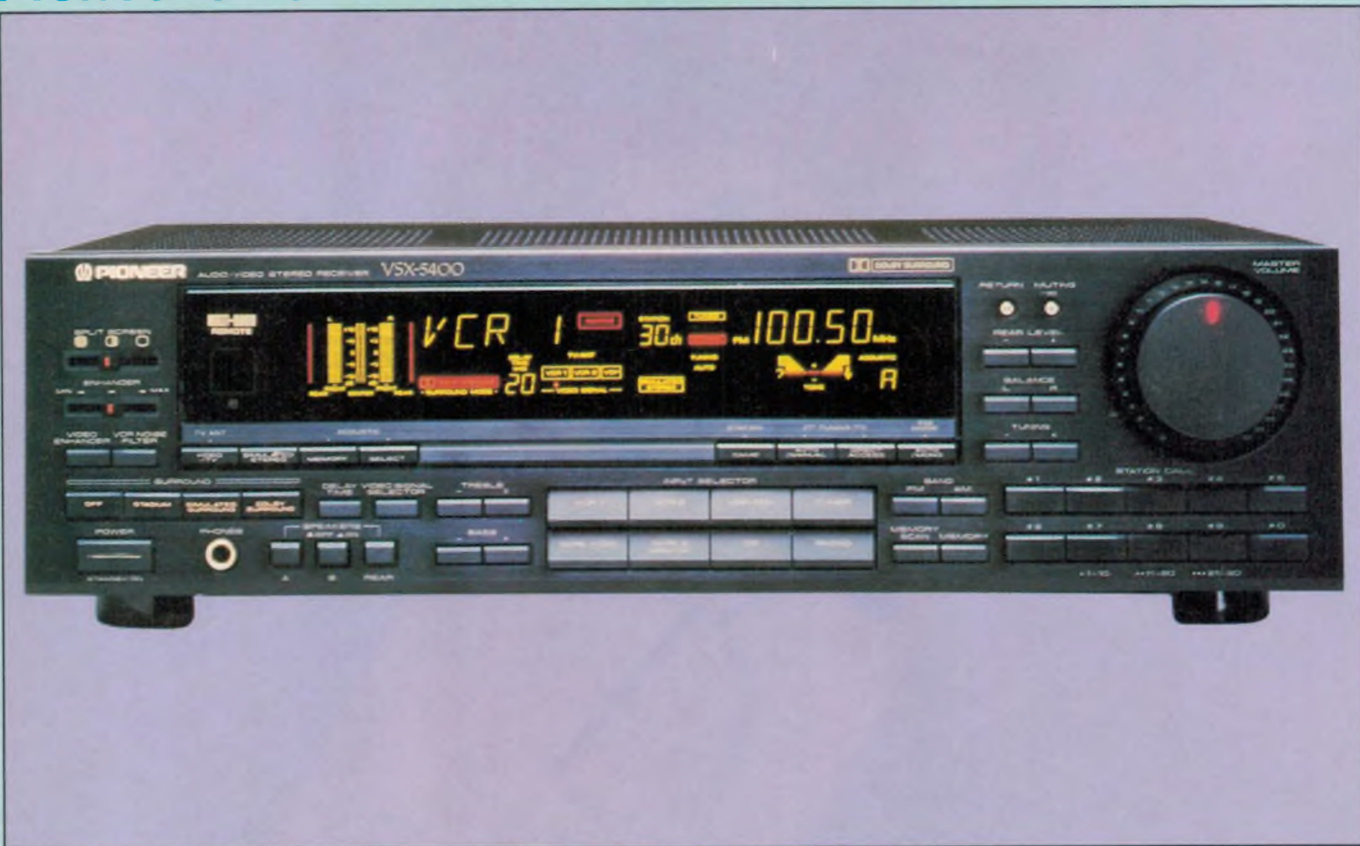
READER INFO NO. 131

United Notions 2355

Pioneer's new VSX-5400 Stereo Receiver:



Heart of an A-V entertainment system

Back in the April issue we carried a review of Pioneer's new VSA-1000 audio-video amplifier, offering full surround sound processing as well as comprehensive video signal selection. Here's a complete AM/FM stereo receiver from the same firm, offering many of the same features.

When we reviewed the VSA-1000, we were quite impressed with the way that it combined so many facilities in the one package: a normal stereo amplifier, a digital surround sound decoder/simulator, additional surround sound channel amplifiers, video signal control and routing – all able to be manipulated using either the usual front-panel controls or a flexible IR remote control unit. The result was a very elegant package, which looked as if it would go a long way towards sorting out the growing electronic complexity in our domestic audio-visual 'entertainment systems'.

But if we thought the VSA-1000 combined an impressive array of functions, there was still more to come. It turns out that its newly released stablemate the VSX-5400 'A-V Stereo Receiver' offers most of the same features and facilities, together with a full high performance digital synthesiser AM/FM stereo radio tuner. So in that sense it combines even more elements that would otherwise involve 'separate boxes' and additional cables, and makes an even larger contribution towards system simplification.

Is there a hidden penalty? Not that we've been able to find. At least not one that seems likely to be significant, for many users.

Of course it's hard to achieve quite the same order of flexibility with an integrated system that you can achieve with a gaggle of separate components – but then, you don't have the same order of system complexity or potential for confusion and mismatching, either.

Traditionally, integrated receivers have been viewed by purists as involving a certain amount of compromise, in terms of performance. However with good design techniques, this needn't be the case. In fact by minimising the need for duplication and redundancy in metalwork, power supplies and line driver/input matching circuitry, an integrated design can allow the designer to achieve a potentially higher order of performance for a given price, than is possible with separate components.

Over the years, Pioneer has in fact built its reputation on achievement in this very area. If my memory serves me right, it was one of the first firms to produce integrated amplifiers and stereo receivers, way back in the valve days. And although it has produced plenty of separate components as well, over the years, there seems to have always been a parallel stream of integrated amps and receivers offering a high ratio of performance to price.

The new VSX-5400 certainly continues this tradition. It combines a main stereo amplifier with a rated output of over 100W per channel; a pair of 'rear' channel amplifiers with rated output of 15W each; a digital surround sound processor, with a choice of various modes including Dolby Surround; an AM/FM stereo tuner with digital synthesiser tuning and either 10- or 30-station programmable memory; full remote control facilities with motorised remote volume control, five programmable tone control 'acoustic' setting memories (as well as 'flat' and the standard 'loudness' characteristic) and selection of surround sound modes; and a reasonably flexible video signal selection and routing circuit. Quite an impressive lineup of facilities, by anyone's standards.

Looking closer

The VSX-5400 is only a little smaller than the VSA-1000 amp, measuring 420 x 124 x 401mm and weighing in at 10kg (a whisker over 22 pounds). Like the amp it's finished in a nice satin black, while the front panel has an impressive array of no less than 54 control buttons, two sliders and a large rotary volume control – plus a multi-function fluorescent display panel. There's also the usual jack socket for stereo headphones.

The rest of the connectors are all on the rear panel, with some 38 RCA-type 'phono' sockets and a DIN socket for audio and video interconnections; 12 lever-clamp terminals for speaker connections; four screw terminals and a coax socket for antenna inputs; three two-pin sockets for supplying 240V to auxiliary gear; and four small sockets for remote control expansion. At the rear there's also a switch to select either 10 or 30 memory mode for the tuner (in 10 memory mode, station callsigns can be displayed); another switch to select one of two possible AM channel spacing/FM de-emphasis characteristic combinations (9kHz/50kHz-50us or 10kHz/100kHz-75us); an input balancing pot for the Dolby Surround circuit; and two switches to select the correct mains voltage setting. As you can see from this flexibility, the VSX-5400 is made for operation in virtually any country.

The IR remote control unit is also pretty impressive, although not quite as elaborate as that for the VSA-1000. In this case there are 62 control buttons, plus a slider which switches between audio and video functions.

Despite this apparent complexity, operation turns out to be fairly intuitive and straightforward. In any case, it's all explained quite clearly in the user manual.

Essentially on the audio side, you can select signals from the inbuilt AM/FM tuner, the inbuilt MM phono preamp, or the CD, Tape 1/DAT, Tape 2, VDP/CDV player, VCR1 or VCR2, with an optional noise filter available for the last two signals. As well as being fed to the amplifier channels, the selected signals are also made available for recording by Tape 1/DAT, Tape 2, VCR1 or VCR2 as desired for dubbing.

The selected signals are fed through the balance, tone control and volume control circuits through linked rear panel sockets to the main amp channels. In addition, they are fed through a mixer to produce a 'centre out' signal, for an optional external amp, and also through the digital surround processing circuitry to produce the signals for the rear amp channels. These too are fed via linked rear panel sockets, to allow further processing or the use of separate amps if desired.

The video side of the VSX-5400 is rather simpler, mainly performing selection of signals from the VDP/CDV, VCR1 or VCR2 when the corresponding audio signals are selected. The chosen video signal is then made available via buffers to the video monitor and RF modulator sockets, as well as to the VCR1 and VCR2 outputs for dubbing. The unit actually also contains a 'high peak' video enhancer with split-screen monitoring facility, but this only operates correctly with NTSC video signals, not the PAL signals used in Australia.

Other features worth noting are electronic overload and 'thump' protection for the speakers, with relays that are also used for muting; 'bar graph' level meters built into the fluorescent display, which show both the front and rear channel levels; a choice of Stadium, Dolby Surround or Simulated Surround modes; and adjustable delay times of 15, 20 and 30 milliseconds.

Rated power output of the main amplifier channels is 110W RMS per channel into 8 ohms, for 0.005% total harmonic distortion, or 100W RMS per channel for 0.001% THD. The corresponding 'dynamic' or IHF burst power ratings are 230W/200W/150W, into 2/4/8 ohm loads respectively.

The 'rear' channels are rated somewhat more modestly, at 15W RMS per channel into 8 ohms for 0.4% THD. However as noted earlier both the 'rear' channel signals and an optional 'front centre' signal are brought out at the rear of the receiver, to allow the use of external amplifiers if desired.

Rated frequency response for all direct audio inputs except those for phono (MM) signals is 5Hz – 100kHz (+0, –3dB), with that for the phono inputs specified as 20Hz – 20kHz +/–0.3dB. Signal to noise ratio for the former inputs is rated at 98dB, while that for the phono inputs is 82dB (IHF, short circuited, A network).

With the tuner section set for 9kHz channel spacing, the AM tuning range is 531 – 1602kHz, with a rated sensitivity via the loop antenna supplied of 300uV/m (IHF). The FM tuning range is 87.5 – 108MHz, with a sensitivity of 1.6uV on mono or 19.5uV on stereo for 50dB of quieting. Stereo separation is rated at 48dB (1kHz), while the frequency response is within +0.5dB/–2dB from 30Hz to 15kHz.

All in all, a very respectable specification.

Our tests

Checked out in our lab with the instruments, the sample VSX-5400 gave quite a good account of itself. We were able to measure a comfortable 105W RMS per channel into 8-ohm loads, with both channels driven, or 81W RMS per channel into 4-ohm loads. The equivalent IHF pulsed power figures were 132W and 180W respectively, again with both channels driven.

The THD for rated 100W RMS into 8-ohm loads checked at very close to the rated 0.005% for the main power amps alone, rising only slightly to 0.01% with the generator fed in via the CD inputs. The corresponding figures for IMD were slightly lower, at 0.009% overall – an excellent result. The figures for 80W into 4-ohm loads were only slightly higher, at 0.018% THD and 0.02% IMD.

We couldn't achieve the quoted figure for signal-to-noise ratio measured from the line level inputs, though; the best we could obtain was –87dB relative to 100W/8 ohms, rather than – 98dB. However the sample unit may have been slightly faulty in this respect, as the residual reading seemed to be signal breakthrough from the tuner rather than noise. The S/N figure for the power amps alone was a very quiet –100dB, however, while that via the phono inputs was –80dB – very close to the quoted figure of –82dB.

The sensitivity figures were very close to the quoted levels, at 2.6mV for the phono inputs and 150mV for all of the line level inputs. The phono overload level was also 150mV, comfortably higher than the quoted 130mV and indicating plenty of preamp 'headroom'.

There were also no problems with frequency/power response for the main channels, either: we measured a response of 10Hz – 20kHz within +/–0.5dB, for the rated 100W RMS output into 8-ohm loads. The tone control ranges were also fine, with the bass control giving 3dB steps and a maximum of +/–12dB at 50Hz, and the treble control giving 2.5dB steps and a maximum of +/–10dB at 15kHz.

It was only with the rear channels that we found the results a little disappointing. We could get 20W RMS output into 8-ohm loads, comfortably more than the rated figure of 15W; but the THD was 0.2% – rather higher than the corresponding figure for the VSA-1000 amp. This is still within the spec, which quotes 0.4%, but it still seems rather incongruous when compared with the much lower figure for the main front channels.

Presumably the designers have worked on the basis that since the rear channels carry only supplementary 'ambient' sound information, there's no need to spend a lot of effort in achieving a particularly low distortion figure.

This one point aside, the lab tests revealed the VSX-5400 as a solid and smooth performer. So we tried it out in the same fairly typical domestic listening room used for the VSA-1000, and with the same lineup of speaker enclosures and signal sources – together with the VSX-5400's own tuner.

And as with the VSA-1000 amplifier, the listening tests turned out to be very relaxed and enjoyable. The sound proved very clean and unforced, even at quite high listening levels, with no obvious nasties from the rear channel speakers when the surround modes were being used – despite the more modest THD figure for the rear channel amps.

As before, the multi-function IR remote control unit makes it very easy to adjust the various system parameters as desired, from the comfort of your armchair. Just the shot for comparing the various surround sound modes, adjusting left/right or front/rear balance, or adjusting the volume when a CD's dynamic range starts to endanger good relations with the neighbours!

We didn't try playing much with the video enhancer side of the VSX-5400, after having been advised by Pioneer that the split-screen monitor function only works with NTSC signals. Pity, that – but perhaps the next model will be PAL compatible.

All told, then, the VSX-5400 A-V Surround Receiver seems an impressive performer, and a worthy stablemate to the VSA-1000. Like the latter it appears to provide an elegant solution to the growing problem of domestic entertainment system complexity – in this case with an even higher level of functional integration.

For the quoted price of $1199, it seems particularly good value for money.

As with the VSA-1000, you should be able to find it at your nearest Pioneer hifi stockist. But if there's any difficulty, or you need further information, you can contact Pioneer Electronics Australia at 178-184 Boundary Road, Braeside 3195 or phone (03) 580 9911. (R.E. and J.R.)

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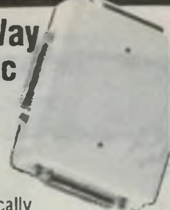

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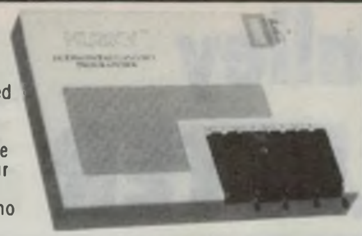

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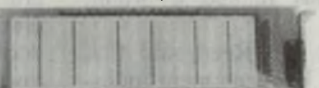

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READER INFO No. 14

Silicon Valley NEWSLETTER

Japan finally recognises TI's IC invention

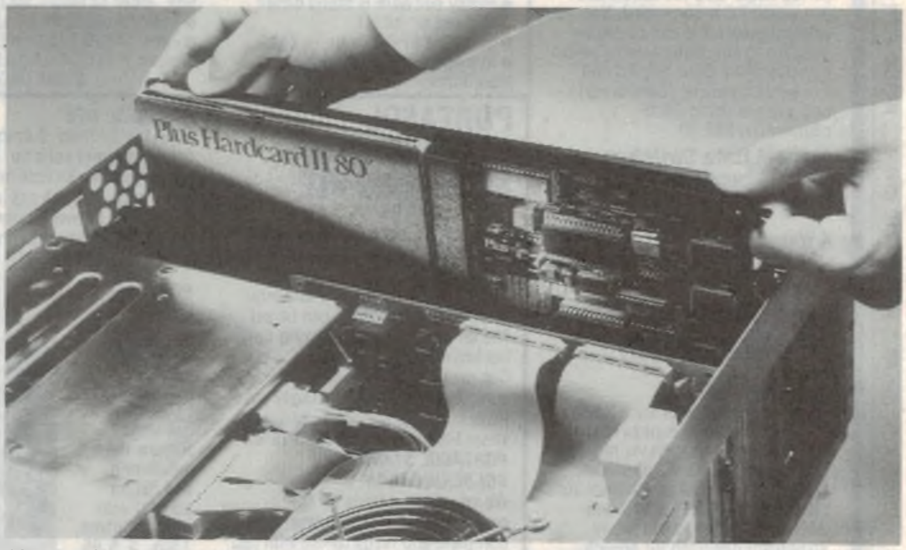
It has taken almost three decades, but Japan has finally recognised the invention of the integrated circuit.

Twenty-nine years after Texas Instruments first submitted an application for a Japanese patent, Japan's patent office announced it has granted the Texas-based company a patent for its invention of the integrated circuit.

As a result of the decision, Japanese semiconductor makers may have to pay a royalty fee of up to 3% on the sale of any IC product they make, a development that could generate annual revenues of US$500 – 700 million for TI.

At Texas Instruments, spokesman Stan Victor said the company believes that the newly issued patent "covers virtually all ICs manufactured in Japan. The opportunity exists to earn a significant on-going stream of royalty income."

Industry observers cautioned that Japanese chip makers will probably oppose paying the royalty payments until ordered to do so by the courts. Also, TI may negotiate with several chip makers to trade royalty fees for chip or other technologies in which the Japanese may have an edge over TI.



Hard disk drive maker Plus Development of Milpitas has just released its Hardcard II plug-in drive and controller combination for PC compatibles, available in both 40MB and 80MB versions. A subsidiary of Quantum, the firm produced the first Hardcard in 1985.

US semi firms face darker days

Darker days appear to lay ahead for the US semiconductor equipment industry. Besides a general slowdown in chip plant expansion, a report released by Semiconductor Equipment & Materials International showed that Japanese and other international equipment makers are continuing to take away market-share from their American competitors.

A survey among 24 major chip equipment buyers showed that 85% of the firms had dramatically reduced their business with US vendors between 1985 and 1988, while drastically increasing purchases from foreign, predominantly Japanese, equipment makers. An additional 65% said they expected the trend to continue into the 1990s.

Major reasons for turning to foreign suppliers, according to the SEMI survey were greater product reliability and the better reputation of the foreign vendors. Price considerations ranked a distant third.

SEMI president Bill Reed said that the decline of the US equipment industry is due not only to direct forces such as increased foreign competition, but also to less visible factors. Most significant are high capital costs in the United States and the escalating R&D budgets, which are becoming increasingly difficult for small and mid-size equipment firms to shoulder. Most of the new generation of Japanese firms are part of larger conglomerates, with deep pockets to finance new product development and take a long term look in market strategy.

US Navy to ban IBM

Many good and bad things have happened to IBM in its 75-year history. But never has America's premier computer supplier been banned from doing business with the US government. However, the US Navy recently took steps to impose an indefinite ban on doing business with its largest data processing vendor.

While two weeks of testimony before the House Government Operation Committee had already disclosed several instances of questionable, if not illegal marketing practices, the Navy's decision to suspend IBM was made following additional disclosure that IBM had defrauded the Navy by selling it used computer equipment that had been labelled and billed as new.

IBM has confirmed the incidents and also admitted violating the 'Buy American Act,' in which contractors must certify that the products they are selling to the US government are mostly American made.

A ban could be very costly for IBM. Out of the more than US$1 billion in business IBM did with the Pentagon in 1988, some US$660 million worth of computer gear was sold to the Navy.

In Washington, Navy officials said the final terms of the IBM ban are still being negotiated.

Bell's optical chip has 2048 transistors

AT&T's Bell Laboratories announced it has developed a new version of an experimental optical integrated circuit chip.The chip, which uses low-pwer light instead of electrons, contains some 2048 transistors, twice as many as in the first experimental chip announced in 1987.

The transistors feature an on/off switching time of less than one picosecond. Another advantage of the optical chip is that all of the data it contains is accessible instantly, as opposed to traditional silicon circuits which allow data to be accessed one bit at a time.

The chip was developed at Bell Lab's Solid State Technology Center in Pennsylvania. A Bell scientist said the optical chip is like a 'huge multi-lane freeway on a chip.' and could force the industry to look at computer processing in a totally different way.

Thin-screen TV moves closer

Development of flat-screen colour television displays that can be hung from the wall like a painting took a big step forward a few weeks ago with the development in Japan of a blue light-emitting LED component that is strong enough to be used in television applications.

The development was announced at Nogoya University, where Isami Akazaki led team of researchers who developed the blue light diode, which has proven to be 60-70 times stronger than any previous experimental blue light LED.

The blue-light LED has been the target of intense research for years, as the missing link in developing LED-based flat panel television and computer displays. While the red and green LED have been available for years, blue-lights LEDs have proven a major obstacle.

Besides obvious applications in displays, the blue light emitting laser is also likely to dramatically boost storage capacity of optical disk drives. Using a blue light laser diode, storage capacity on a typical 250 megabyte optical disk could be increased four-fold to 1 gigabyte.

H-P using cheap Chinese engineers

Apparently acting on tips from angered Hewlett-Packard employees, the US Immigration & Naturalisation Service has begun to investigate whether a program under which H-P is bringing Chinese software engineers to the United States, violates US immigration laws. Under the program, the engineers have been working on various software-related projects at wages that are a fraction of what H-P would have to pay similar US software engineers.

Since the program began more than two years ago, approximately 30 Chinese software engineers have been brought to the US by H-P, although none are registered as H-P employees. The program has continued even during and after the last summer's unrest and crackdown in China.

Currently, 20 Chinese engineers are working at three H-P facilities in Silicon Valley and live in a company-supplied apartment complex in Sunnyvale.

H-P has justified the program as an effort both to cultivate relations with the PRC and save the company some money on wages.

While H-P maintains that the program is legal and legitimate, US immigration laws prohibit the import of foreign workers for jobs that can be performed by qualified US citizens.

Harris closing Intersil plant

Ever since it acquired the semiconductor operation from General Electric, Harris' semiconductor group has had trouble deciding what to do with the Santa Clara based Intersil group.

Following more than a year of rumours that the operations were for sale, Harris said it has decided to close the facilities, which date back to the early 1970's, and transfer the operations to other locations around the United States.

As a result of the move, an estimated 350 workers will have to be laid off over the next 18 months, Harris said. It added that while all manufacturing will be discontinued in Santa Clara, the company will maintain the engineering, sales and customer service groups, involving about 80 people.

Kaypro files for bankruptcy

At one time, Kaypro had a tough time keeping up with demand for its all-in-one portable personal computers, often referred to as 'Volkswagen Beetle' of the computer industry. Now the company has filed for bankruptcy.

Kaypro officials said the company would continue to operate under Chapter 11 protection of the bankruptcy law, and restructure itself in a last effort to survive.

Kaypro made industry headlines in the early 1980s when its sales soared from just US$5.5 million in 1982 to more than $119 million in 1984. But the vigorous new competition in the personal computer market of the mid and late-eighties caused the company to fall on hard times, losing money in four of the last five years. In 1989, Kaypro is reported to have lost US$19.4 million on just $21.8 million in sales.

Japanese firm buys into Silicon Graphics

In yet another investment in Silicon Valley by a Japanese company, that country's second largest steel company, NKK announced it has purchased a block of US$35 million worth of newly issued shares in Silicon Graphics, the Mountain View manufacturer of leading-edge 3-D graphics terminals.

In return for its investment, which amounts to a 10% stake in the company, NKK also gained the exclusive distribution rights of Silicon Graphics products in Japan. SG said it will use the money from NKK to expand its operations and new product development.

Intel in DRAM venture with NMB

Less than two weeks after the failure of US Memories, Intel – one of the seven original backers of the DRAM start-up – announced a major agreement with Japan's NMB Semiconductor that will enable Intel to once again become a major player in the DRAM market.

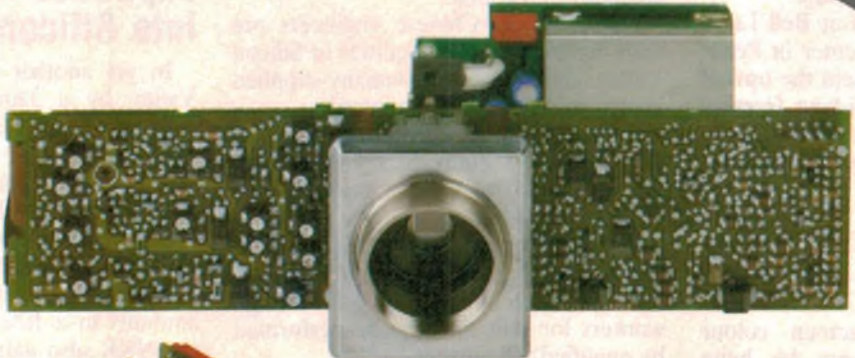
Under the terms of the agreement, Intel will gain the exclusive rights to sell NMB DRAM chips worldwide, under its own label. In addition, Intel will gain access to NMB's innovative manufacturing processes which Intel will be able to apply to its own product lines.

For NMB the deal will give this relatively minor player in the DRAM field access to Intel's highly respected worldwide marketing and sales network. In 1989, NMB sold just US$200 million worth of DRAMs worldwide. But with Intel on its side, those sales could well balloon to over US$1 billion in the next two years.

As part of the agreement, Intel and NMB will set up a joint venture in Santa Clara to be known as Intel/NMBS DRAM Fabrications. The company will be headed by Intel vice president Roger Norby. Also, both companies have agreed to buy a minor equity position in each other.

MAKE YOUR OWN VIDEO CAMERA – NO EXPERIENCE NECESSARY!

ALSO IN COLOUR



Philips brings you a video camera sub-assembly incorporating a solid-state image sensor. Which means that even if you have no video equipment design experience, or no assembly facilities, you can now fit the sub-assembly module quickly and easily into any vision system. (Naturally, Philips will provide you with information support).

JUST ADD LENS

The imaging module requires only a chassis and a standard lens to form a complete monochrome video camera, for use in machine vision or surveillance.

Or connect the module to a computer and you have an industrial inspection and control system. Ideal for extreme low light conditions, such as a gloomy factory, the SSIS used in the module works in an ambient light level of below 1 lux.

CUT THE SPACE

Using only five small flex/rigid PCBs, with a unique layout that minimises RF interference, Philips' advanced surface mounting techniques mean that the sub-assembly can be folded to an area just 89 × 40 × 45 mm or extended to 37 × 170 × 45 mm.

CUT THE COSTS

Why accept a lesser name than Philips when you don't have to? You can have a Philips Imaging Module for less than you think, from $560 (plus sales tax) for one off purchases. There are ten modules in the range to suit your needs. Find out how little it can cost to have the highest standards of resolution and sensitivity for your application. Call Philips Components on 439 3322 in Sydney, 881 3677 in Melbourne, 348 5222 in Adelaide, 277 4199 in Perth, or 844 0191 in Brisbane.

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PHILIPS

PHILIPS

MAY/JUNE 1990

FIRST FULL REVIEW:

BOSE'S NOISE CANCELLING HEADSET

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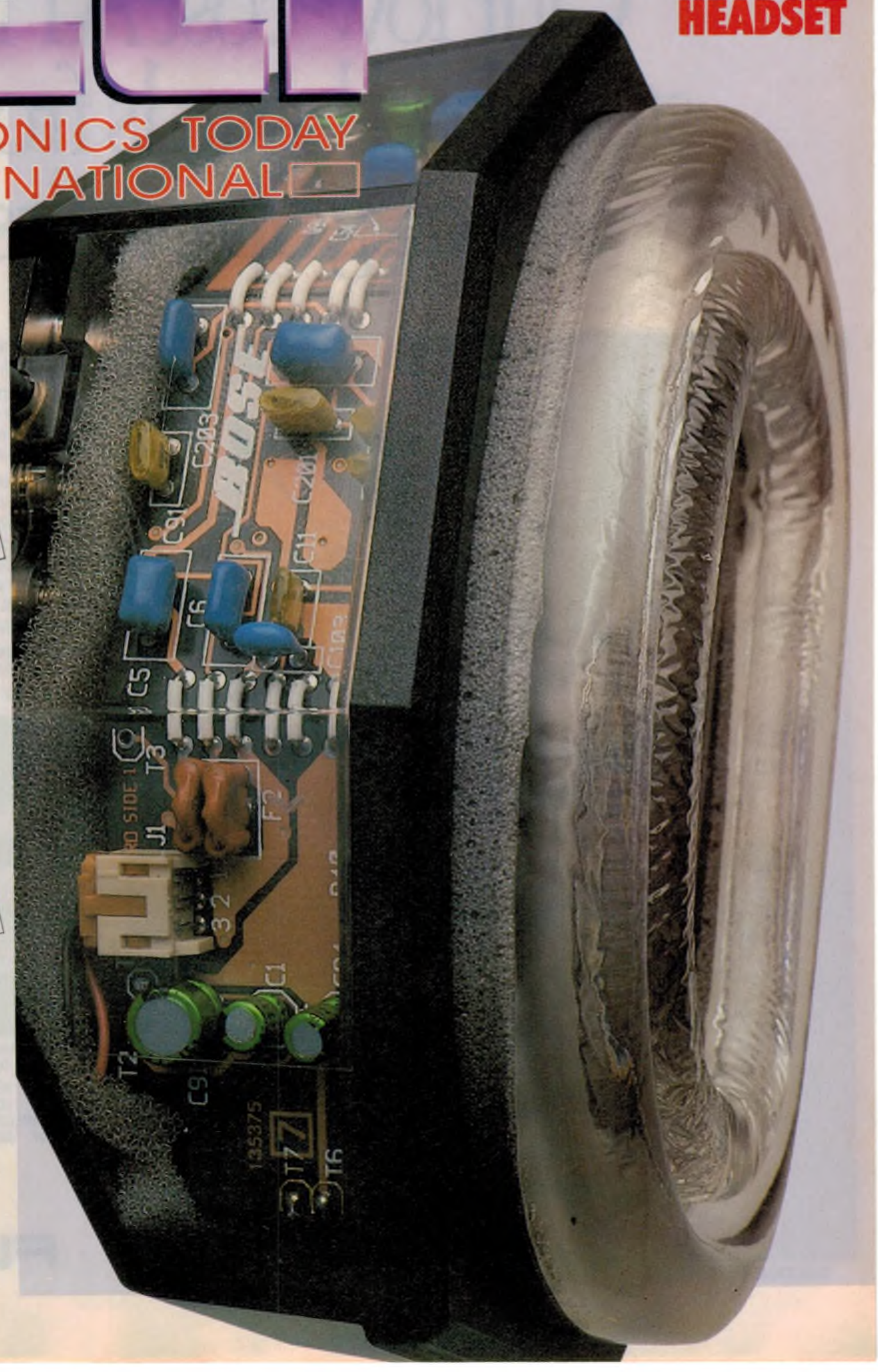

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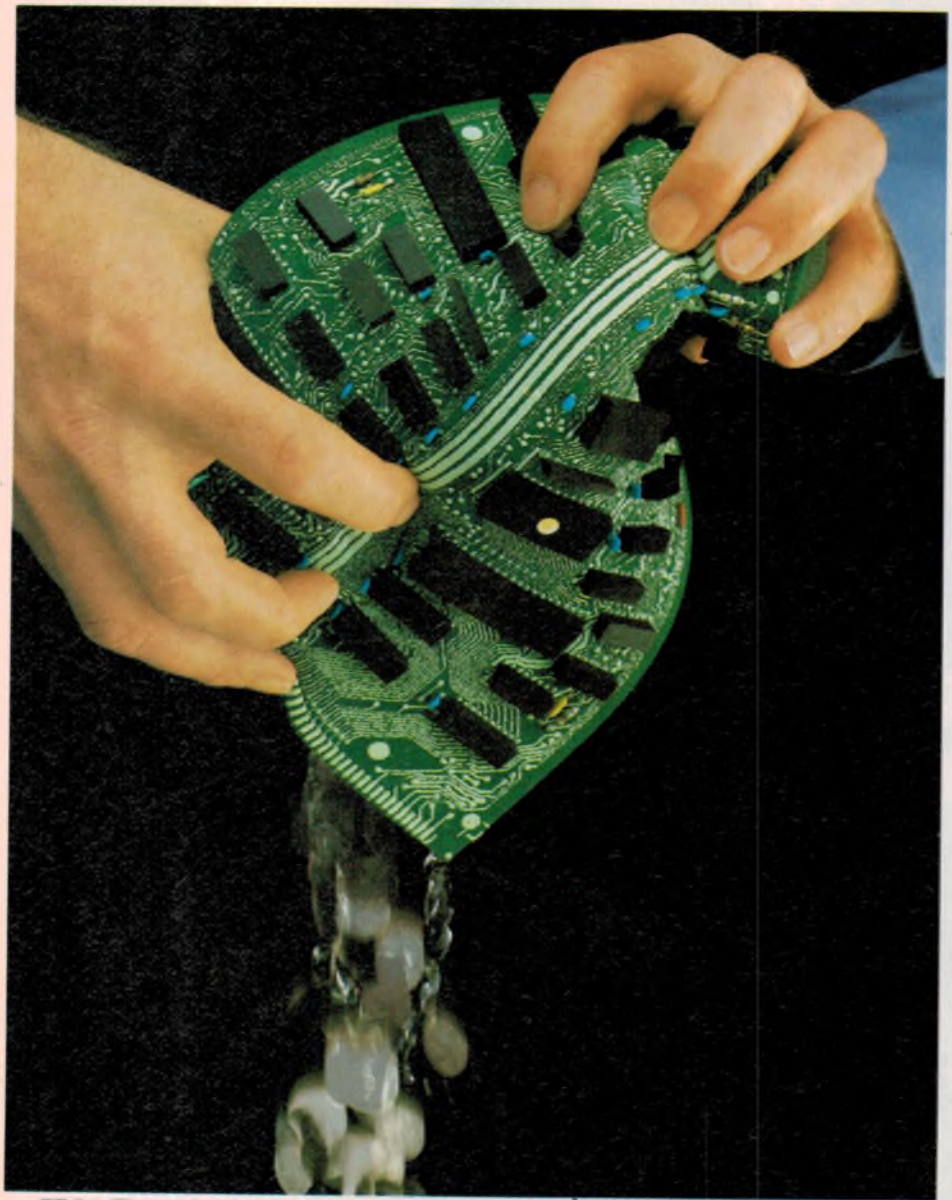
All the IATEst about ATE

FLUKE AND PHILIPS – THE GLOBAL ALLIANCE IN TEST & MEASUREMENT

FLUKE

PHILIPS

Our low-cost ATE stops bad boards from soaking up profits.



Repair boards faster with Fluke's powerful, low-cost board testers.

Fluke's functional test techniques are the fastest way to isolate difficult, dynamic faults in microprocessor-based boards. No matter where you're testing them.

In high-volume manufacturing, our testers will quickly clean up the pile of bad boards identified by your functional tester. Without a major capital investment. In low-volume manufacturing, our flexible, ATE systems can handle your entire testing workload. In service, test a wide variety of board types. It won't require expensive programming.

Put the squeeze on board test cost. Call your local Philips Test & Measurement office today.

Find out which low-cost, high performance Fluke tester is right for you. The 9010A Micro System Troubleshooter, or the 9100A Digital Test System.

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FLUKE

READER INFO No. 4

In the beginning . . .

FREQUENCY

KIM BUCKNOLE

. . . there was Wireless Weekly (1922), which begat Radio and Hobbies in Australia (1939), which begat Radio, Television and Hobbies (1955), which begat Electronics Australia (1965).

In 1971, there was born an electronics title which didn't trace its lineage to Wireless Weekly. Electronics Australia was a conservative title and many of its writers and readers had been with it since Marconi learned to speak English. ETI was inspired by a younger generation for whom there was excitement 'now', not then. EA was conservative not only in its content but in its presentation. If you look at the first ETI (from 1971) alongside a contemporary EA, you will see the difference in content, style and philosophy which has continued to the present day. This is not to criticise EA adversely, but only to say that it was different to ETI or more correctly that ETI has never seen itself as a 'me-too' of EA. Where EA is conservative, ETI tends to irreverence — as might be expected from a younger cousin.

In the fullness of time, it came to pass that both magazines were in adjacent boxes in the same stable, though still horses of a different colour. Many assumed that the publisher would merge the two titles. He didn't. The two magazines dominate the market. A couple of minor rivals came and went in short order. Today there is EA, ETI, the trade press and one other consumer magazine.

The publisher has now decided the time is right to merge the titles as this company positions itself for the future. Consider how electronics has diversified into many specialisations. Predict how things will develop in the future. From a publishing point of view, many of the divisions of electronics merit, or will soon merit, equally specialised magazines to provide the appropriate degree of coverage. Information Technology is a case in point, and is covered admirably in our new title, HUB. Given all that, we want to have an unassailable general electronics title and to have free the resources to develop electronics publishing into the 21st century.

The new title is Electronics Australia with ETI. It will be the market leader by a huge margin and will be able to provide the most comprehensive coverage possible.

It is the publisher's intention that the new magazine should offer the best of EA and ETI, and I am sure that in Jim Rowe's hands this will be the case. ETI's keynote writers will appear in EA with ETI but you will not have to put up with my purple prose after this. I shall be engaged in other ventures within this company.

As departing editor I wish to record my thanks to previous publishers, contributors and ETI staff for making a quite remarkable contribution to electronics publishing over the past 19 years. I have been connected with ETI for only two years but I value highly the contacts made with readers, advertisers, the industry and writers.

Now is not the time to eulogise ETI nor to bury it, since it is not dead. Rather it is time to wish ETI well in its new guise. I hope that readers will continue to find their favourite elements of ETI within the pages of EA with ETI, and I offer them my thanks for their support. Readers are an essential part of the equation for successful magazine publishing. Other parts are the writers, designers and all who produce the finished article. Another crucial element is the advertiser. My thanks to all the advertisers who have contributed to ETI's 19 year success story, and to all the other connections (as the horse racing world has it).

Of all the people who have made significant contributions to ETI over the years, I want to make especial mention of two and I know others will understand my singling them out. I could mention every past editor, but I choose to mention our designer Clive Davis who was involved in the early days and whose designs then as now exemplify how a modern technical magazine should appear. The other is Louis Challis who has appeared in virtually every issue of ETI. Louis' experience is unrivalled in Australia and we as readers have been much enlightened by his words of wisdom.

As I said, no obituary, merely an occasion for me to express my thanks to many people on my ceasing to be connected with ETI. It has been challenging, absorbing, hard work. I shall miss ETI but you won't if you read Electronics Australia with ETI.

eti
ELECTRONICS TODAY INTERNATIONAL

CONTENTS MAY/JUNE

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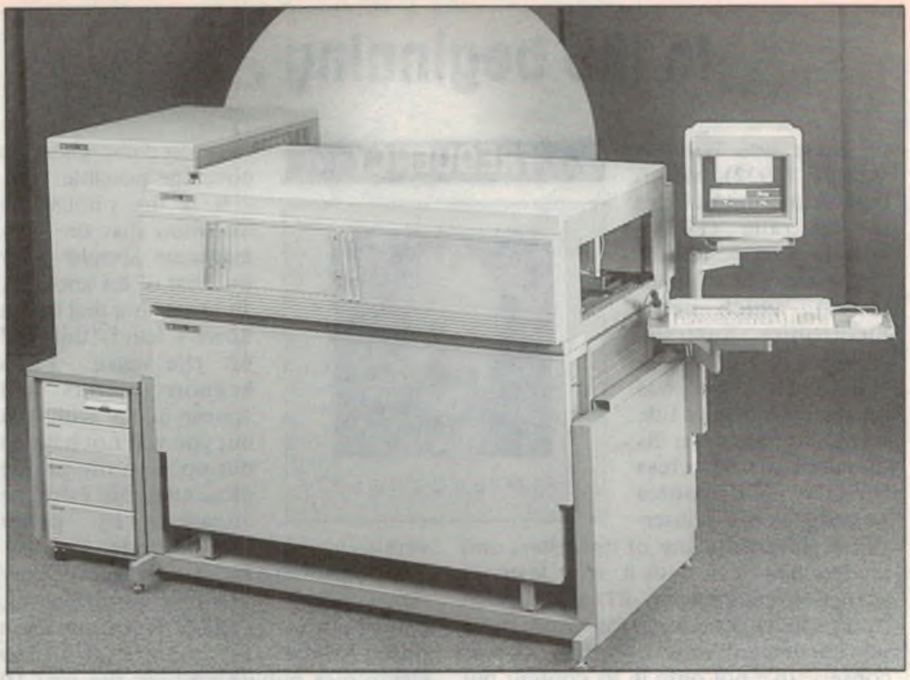
TECHNOLOGY



HP 3070 SMT Series combinational board test system solves test problems of surface mount technology boards with integrated in-circuit functional test features and a sophisticated mechanical fixturing system.

AUTOMATED TEST EQUIPMENT IN ELECTRONICS

Better productivity in manufacturing is a moving goal. As the assembly of electronics becomes more automated, on-line testing becomes more important in improving productivity. By Roger Harrison.

Manufacturing of electronics is becoming increasingly automated. At one time, electronic assemblies made on a production line were passed on for testing, repair and reworking outside the production line before packaging or despatch.

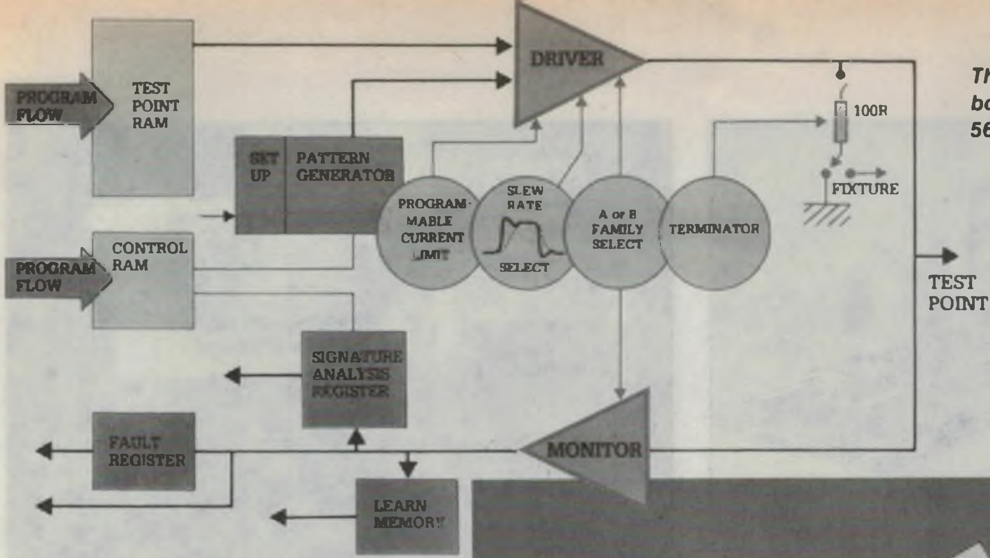
Printed circuits, manufactured by an external supplier or in-house, would pass visual inspections before and after assembly of the components and soldering on the production line. Finally the product would undergo a functional test and alignment before being packed for shipping.

The cycle now includes one or more stages of testing integrated into the production line, using machines that sort out good assemblies from those with manufacturing defects at one stage, and machines providing automated test and alignment at a later stage.

As printed circuit boards grew more complex, there arose a demand to proof them before assembling and soldering the components on board, to save time, money and components. Bare board testing, involving ohmic testing, looking for point-to-point track conductivity and seeking out shorts, was therefore added to the production line process.

Complex programmable test machines were devised to probe a specific array of board locations (possible because pc boards are generally designed on a basic grid). When tested in these machines, the board was held in a jig while metallic probes contacted the board at predetermined points. The instrument ran through a battery of tests, signalling if and where faults occured and passing boards which cleared the test routine.

Good boards would then pass on for



The architecture of a combinational board tester or CBT (Marconi MIDATA 560 series).

assembly of components (known as 'board stuffing') and soldering. Preliminary inspection at this stage would eliminate boards with missing parts, which would be sent to an off-line site for finishing. The product assembly would then be completed and the finished product sent for test and alignment. Any faults at this stage would be rectified and the product re-tested and aligned.

As the complexity of designs grew, so did the demand for throughput on the production line, which required efficient on-line testing at different stages of the manufacturing cycle. In-circuit testing was introduced to test boards immediately following assembly and soldering.

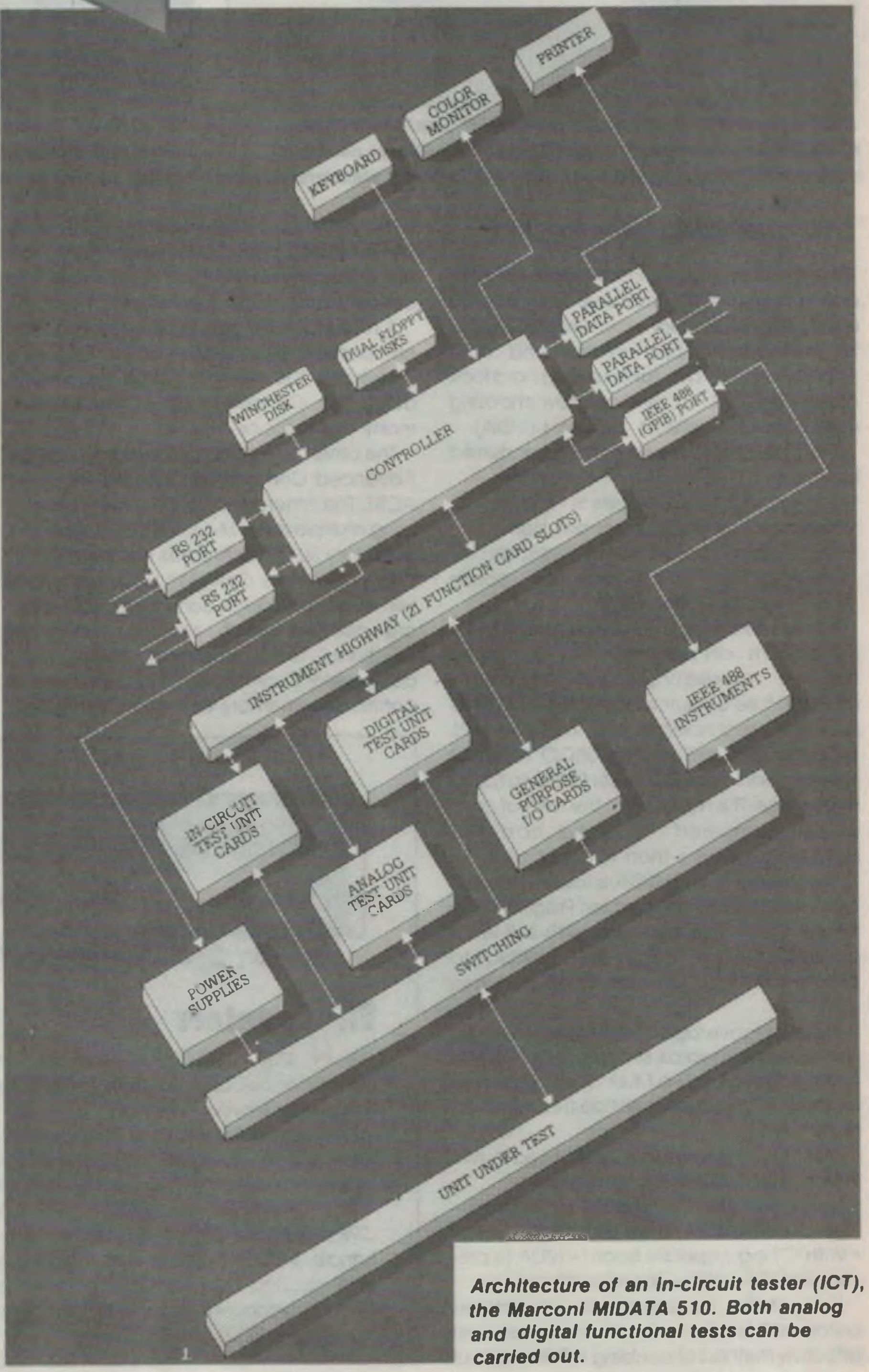
In-circuit testing, or ICT, is a cold characteristic function analysis of a board which is probed between predetermined critical nodes. Power is not applied. ICT machines can test both analog and digital circuitry. The board is held in a jig and probed with contacts – known as a bed of nails. The instrument determines pass/fail characteristics according to a programmed sequence of checks, indicating if and where faults are apparent. Faulty boards can be sent for inspection and repair, or 're-work'. Re-worked boards are then returned for ICT.

Once the product passes ICT, assembly is completed and it is set for functional testing.

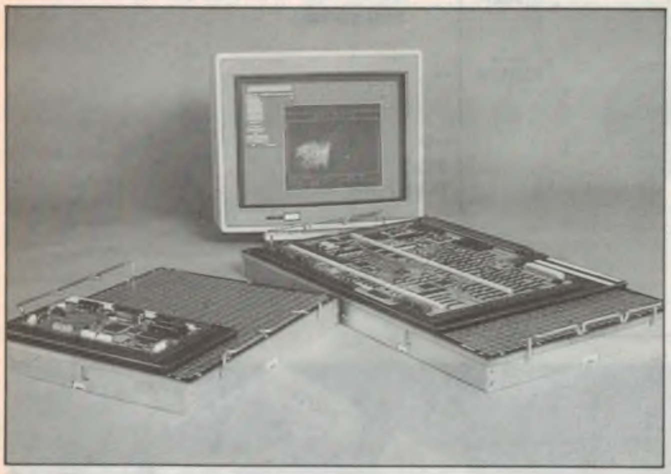
Bottlenecks in production can occur at each testing stage. The demand for efficiency to maintain production throughput has fuelled the drive towards increasing automation in production test equipment.

But in-circuit testing can find only a percentage of possible faults. Combinational board testers (CBT) arose to tackle this by powering-up the board and running functional tests, programmed according to a predetermined sequence. Such tests might look at digital, analog and mixed-signal circuits. This dynamic testing can single out a higher percentage of possible faults, even allowing detection of such things as chips of the wrong logic family on board.

ICT instruments have held sway in electronics manufacturing for many years. But that is rapidly changing.



Architecture of an in-circuit tester (ICT), the Marconi MIDATA 510. Both analog and digital functional tests can be carried out.



The HP SimPlate Express fixture and HP Express fixture software reduces fixture material costs by 30 per cent and construction costs by 30 per cent over industry standard fixtures.

HP 3070 AT Series combinational board test system offers fully integrated digital and analog in-circuit and functional PC board testing for PC boards up to 2592 nodes.

The changing face of ATE

The electronics industry continues to expand, and yet sales of ICT instruments worldwide are slowing down. Many manufacturers, due to changes in technology and cost considerations, have taken a long hard look at the traditional ICT and are now choosing manufacturing defects analysers (MDA).

This changing face of ATE had occurred because:

- Capital cost of ICT testers is high.
- Programming fixture costs are high.
- Fault coverage is good (typically 92 percent), whereas boards still require functional test after ICT.

In manufacturing, the overall cost of test per board is very high, especially compared to the decreasing cost of board manufacture as automation/robotics, SMD and ASIC technologies are implemented. Typically, a board costing $600 to $700 several years ago now costs $200 to $300 to produce. This means that the ratio of cost-of-test compared to board cost has increased by more than 100 per cent.

The capital cost of MDA is lower than ICT, typically less than one-quarter. Programming fixture cost is low because, with self-learn capabilities, only hours are needed to program MDA, rather than months or more with ICT.

The fault coverage of MDA is typically 80 per cent; but boards still require functional testing after MDA. An MDA does not power up the board and does not do functional ICT tests.

More and more MDA is being used in two important production process areas:

- No ICT e.g: populate board – MDA test – go direct to functional test.
- With ICT e.g: populate board – MDA to pre-screen ICT – ICT – then functional test.

Using MDA to pre-screen assemblies before ICT is said to be an extremely cost effective method of doubling ICT throughput without the cost of duplicating ICT testers. All the shorts/opens and component tests are done on the MDA, allowing the ICT to concentrate on the functional ICT test.

A manufacturer can couple good quality components with the MDA on-line testing to watchdog the manufacturing process. In doing this, ICT testers are not required in many applications.

The other ATE rapidly gaining ground is the Advanced Combinational Board Tester, or ACBT. The emergence of new technologies using multiple layer, SMD, ASICS, ECL, BIST and Boundary Scan Techniques has pushed ICT beyond its limits. Owing to complexity and test node limitations, combinational testers are needed which can do sub-circuit functional tests, functional cluster tests, component in-circuit tests, variable in-circuit partitioning, memory emulation high speed test pins, scan tests, real time clock rates and all aspects of test area management.

Such combinational testers are expensive, so again MDA is being extensively used to pre-screen and reduce the load on combinational test sets, obviating the need for multiple high cost installations.

Integration

The drive for better productivity and quality control led to the design, engineering and testing functions becoming more closely integrated with production, particularly as more automation entered the production process.

As computer aided design (CAD) and computer aided engineering (CAE) have become increasingly important tools at the front end of manufacturing, processes at this stage could be linked with events further

EIP Counters

The EIP 575B/578B counters are said to save the expense of a synthesised signal generator because of their ability to set and stabilise the frequency of a basic frequency source.

The locked frequency is settable in 10KHz increments from 10MHz to the max of the counter. The 20GHz 575B and the 26.5GHZ 578B (110GHz optional) are fully programmable via GPIB enabling integration of the locked source into an ATE system.

The 20GHz 585B and 26.5GHz 588B (170GHz optional) can automatically measure CW, pulsed and other time-varying microwave and millimeter-wave signals. They can handle VCO measurements, chirped radar profiling and frequency-agile system analysis; and can fully characterise pulsed signals, including carrier frequency, frequency linearity, pulse width and period. Futher information from Scientific Devices Australia ☎ (03) 579 3622.

down the chain, in particular the testing stages of the manufacturing process. The fabrication cycle now looks something like the flow chart in Figure 1.

The function of production line testing in today's highly automated manufacturing environment is more than sorting the good boards from the bad. The testing equipment must be able to provide data that allows the test engineers to do statistical analysis on the results, which can be fed back into the manufacturer's quality assurance system.

So modern ATE systems are part programmer and part computer/data logger, with the ability to transform vast amounts of test data into information upon which the manufacturer can act.

One of the underlying pressures on manufacturing productivity is the necessity to bring products to the market quickly by shortening product development cycles, in order to capture the financial return on R&D investment. One US study showed that a six-month delay in shipping a new product reduced its after-tax profits by one-third. However, a 50 per cent development cost over-run on the same product only reduced after-tax profits by 3.5 per cent. It pays to spend money up front and get the fabrication cycle down.

To reduce that critical time to market, manufacturers need to get their design, fabrication and test staff working in parallel. Designers can no longer work in an isolated 'erie', cut off from the rest of the process.

With computers involved in all stages of the design, test and manufacture has come computer integrated manufacturing, CIM, of

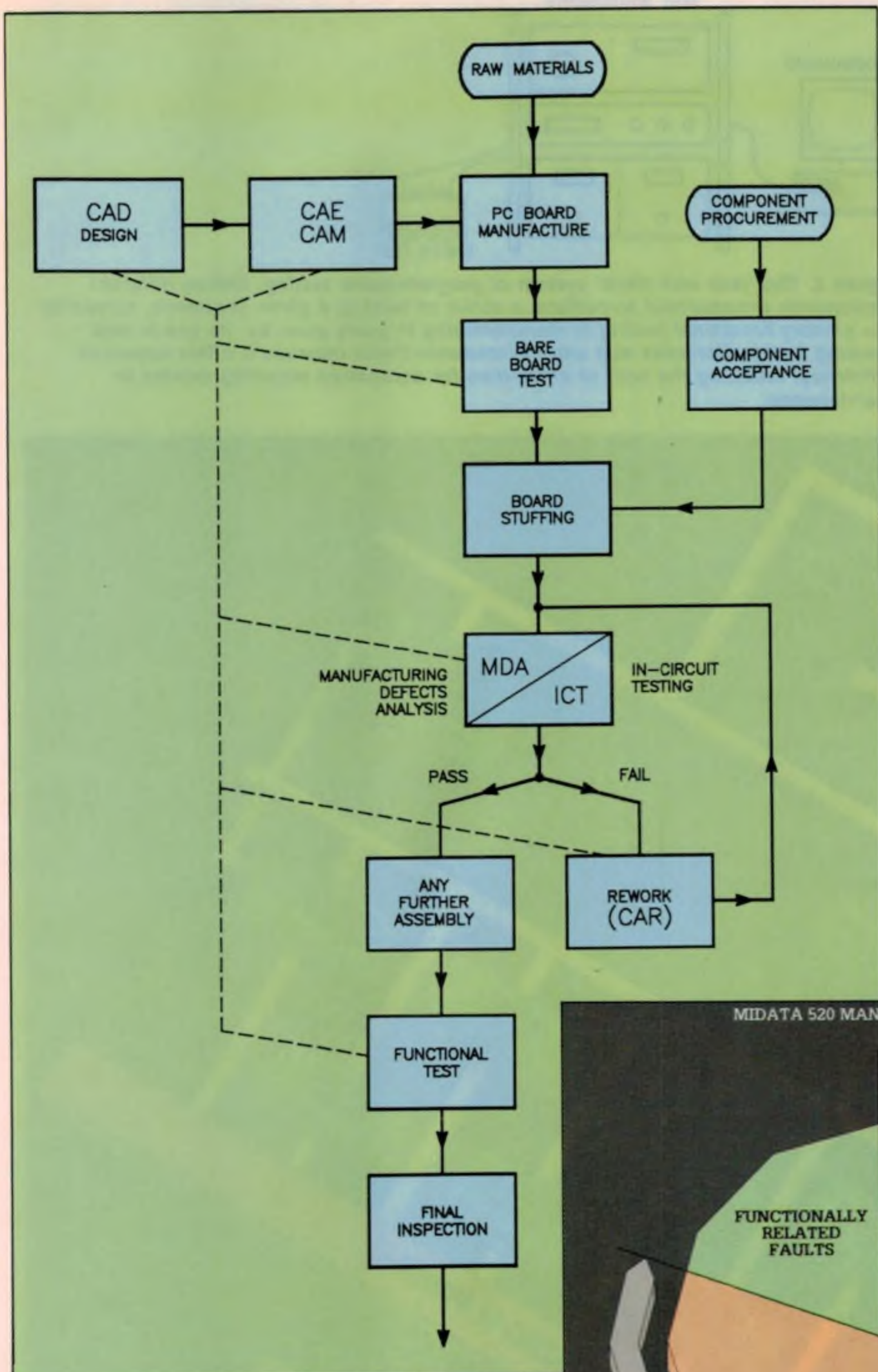
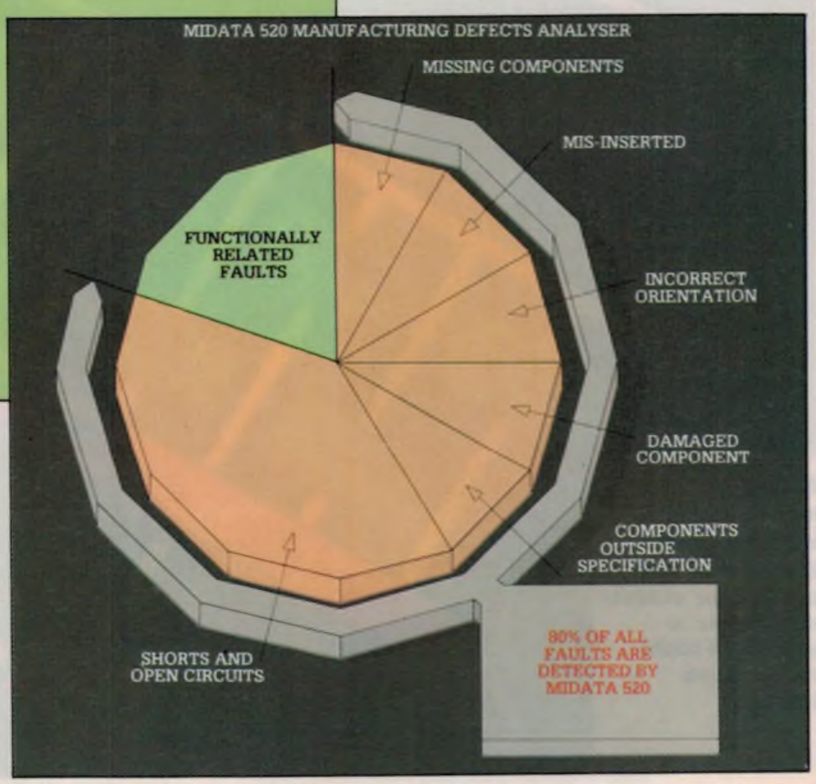


Figure 1. Typical scenario of a manufacturing system today; an example of computer integrated manufacturing (CIM). Note the four testing stages. MDA testing is increasingly being used to pre-screen products before ICT.



Pie chart illustrating how a manufacturing defects analyser (MDA) sorts out some 80 per cent of process related faults. (From the Marconi MIDATA 520 instrument literature).

which Figure 1 shows a likely scenario. It seems the way of the future here is shared data bases and the integration of ATE systems with the computers involved in the process via a local area network.

Automated functional T&M

Functional testing and, if necessary, alignment of a completed product is usually carried out at the end of the fabrication cycle. In the past, this was generally done by qualified test personnel using test instruments such as signal/function generators, oscilloscopes or waveform analysers, power supplies and multimeters. After sales service

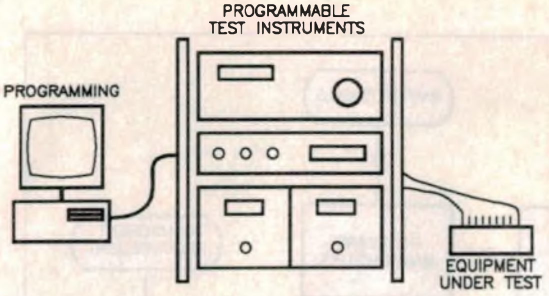
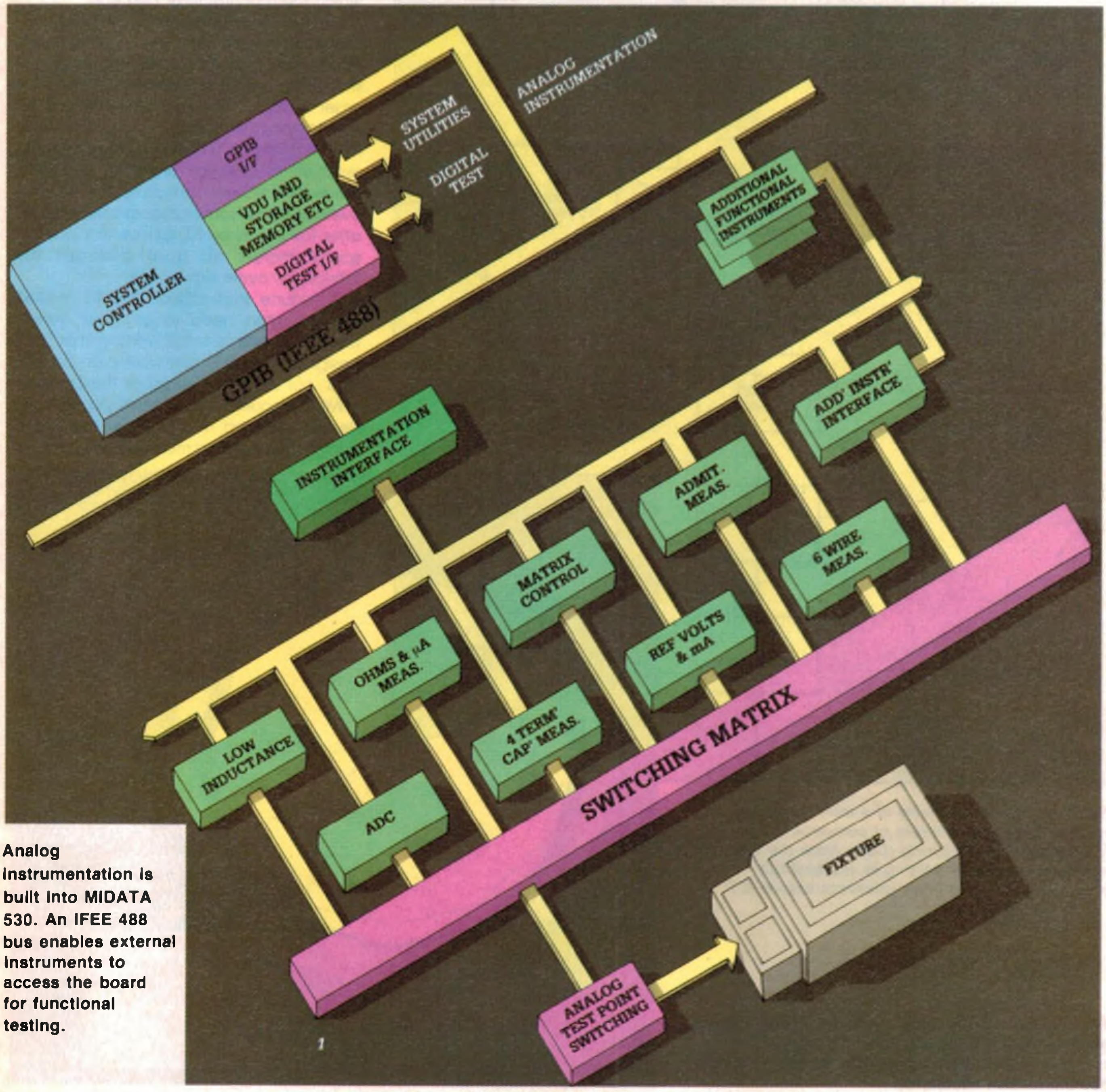
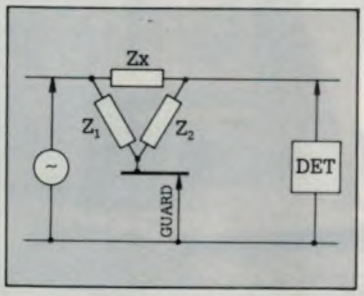


Figure 2. The 'rack and stack' system of programmable testing, linking different instruments programmed to perform a series of tests in a given sequence, served as the primary functional testing in manufacturing in years gone by. Its use is now growing in the after-sales test and maintenance fields because it offers improved efficiency, reducing the cost of down-time for equipment requiring service or maintenance.

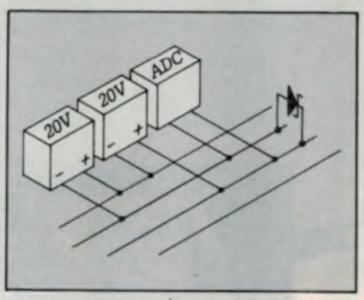


Analog instrumentation is built into MIDATA 530. An IFEE 488 bus enables external instruments to access the board for functional testing.

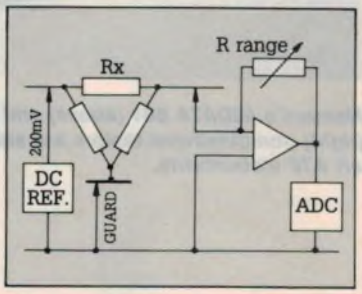


Three wire AC impedance measurement.

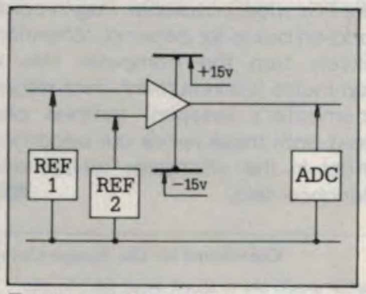
Today's programmable test instruments can be racked together to form a sophisticated functional testing workstation, as illustrated in this Philips PM2240 Test Team package.



Stacking reference supplies to test high voltage zeners.



Three wire resistor measurement.



Testing of OP-AMPS and comparators.

Electronics Australia with ETI

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The changing face of ATE

is still carried out in this way.

Semi-automation of the functional test stage came early, but at a cost. Nevertheless, it meant that semi-skilled personnel could carry out functional testing, characterising the product under test within given parameters.

With the integration of microprocessors into traditional test instruments came programmability. Early programmable test instruments could be interlinked and driven via a programmable controller, later a personal computer. These 'rack and stack' systems, as they became known, were the forerunners of today's highly sophisticated purpose-built programmable ATE machines.

Few bench or rack test and measurement instruments are now without programmability functions, with software packages for the popular PCs widely available. Plug-in cards and add-on boxes for personal computers effectively turn the computer into a programmable test instrument which retains the computer's essential facilities and functions. Both these trends are becoming important in the after-sales service and maintenance field. eti

Contributed by The Apogee Group

The author would like to thank those people who contributed material towards this feature, in particular Marconi Instruments, Hewlett Packard and Philips

Marconi's MIDATA 561 (above) and 562 (right) combinational testers are state-of-the-art ATE instruments.

Electronics Australia

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MAY/JUNE '90

For a prompt reply

POST TODAY

POST TODAY

POST TODAY

Our picture (taken by Peter Beatty) shows the editor presenting the Marantz CV-55 to Paul McLeod. The CV-55 was the prize in a competition run in the November, December and January issues of ETI, and was reviewed by Louis Challis in the November issue. Subscriber Paul is an STO at Ashfield Telecom exchange, NSW, and already owns a Marantz CD-75 Mk II and a 6500 turntable.

— RACAL-REDAC —

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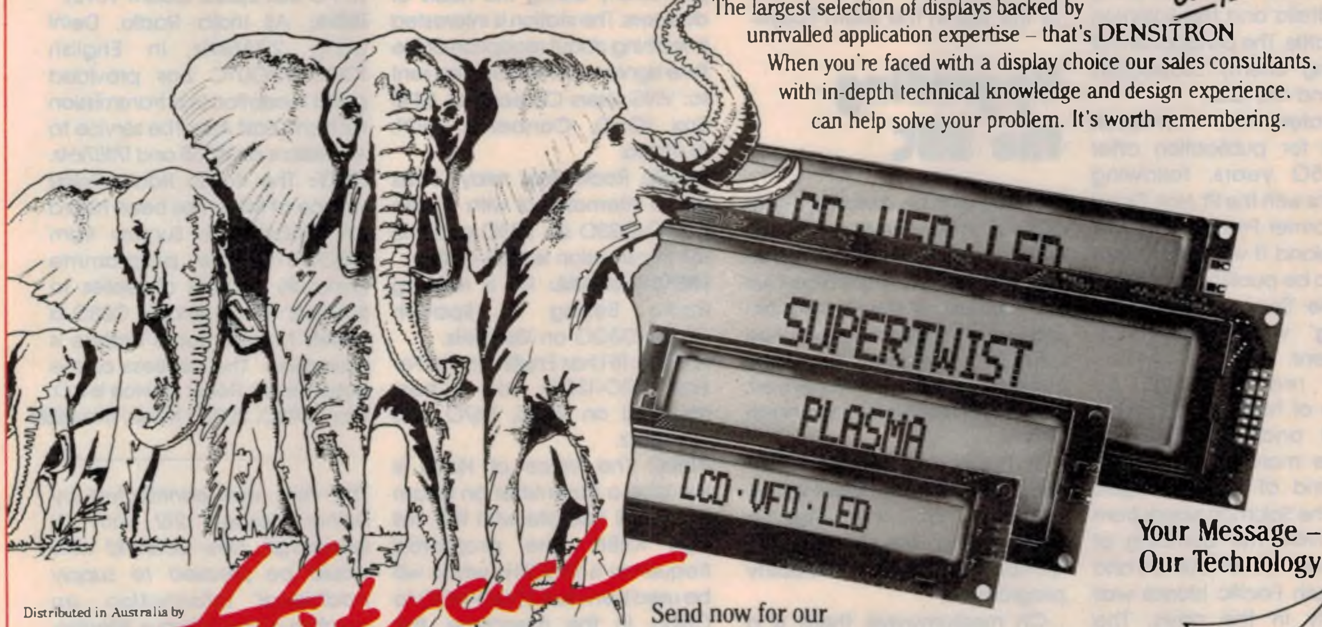

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READER INFO No. 18

ARTHUR CUSHEN

SECRETS OF WARTIME LISTENING

The BBC Monitoring Service recently celebrated 50 years of operation. Its activities provide the world's media with information about what radio stations world-wide are commenting on; particularly concerning domestic affairs.

During the period 1941-45, a monitoring service in Invercargill NZ (operated by the author) resulted in 230 pages of information about New Zealand, Australia and the South Pacific broadcast by enemy radio stations in Germany, Italy, Japan and Japanese control stations in the Pacific and Asian area. Twice-weekly reports were compiled during the height of the South Pacific war from this material, much of it about internal affairs in New Zealand and Australia and the Solomon Islands battle. The principal aim of monitoring enemy broadcasts was to find the leak.

This material has now been released for publication after nearly 50 years, following discussions with the Rt. Hon. David Lange, former Prime Minister of New Zealand. It will form part of a book to be published shortly in which the 'Secrets of Wartime Listening' will be a major component.

Some readers may be unaware of how close to New Zealand and Australia the Japanese march south in 1941 came, and of the prolonged battle in the Solomon Islands from 1941 to 1944. The bombing of Darwin, Townsville, Noumea and other South Pacific islands was frequently in the news. The tremendous toll of aircraft and ships lost in the Solomon Islands gives some idea of the magnitude of the South Pacific war.

Stations in Tokyo, Hong Kong, Shanghai, Saigon, Manila, Singapore, Batavia, Rangoon and other areas in the Pacific broadcast almost daily, in English, giving the Japanese version of progress from the South Pacific war zone.

In its final published form, this material will include details of the callsigns and frequencies of those stations, and will summarise the quality of reception which had to be endured in the 1940s when using a domestic radio receiver – without a tape recorder to help in transcribing the broadcasts. There has been interest from historians both in New Zealand and overseas in this background to the enemy's view of the war in the South Pacific.

Upgrading the BBC

The BBC will be installing more 500kW transmitters next year, according to a World Service programme. Two transmitters will be installed at the Rampisham site in the UK, and in Cyprus two extra 250kW transmitters will be installed to serve the Middle East, South and East Europe and North Africa.

By the end of next year, four new 300kW transmitters will be installed at the Skelton transmitting site in the UK, completing the BBC's audibility programme.

On mediumwave there is a move to repeat the shortwave transmissions, and the BBC World Service is now available in Hong Kong 24 hours a day through the transmitter of Radio Television Hong Kong, frequency 675kHz. There is increasing use of satellite and cable facilities for listeners, with many local radio stations receiving high quality transmissions through this means, and many stations in Australia now carrying BBC programmes via a satellite feed.

In the United States, the American Public Radio carries World Service and cable audio programming is rapidly increasing. World Service is available through the C-Span network, while in Europe several cable networks carry BBC World Service.

Of particular interest in Australia is a recent frequency change, 11715kHz operating 0600-0915 which suffered interference from Radio Beijing from 0830. This channel has been replaced by 17830kHz for the World Service broadcast.

Around the world

AUSTRALIA: VNG, the Time & Frequency Station, is well received on 5000, 10000, 15000kHz in the South Pacific particularly during the hours of darkness. The station is interested in learning about reception of the time signal; reports should be sent to: VNG Users Consortium, GPO Box 1090, Canberra 2601, Australia.

BRAZIL: Radio Braz relays Swiss Radio International with English 0200-0230 on 17730 and the full transmission is 0115-0300.

FRENCH GUIANA: RFI is relaying Radio Beijing in Spanish 0200-0300 on 13685kHz.

FRANCE: RFI has English to the Far East 1230-1300 and is best received on 9805, 11670 and 17650kHz.

GUAM: The Voice of Hope is installing a transmitter on Guam which will operate with the call sign KHBN. The projected frequency is 9830kHz which will be used between 1000-1600 to China. In the meantime, the station has taken broadcasting hours on KSDA operated by Adventist World Radio and using 15225 Monday-Friday and was first reported last October with the schedule 0400-0700UTC. Reception reports are requested to PO Box 22228, Guam 96921.

INDIA: All India Radio, Delhi using 21735kHz in English 1000-1100UTC has provided good reception in a transmission for North East Asia. The service to Australia is on 15335 and 17387kHz.

ITALY: The Italian Radio Relay service at Milan has been heard on 9860kHz on Sunday from 0800UTC. The programme generally consists of replies to listeners' letters and at 0830 a United Nations Radio feature is broadcast. The address of the Italian Radio Relay Service is P.O. Box 10980, 20110 Milan, Italy.

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.

WORKSTATION

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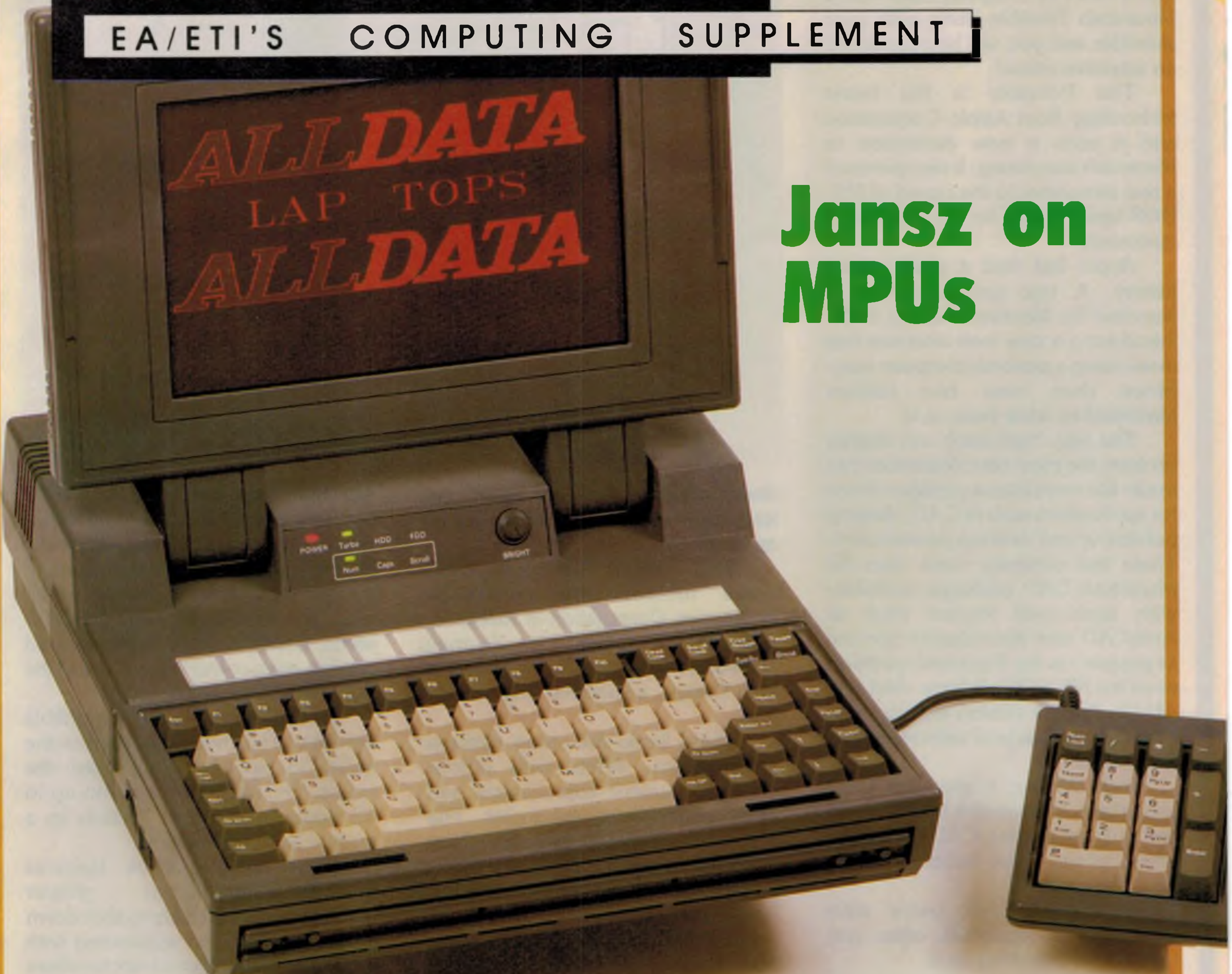

Jansz on MPUs

CAD Gone Walkabout!?!

ALLDATA NEW LAP TOPS

Kester Cranswick discovers that portable CAD is no longer vapour-ware, in his review of Macintosh's new portable.

PORTABLE CAD!

It takes a mighty special computer to turn heads these days. But walk into a room of computer buffs with a Macintosh Portable slung over your shoulder and you will be guaranteed an attentive crowd.

The Portable is the latest technology from Apple Corporation and it adds a new dimension to Macintosh computing. It also promises a real alternative to the crowd of MS-DOS laptops vying for the attention of customers.

Apple has had a phenomenal history. A true garage startup, it launched the Macintosh back in 1984, introducing a new look interface that made using a personal computer easy. Since then over two million Macintoshes have been sold.

The very high resolution display on even the most basic Macintosh has made the computer a popular choice for applications such as CAD, desktop publishing and desktop presentation. There are currently more than 55 Macintosh CAD packages available, with such well known titles as AutoCAD and MicroStation proving as popular on the Macintosh platform as on the MS-DOS platform. And with AU/X, Apple's version of Unix, now available, the range of software will be even wider.

Rick Whiley, a specialist CAD consultant, believes the Mac has well and truly arrived as a CAD computing environment. "The interface is the key," he said.

Seasoned CAD users who experience a Macintosh often find themselves switching to it.

"Once you get one into an organisation, it steamrolls," claimed Whiley. That is because it is a horizontal machine, appealing to many different types of users, yet keeping a consistent interface for all applications.

Well known Macintosh CAD users include the Australian Submarine Corporation in Adelaide, BHP, Lend Lease (the Sydney architects), D'Angelis Taylor and Multi Hull Design, a specialist engineering firm.

These firms are using desktop Macintoshes, often with colour displays, numeric coprocessors and other performance enhancers. The Macintosh Portable presents them with a new option, though one that is unlikely to replace the desktop Macintosh.

It is also unlikely to tempt users after a budget computer. The basic model with single floppy disk and 1MByte RAM, is $50 short of a $10,000 price tag. The review sample, with 2MByte RAM and a 40MByte hard disk, costs $11,450.

The cost is not the only factor mitigating against the success of the Portable. In some respects, the design is out of date, certainly compared with what is happening in the MS-DOS arena. Backlit displays, briefcase-sized casings, even colour screens are all the rage now.

But the key needs of a portable *are* met. The most important is the ability to operate away from the mains. The Macintosh can run up to 12 hours at a stretch, thanks to a masive lead acid battery.

Other on-the-move features include intelligent power management, the ability to shut down in the middle of an application with power-on bringing you back to where you were, and an alarm feature that turns the Portable on at a pre-set time.

The Portable does everything a desktop Macintosh can do, with a

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READER INFO No. 19

built-in trackball substituting for a mouse and a liquid crystal display that uses technology straight from pocket televisions and is 50 per cent bigger than that of the desktop Macintosh SE.

The hardware comes in a substantial black nylon shoulder bag, emblazoned with the Apple logo. It is the right size for an aeroplane and has an excellent handle. Inside is space for the Portable, pockets for the AC adaptor and mouse, plus a large mesh pocket for software, manuals etc.

Where the Macintosh runs into trouble is its size and weight. Measuring 387mm by 365mm on the desk, and 103mm with the lid folded down, the wedge-shaped computer is one of the largest laptops money can buy. And weighing over seven kg, it is one of the heaviest too.

The clamshell case, made of strong polycarbonate, has a full width retractable handle along the top. Pushing the handle in frees the top section of the case, which pivots up to reveal an LCD screen with recesses on either side of the display to accommodate the trackball. The screen can be folded back through any angle up to about 120 degrees and, as its apogee, makes the Portable 279mm high.

Before any work can be done on the Portable, the battery must be connected. The back of the casing comes free when two buttons on the rear are pressed. A cover over the battery, which is the size of a bag of flour, is removed, the battery lifted out, a plastic sheet removed and the whole lot reassembled. Then a push of any key fires the Portable up.

Lead acid batteries are a rarity in the laptop field. Most vendors opt for smaller, lighter, nickel cadmium batteries, but Apple found that they would not power all the Portable features for a long enough time, had variable discharge patterns and suffered from charge memory. So it went for less fashionable lead acid.

Certain system information, such as time, date and device settings, is held in a 128 byte area of memory. Removing the main battery does not erase this data. A small PP3 battery provides backup power for up to five days with a flat lead acid battery.

The main battery can be charged from the mains as you work. About 10 hours is needed for a full charge, but 80 per cent of capacity will be reached in about three hours. A spare battery costs $80, a standalone battery recharger unit is $210.

There are four low power warnings, the first coming on screen with 30 to 60 minutes of juice left. Three messages later and the Portable takes its life into its own hands by going to its sleep state.

All the I/O action is at the back.

Disk intensive applications will exhaust the battery in about six hours. Rarely accessing the hard disk will double this time. Clearly, the way to maximise battery life is to minimise power consumption. There are a number of ways to do this.

Going to sleep

The first involves setting the sleep interval. The computer can be set to go to sleep after from one to 30 minutes of inactivity. The spinning of the hard disk can also be automatically turned off after a period of inactivity. When it is needed by an application, it wakes up. This slows down data access, but saves power. Another setting will disable sleep when a mains adaptor is attached.

That's all very well. But the best of sleep is that the computer remembers where you are when you kill the power. The computer can be put to sleep from within any application and pressing a key to restore power brings you back to exactly where you were. Every portable computer should have this.

Another excellent feature of the Portable's power system is that this is the first computer I have seen with a non-volatile RAM disk. Providing there is enough memory, and the hard disked Portable has 2Mbyte as standard, a RAM disk can be set up to store system files, minimising the need to use the hard disk for commonly used system files.

To cap all this, the Portable has a rest facility that reduces the CPU speed from 16MHz to 1MHz when nothing happens for 15 seconds. Normally you don't notice this. So, apart from the size and weight of the battery, full marks to Apple for its power system.

Definition and display

The other critical area is the display. The Macintosh interface of menus, icons, windows and mice is simple, intuitive and powerful. But it requires two things — a high resolution display and a responsive mouse. On non-Macintosh laptops, high resolution displays are now quite common, but getting a mouse to work well is still a problem. The biggest drawback is that after-images are left as the mouse is moved.

There is also a lack of uniformity among MS-DOS graphical user interfaces. The Macintosh was there first and still does it best.

On the Portable, the display's biggest problem is that it is not backlit. The Active Matrix LCD relies on reflected lighting and in a dim room, this doesn't always give a useable display. In time, the Portable will no doubt get a backlit display. Until then, you will have to make do with what

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is a perfectly good display.

It looks like any other Macintosh interface, though the overall screen background is grey rather than white. This is a power saving measure and the screen background can be turned white, black or any pattern very easily. Contrast can be adjusted, though there is little need for that.

Compared to other LCD displays, the Portable screen is way ahead. It has superior definition and can be viewed from any angle. The display has one major advantage over that of the Macintosh SE; 50 per cent more screen area, so it can show a full width A4 page.

Definition, at 640 × 400 pixels, is excellent, with the display as crisp and accurate as any Macintosh. Some users even report that the Portable display does not strain their eyes as much as desktop Macintosh displays.

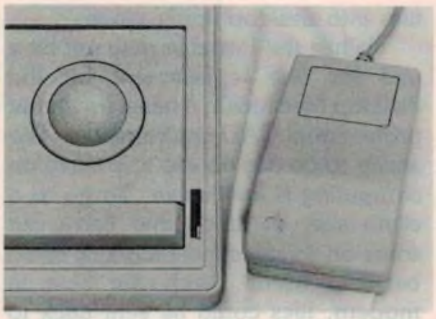
When the cursor is moved rapidly, it vanishes momentarily to eliminate after-images which can be a little disconcerting at first. To move the cursor, there is a built-in mouse substitute called a trackball. Three centimetres across and with a button located for a quick thumb or heel of the hand press, it works better than any other trackball you'll find. A little practice and you will be as at home with it as with a conventional mouse.

Apple supplies an external mouse for users who will be at a desk. It is a low power version of the standard mouse, to minimise power consumption, and has quite a short cable.

The trackball is on the right of the 68-key keyboard. With a little fiddling, involving removing rubber feet on the base of the computer and poking a few catches through slots, the trackball and keyboard can be removed from the Portable and swapped over. Southpaws never had it so good!

The keyboard is more like that of an Apple II than a Macintosh, with a springy key action and solid feel. It is rather too flat for a touch typist and lacks features such as function keys and a numeric keypad. Still, as laptop keyboards go, it is good and a numeric keypad is available at a cost of $110.

All the I/O action is at the back, with an array of unprotected ports giving some impressive expansion potential. Next to the power input port is an audio socket. The Macintosh has



A trackball substitutes for a mouse.

excellent sound capabilities, with a four voice sound generator, speaker and 4-bit D/A converter. If music is your forte, the Macintosh is a winner.

Separate mini-DIN sockets are for connecting a printer and modem. Next to that is the Apple Desktop Bus plug, used by the mouse, and other external devices, and a bracket for securing the Portable to a non-portable object.

Moving left, there is a 50-pin SCSI interface. SCSI enables high capacity, high speed drives and peripherals such as scanners to be attached. Then there is a 19-pin port

SPECIFICATIONS:
MACINTOSH PORTABLE

Processor: 16MHz Motorola MC68HC000, 6502 Power Management processor
Memory: 2MByte 100ns SRAM, expandable up to 9MByte, 256KByte ROM, expandable to 4MByte
Keyboard: 63-key Apple keyboard, built-in trackball, accessory Apple Desktop Bus mouse
Expansion Slots: modem slot, Processor Direct Slot
I/O: two 8 pin serial ports, SCSI interface, external disk drive port, Apple Desktop Bus port, audio port, video-out port
Storage: 1.4MByte 3.5 inch floppy, 40Mbyte Apple hard disk
Display: Built in 10 inch active matrix reflective liquid crystal display. Resolution of 640 × 400 pixels
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for an external disk drive and a 15-pin video output port. This needs a $475 video adaptor, giving you an external CRT display.

There is internal expansion potential as well. Next to the battery are four slots, one for a yet-to-be-released internal modem, two for memory expansion and the fourth for the future.

Standard memory on the hard disk Portable is 2Mbyte of static RAM, with a 100ms access speed and very low power consumption. When 8Mbyte expansion cards become available, up to 9MByte of RAM will be feasible. In view of the ease with which a Macintosh can run multiple tasks with its MultiFinder facility, there are plenty of reasons to add more memory.

The spring mounted hard disk is a 28ms 40MByte Connor affair. As an extra to the basic Portable, it would cost $1945. Apple's floppy is the appropriately named SuperDrive, which can read both Macintosh and MS-DOS three and a half inch disks. A software utility can translate between common MS-DOS and Macintosh file formats, so the Portable in an MS-DOS environment is not entirely out on a limb.

System software

The system software, pre-installed when you buy the Portable, contains other utilities such as an alarm clock, puzzle, notepad, scrapbook and freeform database called HyperCard. A Control Panel enables system parameters to be easily changed and there is a battery desk accessory that shows the level of power remaining and has a button to put the Portable to sleep. This accessory can be called up in the midst of any application. ROM starts at 256KByte. This can be expanded too, up to 4MByte. As yet there is little reason to do this, but the facility could be exploited by system developers through ROM- resident applications.

The Processor Direct Slot, also for future development, is the means to connect a card to the CPU bus.

The Portable's CPU is a CMOS version of the 32-bit Motorola 68000 processor, running at 16MHz. The desktop Macintosh SE has an 8MHz 68000 processor, though there is more to performance than mere clock speed. There is also a second processor that monitors power-related functions.

The Portable is slightly retarded in having no inbuilt maths coprocessor, or the means to add one. For a CAD user, that could be a limitation. In fact, not all Macintosh CAD software is recommended for the Portable. AutoCAD and MicroStation are really not practical. You might consider Claris CAD, Pegasys and PowerDraw as alternatives, and use file translators or import/export facilities to read the files into desktop applications.

While the Portable may not be a one for one replacement for the desktop Macintosh, it has a use in the professional CAD environment. The ability to go out on site and carry on computing is invaluable. To go to a client site, sit down and carry out some on-screen conceptualising could be very useful. With the built in modem, files could be sent back to head office for further work.

As a portable computer, the Macintosh is an outstanding achievement. It has drawbacks in its size and weight, price and non-backlit display, but the fact that it is a battery powered Macintosh is reason enough to recommend it.

The hard disk version is the better buy, unless you are running very small applications. If you are toying around with the idea of a superior MS-DOS laptop, check out the Macintosh. It could be just the tool you need. ■

Company profile

Capital Computers was established six months ago by Joe Gavan, formerly with L.M. Ericcson and Natcomp. Vic Gaffney reports on the company's ethos and hopes for the future.

CAPITAL COMPUTERS — The Future Looks Bright

Capital Computer Equipment was founded six months ago when Joe Gavan decided to start his own business based on old-fashioned ethics including courteous service, accuracy in interpreting his customers' needs, and independent advice on the latest PCs, printers and software.

Capital Computers is now a force to be reckoned with, being one of few dealers in Australia accredited to sell Lotus 123.

The company aims to independently evaluate a range of hardware and software to provide their customer base with the right information to make an informed decision.

They say that many clients are confused by conflicting opinions, and risk being pressured into buying products from dealers who will give only enough information 'to make a deal'.

Ninety per cent of the company's client base are medium to large companies, with a significant cross-section of Government departments and universities. Their product offering specialises in 386 technology for business applications, high-end solutions, a range of business software (popular and obscure), networking, trouble shooting and problem solving.

Training

All of Capital's staff, including Joe Gavan and key staff, Steve Bajada and Robert Inguanti, spend 10 per cent of their working week in training. The company ethos is that being informed enables the staff to provide totally independent advice and find a way to meet the objective of the customer, within their budget.

Predictions

According to Joe Gavan, the 80286 chip has been superceded, and sales are falling. He predicts strong sales well into the mid '90s on 80386/25 and 80386/33 technology. With an abundance of software available for 386 machines, most people are looking to upgrade their PCs and servers to 386 machines, and even Intel in the USA has advertised that the 286 chip is 'brain dead'. The minimum standard corporates should now be looking at, says Joe Gavan, is the 386/SX, especially as good 386/SX now costs only 10 per cent more to buy than a cheap 286 machine.

He also expects huge growth this year in portable 386 machines like the world-class Renard battery powered 20 MHz 386 laptop; listed in Capital's monthly catalogue.

The catalogue features what the company is advertising for the month, specials, reports on product evaluations, news on training courses, up and coming trade shows, free giveaways and new releases.

It is distributed specifically to the business market place, serious PC users and the Government sector, and was conceived to help Capital's customer base keep up to date with the latest products in the market place, and to get the most out of their investment.

Capital gives advice on hardware including ALR (Advanced Logic Research), Alldata, Amstrad, Arrow, AIT, Bristol Research, Bondwell, Brother, Compaq, Chendai, Epson, Intel, Netcomm, Hewlett Packard, Ricoh, NEC, Renard, Neostar, Miniscribe, Tystar, Seagate, Star, Wyse, Wearnes and Ultra.

They have conducted appraisals on dozens of software packages, and can ferret out even the most obscure packages.

Back-up is very important to the company. "One thing that really sorts out the chaff from the oats is the ability to support a site once the sale takes place," says Joe Gavan. "Steve Bajada heads our engineering team and takes care of most after-sales inquiries.

"It is important to the customer to get prompt and reliable service at all times."

Catalogue available from Capital Computer Equipment Pty Ltd at 618 St Kilda Road, Melbourne 3004. ☎ (03) 525 2622 or toll free ☎ (008) 33 5833. ■

READER INFO No. 154

WORKSTATION

Upgradeable Microlaser Printer

Texas Instruments has announced a low cost, desktop microlaser printer which allows users to upgrade to PostScript in a matter of minutes.

The Microlaser's modular architecture allows user installable upgrades of Adobe's PostScript interpreter and memory. The interfaces plug directly onto the printer controller board so the printer can be expanded. The microlaser is capable of printing six pages per minute.

The basic microlaser is compatible with the Hewlett Packard LaserJet(R) Series II and comes with a 0.5 megabyte of RAM, priced at $2790. The PS35, a true Adobe PostScript Printer priced under $5000, combines the features of the basic microlaser with 35 PostScript typefaces and an additional one megabyte RAM. For further information, contact Patrick Canturi, Texas Instruments Australia, ☎ (02) 887 1122.

READER INFO No. 266

Instrumentation Interface

IOtech Inc of Cleveland, Ohio has entered into an agreement with Digital Equipment Corporation (DEC), in which both companies will jointly develop instrumentation interfaces for Digital's desktop workstations.

Their first product is an IEEE 488 interface for DEC's new VAXstation 3100 and MicroVAX 3100 workstations. The product, called SCS1488/D, includes a SCSI to IEEE converter and two software drivers for the DEC VMS operating system. The SCSI488/D attaches to the external SCSI port on the workstations and controls up to 14 IEEE instruments and peripherals. Up to four SCSI488/D converters can be attached to one workstation, for a total control capacity of 56 IEEE instruments and peripherals. Data is transferred between the workstation and IEEE instruments at a maximum rate of 500K bytes/second.

Two software drivers are included with the SCSI488/D package. The first software driver is DEC's IEZ11, which provides a low-level software interface, consistent with previous IEEE interfaces from DEC. This provides present users of DEC's IEEE 488 interfaces with upward compatibility. The second driver is IOtech's Driver488/D, which provides a high-level language interface, callable from C and Fortran. Driver488/D is consistent with PC and Macintosh drivers from IOtech, and uses Hewlett-Packard style IEEE syntax to allow programming with familiar IEEE commands such as ENTER, OUTPUT, SPOLL and PPOLL.

The SCSI488/D can also direct the user's program to vector to a service routine when a Service Request (SRQ) occurs on the bus. This allows the user's program to asynchronously respond to requests from IEEE devices while the CPU continues to process information. This feature has been available on IEEE controllers from Hewlett-Packard, but has been missing on many PC-based IEEE controllers. Further information from Scientific Devices Australia ☎ (03) 579 3622.

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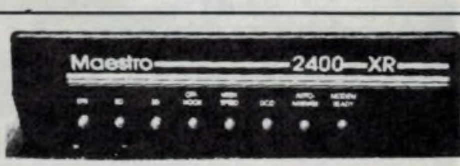

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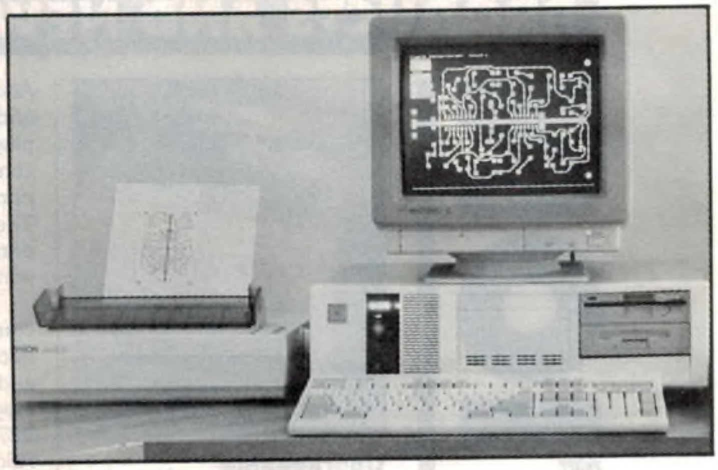

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Our pic shows Tim Wortman, general manager of the T&M Division of Philips Scientific and Industrial, with Henry Nguyen, the winner of the Philips/Fluke promotion contained in our November, December and January issues. Henry's prize was a Philips PM3335 D/A Smart 'Scope and a Fluke 45 Dual Display Multimeter which was itself the inaugural winner of the ETI Industry Award 1989 in the Instrumentation category. Henry is employed as a technician by GPT in NSW.

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READER INFO No. 19

In this, Part 3 of a five-part series, Elmo Jansz looks at the absolute addressing mode, and at how the Processor Status Register is used to execute branches and loops.

THE BASICS OF MICROPROCESSORS

Elmo V Jansz is Head of Electrical Engineering at Hobart Technical College, Tasmania. He is a professional electronics engineer with over 15 years experience in electronics and communications engineering.

This month, we will study a second addressing mode called Absolute Addressing. You will recall from last month that in the immediate mode, information was loaded directly into the accumulator or the X or Y register. In contrast, the absolute addressing mode gives an address in memory from where information can be obtained or where information contained in a register can be transferred to or stored. The absolute addressing mode is shown in the second column in the op-code chart published last month. Just as with the immediate mode, there are three secondary columns.

These show the op-code, the number of cycles and bytes involved. Taking the LDA instruction as an example, we see that the op-code is AD, four clock cycles and three bytes of memory are required. Since four clock cycles are involved in this case as opposed to two in the immediate mode, absolute addressing uses more computer time. The op-code requires one byte of memory while the address requires two more.

As an example, let us suppose we wish to load the accumulator with the information in address location $03D0. A typical assembly language program to carry this out is shown below.

```
LOC 1   EQU   $03D0
LOC 2   EQU   $03D2
★
START   LDA   LOC 1
        STA   LOC 2
END     BRK
```

Notice the use of labels to facilitate program writing. The memory locations $03D0 and $03D2 have been allocated labels LOC 1 and LOC 2 respectively. The line labelled START indicates that the accumulator is loaded from the contents of address location $03D0 or LOC 1. The next line uses the mnemonic STA, which stands for store accumulator and also indicates that it is to be stored in address location $03D2 or LOC 2. Before running the program, location $03D0 will have to be loaded with a byte of data.

Let us now use the op-code chart and hand assemble the program. Try to write this yourself and compare your solution with that shown below.

```
0800   AD DO  03
0803   8D D2  03
0806   00
```

Notice that all addresses are in reverse. To enter and run the program, first switch on the computer and stop the disc drive from rotating, as we did last month, by using Open — Apple — Control — Reset. Now enter the monitor program, by pressing CALL — 151. The * delimited should appear as we had last month, indicating that we are now in the monitor. Now type 0800 : AD DO 03 ® and do the same for each line. To test the program some data is required in $03D0 — type 03DO: FF. Now type 8000G to run the program, and then 03D2 ® . You should see 03D2 : FF indicating that the program has worked as expected.

We will now learn two more addressing modes. These are the Zero Page and Implied Addressing Modes shown in columns three and five respectively in the op-code chart. Let us take the zero page mode first. In this mode, the second byte of the instruction gives the low order byte of the address of the operand. The high order byte is always understood to be 00. The zero page mode is similar to the absolute mode with the high order byte of the address of the operand always being 00. Observe from the op-code chart the the LDA and STA instructions involve three clock cycles and three bytes. Using zero page addressing the above program can be written as shown below.

```
LOC 1   EQU   $05
LOC 2   EQU   $06
★
START   LDA   LOC 1
        STA   LOC2
END     BRK
```

Now try hand assembling the program and run it. A solution is shown below. Do not forget to put some data into location $05 before running the program.

```
8008   : A5   05
800A   : 85   06
800C   : 00
```

In the implied addressing mode no external addresses are involved. The implied addressing mode is shown in column five. Notice that in instructions such as TAX, TXA etc. the origin and destination of the operand are specified in the instruction.

The TAX instruction tells us that information from the accumulator is to be transferred to the X — Register.

Recall from earlier parts of this series that both registers are internal to the 6502.

Process Status Register

We will now learn how the MPU uses the Processor Status Register, also called the P-Register, to make decisions, i.e. to execute branches and loops. The P-Register is shown below.

BIT7	6	5	4	3	2	1	BIT0
N	V		B	D	I	Z	C

The P-Register, you will recall from our earlier discussion, is an 8 bit register which is internal to the MPU. Bit 5 is not used. Each of the flags can be at logic level 0 or 1. If a flag is at logic level 0 it is said to be cleared. If at level 1 it is said to be set. The flags are modified when certain instructions are executed within a program. We will now explain how each one of them is used. Do not be overly concerned if you do not fully understand how these flags operate at this stage. You will acquire a clearer picture once you use them .

1. The Carry Flag (C). This is bit zero of the P-Register. It is set i.e. C = 1 when an addition, shift or rotate operation generates a carry. It is cleared i.e. C = O when a subtraction or compare operation produces a borrow. The carry flag can be set or cleared externally with the SEC and CLC instructions respectively.
2. The Zero Flag (Z). This is bit one of the P-Register. It is set when the accumulator, the X or Y register or a memory location contains all zeros as a result of an arithmetic, logical, shift, rotate, increment or decrement operation.
3. The Interrupt Disable Flag (I). This is bit two of the P-Register. It is set whenever an interruption to a program or a break occurs. The I-flag is cleared after the execution of an RTI (Return from Interrupt) instruction.

   The Decimal Flag (D). Bit 3 of the P-Register is the decimal flag. Unlike the above flags, it is not automatically set and cleared by other instructions. It is used to tell the MPU that addition or subtraction is to be carried out in the decimal mode. i.e. the numbers used are in Binary Coded Decimal (BCD). This is similar to pure binary, except that here, pure binary is used to express only the first 10 decimal numbers.

5. The Break Flag (B). This flag is bit four of the P-Register. It is set whenever a BRK instruction is executed.
6. The Overflow Flag (V). This is bit six of the P-Register. It is set whenever an addition or subtraction produces a number that is greater than $7F = 127_{10} or less than $80 = -128_{10} and is used in Signed Number Arithmetic.

The flags in the P-Register may be modified as a result of the execution of certain instructions. The particular flags that are affected by an instruction are shown in the Processor Status Codes Column in the 6502 Instruction Set (last month).

Branch Instructions

We can now discuss Branch Instructions and understand how they are related to the flags in the P-Register.

Branch instructions are used to test bits in the P-Register. If the condition being tested is met, the program counter is altered, causing the program to jump to an instruction other than the one following the branch instruction. On the other hand, if the condition is not met, the program executes the instruction immediately following the branch instruction.

We will now define the branch instructions available to the 6502 before discussing a program segment involving a branch instruction.

BCS —Branch on Carry Set. The branch occurs if the carry flag is set i.e. C = 1.

BCC —Branch on Carry Clear. The branch occurs if the carry flag is clear i.e. C = 0.

BEQ —Branch on Result Equal to Zero. The branch occurs if the Z flag is set i.e. Z = 1.

BMI — Branch on Minus. The branch occurs if the negative flag is set i.e. N = 1.

BPL —Branch on Plus. The branch occurs if the negative flag is clear i.e. N = 0.

BVS —Branch on overflow set. The branch occurs if the overflow flag is set i.e. V = 1.

BVC —Branch on Overflow Clear. The branch occurs if the overflow flag is clear i.e. V = 0.

Let us now apply some of the information we have gained in this unit to the following program. We wish to write a program that will test the N flag in the P-Register and if set to move to another location, where the accumulator is loaded in the immediate mode with $AA. The accumulator is then stored at $03D0.

On the other hand if the N flag is not set, the contents of the accumulator are to be stored at $03D1. We will check the correct operation of the program by first loading the accumulation with $FF and then with $0F. We will use the BMI and JMP instructions.

The program should be similar to that shown below:

```
1.   LOC 1   EQU   $03D0
2.   LOC 2   EQU   $03D1
3    •
4.           LDA   #$FF
5.           BMI   DEST
6.           STA   LOC 2
7.           JMP   END
8.   DEST    LDA   #$AA
9.           STA   LOC 1
10.  END     BRK
```

In the first two lines, the addresses we are using have been defined by labels LOC 1 and LOC 2. The fourth line of program loads the accumulator immediately with $FF. Note that $FF = 1111 1111 which makes bit 7 equal to 1 and consequently the N-flag in the P-Register is set. The next line of program reads Branch if Minus to the location called DEST. Since bit 7 is 1 the BMI test is satisfied and the program jumps to line 8 where the accumulator is loaded with $AA and then stored at LOC 1 or $03DO. The program then ends.

If the BMI test was not satisfied, the program continues with line 6. Let us now check this out by loading the accumulator with $0F in line 4. In line 5 the BMI test is carried out, but this time bit 7 is 0 since $0F = 0000 1111. The next line of program is store accumulator at location $03D1 and the program then jumps to the end. After the program is run under each of the above conditions, locations $03D0 and $03D1 should be examined to ensure that the correct data has been moved into these locations.

The above program uses an addressing mode called relative addressing. This is a method of indicating to the program counter, how many bytes it has to jump over to obtain the next address. In the above example the program has to jump to the location labelled DEST, when the BMI test is satisfied. The number of bytes it has to jump over is indicated as an off-set. We will illustrate how this is done by an elementary example.

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READER INFO No. 66

1. 0030 AD)
2. 0301 OA) Load the Accumulator with the contents of $520A.
3. 0302 52)
4. 0303 10 BPL — Branch if possible
5. 0304 OFF-SET
6. 0305 8D)
7. 0306 10) Store Accumulator at $CO10.
8. 0307 CO)

The first three lines indicate that the accumulator is to be loaded in the absolute mode from the contents of address $520A.

Line four gives the op-code for the BPL instruction. Line five gives the off-set or the number of bytes over which the program counter has to jump in order to arrive at the address of the next instruction. The starting address or origin of the program counter is normally the address

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READER INFO No. 67

immediately after the off-set, $0305 in this case.

Let us assume that when the BPL test is satisfied the program is required to jump to address location $03FA, from when the MPU gets its next instruction. The required off-set is calculated by subtracting $0305 from $03FA. This gives $F5.

The program should now read as follows:

0300	AD
0301	OA
0302	52
0303	10
0304	F5
0305	8D
0306	10
0307	CO

If the BPL test was not satisfied the MPU reads the byte at $0305 and continues with the program. Note that the off-set is calculated relative to the address of the op-code that follows the branch instruction. Hence the words 'Relative Addressing'. The branch instruction is enclosed within the dashed lines. Branching can be to an address in the backward direction as well. Consider a program segment in which a BNE (Branch if not equal to) instruction is stored in location $AD25. You will recall from earlier that if the BNE test is satisfied, the Z flag in the P-Register is clear i.e. Z = O. Assume that if Z = O, the program must branch backwards to $AC20.

The program segment should look like this:

1.	AD25	DO
2.	AD26	OFF-SET
3.	AD27	Next Byte
4.	AD28	|
5	|	|
	|	|
	|	|
	|	|

The op-code for the BNE instruction is at location $AD25. The next byte, which is the off-set, is followed by the rest of the program commencing at $AD28. Suppose that when the BNE test is satisfied, the program must jump backwards to $AC20. The required off-set is calculated as follows:

The starting address is $AD28, in like fashion to what we had above.

The new address location is subtracted from this i.e. $AD28 — $AD20 = $08. Since the branch is in the backward direction $08 must be converted to its two's complement. This is done by complementing all the bits and adding 1 to the least significant bit.

$08	=	0000 1000
Complementing		1111 1111
Adding 1 to the LSB		1
		1111 1000

The required offset isF 8 $F8

The program should now look like this:

|	|
|	|
|	|
AD25	DO
AD25	F8
AD27	Next Byte
AD28	|
|	|
|	|
|	|

(Continued next month) ■

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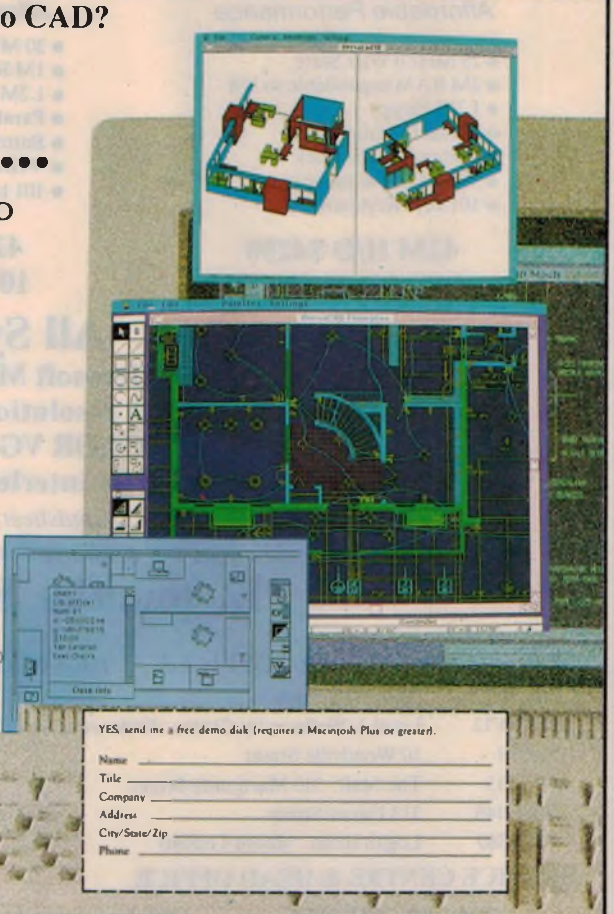

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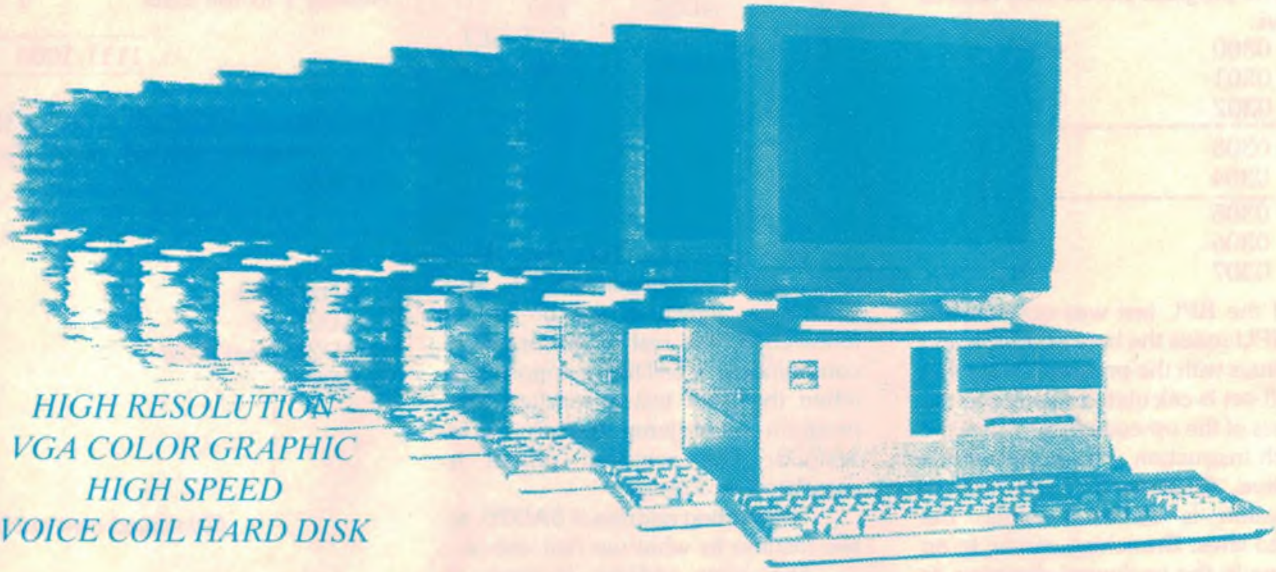

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READER INFO No. 31

SOUND INSIGHTS

EA/ETI'S AUDIO & HIFI SUPPLEMENT

CARDILINI ON YAMAHA

CHALLIS ON BOSE

POLISH UP YOU

Les Cardilini reviews Yamaha's new CD players. The CDX930 and CDX 1030 models use controversial single-bit technology to counteract zero-cross distortion.

R GOLDEN EARS

Many hi-fi purists remain critical of compact disc digital audio despite the fact that digital audio, and the compact disc system in particular, has brought the best stereo sound quality to the masses at a price even the beginner can afford.

The objection of audiophiles is that music from compact discs has not sounded as 'warm and natural' as from vinyl discs. Perhaps not in the past. But what about tomorrow?

Many listeners will be better able than measuring instruments to determine differences in the subjective quality of sound reproduced by parts of a hi-fi system, CD players included.

The 'objectionable' character of digital sound could have its roots in an area of signal processing similar to that which drew criticism of transistor amplifiers during the equally turbulent transition from the era when valve was monarch.

The problem then was the perceived harshness of transistor crossover and switching distortion, especially in quiet passages of music.

In the case of digital audio the traditional multi-bit digital-to-analog converters face a formidable task in following a music signal passing from positive to negative, and vice versa, through zero. In a 16-bit converter, 15 of the 16 bits must change from a logical high state to a logical low condition (or vice versa) while the remaining bit does the opposite.

A potential problem is that each of the 16 bits in a digital-to-analog converter has a different but related weighting, or value. To match them all perfectly during manufacture, let alone as they are subjected to changes in operating temperature and through aging, would be a delicate engineering feat.

Unless the matching is perfect then 'zero-cross distortion' will be introduced. This will happen perhaps thousands of times a second whenever a disc is playing and may characteristically colour the sound, however delicately. If you are able to detect this, you probably would not like it.

Noise and distortion, including zero-cross distortion, are more objectionable in quiet passages of music or other material. An analogous form of distortion can occur at other signal levels, but for the same reason; the weighting of binary bits in a multi-bit converter.

Single-bit systems

The key, of course, is multi-bit; you only have to match things when you have more than one. So, why not have a system with only a single bit?

A single-bit system is in contradiction with the numbers game that has developed around CD player specficiations where 18-bit, 20-bit and more converters (not to mention oversampling rates of 2-times, 4-times, 8-times and more) have been growing in popularity and promotion.

Single-bit technology is a new technique in digital-to-analog and analog-to-digital conversion that is increasingly used in compact disc players. It follows development of the MASH system at the NTT (Nippon Telephone and Telegram Company) Central Research Laboratory in Japan.

Yamaha Music was among the first to develop higher bit models with hi-bit technology. Yamaha has now introduced s-bit technology into its product range with the release of two new, high end, compact disc players using single bit digital-to analog conversion.

The Yamaha Natural Sound Compact Disc Players Models CDX930 and CDX1030 include many features which should appeal to the audiophile. Both are styled in either black or titanium. The front panel is relieved by a gentle sloping towards the top and bottom with lends a silkier feel to the finely brushed finish. The elegance of their appearance is enhanced by the conservative front panel lettering.

Both models have a heavy extruded aluminium disc tray with friendly thick moulded soft rubber pads to protect discs from scratching. The pads accept both standard-size compact discs and the smaller 'single' versions. An anti-vibration and anti-resonance chassis is also featured in both models.

The CDX1030 has a double top cover and double bottom for additional screening and damping. Full Class A audio amplifier stages are used and the circuit boards are completely independent. An 'ultra-heavy' power transformer has been included in this model. Both models have balanced audio outputs from the converters, thus improving common mode noise rejection.

The two models are outwardly identical, but the 10.5 kg weight of the CDX1030 is testimony to additional features over the CDX930, which weighs in at 5.7 kilograms.

Apart from the power switch, all functions of the players can be programmed via the infrared remote control, including volume in the system loudspeakers and the front-panel headphone facility. Both models also have a 'file memory' system which can store your preferred tracks on particular discs and automatically recall them whenever that disc is played.

The file memory system can be cleared or modified quite simply via the remote control or at the front panel controls on the player (where the function pushbuttons are arranged in a single line under the disc tray and illuminated display). The display can be switched to show either all relevant information for the disc in the system or an indication of track and playing time only.

RCA and Optical Digital Outputs are available on both models, for use with external equipment containing suitable digital to analog converters.

Both gave impressive performances with different kinds of music, especially on discs with simple, quiet solo performances where misbehaviour in digital circuits is more likely to materialise as colouration or grittiness in the sound. No mechanical playing noises in the disc and laser pickup transport were audible, even during the quiet of an after midnight audition; an important point for players that claim wide dynamic range and high signal-to-noise ratio in the electronic circuits.

The newcomer to serious hi-fi should be tempted by the clean natural sound of Yamaha's first s-bit machines and even the critical audiophile might concede some ground.

The CDX930 and the CDX1030 are relatively priced at $799 and $999 (rrp). More information from Yamaha Music Australia Pty Ltd 17-33 Market Street, South Melbourne, Victoria 3205. ☎ (03) 699 2388.

We've all met them.

The moment they enter, the party seems to change pace. They have a knack of livening things up, getting everyone into the party mood.

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It's fully transportable, which means if you suddenly want to move your party outdoors, you can, without having your revellers miss out on their favourite music.

And because the Unity System is transportable, you can position it exactly where you want to take full advantage of its big, rich sound.

Sleek and stylish, the Unity System features the following superb components:

AMPLIFIER

The amplifier's Active Servo Technology brings you sound you've only dreamed of hearing from a small audio system. With the 4-band graphic equalizer, you can tailor the sound to compensate for your room's acoustics. And the Dynamic Sound Switch puts even more bass response into the output.

TUNER

The AM/FM Tuner uses synthesizer tuning to precisely locate and lock on to any station. And you can preset it to instantly tune in one of your 10 favourite stations with just a push of a button.

CD PLAYER

The CD Player plays both regular CDs and CD singles. It has Direct Track Access and a 20-

selection Music Calendar. You can also make a random programme of up to 20 tracks to access only the selections you want to hear.

CASSETTE DECKS

The two independant cassette decks have Auto Reverse Playback (A, B) and Recording (B), so you can operate them in relay for endless playback or long recordings. And better sound reproduction is assured as they both have Dolby B Noise Reduction®.

SPEAKERS

The speaker's Active Servo Technology produces a full, rich sound with the deepest bass and clearest high reproduction. The speakers can also be detached from the main unit and placed farther apart for greater stereo seperation. The tripod speaker stands come as an optional extra.

The Unity System is completed by a single Remote Control that operates every function including the volume level.

Perfect for entertaining, this system can also be used as a second sound system elsewhere in the house; it makes an ideal system for a holiday house, in fact anywhere you think you might appreciate superb sound.

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So if you're looking for a big sounding system without the big price tag make sure you come and hear the Unity System at your local Yamaha Hi-Fi Specialist . Priced at only $1199 and with a full 5-year warranty*, it's no wonder the Unity System is attracting a lot of attention.

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READER INFO No. 32

Improved connector

THE AXR Audio Connector – known generically as the 'Cannon' connector – has been improved and updated by Alcatel Components of Melbourne.

In three-, four- and five-pin-models, the AXR is used around the world for microphones, tape recorders, VCRs, amplifiers, mixers, test instrumentation, medical electronics, computers, TV cameras, industrial control devices and audio/visual systems on transportation facilities.

The new model has a cleaner, more modern styling; and is said to be much easier to assemble and to retain all the standard

'Cannon' attributes. Further information from Alcatel STC – Cannon Components ☎ (03) 555 1566.

READER INFO No. 271

New Klipsch distributor

American loudspeaker manufacturer Klipsch & Associates has appointed Mr Ian Thacker (trading as Legendary Loudspeakers) as their sole distributor for the South West Pacific region. Mr Thacker, formerly of The Australian Sound Company (TASC), has been associated with the Klipsch company and its products for the past 15 years.

Klipsch products include home entertainment speaker systems that, they say, set standards in efficiency, low distortion and cabinetry; the 'Tangent' series of home speaker systems and the internationally regarded range of professional sound reinforcement loudspeaker systems.

Klipsch dealers work with owners to incorporate minor update modifications in their loudspeakers. Klipsch representatives attend training seminars in Arkansas. For further information contact Ian Thacker, Legendary Loudspeakers, ☎ (03) 696 2057.

READER INFO No. 272

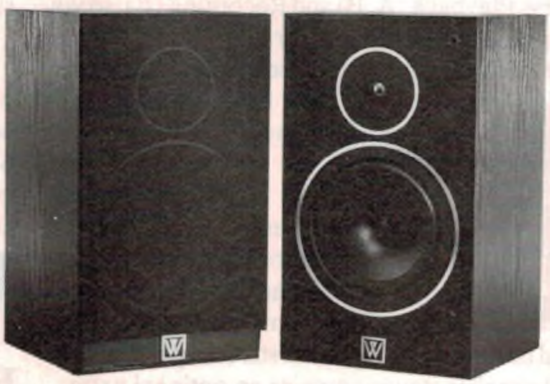
Meridian Audiophile CD player

THE 208 is the first production player to use the Bitstream process for single bit pulse density modulation (PDM) D/A conversion.

Meridian has incorporated several proprietary features to ensure the highest levels of performance. The 208 has already been hailed as the world's best CD player. The price in Australia is $3999 and further details are available from Audio 2000 ☎ (02) 819 6533.

READER INFO No. 273

New Wharfedale



THE LATEST model in the Wharfedale 'Precision 5' speaker series is the 505.2.

Power handling is 100 watts, with a frequency range of 42Hz-22KHz. With two drive units, the 505.2 has a sensitivity of 87db.

Recommended retail price for the 505.2 is $799. For further information contact Doug Osmond, Audio Products, ☎ (02) 997 466.

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THE HOLY GRAIL OF ACOUSTICS

Louis Challis discovers the elusive secret of noise control in a pair of Bose aviation headsets.

Most of you will have read, with feelings ranging from scorn to credulity, how alchemists in the 1600s and 1700s tried to turn base metals into gold. Those stories (and the mirth they created in my high school chemistry class) were not lost on me when years later I discussed a seemingly equally naive proposition that a student put to me during one of my lectures on engineering noise control.

His proposal was that if it is possible to reinforce sound as a result of multiple sources, and even through unwanted sound reflections (I noted that he chose his words carefully), then it should be possible to attenuate (or diminish) the level and extent of an annoying sound using a separate sound source which is 180° out of phase with the original, and thereby to provide a practical means of *electro-acoustic sound cancellation*.

Of course I have forgotten the student's name, but I do remember the thrust of my response. I pointed out that, while in theory it might be possible to achieve that reduction at one point in space, it would not provide a spatial solution, for if one moved a few inches or possibly even millimetres to either side of the reference point, the cancelling sound wave would become an additive wave instead of being subtractive and the magic would disappear.

Although I didn't know it then, a founding father of the American electro-acoustics industry, H.F. Olson, had developed precisely the same idea back in the 1950s, and been so excited by it that he took out a patent on the concept. I suspect he believed that his invention (for that is what it was) would revolutionise noise control.

Alas! Progressive as his idea seemed, Olson's patent, like many others of equal novelty, languished in the files of the 'also rans' – because the technology needed to bring his idea to fruition did not exist.

Forty years later, most of the electronic wizards of the 20s and 30s had moved on to that 'great big electronics lab in the sky'. In their place was a new team of engineering, architecture and science based professors at Harvard, MIT and Stanford, whose names became the by-words of the electronics and acoustics profession.

Around this time, three eminent gentlemen at the Bell Telephone Laboratories, Messrs Barden, Brattain and Shockley, were working on the development of the transistor – which some believed offered little scope for success (even when compared to Olson's anti-noise concept).

As it transpired, the two concepts were inextricably linked, for without the speed, size, low weight and power of the transistor, Olson's idea would still be lying in one of the U.S. patents office's dusty archive boxes.

The idea of re-exploring the feasibility of Olson's patent germinated in the minds of intrepid researchers at about the same time in the 70s. The foremost of these were G.E. Warnaka, B. Chaplin and J.E.F. Williams, who had working models to display the practicality of Olson's concept to an incredulous gathering of engineering, acousticians and scientists by the early 1980s.

> ***The Bose aviation headset is the first practical active noise reduction device available for general sale.***

The first generation of noise cancelling systems

The first generation of active noise cancelling systems were rather primitive, as they used many discrete transistors on large printed circuit boards to compute the complex iterative signal required for the noise cancelling signal.

The early designs required some form of strobe or externally generated trigger signal to provide positive synchronisation, and although effective, they lacked the flexibility that would ensure practical trouble free operations in the field, particularly with non-cyclical low frequency noise.

The first thing the researchers noted during their experimentation was the limited range of frequencies (or more specifically wave lengths) over which the noise cancelling systems would work. The upper limits were generally in the vicinity of 500 Hz, with effective attenuations of the order of 30 decibels being readily achievable within that 500Hz band width. Between 500 Hz and 1

kHz there was an interesting grey zone, where practical attenuation was possible but woolly. Above 1 kHz the shorter wave lengths of the sound presented a practical spatial problem which made reliable noise cancellation extremely difficult.

In the majority of architectural and engineering noise control problems, it is a simple matter to achieve good, or even outstanding, attenuation at high frequencies. The lower, and particularly the very low frequency sounds, with their long wavelengths, are invariably the most difficult to attenuate. The costs and complexity of the silencing solutions at those frequencies are daunting. Here, for the first time, the problematic long wave lengths of low frequency sounds had become an attribute, and we were able to turn the tables on a group of problems which had previously caused much anguish.

I first attempted to use active noise cancellation to tackle the noise annoyance caused by a large transformer to a woman living next door to a regional sub-station in Queensland. The first generation noise cancelling system which I used is shown in Figure 1. Subject to the limitations of requiring an external synchronising signal at 50 Hz, it provided a practical means of attenuating the transformer's noise emission at frequencies below 600 Hz inside the woman's bedroom. Active cancellation for the higher frequencies proved elusive, particularly when all three transformers in the substation were working.

I was satisfied that active attenuation had made great strides, but my assessment of what I had actually achieved was that it did not offer a complete solution. In the end, after considerable anguish, I elected to use a more conventional architectural solution – much, I suspect, to the client's relief.

British Gas successfully combined an active noise cancellation system with a conventional passive silencing system in order to cover the infrasonic frequency range below 50 Hz. They neatly installed an array of sub-woofers around the perimeter of a gas turbine discharge stack on a gas pumping station to obviate a potential community noise problem. What they achieved put active noise cancellation into the record books and in the public eye.

That was in 1982, since when, a lot more has happened than you might think. Of course many of the most exciting of those developments are classified, as they relate to defence applications. Others, many innovative and some (to which I am privy) outstanding, have occurred in the field of commerce, where successful users have been unwilling to talk about their achievements. But as wonderful as some of those scientific developments have been, they did not prompt this review. Let us step backwards to the year 1979, when Amar Bose was supposedly flying from one city to another in the USA, and as the folklore would have us believe, compared a set of quality headphones with the older style piped head sets.

Amar Bose investigates

Now Amar Bose has an active and enquiring mind, and of course he asked himself why the sound of the quality headphones was so inferior to what he would have expected. He understood that the masking effect of the cabin noise was a factor, which should have been minimised but had not been. He soon realised that a dominant factor was the result of the poor low frequency sound attenuation, which no commercial head phones (or ear muff for that matter) are capable of resolving.

Without realising the full implications of the problem or resolving any of the more vexing problems of the solution, Amar decided to initiate another research study for his busy Research & Development team at the Bose Corporation.

Before we examine the fruits of that program, it is important to explain the theoretical issues and the nature of the problem facing the Bose Corporation. Sound attenuation is a relatively tricky business and of the three primary avenues generally available to us, the use of personal hearing protection tends to be the least desirable option. To most people that means the use of ear muffs or ear plugs.

While well-fitting sets of ear plugs can provide useful attenuation of extraneous low frequency noise, most ear muffs don't perform quite as well. They tend to suffer from serious problems from cavity resonances. This results in minimal attenuation or even noise amplification problems at the lower frequencies. All too often those resonances fall in the frequency region where we can least afford it.

An interesting example of this is associated with engine maintenance personnel who work with diesel or jet engines in test cells, and who are involved in run-up tests. Those earmuff resonances are for them, not only disturbing, but in some circumstances quite dangerous.

The long term noise exposure of flight crews to the sound of their engines is a problem which flying caps or headphones don't properly control. The low frequency components cause fatigue as well as affecting ability to monitor radio communications.

If a solution could be developed for just one of those problems, it could be used in situations from tanks to trucks and from underground mines to planes – the sky's the limit!

The Bose Corporation worked on this problem for years, with many prototypes which all came closer to fulfilling the requirements of one of the most interested of their sponsors – the US Airforce. They wanted a self contained lightweight set of aviation ear muffs to attentuate those nasty low frequencies and to reduce flyer fatigue.

I became aware of the Bose research program four years ago, when Dick Rutan and Jeana Yeager in the Voyager completed their sensational non-stop circumnavigation of the world in nine days in a plane which lacked any of the normal forms of noise control treatment.

However, during the final preparations for that flight, Bose Corporation (apparently with US Air Force's approval) offered the only two working pairs of their latest prototype aviation headsets to Rutan and Yeager. While both head sets failed prematurely as a result of perspiration corrosion during the flight, the extended operating period those noise cancelling ear communication headphones provided probably saved Rutan and Yeager from premature deafness.

News of the flight was on every TV channel and radio station, and in every newspaper in the world, but news of the Bose aviation headsets and their application for hearing conservation was slower in breaking. It was as thqugh the Bose Corporation was apprehensive about telling their competition what they were doing, for we do know that at least two other firms were working on the same problem. As soon as I heard the news, I eagerly asked how soon I could get a pair of headsets to evaluate. I had a number of applications for the muffs with more coming to mind as I waited.

Foremost were the RAAF pilots flying Hercules and Caribou aircraft, but I didn't forget the drag line and bulldozer operators in coal mines whose needs are just as important. But I really had one specific group of RAAF engine maintenance personnel in mind who work under very difficult and noisy conditions. If these aviation headphones could resolve even a portion of the communications requirements with which I was involved, then I would be satisfied that the wait was worthwhile.

Louis finds his holy grail

Following my return from the Christmas holidays, I was elated to find a message that the first pair of Bose aviation headsets in Australia were available for me to carry out full evaluation, and two days later I had them.

The aviation headsets they sent me are a demonstration set in which the active elements of the noise cancelling system have been deliberately exposed behind a clear plastic cover. The appearance of electronics is somewhat deceptive, as I would have expected circuitry which is physically large and more complex. Bose have developed proprietary ICs and a control circuit well in advance of commercially available units. If you compare the bulk and dimensions of our 1982 noise cancelling control system (see Figure 1) with the size of the electronics in Figure 2, you can appreciate just how far the technology has advanced. As I soon found, the most telling test is to wear the aviation headsets in a noisy environment like your car, and you immediately know that they really do work and how well they work.

MEASURED ATTENUATION OF BOSE 'AVIATION HEADSET' WITH & WITHOUT ELECTRONIC CANCELLATION FUNCTION

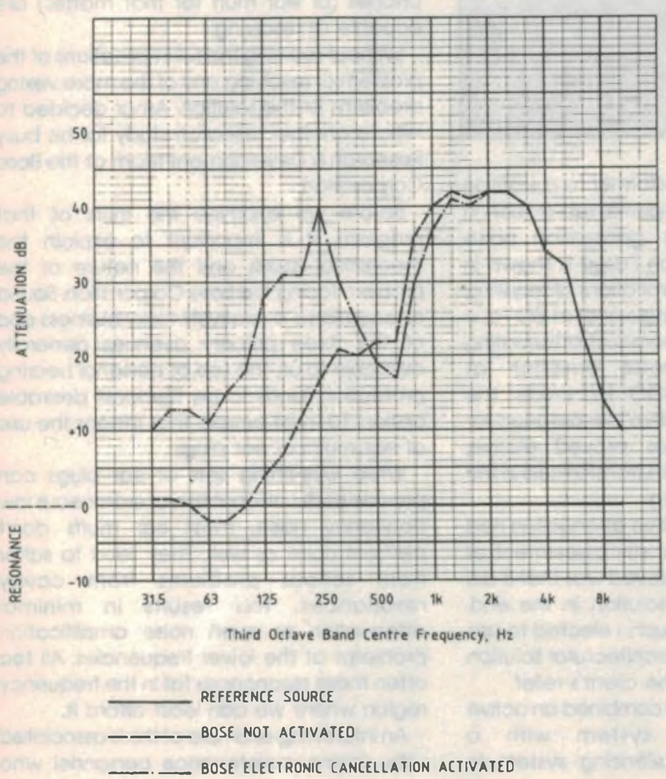
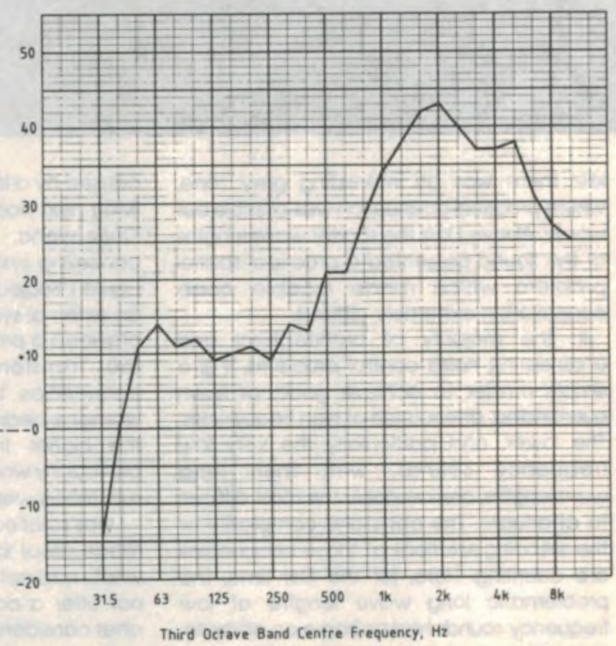


Figure 3.

MEASURED ATTENUATION OF TYPICAL EARMUFF UTILISING SAME MEASUREMENT TECHNIQUE AS AVIATION HEADSET



N.B. TEST RESULT UNDER PERFECT CONDITION WHICH DO NOT APPLY TO HEAD WITH HAIR AND NON-UNIFORM SURFACE

Figure 4.

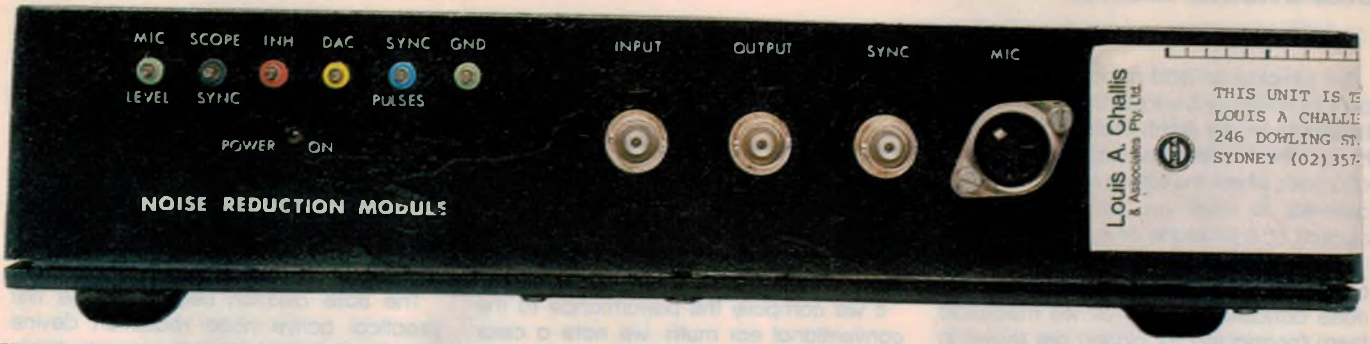


Figure 1: First generation noise cancelling system.

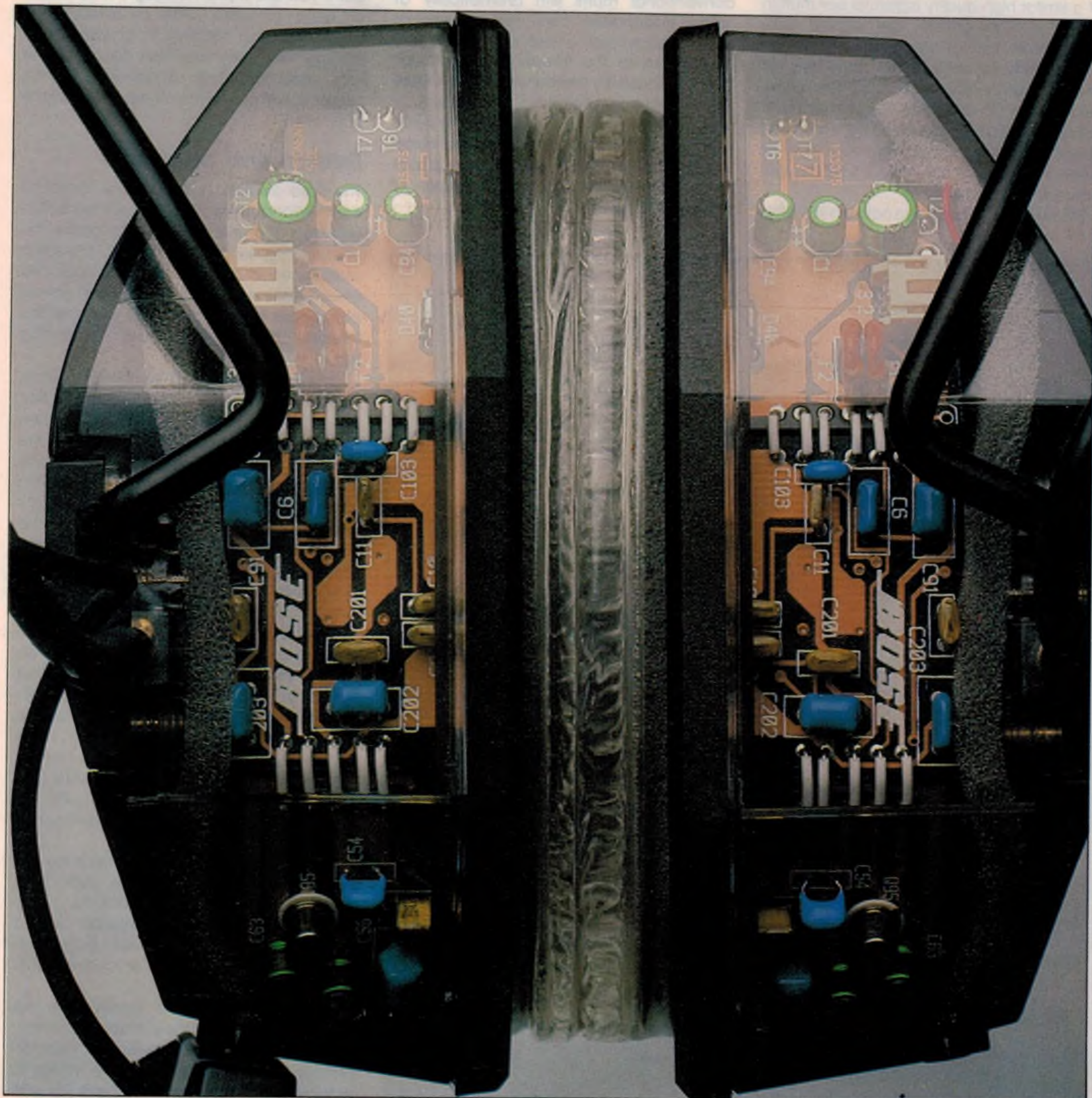


Figure 2: The Bose aviation headset; notice how technological advances have reduced the size of the electronics.

But jumping on past my observations, to our laboratory test, we put the Bose avation headsets on our British Standard's artificial head in the middle of our large reverberation chamber, where the diffuse sound field is not dissimilar to what you would find in the cockpit of a jet plane or even a Hercules.

The results of the natural (non-noise cancelling attenuation) and the activated noise cancelling system as we measured them (normalised for clarity) are shown in Figure 3. For comparison I present the results of a similar high quality industrial ear muff in Figure 4. The graphs are almost self-explanatory, but let me explain what they mean. Firstly, to achieve the same level of low frequency attenuation at the lower frequencies (15 dB) is just about impossible – short of encasing your head (or the space in which you are located) in a thick layer of steel or reinforced concrete – which might prove to be a little tricky ....

The next thing you should notice is the drop in attenuation performance of the aviation headsets above 500 Hertz, where the noise cancelling system is deliberately rolled over to avoid unsolved problems in that region.

Last of all you should note that there is a slight loss of performance above 1.5kHz, where the natural attenuation performance of the aviation head set soon exceeds 30 dB of straight acoustical noise reduction.

If we compare this performance to the conventional ear muffs, we note a clear inequality in their performance – while the conventional muffs win dramatically at higher frequencies, their performance at lower frequencies is between poor and outrageous as the frequencies approach their critical cavity resonance region (where they behave like Helmholtz resonators).

My next test was to determine if the same results could be maintained on a real head, which might, for example, be using glasses or have thick hair to degrade the quality of the seal.

I found that the loss of seal has no real deleterous result at the lower frequencies and the muffs continue to work under conditions which would result in a drastic reduction of performance of the conventional muff. There was still a drop in the attenuation performance of the aviation headsets at high frequencies – where there would be in any other muff or headset.

The Bose aviation headset is the first practical active noise reduction device available for general sale. They aren't cheap, but if you are a pilot, a drag line operator, or have to work (with or without the communication facility) in a very noisy environment, they are likely to prove the most valuable piece of personal hearing protection equipment you are ever likely to buy.

Design and operation

The Bose aviation headsets look similar to conventional earmuffs and communication headsets, if one is prepared to ignore the unusual angularity of the plastic moulding used for each of the actual muff cups. The clear plastic elements replace the normal black ones in order for us to examine the internal construction without dismantling them.

Ignoring the extended microphone boom arm, which is a conventional headset facility, the first thing that one notices when examining the inside of the cups is the proximity of a sub-miniature microphone immediately behind the protective foam plastic insert, which would place it directly in line with the expected position of the wearer's ear canal. Immediately behind each of those microphones (and there is one in each ear cup), is a wide range ear piece (which in this case takes the form of a very efficient dynamic transducer). Each of these wide range ear pieces fulfills a dual function, firstly to provide normal communication and secondly to individually provide the fully adaptive microprocessor controlled active attenuation system. One of the most important features of the Bose active attenuation system is that it does not require any form of external synchronisation with the incoming acoustical signals in order to fulfill its function.

These aviation headsets incorporate the normal tip, ring and sleeve jack plug connections for headphone and microphone connection, together with a supplementary 12 volt DC power plug which is not normally required for conventional aviation headsets.

Alas, these headsets must have an additional power source in order to function, and either an external power jack must be provided, or the user must be willing to provide a portable battery source (as was provided to me to assist in our evaluation). eti

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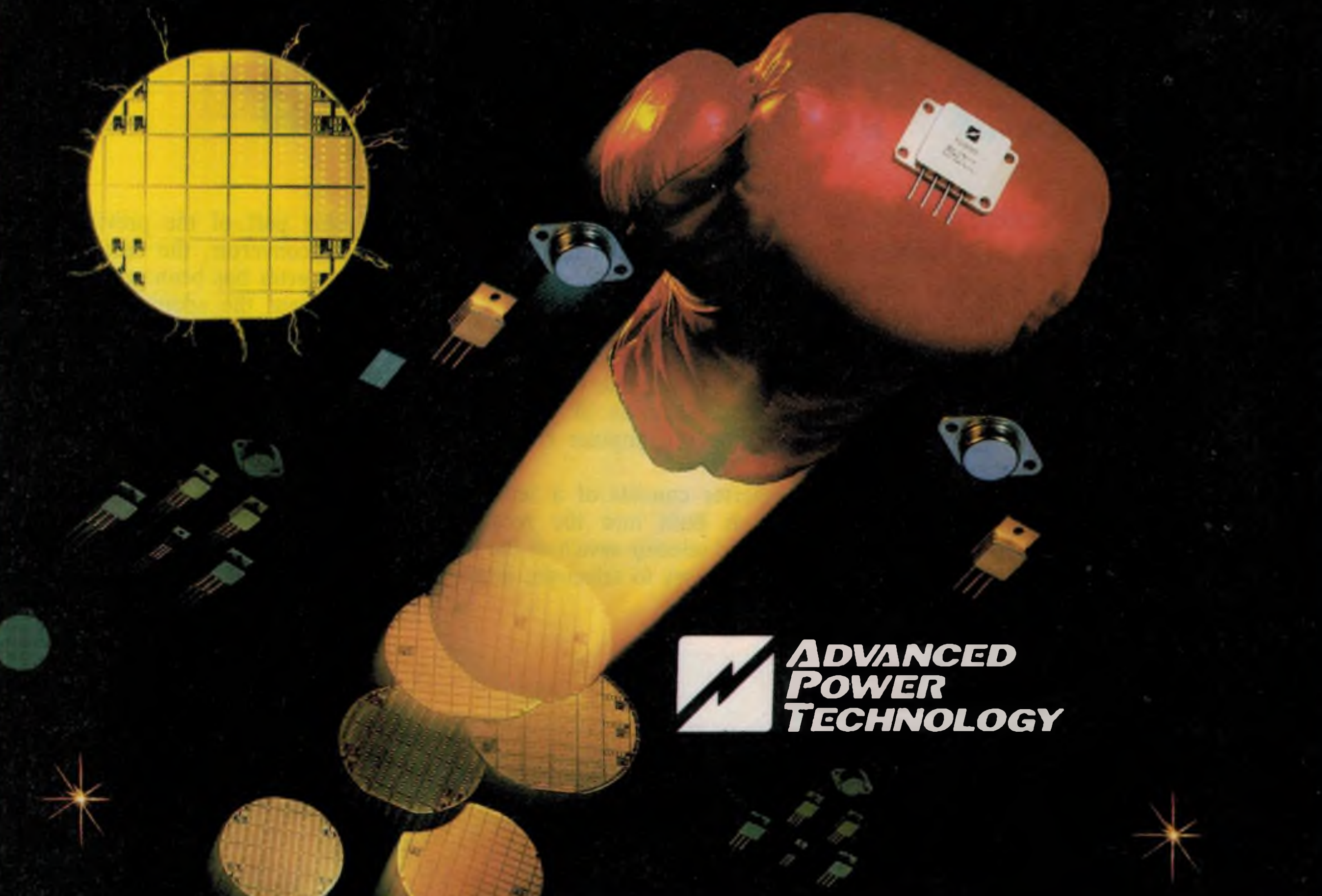

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0.021 - 0.21	95.0 - 39.0	380 - 156	9000 - 13000	360 - 675	0.738 × 0.585 (108)
0.04 - 0.40	83.0 - 20.5	332 - 82	4500 - 6500	160 - 370	0.588 × 0.388 (107)
0.20 - 1.30	26.0 - 8.5	104 - 34	1800 - 2950	60 - 130	0.414 × 0.254 (106)
0.30 - 2.40	18.5 - 5.0	74 - 20	1300 - 1800	45 - 105	0.290 × 0.250 (105)
0.65 - 4.20	11.0 - 3.0	44 - 12	650 - 950	20 - 55	0.199 × 0.203 (104)

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READER INFO No. 34

Construction Project:

A converter for the 420-450MHz band

Here is a further module for our multi-band FM receiver project. Now you can also listen to the '70cm' amateur band, in addition to the 2m and 6m bands.

by DEWALD DE LANGE

Our multi-band FM receiver design started with the basic 50-54MHz receiver, as described in the January and March 1990 issues. A second band was added with the 144-148MHz converter module described in the May issue.

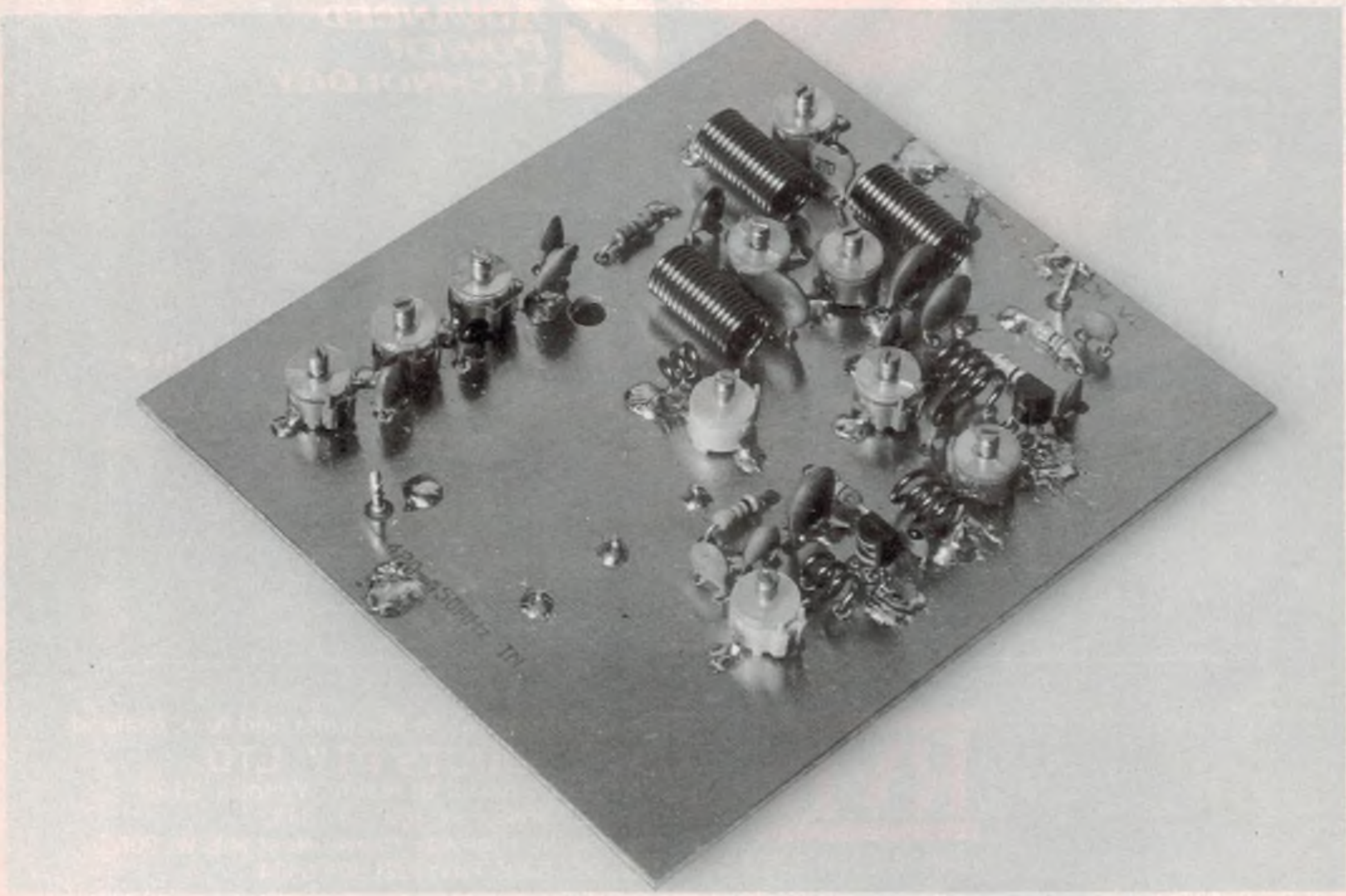
The further converter module to be described here will give the receiver a third band. The unit converts frequencies between 420 and 450MHz down to the 50-54MHz input range of the basic FM receiver. It will enable you to monitor any 4MHz segment of the 70cm band, including the popular frequency of 432MHz.

The converter consists of a separate board that is built into the receiver case. The band selector switch of the receiver makes it easy to select the different bands.

By using part of the previous (144-148MHz) converter, the design of this 70cm converter has been greatly simplified. It means the additional band can be added at minimum cost, and with a relatively simple construction.

Circuit description

To convert frequencies from the 420-450MHz band down to the 50-54MHz band, they must be mixed with a LO (local oscillator) signal between 370 and 396MHz. The exact LO frequency will depend upon the particular 4MHz band we wish to cover.



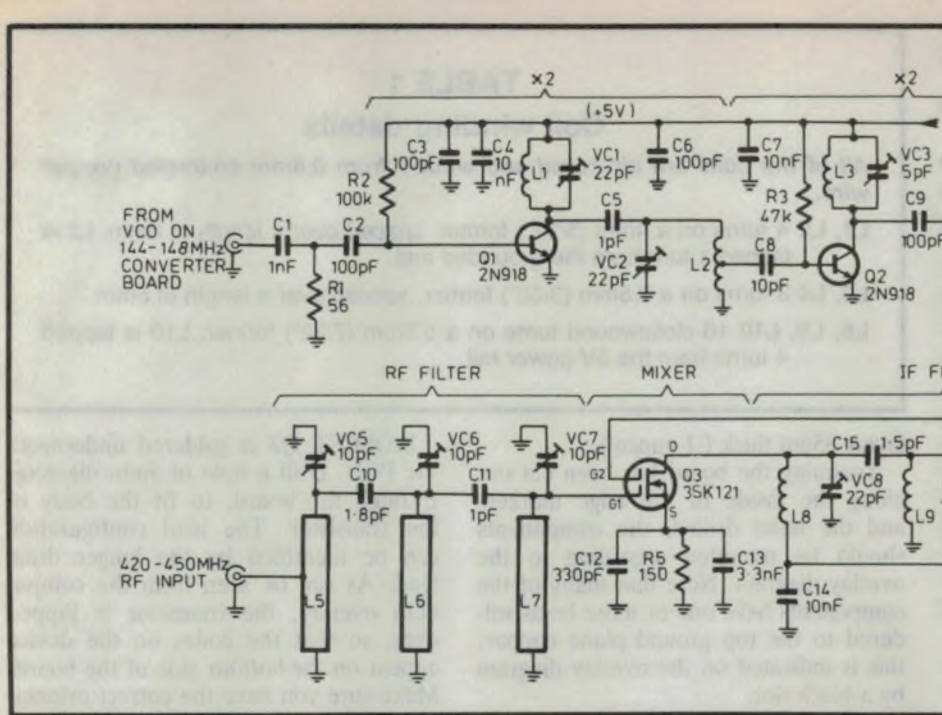


Fig.2: The complete schematic for the converter. Its relative simplicity stems from the fact that the local oscillator signal is derived from the PLL in the 144MHz converter described previously.

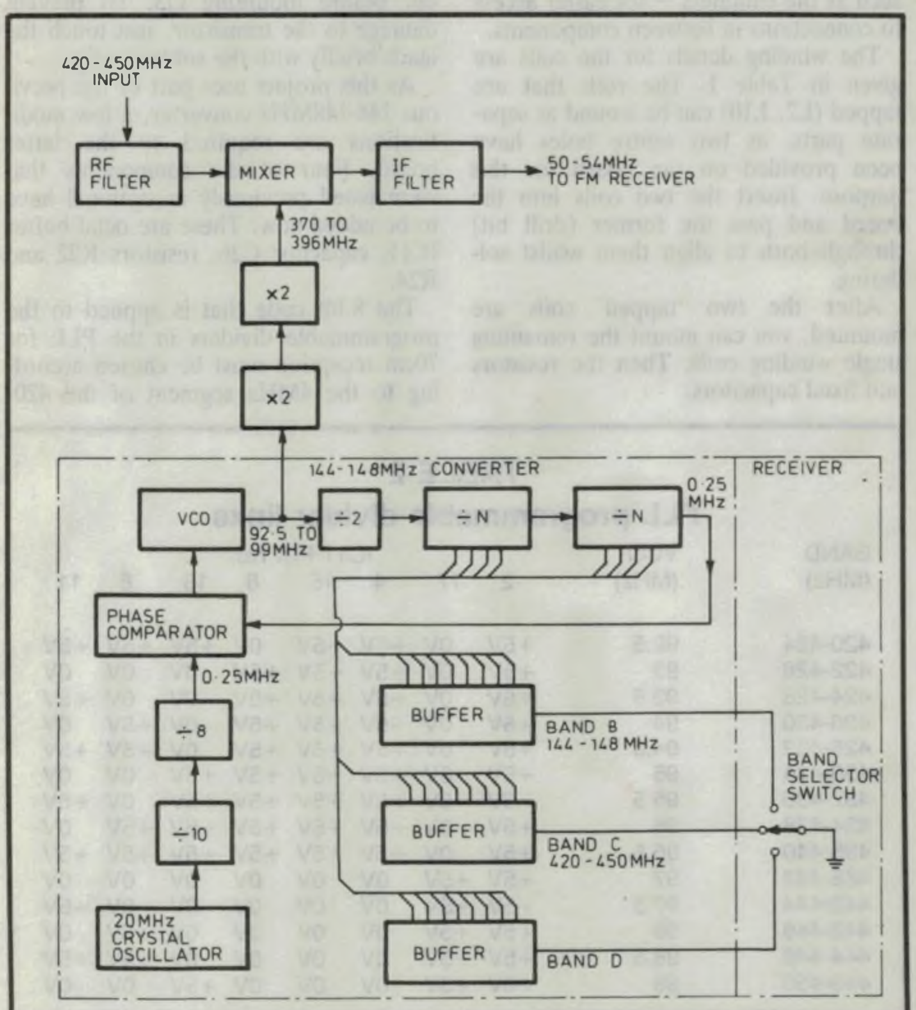


Fig.1: A block diagram which illustrates the operation of the new converter. Existing circuitry is shown in the dashed boxes.

Our previous (144-148MHz) converter was designed to act as a signal source, from which the LO of this converter could be derived. To understand how, we need to recap the operation of that converter.

The 144-148MHz band used a 94MHz LO, again to produce a 50-54MHz IF (intermediate frequency). This LO signal was generated by means of a VCO (voltage controlled oscillator), through a phase-locked loop (PLL). The VCO frequency is altered by changing the programmable division ratio within the PLL.

The block diagram in Fig.1 illustrates the idea behind this new converter design. By setting the VCO to between 92.5 and 99MHz and multiplying by 4, we can obtain the desired frequency in the 370 to 396MHz range.

To allow for a different VCO frequency for each band, the code to the programmable dividers has to be changed when the band is selected. This is achieved by means of tri-state buffer ICs, which are enabled via the receiver's band selector switch.

The frequency steps with which the VCO can be adjusted, to set the exact 70cm tuning range, is determined initially by the phase comparison frequency of 0.25MHz, multiplied by 2 because of the fixed division following the VCO. After the 4 times frequency multiplications the step size for the 370-396MHz LO becomes 2MHz. This gives the intervals with which a 4MHz band

70cm Converter

can be selected in the 420-450MHz range.

Having obtained the LO frequency in this way, all that remains is preselection of the 70cm input signals, the mixing function itself, and IF filtering.

The complete circuit is illustrated in Fig.2. As you can see there isn't much to it. The coaxial cable from the VCO on the 144-148MHz converter board is terminated into the 56 ohm resistor R1. Although this cable is fairly short, a capacitive load at the end of an unterminated cable can transform its input to a short circuit.

The VCO signal around 96MHz drives Q1 in a class-C fashion. The second harmonic around 192MHz is filtered out by tuned circuits L1, VC1, L2 and VC2.

A similar frequency multiplier circuit is formed by Q2, to obtain the final frequency around 384MHz. Resistor R4 is used as high impedance coupling between the tuned circuits, instead of a very small capacitor. This LO signal is then applied to the second gate of the MOSFET mixer Q3.

The RF and IF filters each consist of a three coupled resonators. In the input RF filter, lengths of microstrip line (L5, L6 and L7) are used to simulate the small inductance values required. These are tuned by VC5, VC6 and VC7 respectively, with C10 and C11 providing loose coupling.

On the output side, L8/VC8, L9/VC9 and L10/VC10 provide the three tuned circuits, loosely coupled by C15 and C16. C14 and C17 provide DC decoupling for the +5V supplied from the receiver via the 50-54MHz line.

The current through MOSFET Q3 is set by source resistance R5 to about 10mA, whilst C12 and C13 bypass the source for RF and IF frequencies respectively.

Construction

All parts for the new converter are built on a double-side PC board, measuring 100 x 89mm. The etching patterns for both the top and bottom of the board are reproduced on these pages, for those who wish to etch their own; they are coded 90cs5t (top) and 90cs5b (bottom) respectively.

Note that the converter really must be built on this board, as the microstrip lines used for input tuning are an integral part of it. To ensure correct operation, the board must also be made from normal FR-4 epoxy fibreglass laminate, with a thickness of 1.5mm and copper layers 35um thick ('1 ounce').

Assuming the board has been cut out along the inside of the edge markers and the holes drilled, the components should be mounted according to the overlay diagram. Note that many of the components have one or more leads soldered to the top ground plane copper; this is indicated on the overlay diagram by a black dot.

Start with the components that are soldered to the top ground plane – such as the trimmers – for easier access to connections in between components.

The winding details for the coils are given in Table 1. The coils that are tapped (L2, L10) can be wound as separate parts, as two centre holes have been provided on the board for this purpose. Insert the two coils into the board and pass the former (drill bit) through both to align them whilst soldering.

After the two 'tapped' coils are mounted, you can mount the remaining single winding coils. Then the resistors and fixed capacitors.

MOSFET Q3 is soldered underneath the PCB. Drill a hole of 5mm diameter through the board, to fit the body of the transistor. The lead configuration can be identified by the longer drain lead. As can be seen from the component overlay, the transistor is flipped over, so that the codes on the device appear on the *bottom* side of the board. Make sure you have the correct orientation, as it is rather difficult to de-solder.

Tin the tracks on the boards with solder before mounting Q3. To prevent damage to the transistor, just touch the leads briefly with the soldering tip.

As this project uses part of the previous 144-148MHz converter, a few modifications are required to the latter board. Four of the components that were listed previously as optional have to be added now. These are octal buffer IC11, capacitor C26, resistors R22 and R24.

The 8-bit code that is applied to the programmable dividers in the PLL for 70cm reception must be chosen according to the 4MHz segment of the 420-

TABLE 1
Coil winding details

All of the coils are air cored and wound from 0.8mm enameled copper wire.

L1, L2 4 turns on a 4mm (5/32") former, spaced over a length of 8mm. L2 is tapped 1 turn from the grounded end.

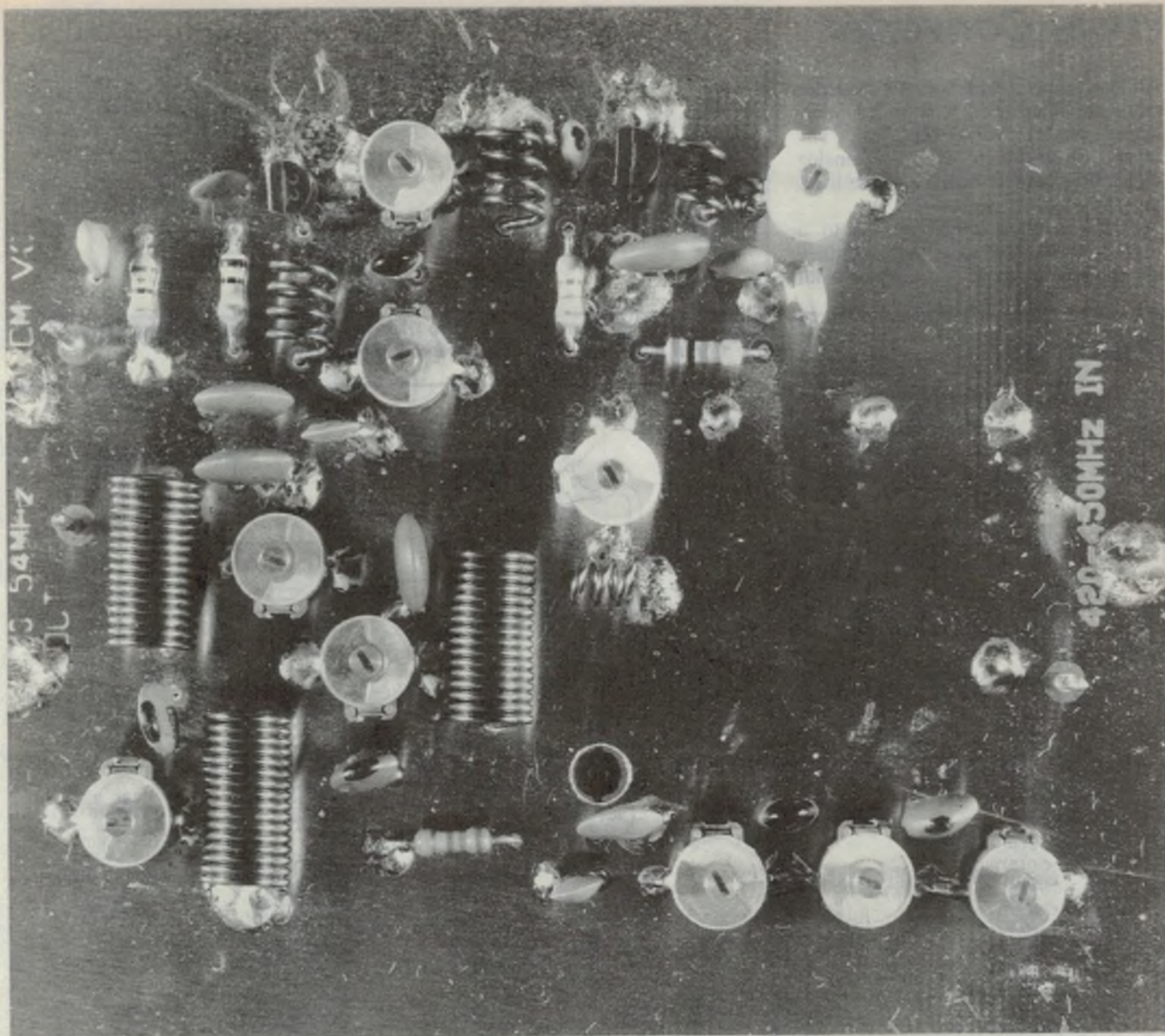
L3, L4 3 turns on a 2.5mm (3/32") former, spaced over a length of 5mm.

L8, L9, L10 16 closewound turns on a 5.5mm (7/32") former. L10 is tapped 4 turns from the 5V power rail.

TABLE 2
PLL programmable divider links

BAND (MHz)	VCO (MHz)	IC11 PIN No.* 2	17	4	15	6	13	8	11
420-424	92.5	+5V	0V	+5V	+5V	0V	+5V	+5V	+5V
422-426	93	+5V	0V	+5V	+5V	+5V	0V	0V	0V
424-428	93.5	+5V	0V	+5V	+5V	+5V	0V	0V	+5V
426-430	94	+5V	0V	+5V	+5V	+5V	0V	+5V	0V
428-432	94.5	+5V	0V	+5V	+5V	+5V	0V	+5V	+5V
430-434	95	+5V	0V	+5V	+5V	+5V	+5V	0V	0V
432-436	95.5	+5V	0V	+5V	+5V	+5V	+5V	0V	+5V
434-438	96	+5V	0V	+5V	+5V	+5V	+5V	+5V	0V
436-440	96.5	+5V	0V	+5V	+5V	+5V	+5V	+5V	+5V
438-442	97	+5V	+5V	0V	0V	0V	0V	0V	0V
440-444	97.5	+5V	+5V	0V	0V	0V	0V	0V	+5V
442-446	98	+5V	+5V	0V	0V	0V	0V	+5V	0V
444-448	98.5	+5V	+5V	0V	0V	0V	0V	+5V	+5V
446-450	99	+5V	+5V	0V	0V	0V	+5V	0V	0V

*Note: All eight pins must be fitted with a link, to either 0V or +5V as shown.



A top view of the assembled converter board, showing the location of all main components. Note that Q3 is mounted on the lower side of the board, with its body visible through the relief hole.

450MHz band you would like to receive. Let's explain the procedure by way of an example.

Say we want to cover the 430 to 434MHz segment. To convert this to the 50 to 54MHz band requires a LO frequency of 380MHz, being the difference between these frequencies. Because of the 4x multiplication used, this means we have to start with a VCO frequency of one quarter of 380MHz, or 95MHz.

Refer now to the construction project on the 144-148MHz converter. The VCO frequency has to be divided down to the equivalent of 0.5MHz in the PLL. The programmable division required is therefore 95/0.5 = 190. As mentioned in the article on the PLL, the input code for the IC11 buffer is the binary equivalent of 190 – 2 = 188, which is 1011 1100. This code is applied to IC11 by soldering a link through the board, either to ground or to +5V.

To save you the hassle of working the programming links out, the linking for all possible band segments are given in Table 2.

This converter is the third board that will be mounted inside the receiver case. To do this, drill and ream a hole for the 420-450MHz BNC input connector in the back of the case, at the same height as the other BNC connectors and about 45mm away from the 144-148MHz input.

The BNC connector will provide sufficient support for one side of the board. To anchor the other side of the board, use a small angle bracket, with mounting screws through the case and the board.

Alignment

It is easier to do the alignment outside the receiver case. The EXT input of the receiver can be used for this purpose. Remember to switch the receiver off whilst soldering the connecting cables.

Connect a 50 ohm coaxial cable from the 50-54MHz output of the new converter board to the EXT input of the receiver. Switch the band selector switch to the EXT position.

Connect another cable from the 50 ohm output of the VCO on the 144-148MHz converter (R24) to the multi-

70cm Converter

An analog meter with a high-impedance input amplifier (i.e., a so-called 'electronic' meter) works the best. The other, direct-driven type of analog meter isn't suitable because of the loading it introduces.

VC1 and VC2 should be set to a more-or-less equal capacitance. If they are not, one trimmer will appear a lot

PARTS LIST

1 Double-sided PCB coded EA90cs5, dimensions 89mm x 100mm
1 BNC panel-mount connector with solder lug

Semiconductor s

2 2N918 or PN3563 NPN transistors
1 3SK121 dual-gate MOSFET
1 74LS240 or 74HC240 octal buffer*

Capacitors

2 1pF ceramic
1 1.5pF ceramic
1 1.8pF ceramic
1 2.7pF ceramic
1 10pF ceramic
4 100pF ceramic
1 330pF ceramic
1 1nF ceramic
1 3.3nF ceramic
1 10nF ceramic*
4 10nF ceramic
2 1.4-5pF Philips trimmer (grey)
3 2-10pF Philips trimmer (yellow)
5 2-22pF Philips trimmer (green)

Inductors

7 Air core coils, wound as in Table 1.

Resistors

Carbon film 5% 1/4W: 1 x 51, 1 x 56*, 1 x 150, 1 x 1k, 1 x 47k, 1 x 100k, 1 x 15k*

Miscellaneous

Light 50 ohm co-axial cable, light hook-up wire, 0.8mm enameled copper wire for coils, PCB pins, angle bracket, two 3mm screws and nuts.

* Additions to the 144-148MHz converter board if not previously fitted.

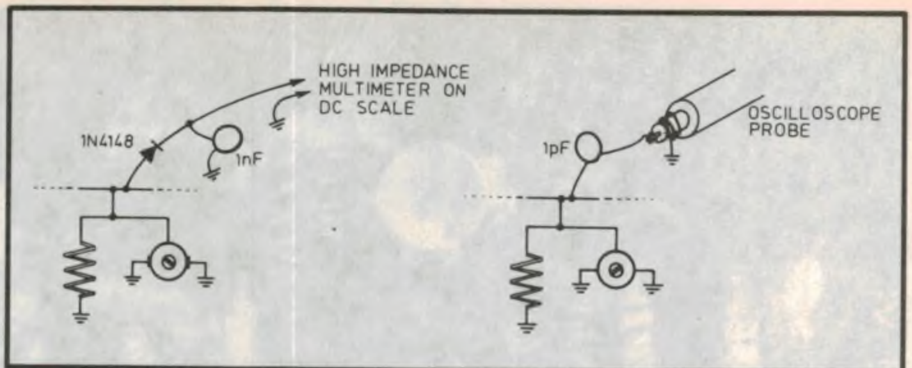
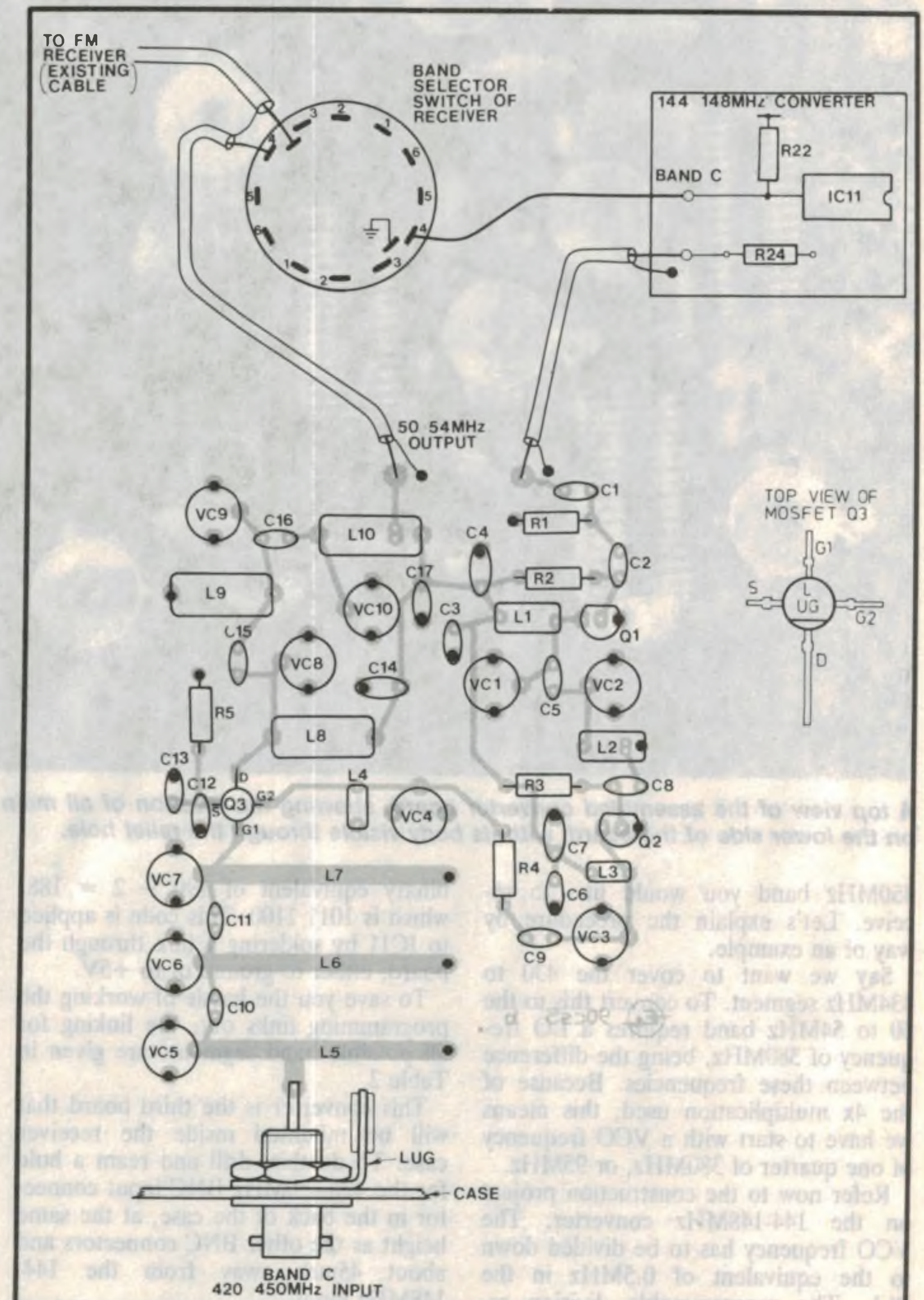
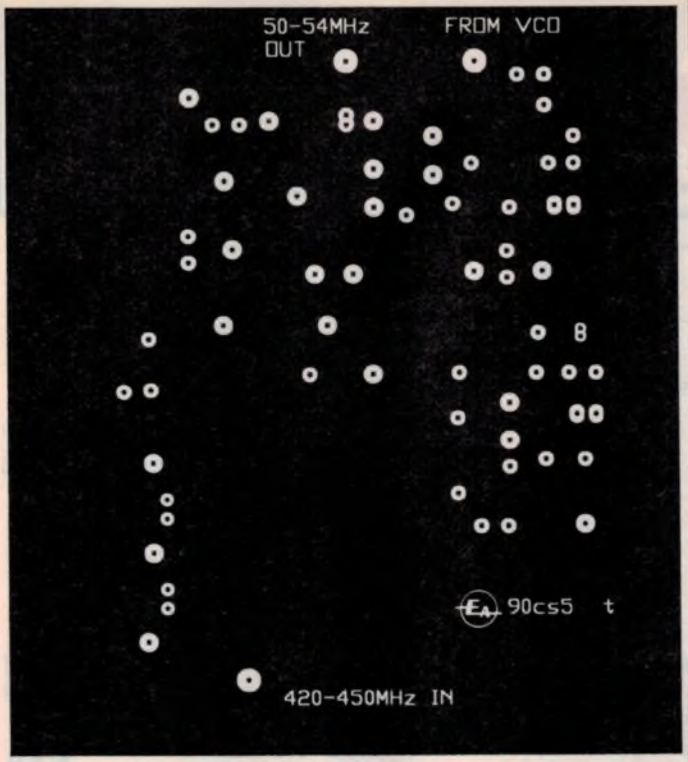
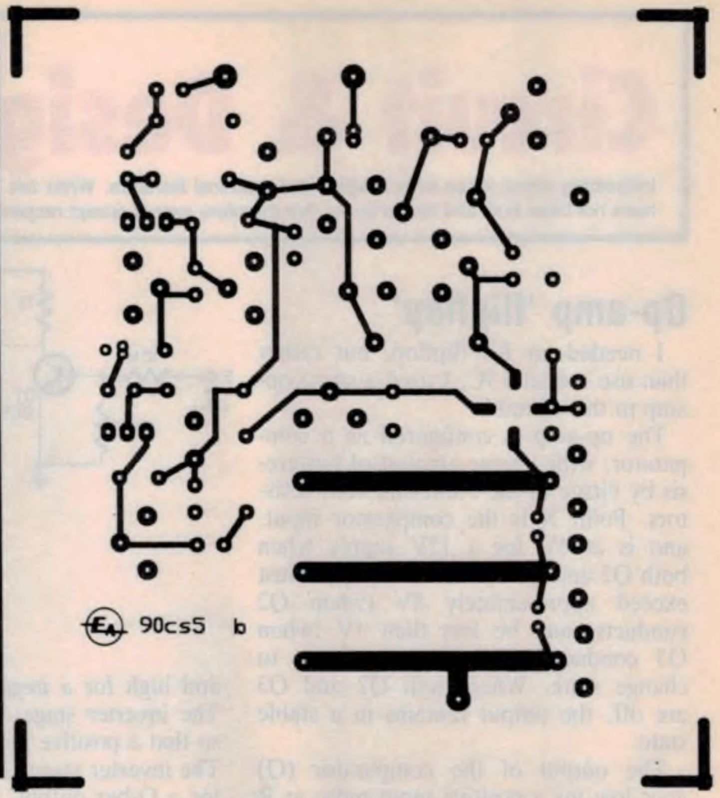


Fig.3: Two ways of coupling to the tuned circuits of the converter, to monitor the signal levels while you're lining up the filters.



The overlay diagram for the converter, showing both the location of parts on the PCB, and the interconnection wiring. Note that the black dots indicate a soldered connection to the ground plane copper.





Here are the two PCB etching patterns for the converter, with the top one at left. Note the three 70cm microstrip lines on the bottom pattern, at lower right.

more sensitive than the other.

To eliminate the de-tuning effect caused by the probe, re-adjust every trimmer when the probe has been moved to the next tuned circuit.

When the multiplier chain is operating correctly, a signal at 4 times the VCO frequency and with a peak amplitude of more than 2V should be present at gate 2 of Q3.

To set the RF and IF filters requires a small signal source in the 420-450MHz range, preferably with some recognisable modulation on it.

Start by setting the trimmers VC5 to VC10 to their midway position. Connect a signal to the 420-450MHz input of the converter, at the centre frequency of the 4MHz band you've chosen. Tune the receiver to this signal.

Adjust trimmers VC5 to VC10 for a peak deflection on the signal strength meter. Also set VC4 again (without any probe on it), according to this meter. The meter we refer to in the rest of this alignment procedure is that of the receiver – the scope probe or diode detector circuit is no longer required.

Next the IF filter needs to be set to the correct Butterworth amplitude-frequency response. Set VC9 to a maximum capacitance. Adjust VC8 and VC10 for a peak meter deflection, with the signal source and receiver still tuned for the centre of the band segment.

plier input of the converter. Ground the enable input of IC11 on the 144-148MHz converter (marked Band C). Do not turn the selector knob whilst this connection is in place.

Firstly, the frequency multiplier chain needs to be set-up. Switch the receiver on, and check that you have the correct VCO frequency, according to Table 2. Also see that the +5V supply is coming through to the converter board.

To set the trimmers of the multipliers requires a low capacitance probe. If you have access to a high frequency scope, use a 1pF capacitor in series with the probe, as shown in Fig.3. The signal will be attenuated, due to the 13pF (typical) input capacitance of the probe, but the signal level is not important as we are really only interested in tuning for a peak response. Keep the ground lead to the probe as short as possible.

It is probably unlikely that you will have a suitable scope. This isn't a problem, as the simple detector shown in Fig.3 works just as well. You may just have to be more patient, especially if you're using a slow digital multimeter. Now change the RF input frequency and receiver tuning to either edge of your 4MHz band segment (+ or –2MHz). Then adjust VC9 for a peak meter deflection.

The RF filter can be given a flat response from 420 to 450MHz by using the same procedure on VC5 to VC7. Alternatively, if you don't envisage changing the LO frequency, you could just leave the RF filter as it is. Its bandwidth is sufficient to cover 4MHz even when all three trimmers are 'peaked' at the centre frequency.

That completes the alignment procedure. Since there are only three active devices in the circuit, fault-finding should be straightforward. Problems in the multiplier stages would have been apparent during the setting-up procedure. A lack of sensitivity would point to a problem with the MOSFET Q3.

The converter board can now be built into the receiver case. The enable input of IC11 on the 144-148MHz converter (marked Band C) and the VCO output are connected to the 4th positions of the selector switch, as shown in the component overlay.

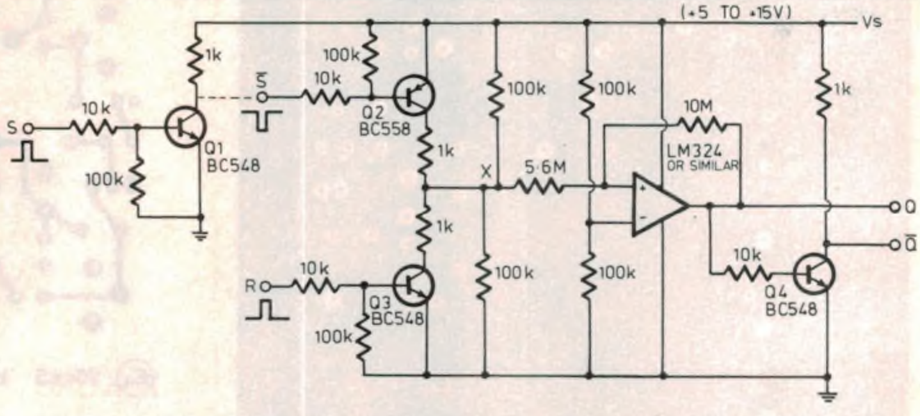
The sensitivity of the prototype measured less than 0.6uV for 20dB (S+N)/N ratio over the 4MHz band. The 3rd order RF filter should give an image rejection of greater than 42dB.

We started this series of amateur radio project with the intention of providing simple and low-cost designs. We believe this converter certainly fulfills that requirement. The overall cost of the multi-band receiver should also be attractive, in the light of the three bands offered.

Circuit & Design Ideas

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

Op-amp 'flipflop'



I needed an RS flipflop, but rather than use a digital IC, I used a spare op-amp in this circuit.

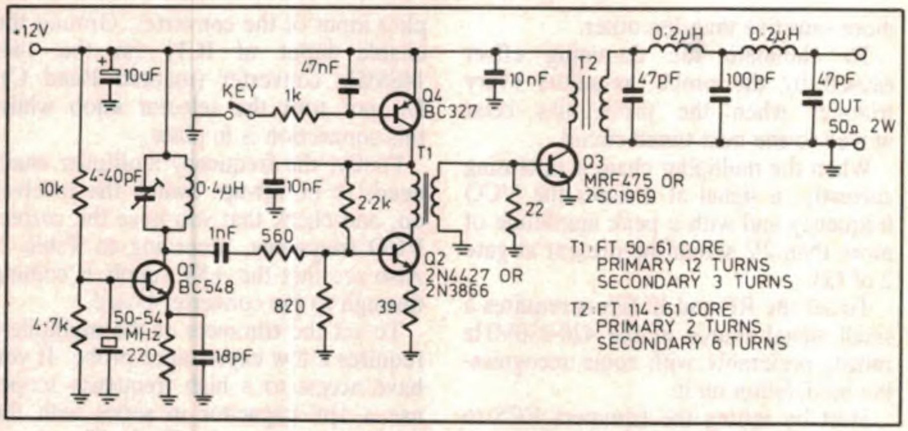
The op-amp is configured as a comparator, with a large amount of hysteresis by virtue of the 5.6M and 10M resistors. Point X is the comparator input, and is at 6V for a 12V supply when both Q2 and Q3 are off. The input must exceed approximately 8V (when Q2 conducts) and be less than 4V (when Q3 conducts) for the comparator to change state. When both Q2 and Q3 are off, the output remains in a stable state.

The output of the comparator (Q) goes low for a positive input pulse at R and high for a negative pulse at S-bar. The inverter stage of Q1 can be added so that a positive pulse at S sets Q high. The inverter stage Q4 can also be added for a Q-bar output, if needed. The two 1k resistors in the collectors of Q2 and Q3 limit the current in the event that both R and S are high at the same time.

Peter M. van Schaik,
Inverell, NSW

$40

Simple QRP transmitter for 6m



For those who can't afford a ready-made transmitter, here is a simple and cheap CW (morse code) transmitter for the 50-54MHz amateur band. It features a 2 watt output, more than adequate for QRP use.

Why CW? After all FM or single side-band are far easier to use. The problem is single sideband needs expensive crystal filters and balanced modulators, and FM would require a lower crystal frequency and at least two frequency multipliers to achieve adequate deviation. Both these options would at least double the complexity (and cost).

Q1, a BC548, forms a crystal oscillator with associated components. The crystal should be at the desired frequency and a third overtone type. The 4-40pF trimmer capacitor and 0.4uH inductor form a tuned circuit at the crystal frequency. The trimmer should be tuned for maximum output at the correct frequency (typically 4 volts peak on the collector of Q1).

The second stage (Q2 + components) is a buffer and amplifier operating in class A. At the input is an attenuator consisting of the 560 ohm, 820 ohm and 2.2k resistors. This has a 7dB loss to provide the correct level input, but its main function is to isolate the oscillator from the rest of the circuit – to increase stability and stop detuning of the tuned circuit on the collector of Q1.

A 2N3866 or 2N4427 is used for Q2 to provide high gain at the required frequency and handle the high DC current (80mA) necessary for class A operation. Because of this dissipation of almost a watt, a clip-on heatsink is required for Q2. Q4 and associated components key this stage. A transistor and two components are used rather than just a morse key, to stop key clicks appearing in the output.

Q3, the power amplifier, is fed around 150mW by transformer coupling from Q2. The transformer matches the output impedance of Q2 (120 ohms) to the 5 ohm input impedance of Q3. This stage is operated in Class C for high efficiency. A second transformer (T2) is used to match the output impedance to 50 ohms. Both transformers are of the conventional type wound on ferrite toroidal cores. This then feeds a low pass filter to remove harmonics and the output.

A 2SC1969 or MRF475 is used for Q3. As both of these transistors are intended for higher power outputs, the output is fairly tolerant of mismatched loads. Q3 will however need a medium sized heatsink to dissipate 2-3 watts. It should also be insulated from the heat-sink as the collector (connected to the case) is not at ground potential.

Jeffrey Harrison,
Mt. Waverley, Vic.

$50

Checkerboard pattern generator for ATV

The idea for this project came from an evening when 70cm and 2m was opened to our New Zealand amateurs.

When looking for DC ATV signals, the normal colour bars, stairstep or grating signals are useless. What's required are large areas of black and white such as a checkerboard pattern.

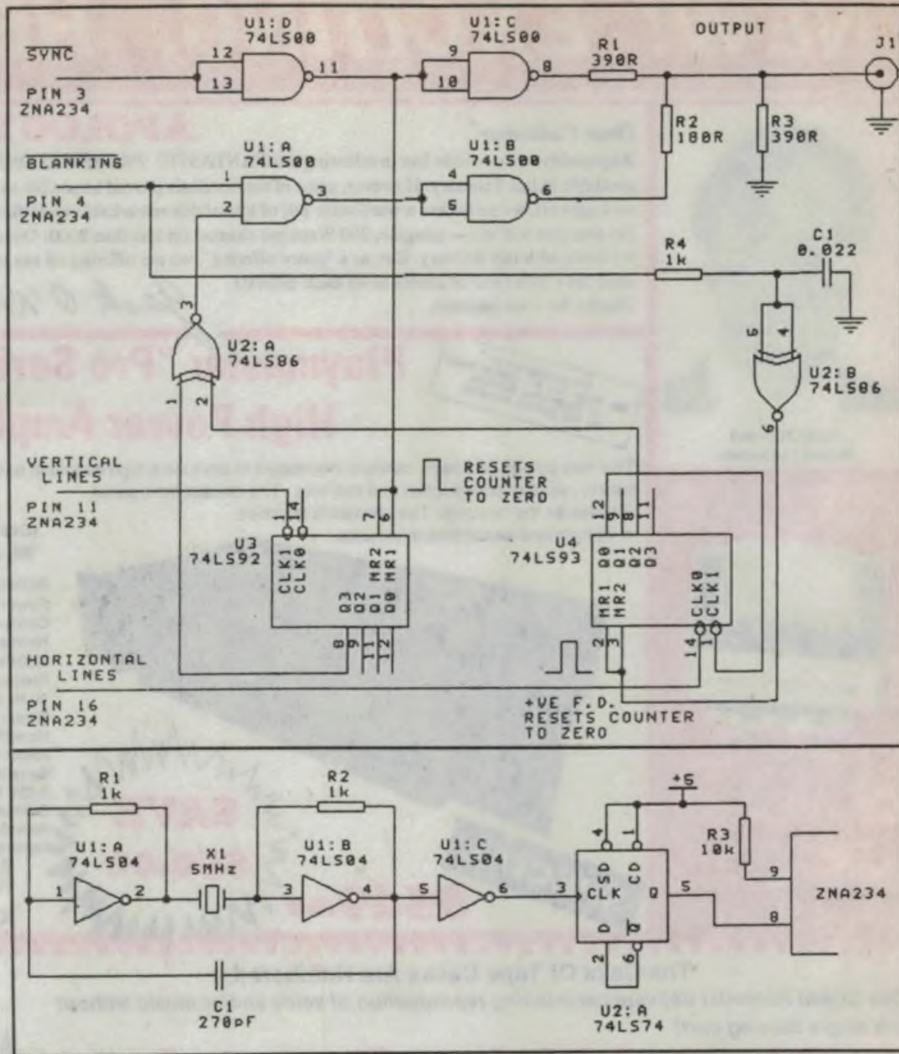
This circuit can interface to any circuit which uses the ZNA234 SPG and pattern integrated circuit, such as the colour bar unit as described in *Electronics Australia* October 1987 by G W Black.

The circuit provides a separate output, which is provided by a 7400 and summed together to provide a correctly blanked checkerboard pattern with syncs. As shown on the schematic, sync and blanking are taken from pins 3 and 4 respectively of the ZNA234. Positive sync is taken from pin 11 of U1d and provides the reset pulse to the vertical counter by taking pins 6 and 7 of U3 +ve during the sync period.

The vertical counter (U3) is clocked via the CK2 input from pin 11 (vertical lines) from the ZNA234. The divide by six output then feeds one input of an exclusive OR gate (U2a). The reset for this counter is provided by producing a vertical drive pulse via the 1k resistor and the 22nF capacitor and U26.

The combined output from pin 3 of U2a is blanked and inverted in the 7400 and combined via the 180 ohm resistor with the sync pulses via the 390 ohm resistor R3.

The different count ratios are required to try and provide a reasonable square output. While not perfect, it does the job. The design is open to other integrated circuits, the ones used being to hand.



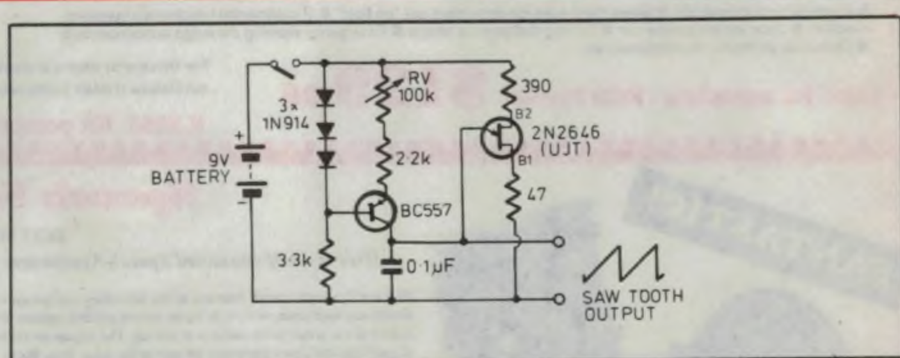
For ATV use the ZNA234 can be fed via an external 2.5MHz clock, derived from a 5MHz oscillator via a flipflop. The 5MHz oscillator is formed by a 7404 hex inverter and is squared up by a hex buffer before being fed to the 74LS74 dual edge triggered flipflop. The output from pin 5 is fed to pin B (ZNA234) while the other oscillator pin, pin 9, is tied to the positive rail by the 10k resistor.

Richard Carden, VK4XRL,
Wavell Heights, Qld.

$45

Linear UJT sawtooth oscillator

While a 2N2646 unijunction transistor provides a convenient source for a sawtooth wave, its output is not linear because it is derived from the exponential charging voltage across a capacitor. This can be largely corrected by charging the capacitor from a constant current source, such as the BC557 connected as shown in the diagram.



Because this BC557 transistor is connected as an emitter follower with the three 1N914 diodes maintaining its base voltage at about 2V less than the positive supply line, its collector current during the charging period of the capacitor will be dependent on the setting of RV which will also control the frequency.

Using the values shown, the frequency range obtained was 50Hz to 1500Hz, and with the transistors used it continued to operate with this supply voltage reduced to below 6 volts. Note that the usual formula for calculating the frequency of the UJT oscillator will not apply.

J. Emery,
Bullcreek, WA

$35

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Jack O'Donnell
Managing Director

APOLOGY

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Jack O'Donnell

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(See EA December '89, January '90)

PERFORMANCE
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Continuous: 140W RMS into 8 Ohm - 200W RMS into 4 Ohms
Harmonic distortion:
0.005% at 100W RMS into 8 Ohms
Frequency response
10 Hz to 100kHz (-3dB points)
Signal to noise
More than 100dB below rated output (unweighted)
Sensitivity
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(Silicon Chip Dec'89)

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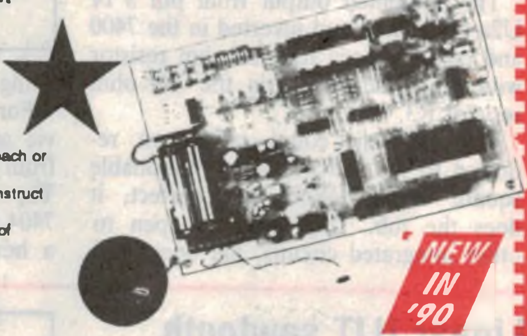
Typical applications include:
● Alarm system messages ● Sales messages for customers put "on hold" ● Experimental telephone answering machine ● Door station announcer ● Talking displays for shops ● Emergency warning message announcement ● Operation instructor for machinery etc.



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(ETI March '88)

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(See EA Dec'87)

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(See Silicon Chip Nov '87, Jan '88)

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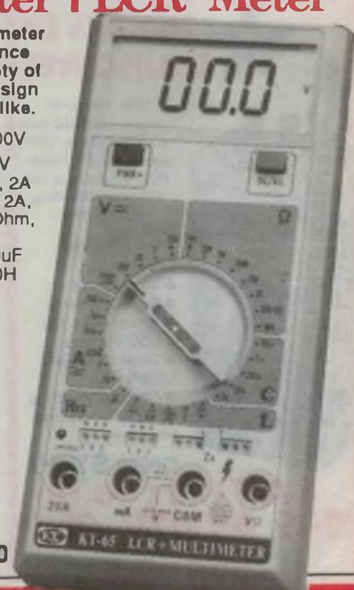
AC Current: 200uA, 2mA, 20mA, 200mA 2A, 20A **Resistance:** 200Ohm, 2kOhm, 20kOhm, 200kOhm, 2MOhm, 20MOhm, 200MOhm
Capacitance: 2nF, 20nF, 200nF, 2uF, 20uF
Inductance: 2mH, 20mH, 200mH, 2H, 20H
hFE test, Diode test



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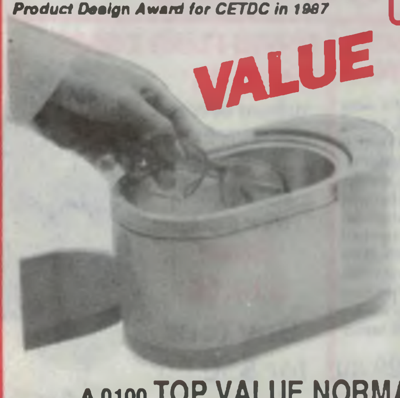

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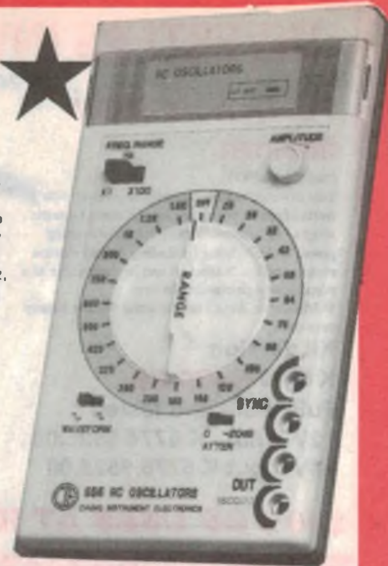

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See EA April/May 89

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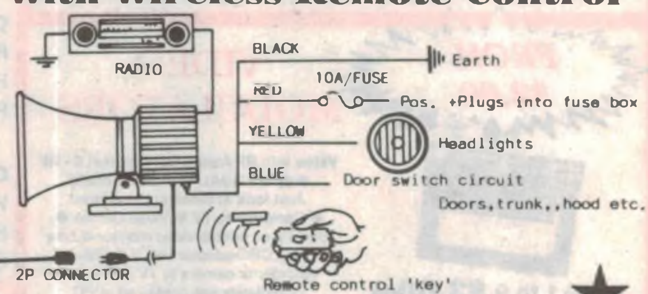

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VALUE

(See EA July '89)
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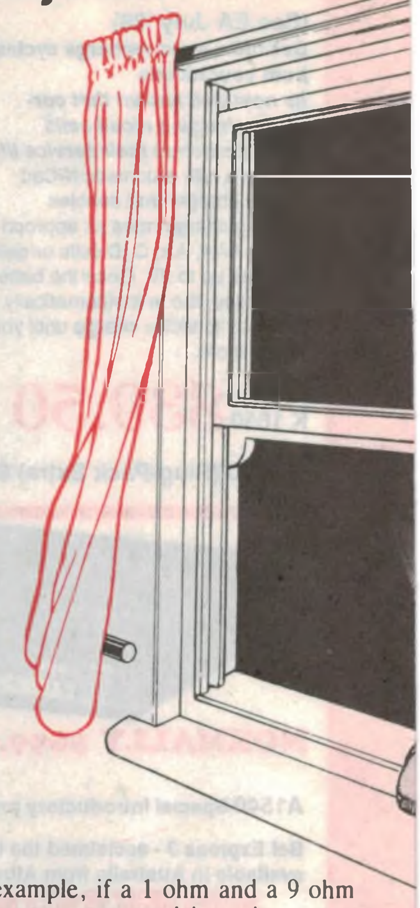
Dick Smith 'Fun Way Into Electronics' Project:

A simple Light Activated Switch



Here's another little project especially for newcomers to electronics, adapted by permission from Dick Smith's extremely popular book *Fun Way Into Electronics*, Volume 2. It's an easy to build light sensitive switching module, which can be used for safeguarding a window or doorway, activating a doorbell when customers enter a shop, or any similar job that requires sensing a change in light level.

It's late at night and everyone is asleep. A thief walks down the street, looking for a likely target. He picks your house.

The house is too exposed to the street for entry from the front, so he decides to take a look around the back.

Silently he sneaks along the passage: then suddenly a bell starts clanging. Instantly everyone is awake – and the thief is off!

Without knowing it, the thief walked into an invisible light beam, shining across the passage into your 'Fun Way' light activated switch. The moment the thief's body cut the beam, the alarm sounded.

Sounds too easy? Build this light activated switch and find out just how easy an alarm of this type is to make!

Of course, there are dozens of other applications for a light activated switch: build it and you could discover one of them.

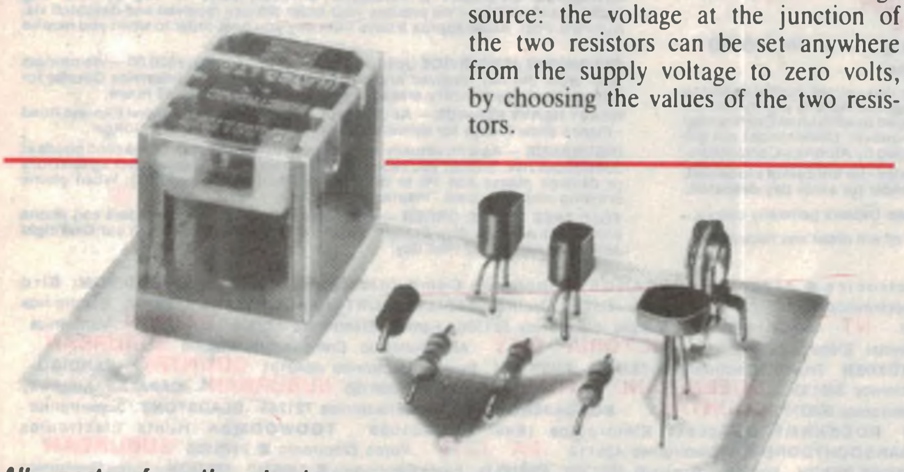
How it works

A light dependent resistor has a very wide range of resistance – in bright light the resistance may fall to just a few hundred ohms (or less). In total darkness, the resistance is usually in the order of a few megohms.

We make use of this wide variation in our simple light activated switch.

Between the positive and negative supply there is a 'voltage divider'. As its name implies, a voltage divider simply 'taps off' a certain percentage of the voltage across the whole divider.

A simple voltage divider consists of two resistors connected across a voltage source: the voltage at the junction of the two resistors can be set anywhere from the supply voltage to zero volts, by choosing the values of the two resistors.



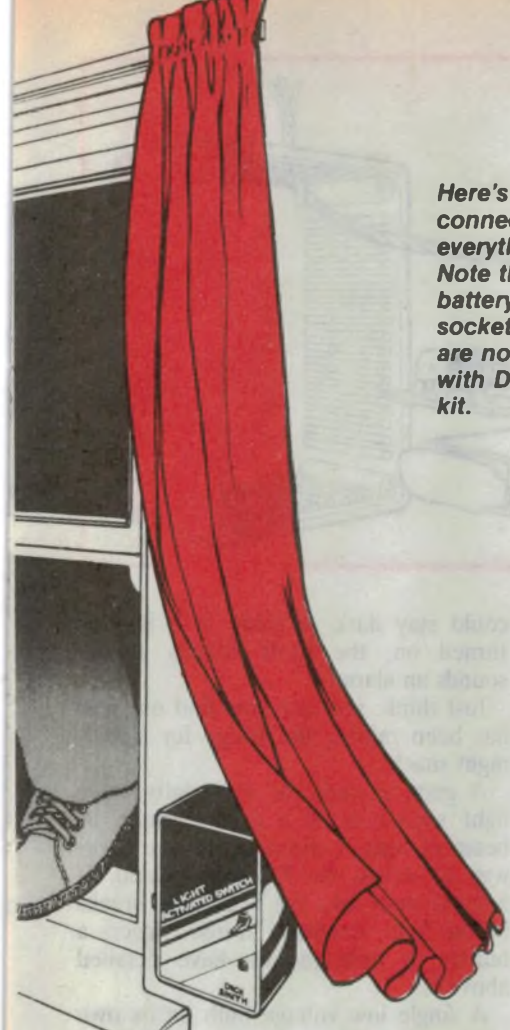
All parts for the basic light-activated switch fit on a small PC board.

For example, if a 1 ohm and a 9 ohm resistor were connected in series across a 10 volt supply, the voltage at the junction of the resistors would be 9 volts with the 1 ohm on top, but would be 1 volt if the 9 ohm were on top.

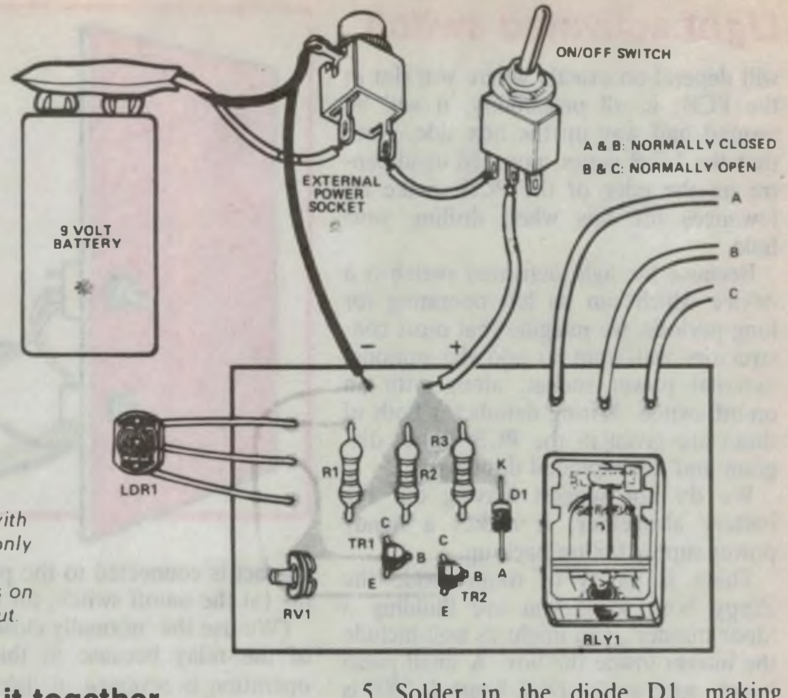
In the light operated switch, the voltage divider consists of two 'variable' resistances. The bottom one is RV1, while the top one is the LDR and R1. In fact, R1 doesn't have any significant part to play in the voltage divider: it is simply to limit current through the LDR and transistors to a safe value should the LDR's resistance fall to a very low level.

The voltage at the centre of the voltage divider (and, therefore, on the base of transistor TR1) is dependent on the setting of RV1, and the amount of light falling on the LDR. In darkness or very low light, the LDR is a very high resistor, (much, much higher than RV1 even set at its maximum). So the voltage at the base of TR1 is too low to turn it on.

When the light level rises, and the LDR resistance falls, the voltage at this point rises. The point is soon reached where the voltage rises high enough to turn on TR1. RV1 can be adjusted to balance out some of the effects of the LDR, and so act as a 'sensitivity' control.



Here's how to connect everything up. Note that the battery, power socket and switch are not supplied with DSE's basic kit.



NOTE! For LDR's with two leads, only use top two connections on P.C.B. Layout.

Because the emitter of TR1 is connected directly to TR2's base, TR2 also turns on with TR1, pulling in the relay. If the light level falls again, TR1 and TR2 turn off, and the relay drops out.

The diode D2 connected across the relay suppresses any voltage 'spikes' which occur as the magnetic field surrounding the relay coil collapses. These spikes occur when the transistor turns off – the changing magnetic field (in this case a decaying field) can induce high voltages across the relay coil. If not suppressed, these could damage the transistor.

Putting it together

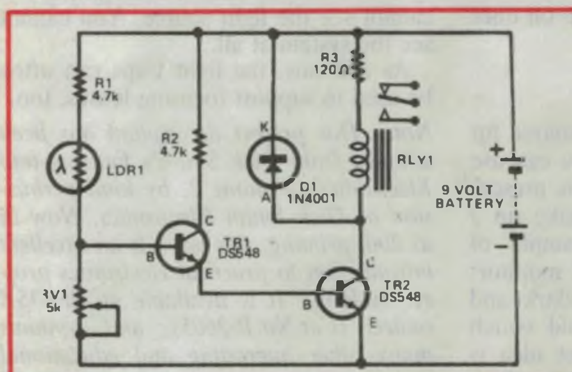
To help you in building this project, the construction steps have been itemised. We suggest you tick them off as they're completed.

1. If you have purchased a kit (Dick Smith Cat. K-2632 or similar), check off the components against the parts list to make sure they are all there and are the correct types and values.
2. If you have not purchased a kit, you will need to obtain the components listed and either make a printed circuit board using the component drawing as a guide, or use Vero board or perforated board and the component drawing as a guide.
3. Mount the components as shown in the component drawing – resistors first (don't forget 'dress'). Then solder these in.
4. Position the relay RLY1 using the five pin configuration as a guide and solder in it.
5. Solder in the diode D1, making sure you have the correct polarity. Place LDR1 in the position shown and solder it in. It is not polarised but in some cases, if you have purchased a kit, you could be supplied with a double LDR, i.e., one with three leads. In this case the third lead (not the centre one) goes to the blank pad. Wired in this way only half the LDR is used and if it at some time breaks down you can unsolder it and use the other half.
6. Carefully position the two transistors TR1 and TR2 so that they are orientated correctly and solder them in, using a heatsink clip to prevent damage from overheating.
7. Solder on the battery snap lead, ensuring first that it is the correct polarity – red positive (+), black negative (–).
8. Clip off all excess wire neatly, making sure that all of the soldered connections are properly made.
9. Check all components to ensure correct position and polarity before connecting the battery.
10. Connect the battery. If LDR1 is in the light, the relay will probably operate immediately but will drop out as soon as you cover the face of the LDR with your fingers.

What to do next

The light activated switch PCB has been designed to fit into a slotted Zippy box. The LDR has been mounted on the edge of the PCB, so its a simple matter to drill a hole through the side of the box for light to reach the LDR.

Naturally, the position of this hole



The complete circuit schematic for the switch. It uses only a handful of parts, but can perform many useful jobs.

Light activated switch

will depend on exactly where you slot in the PCB; in all probability, it will be around half way up the box side. Note that the LDR is not mounted dead centre on the edge of the PCB; make allowances for this when drilling your hole.

Because the light activated switch is a device which can be left operating for long periods, we imagine that most constructors will want to add the optional external power socket, along with an on/off switch. Wiring details for both of these are given in the PCB layout diagram and the exploded drawing.

We do not suggest leaving out the battery altogether, it makes a handy power supply failure back-up.

There is plenty of room inside the Zippy box, so if you are building a 'door minder', you might as well include the buzzer inside the box. A small piezo buzzer such as the Dick Smith L-7009 is ideal in this application; it is polarised, however, so watch the connections. The negative lead goes straight to the negative supply (the negative lug on the external power supply socket is a good connection point); the positive lead goes to one of the 'normally closed' contacts of the relay (A or B in the PCB layout), while the other normally closed contact is connected to the positive supply (at the on/off switch, for example).

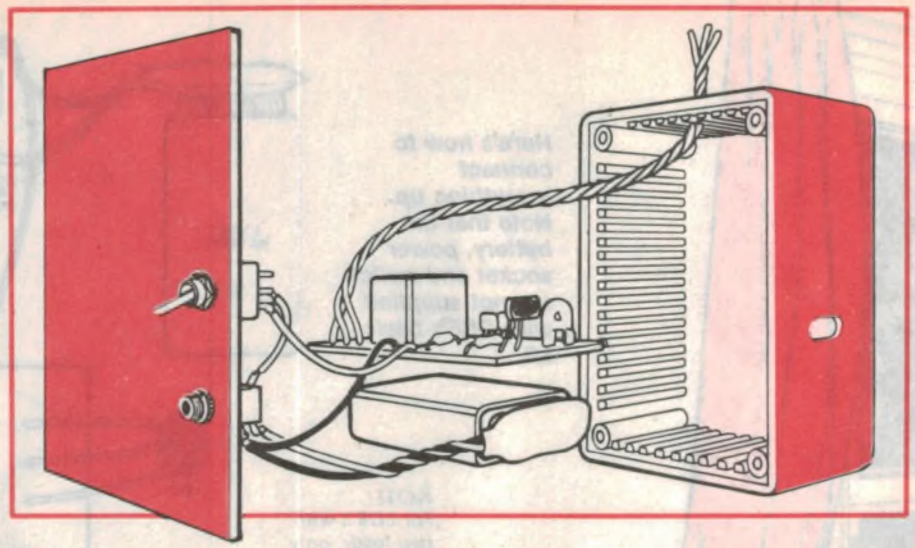
(We use the 'normally closed' contacts of the relay because in this role, the operation is reversed: if light is shining on the LDR, the relay pulls in. If someone walks in front of the LDR, the relay drops out – therefore, the contacts labelled 'normally closed' are becoming 'normally open' contacts! Confusing, isn't it...)

If the light activated switch is being used as part of a security system, use the contacts that best suit the system. But remember our comments above about 'reversed roles!'

There are other uses besides alarm circuits for this project: for example an automatic darkroom warning light. As soon as the darkroom lights were turned off, this project could not only light a 'darkroom in use' light, but also turn on the darkroom safelight!

Or you could make a letter box monitor: a light inside the house could come on if letters were dropped in, hiding the LDR from a small light inside the letter box.

Don't forget that the relay contacts can be made to switch another, larger relay with more contacts and/or more carrying capacity. You could even make the light activated switch 'latch' on once it has triggered.



PARTS LIST

Resistors:

R1	4.7k ohms
R2	4.7k ohms
R3	120 ohms
RV1	5k ohms trimming potentiometer

Semiconductor Devices:

TR1, TR2	NPN type DS548 transistors or similar
D1	1N4002 diode
LDR1	Light dependent resistor

Miscellaneous:

RLY1	9-12 volt relay with changeover contacts.

Battery snap, solder, hook-up wire.

You will also need a 9 volt transistor battery (not normally supplied with a kit) or some other 9V DC power supply.

Also required is a suitable mounting board or printed circuit board of correct design (DSFW2). The DSE Light Activated Switch kit K-2632 contains the correct PCB.

The light source

You have a choice of light source for your light activated switch: you can use artificial or natural light that is present anyway (ambient light), or make up a special light source. An example of using natural light is in a dusk monitor: after sunset, the LDR goes dark and the relay drops out. This could switch on outside lights, etc. Another idea is where the LDR is in a room which could stay dark at night. If a light is turned on, the LDR detects it and sounds an alarm!

Just think: you can now find out who has been raiding the fridge for a midnight snack!

A good example of a specially made light source is in a door minder. A beam of light is shone across the doorway to where the LDR is located. If anyone steps into the beam and breaks it, the light activiated switch triggers a buzzer or light (as we have detailed above).

A single low voltage bulb on its own is often enough, but for best results, the beam should be focused. You can have a lot of fun experimenting with lenses and beams to get the greatest range: small lenses are usually available quite cheaply at disposals and hobby stores.

To obtain minimum false light entry into your 'beam' system, the LDR should be set well back into a light trap such as a cardboard tube painted black on the inside. In fact, the whole Zippy box can be mounted inside a blackened tube!

The light source too, can be mounted in a light trap: this makes it much harder for anyone to see the light beam system – as you cannot see light, if you cannot see the light source. You cannot see the system at all.

As a bonus, the light traps can often be used to support focusing lenses, too.

Note: This project description has been adapted from Dick Smith's Funway into Electronics', Volume 2, by kind permission of Dick Smith Electronics. Now in its 20th printing, this book is an excellent introduction to practical electronics project building. It is available at all DSE outlets (Cat.No.B-2605), and contains many other interesting and educational projects.

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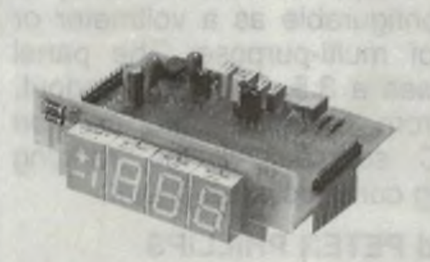

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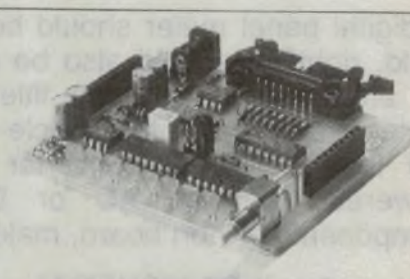

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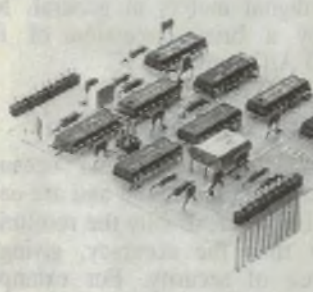

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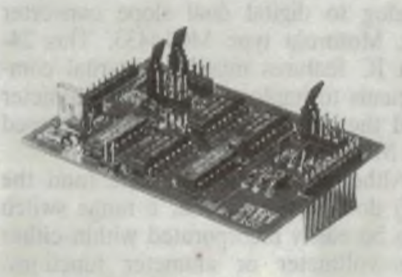

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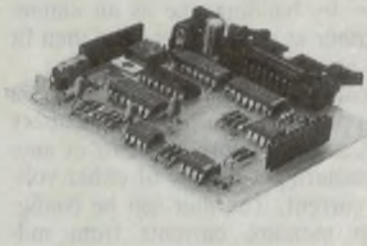

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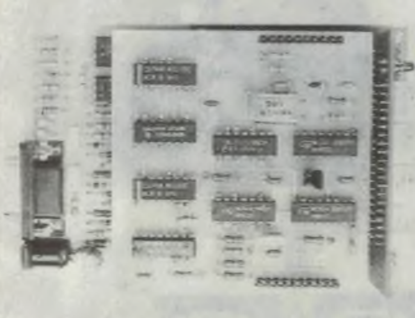

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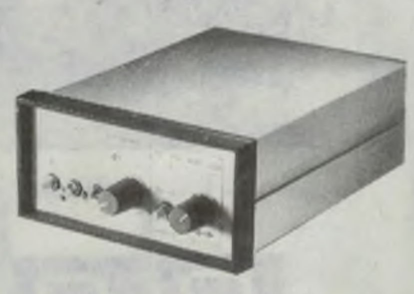

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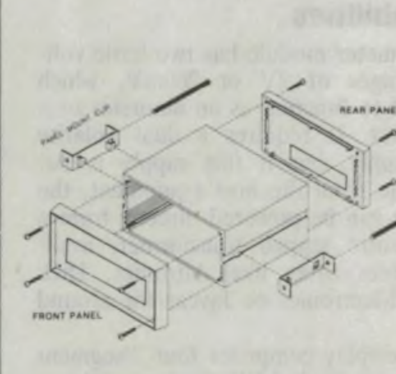

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Construction Project:

A multi-purpose 3.5-digit Panel Meter

A digital panel meter should be cheap, accurate and easy to build, right? It should also be configurable as a voltmeter or an ammeter, to rate the title of multi-purpose. The panel meter presented in this article uses a 3.5 digit LED readout, the latest A to D converter from Motorola, and can be powered from an AC or DC source. All the ranging components are on board, making construction a snack.

by JEFF MONEGAL and PETER PHILLIPS

How many times have you needed an accurate display of the current being taken from a power supply, while the one and only multimeter is tied up measuring something else?

Now you can overcome the problem with our multi-purpose digital panel meter – by building one as an ammeter, another as a voltmeter, and then fit both to your power supply.

The panel meter can also be used in other applications, such as in a battery charger, a temperature indicator or anywhere requiring a display of either voltage or current. The unit can be configured to measure currents from milliamps to 2 amps and voltages from millivolts to 200 volts, making it a piece of test equipment worth its weight in versatility alone. Best of all it is cheaper than any 3.5-digit panel meter on the market today.

Capabilities

The meter module has two basic voltage ranges of 2V or 200mV, which allow it to function as an ammeter or a voltmeter. It requires a dual polarity DC supply, but if this supply is not available from the host equipment, the module can be powered directly from a 15V centre tapped transformer, available from firms like Altronics, Dick Smith Electronics or Jaycar for around $8.

The display comprises four 7-segment common cathode LED displays, giving a 3.5 digit display. If the recommended components are used, the accuracy of the meter will be in the order of 1%, while an adjustment is provided to allow calibration to whatever limit your reference can provide.

The module uses a state of the art analog to digital dual slope converter IC, Motorola type MC14433. This 24-pin IC features minimal external components to implement a complete meter and the design of this project is based on Motorola application notes.

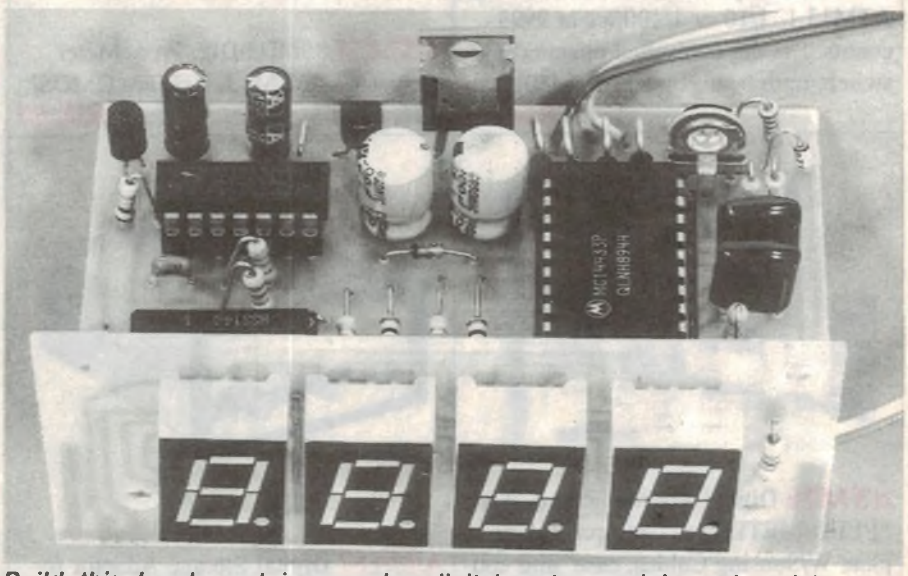
Although the basic module (and the kit) does not include it, a range switch can be easily incorporated within either the voltmeter or ammeter functions. However, it is rather complex to make the one module a switchable voltmeter/ammeter, due to the number of components that need to be changed when switching between functions. The module was designed for fixed range operation, but a description of how to add a range switch is included in this article.

A kit of parts for this project will be available from CTOAN Electronics for $39.95. Bulk purchasing has meant a considerable cost reduction of the A/D converter IC, compared to purchasing these singly and the kit includes all the 1% scaling resistors.

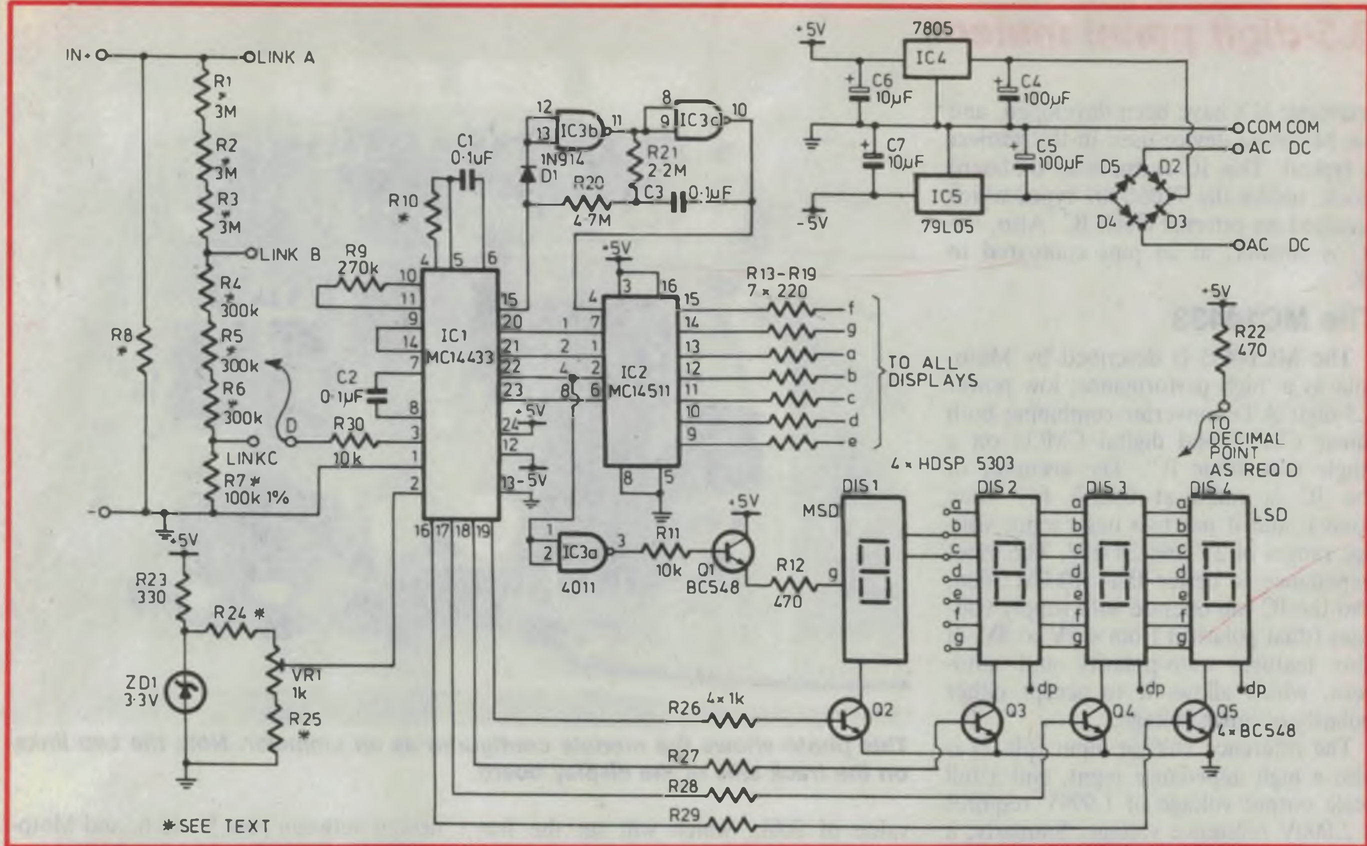
Before describing the project, first a look at digital meters in general, followed by a brief discussion of the MC14433 A/D converter IC.

Accuracy vs. resolution

Digital meters are popular because they have a high resolution and are easy to read. However, usually the resolution is higher than the accuracy, giving a false sense of security. For example, when set to its 2V scale, this meter, like



Build this handy and inexpensive digital meter module and update your benchtop power supply, by replacing its existing moving coil meters.



The circuit diagram of the meter. The digital to analog converter is IC1 which drives the display via IC2 and the multiplexing transistors Q2 to Q5. Over-range indication is provided by the oscillator around IC3(b) and (c), and IC3(a) operates segment 'g' of the most significant display to show a negative input.

most DVMs, is able to resolve voltages as low as 1mV, giving a resolution of 0.05% of full scale. However, if the accuracy is quoted as within (2% plus or minus one digit), a reading on the 2V scale may be in error by up to 41mV, making the 1mV resolution an overkill.

Accuracy is a function of correct calibration and stability of the components associated with the meter, and a figure of 1% or better should be obtainable. Obviously, the higher the stability of the components the better, although the accuracy can still never exceed that of the instrument used as the reference during calibration. Naturally, regular calibration is essential to maintain this figure. The same goes for any measuring instrument, and even the highest quality instruments need regular calibration against a standard reference.

However, a high resolution allows minor changes in a reading to be easily detected, even if the absolute value is out by 1 or 2%. And that's the main virtue of a digital readout – its resolution.

In a power supply, resolution is often more important, providing the accuracy is reasonable. A typical analog panel meter is usually within 5%, but its resolution is often not much better, making the digital readout a good choice to monitor voltage and current values in a power supply.

The A/D converter

The basis of any digital meter is an analog to digital converter (ADC) in which an analog input signal is converted to a digital output that can be displayed on a digital read-out. The two main characteristics associated with any ADC are the conversion time and the linearity.

There are numerous methods used to perform analog to digital conversion, and the choice of method depends on the application. For a digital voltmeter, the dual-slope conversion method is generally used, as linearity is good although conversion time is relatively long. This method is fairly complex, as it requires two basic cycles for the conversion, both controlled by a digital clock signal.

When the cycle is started, the input voltage being converted is connected to an integrator for a fixed time interval, produced by counting a certain number of clock cycles. The integrator is basically a capacitor connected across an op-amp, and the capacitor is charged by the output of the op-amp whilever the input voltage is connected to it. Thus the output of the op-amp will *ramp* in a direction depending on the polarity of the input voltage, at a rate proportional to the value of the input voltage. When the fixed time interval has elapsed, the integrating capacitor will be left charged to a value proportional to the input voltage.

The second half of the conversion cycle measures the time taken to discharge the capacitor, by applying a reference voltage of the opposite polarity to the integrator. During this time, the clock is used to increment a counter from zero, stopping when the integrating capacitor has been discharged. The final count value is then stored in a latch for use by the digital display.

Obviously, this type of converter is fairly complex, and a dedicated IC is the most practical method of implementing the dual slope conversion technique. Around 1980, Intersil introduced the 7106/7107 dual-slope ADC devices designed specifically for use in a digital meter. Since then other dual-slope A/D converter ICs have been developed, and the Motorola device used in this project is typical. This IC features an on-board clock, unlike the 7106/7107 types which required an external clock IC. Also, the IC is smaller, at 24 pins compared to 28.

The MC14433

The MC14433 is described by Motorola as a 'high performance, low power 3.5-digit A/D converter combining both linear CMOS and digital CMOS on a single monolithic IC'. The accuracy of the IC is rated at 0.05% (+/– one count), and it has two basic input voltage ranges of 2V and 200mV. The input impedance is better than 1000M ohm, and the IC can operate with supply voltages (dual polarity) from 4.5V to 8V. It also features auto-polarity and auto-zero, which allows it to accept either polarity of input voltage.

The reference voltage input (pin 2) is also a high impedance input, and a full scale output voltage of 1.999V requires a 2.000V reference voltage. Similarly, a full scale output of 199.9mV needs a reference voltage of 200mV.

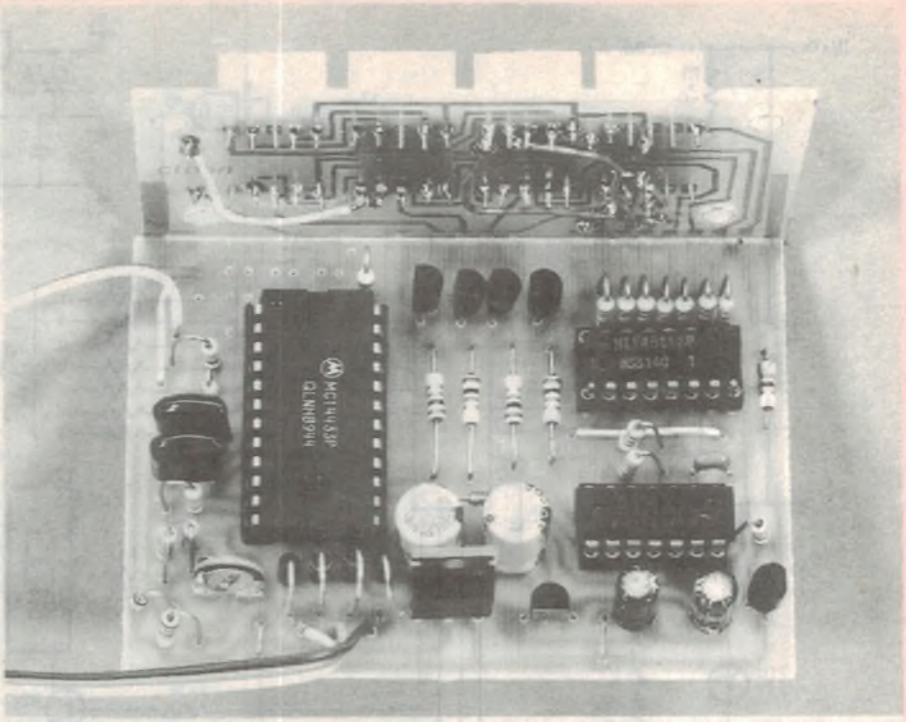
The internal clock frequency is set by the resistor value connected between pins 10 and 11. Motorola recommend a value of 300k, which will set the frequency to 66kHz and give a conversion time of around 250ms. The 270k value used in the project gives a clock frequency of around 60kHz.

The integrating capacitor (C1) is connected between pins 5 and 6, and Motorola recommend a 0.1uF, mylar type. Intersil recommend a polypropylene type (1.0uF) for their IC, which, apart from being expensive, is rather large. We have used a 0.1uF 'green cap', which gives good stability and linearity.

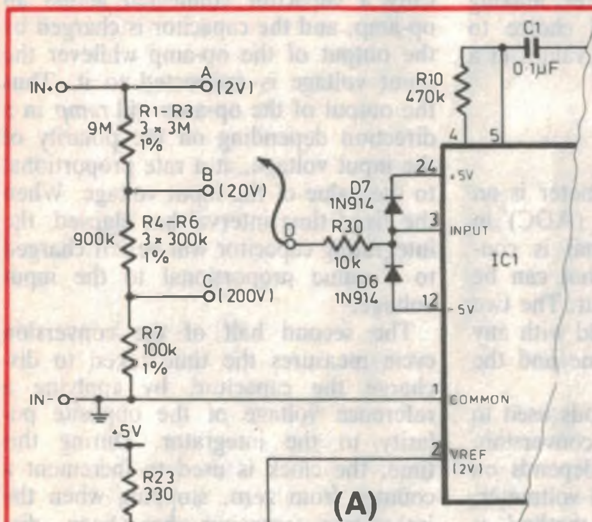
The resistor (R10) associated with C1 is specified as a 480k for an input of 2V and a 28k for 200mV input. The 470k and 27k values used are recommended by Motorola in lieu of the mathematically correct values. For best stability a metal film resistor should be used for R10, and these will be supplied in the kit.

The capacitor (C2) connected between pins 7 and 8 is referred to by Motorola as an 'offset' capacitor, with a recommended value of 0.1uF. No type is specified, but tests on the prototype showed a mylar type gave the best performance.

The digital output is multiplexed and



This photo shows the module configured as an ammeter. Note the two links on the track side of the display board.



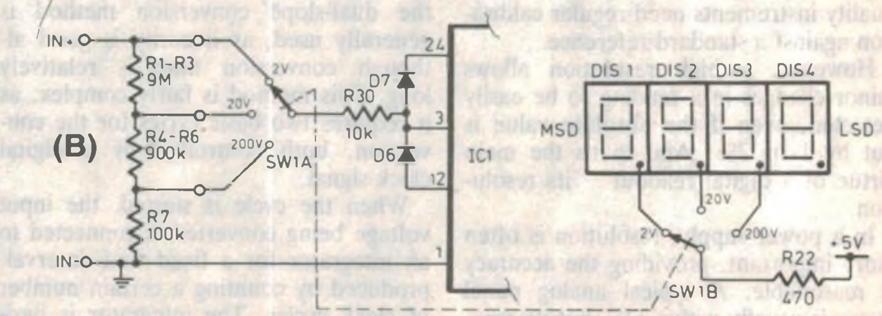


Fig.1: (a) shows the module wired as a voltmeter. Note the optional input protection circuit of D6 and D7 and the values of R10, R24 and R25. If a range switch is added, as shown in (b), the diodes should be fitted by mounting them on the track side of the PCB.

the IC can drive both LED and LCD displays. We chose LED displays as the circuit is simpler, the cost is lower and the display easier to read. The IC has other outputs, including an over-range output at pin 15, which goes low if the input at pin 3 exceeds the reference voltage.

The main feature of the MC14433 is the small number of external components needed to realise a complete meter, which, coupled with low cost and high performance make it an ideal choice for a panel meter.

How it works

As already described, most of the work is done by the dual-slope analog to digital converter chip IC1. The rest of the circuit comprises the input scaling network, the reference voltage, polarity and overload indicating circuits and the power supply.

All the components shown in the circuit diagram are mounted on the PCB, although not all components are needed, depending on whether the module is to be an ammeter or a voltmeter. Three voltage ranges are provided; 2 volts, 20 volts and 200 volts, Similarly, there are three current ranges of 20mA, 200mA and 2A.

When the meter is configured as a voltmeter (see Fig.1(a)), R8 is deleted and resistors R1 to R7 are fitted to the PCB. These are used to attenuate the input voltage so that the maximum voltage applied to pin 3 of IC1 is no more than 2V. For the 2V range, point D connects to point A, while for the 20V and 200V ranges, point D is connected to points B or C respectively.

The attenuating network is simply a potential divider network, where the voltage at point B is one tenth of the input voltage, while the voltage at point C is reduced by a hundred times. Thus, an input of 20V will produce 20V at point A, 2V at point B and 0.2V at point C. The input impedance of the voltmeter equals 10M, which is the sum of the resistance values used in the attenuating network.

The reference voltage for IC1 is derived using the network comprising R23, R24, R25, VR1 and ZD1, supplied from the regulated +5V supply. When the meter is connected as a voltmeter, R24 and R25 are 3.3k and 4.7k respectively, and VR1 is used to adjust the reference voltage to 2V. As already described, the timing resistor R10 is 470k for a 2V reference voltage.

Pins 20 to 23 of IC1 are multiplexed digital outputs and pins 16 to 19 are the display select outputs. The digital output of IC1 is connected to IC2, a CMOS type 4511 seven segment decoder driver, and this IC along with the display select outputs of IC1 multiplexes the LED display.

Because the module has auto-polarity, segment 'g' of the most significant display (MSD) is used to indicate a negative input voltage. Under this condition, pin 22 of IC1 will be low during the on-time of the MSD display (driven on by pin 19). The low signal is inverted by IC3a, which turns on Q1 to supply current to segment 'g' via R12.

Whenever the input voltage is above the reference voltage, pin 15 of IC1 goes low, thereby reverse biasing D1 which allows the oscillator around IC3b and IC3c to operate. The square wave output at pin 10 of IC3c is used to make the display flash, by applying this signal to the blanking input (pin 4) of IC2. The flash rate is set to around 0.75Hz by R20, R21 and C3.

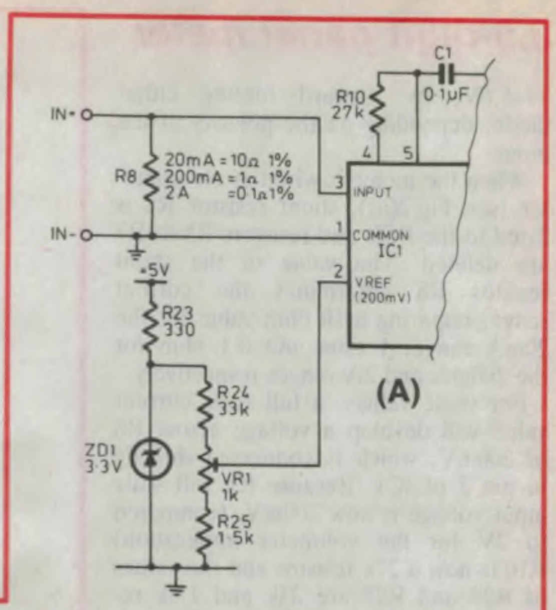
The +/–5V supply rails are regulated by IC4 and IC5. Because the negative supply requires very low current, a 79L05 regulator is used for IC5. The minimum AC input is 7.5V-0-7.5V, although higher values can be used, as later described. The circuit can also be operated directly from a dual polarity DC supply (minimum of +/–8V). Because of the diodes, polarity of the DC supply is not important.

The decimal point for the display needs to be selected externally, either with a link from R22 or through a switch as shown shortly.

If required, a three position, double pole selector switch can be used to switch between voltage ranges as shown in Fig.1(b), and wiring to this switch may be taken from the PCB points reserved for the links. As also shown, the other half of the selector switch is used to switch the decimal point of the display.

However, if a range switch is used in the voltmeter application, a protection network is essential to prevent the voltage at pin 3 of IC1 exceeding the supply rail to the IC. In its basic form, no input protection is provided, as a dedicated single range meter would not normally be subject to overload.

The protection circuit is shown in Fig.1(a), comprising D6 and D7 connected from pin 3 of IC1 to the two supply rails. Provision is made to fit these diodes on the underside of the PCB as shown on the layout diagram. The diodes will limit the voltage to



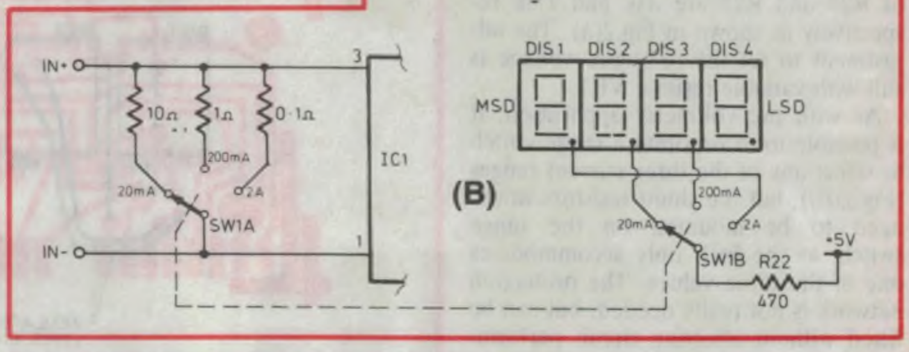


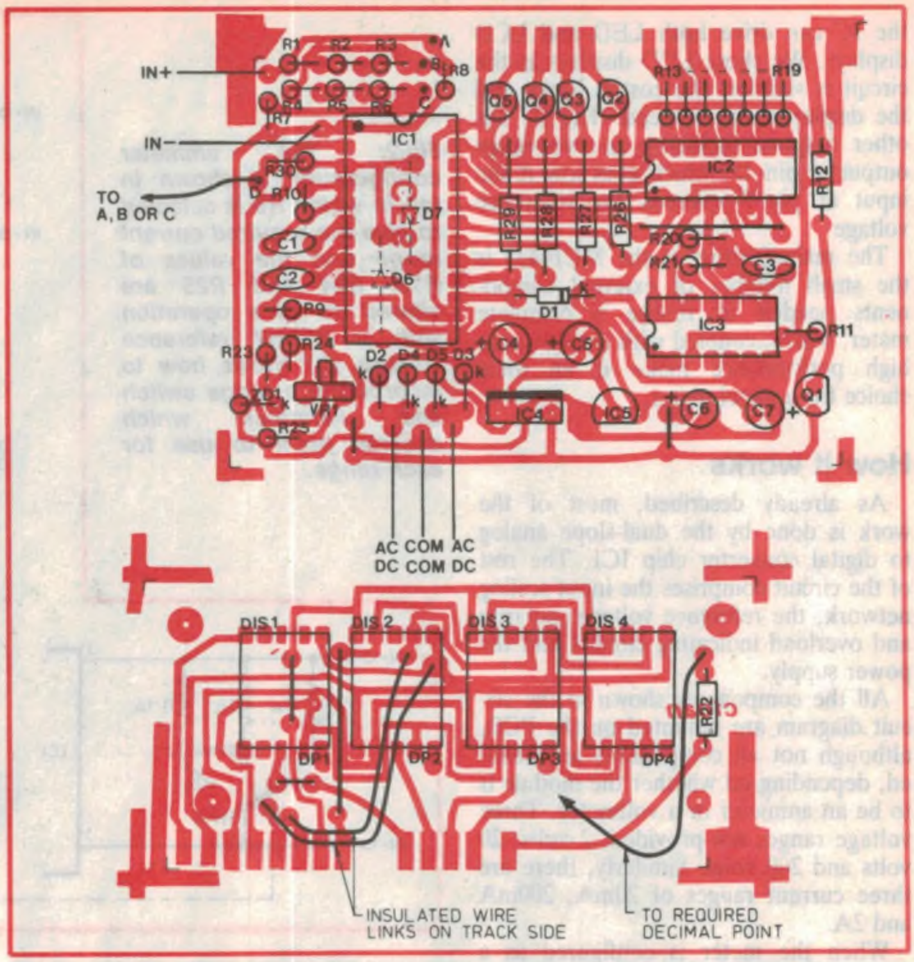
Fig.2: The ammeter configuration is shown in (a), in which R8 is selected to give the required current range and the values of R10, R24 and R25 are altered to give operation with a 200mV reference voltage. (b) shows how to incorporate a range switch and identifies which decimal point to use for each range.

+/–5.6V, by forward biasing either diode, depending on the polarity of the input.

When the meter is wired as an ammeter (see Fig.2(a)), shunt resistor R8 is fitted to the PCB and resistors R1 to R7 are deleted. The value of the shunt resistor R8 determines the current range, requiring a 10 ohm value for the 20mA range, 1 ohm and 0.1 ohm for the 200mA and 2A ranges respectively.

For these values, a full scale current value will develop a voltage across R8 of 200mV, which is connected directly to pin 3 of IC1. Because the full scale input voltage is now 200mV, (compared to 2V for the voltmeter application) R10 is now a 27k resistor and the values of R24 and R25 are 33k and 1.5k respectively as shown in Fig.2(a). The adjustment to set the reference voltage is still with variable resistor VR1.

As with the voltmeter application, it is possible to incorporate a range switch to select any of the three current ranges (Fig.2(b)), but the shunt resistors would need to be mounted on the range switch, as the PCB only accommodates one of the three values. The protection network is not really needed, but can be fitted without affecting circuit performance.



The layout diagram. The optional protection diodes D6 and D7 are mounted on the track side of the main PCB. To conserve space, most of the components are mounted vertically.

Construction

The kit of parts available from CTOAN Electronics includes all components and the PCBs. (See ordering address at end of this article)

Before commencing construction, check the PCBs carefully, as the closeness of some of the tracks increases the likelihood of accidental bridging between them. Also, determine whether you want an ammeter or a voltmeter, whether it is to have switched ranges or fixed ranges and, if the latter, what range. Then by referring to Figs.1 and 2, determine the ranging components required and the values of R10, R24 and R25. *Note particularly the need for the protection circuit of Fig.1(a) if a range switched voltmeter is being constructed.*

Start construction by fitting the three links to the main board, followed by the IC sockets. Next solder the resistors, followed by the transistors, capacitors and diodes. Be careful not to bridge adjacent pads when soldering, and check for correct orientation of all polarised components. Finally, fit the two wires for the input voltage and the three power supply wires. The board should be inspected carefully for solder bridges and other construction errors before commencing work on the display board.

The display board has three links on the component side (one is under the MSD display) and these should be fitted first. The four displays can now be soldered in place, orientated so that the decimal point is at the bottom of the board.

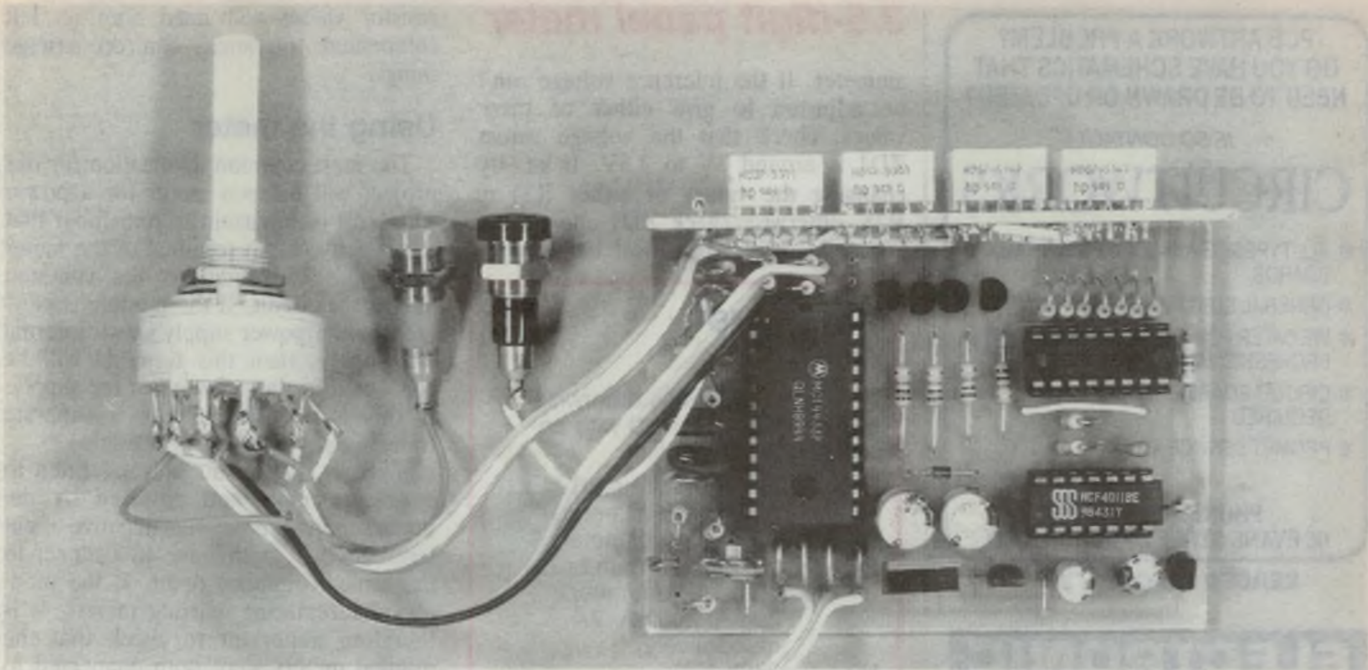
As shown on the layout diagram, there are two insulated wire links required on the track side of the display board. Now fit the 470 ohm resistor and the link to the required decimal point. See Figs.1(b) and 2(b) for details of which decimal point to use for each range. Finally, check the board for any constructional errors before attaching it to the main PCB.

The display PCB is soldered directly to the main board, so that the two boards meet at 90°. Butt the boards, with the display board extending about 3mm below the main board and apply solder at one point to hold the boards together. Once satisfied with their relative positioning, solder the boards together at all remaining connection points.

To ensure mechanical strength and a reliable connection, we recommend soldering a wire bent into a right angle at each connection point. This is a rather fiddly operation, but it will enhance the reliability of the meter. Alternatively two small brackets made of scrap blank PCB material can be soldered to the two ends of the main board and display board, in the form of a gusset. Either way, the whole unit should be a very rugged assembly. Holes are drilled in the display board to allow the unit to be mounted to a front panel.

Testing & calibrating

Once assembly has been completed, the project can be tested. Plug in all ICs except IC1, and apply power to the unit. The power source can be either a 7.5-0-7.5 AC supply (minimum) or a dual polarity +/–8V (minimum) DC supply. The current will be around 120mA or so, and the maximum supply voltage should not exceed 15V (AC or DC). We used one of the venerable



This photo illustrates how a range switch can be added and shows the meter connected as a voltmeter, in which the switch wiring terminates at points A, B, C and D on the main PCB. The decimal point of the display is also switched.

2155-type transformers (multi-tapped 1A secondary) by connecting to the 0V, 7.5V (to circuit common) and 15V tappings. Note that the polarity of a DC supply is not important as the diodes will steer the supply correctly.

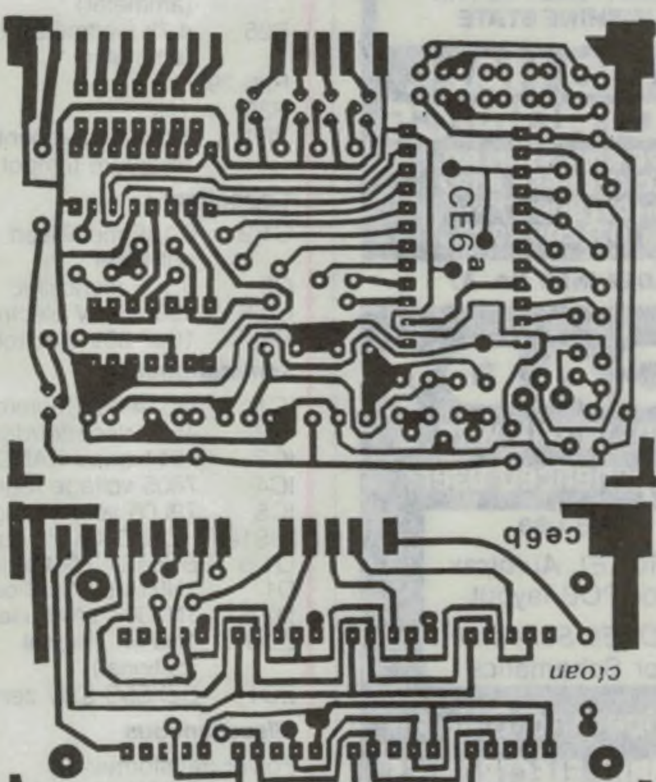
When power is applied, the LED display will not light at all, (even the decimal point), but the +/–5V supply lines can now be checked to confirm they are correct. Also check if the regulators are getting hot, in case there is a short circuit somewhere on the boards. If all is well, switch off the power and insert IC1.

With power re-applied, the display should now light, showing a value that may be varying due to stray pickup. Connect the inputs of the meter to measure the quantity the meter is configured for, and confirm that the display responds. If the display is always flashing or the negative sign is on when it shouldn't be, check for track shorts.

If the display doesn't change or incorrect characters are being displayed, try a replacement for IC2. We constructed numerous prototypes and found that most faults (if any occurred at all) were due to solder bridges, rather than a faulty IC or component.

If all is well, try testing the over-range indication by applying an input value slightly above the full scale value. The whole display should flash on and off. Then try reversing the polarity of the input, and confirm that segment 'g' of the MSD display lights. Finally the unit can be calibrated by comparing the reading to that of a known reference meter. Adjust VR1 until the two meters agree, and confirm that the readings agree over a range of inputs. If necessary, average the setting of VR1, although the prototypes all showed excellent linearity.

You should find that the reference voltage at pin 2 of IC1 is very close to 2V for the voltmeter and 200mV for the



The artwork for the project is reproduced full size for those who wish to make their own PCB.

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ammeter. If the reference voltage can't be adjusted to give either of these values, check that the voltage across ZD1 is around 3V to 3.3V. If so, try changing the values of either R24 or R25, otherwise check ZD1 and the associated circuit. It is most unlikely the resistor values will need altering, but component tolerances can do strange things.

PARTS LIST

Resistors

All 5%, 1/4W unless otherwise stated. Those marked with an asterisk are metal film.

R1,2,3	3M 1% (voltmeter) *
R4,5,6	300k 1% (voltmeter) *
R7	100k 1% (voltmeter) *
R8	10 ohms, 1 ohm or 0.1 ohm 1% (ammeter: 20mA, 200mA, 2A respectively) *
R9	270k *
R10	470k (voltmeter) or 27k (ammeter) *
R11	10k
R12,22	470 ohms
R13-19	220 ohms
R20	4.7M
R21	2.2M
R23	330 ohms *
R24	3.3k (voltmeter) or 33k (ammeter) *
R25	4.7k (voltmeter) or 1.5k (ammeter) *
R26-29	1k
R30	10k
VR1	1k vertical mount miniature trimpot

Capacitors

C1,2	0.1uF metallised polyester
C3	0.1uF monolithic
C4,5	100uF 16V electrolytic
C6,7	10uF 35V electrolytic

Semiconductors

IC1	MC14433 (Motorola)
IC2	4511 decoder/driver
IC3	4011 quad NAND
IC4	7805 voltage regulator
IC5	79L05 voltage regulator
DIS1-4	HDSP5308 (or equiv)
Q1-5	BC548 NPN transistor
D1	1N914 signal diode
D2-5	1N4004 1A diode
D6,7	1N914 signal diodes (optional)
ZD1	BZX55C 3.3V zener

Miscellaneous

Power transformer 240/7.5-0-7.5V (if required); IC sockets, 1 each: 24, 16 & 14 pin; PC boards coded CE6a and CE6b; wire, wire links, solder etc.

Using the meter

The most common application for this project will be as a meter for a power supply. It is important to remember that the negative input terminal of the meter module is connected to the common line of the circuit. If the module is powered by the power supply's own internal DC supply, then this terminal will be connected to the common of the supply. If this is a problem, use a separate transformer to power the module.

Similarly, if two modules are fitted to a power supply and powered by the same supply source, the negative input terminals will both have to connect to the same (common) point. If the modules are replacing existing meters, it is therefore important to check that the original meters were both connected to this common point. If not, power one or both of the modules with separate supplies.

Although the module is small enough to replace most typical moving coil meters, it is not necessary to mount the modules into the case of the power supply. Instead, a separate case containing one or more modules could be constructed, and connected to the output terminals of the power supply. The modules can be powered with a transformer, and the resulting unit will be available for general use if required.

Whatever your use, this project should give you a meter that is stable, reliable and accurate. To enhance the display, use some type of red filter over the displays, and throw away those tired old moving coil meters.

A kit of parts for this project is available from CTOAN Electronics for $39.95 plus $2.50 post and packing. The kit contains the PCBs and all components, including all the 1% resistors required in the ranging circuits. A fully built and tested unit made to your specifications is available for $65.95.

CTOAN Electronics also offers a full backup and repair service for the kit. The cost is $20.00 plus $2.50 P&P which covers replacement of IC1. Only kits built as described in this article can be accepted for repair. To order, write or phone:

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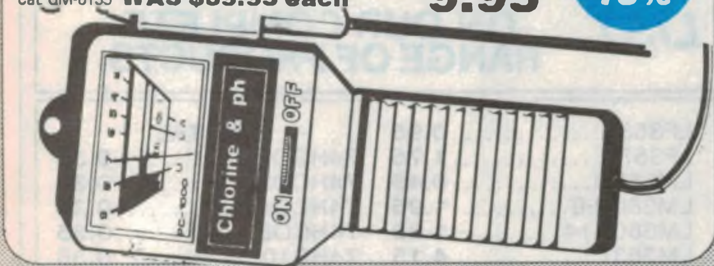

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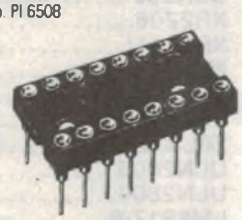

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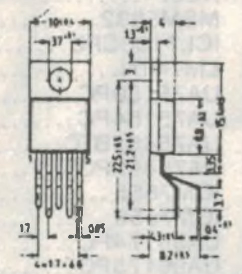

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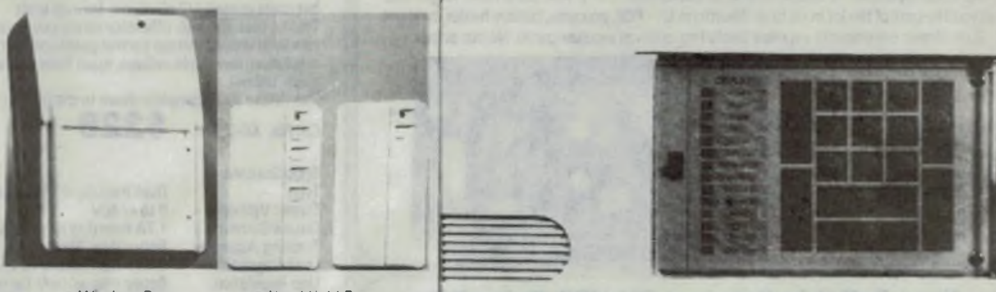

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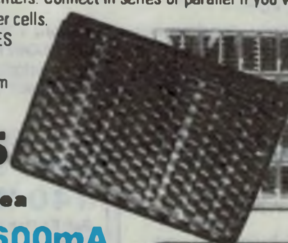

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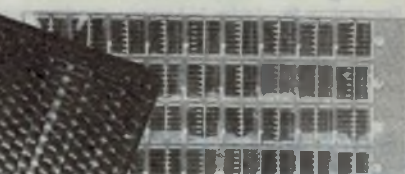

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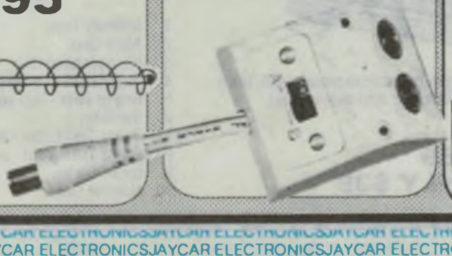

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A 1.5 to 9V DC/DC convertor

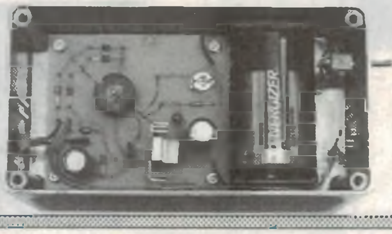
Ref: EA May 1990
Replace those expensive 9V batteries with an economical 1.5V D cell. Lasts much longer and saves you the cost of the kit in no time. Shortform kit - PCB, potcores, battery holder, heatsink and all electronic components supplied (excluding optional receiver parts). No box or box hardware supplied.

Cat. KA-1724

ONLY

$19.95

Box not supplied



±50V (0-100V) 1.5A Dual Tracking Power Supply Kit

Ref: Silicon Chip April '90
This magnificent switchmode type laboratory power supply has great professional features but costs around 1/2 of inferior built up units.
This kit features high efficiency toroid power transformer, professional high resolution 10-turn wire wound voltage control potentiometer, latest I.C. technology, excellent line load regulation, low ripple voltage, apart from a smart plastic case! (for more information see specs below)
The Jaycar kit is complete down to the last nut and screw as well as all hard-to-get I.C.'s.

Cat No. KC-5073 **$229**

Specifications

Type:	Dual tracking with switchmode pre-regulators for high efficiency
Output Voltage:	0 to +/-50V
Output Current:	1.7A from 0 to 87V; 1.5A at 91V; 1A at 100V
Tracking Accuracy:	Better than 30mV
Load Regulation:	Better than 500mV at +/-V and 1A
Line Regulation:	Better than +/-5mV for mains voltages from 220-260V AC
Ripple output:	Less than 3mV p-p at full load
Protection:	Fully protected against output short circuits and forward and reverse voltages connected to the output; fuse protection for the power transformer.

Non First Syllable Dropped Off VOX Relay Kit

Ref: Silicon Chip April '90. At last a VOX (Voice Operated Relay) that does not cut off the first bit of speech! This clever project uses an acoustic delay to prevent the common fault in all but the most expensive VOX circuits - the 10mS or so of that is lost by relay operating time. It may not sound much but it is very annoying and a long time in speech terms.
This kit is supplied by Jaycar in a short form, i.e. without case, front panel, plug adaptor etc. This saves you over $20 on the price otherwise, as we believe most of these projects will be built into other equipment anyway. All other parts (including all PCB parts) included.

Only $59.95 Cat. KC-5074

Specifications Signal delay: 16.4 miliseconds • Clock frequency: 15.7kHz • Frequency response: 100Hz to 43kHz within (pm) 3dB • Maximum output signal: 800mV RMS • Maximum input sensitivity: 0.7mV RMS (to actuate relay) • Harmonic Distortion: <0.5% at 250mV and 1kHz <1.5% at 800mV and 1kHz • Signal to noise ratio: (ms) 66dB unweighted with respect to 500mV RMS at the output

LEAD ACID BATTERY CHARGER

Ref: Silicon Chip March 1990
Comprehensive battery charger for GEL batteries. Charges both 6 & 12 volt batteries. Charging rates: 1.2Ah (250mA); 2.5Ah (520mA); 4.5Ah (900mA); 6Ah (1.2A); 15Ah (3A). Charges our range of GEL batteries. Includes PCB and all board components. No box or front panel. Transformer not supplied: 1.2Ah-4.5Ah use MM-2008 $18.95 or 6Ah-15Ah use MM-2000 $37.95.
Cat. KC-5071
$69

PRO SERIES 1 POWER AMP - 140 WATTS RMS PER CHANNEL

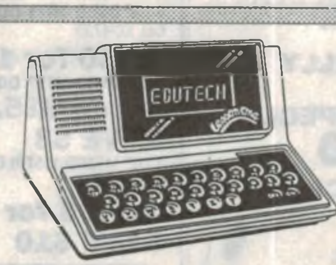
Ref: EA Dec 1989/Jan 1990
NEW - upgraded design - now gives 140W rms channel into 8 ohms.
Dual toroidal transformers supplied.
Cat. KA-1725
$599

VHF Powermatch Mk II

Ref: EA July 1990
Measure RF volts, power SWR and impedance well into the UHF region. The Jaycar kit is shortform in this instance. All specified components EXCEPT the diecast case and bracket, labels, etc., is supplied. The diecast case, Cat. HB-5016 is available separately for $25.95.
Kit (shortform) Cat. KA-1728

ONLY $39.95

ADELAIDE STORE NOW OPEN
190 Wright Street
Ph: (08) 231 7355



Children are encouraged to learn to compose music, spell, learn maths and play strategic games all on their own without supervision!!
Cat. XC-3050
NORMALLY $69
SAVE $30 ONLY $39

Lesson One

1. Memory Tune
2. Math Quiz
3. Multiplication Quiz
4. Am I Correct - math practice
5. Begins with - first spelling
6. Spelling
7. Guess That Letter - auto or program manually
8. Guess That Word - auto or program manually
9. Letter Finder
10. Number Finder

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30 Piece Engineer's Driver Set

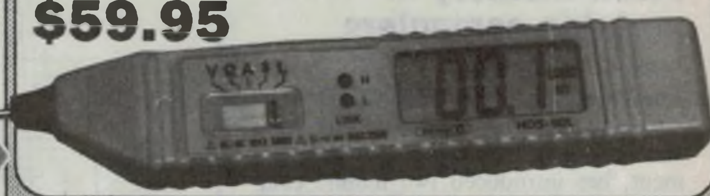
At last! A driver set incorporating those obscure shaped heads!
Have you ever needed recently to service an electric tool? Chances are you would not have been able to do so because the screws holding the appliance together had strange shaped heads.
Well now you can with our 30 piece driver set! This set contains all the driver bits you are EVER likely to encounter. (See below). Basic to the set is an 8 1/2" Chrome-Vanadium driver which will accept any of the 28 hardened steel bits supplied. They are held into the socket of the driver by a small magnet - so you can use the driver in any position. The screw together hollow handle will hold several tips so you don't have to take the whole set with you into the field. There is a tip here to suit almost any screw/nut you may come across.

Here's what you get:
- 5 slotted bits 0-1, 3-4, 5-6, 8-10, 12
- 5 hex bits 3/32", 5/64", 7/64", 1/8", 9/64"
- 4 Philips bits No 0, 1, 2 & 3
- 4 square recess bits No 0, 1, 2 & 3
- 6 Torx bits T10, T20, T25, T30, T40
- 2 Pozidrive bits No 1 & 2
- 1 x 1/4" drive socket adaptor
- 1 x 1/4" drive hex bit holder

And it's all housed in a sealable tough plastic case.
Cat. TD-2000
$19.95

Probe Type Digital Multimeter 3 1/2 Digits - Manual or Auto Range with Logic Probe

This fantastic 3 1/2 digit meter is actually easier to use than a conventional hand-held unit. The readout is in the body of the 'probe' itself so you don't have to avert your eyes to get a circuit reading. The unit has most of the features of conventional meters as well!
Logic Probe Bonus. This TTL/CMOS compatible feature will test logic 'HI' or logic 'LO'. The circuit is protected to 250V. All electrical symbols are shown in the large (42mm x 18mm) window.
Cat. QM-1420
$59.95



RE/Sponse SPEAKERS

- High Power
- High Quality
- Dual Impedance

See catalogue for full specs.

6" woofer
4/8 ohm 80W rms Cat. CW-2140 **$69**

8" woofer
4/8 ohm 120W rms Cat. CW-2142 **$99**

10" woofer
4/8 ohm 160W rms Cat. CW-2143 **$149**

12" woofer
4/8 ohm 200W rms Cat. CW-2145 **$179**

Dome midrange
4/8 ohm Cat. CM-2090 **$47.50**

Dome tweeter
4/8 ohm Cat. CT-2010 **$29.50**

AUTORANGING TRUE RMS 3.75 DIGIT METEX

- 5/sec sampling
- Data hold
- Frequency counter
- Diode continuity

See catalogue for full details
Cat. QM-1500
$169.50

3.75 DIGIT 4000 COUNT 39 RANGE

- Inductance
- Capacitance
- Frequency
- Temperature
- Peak hold
- Logic

See catalogue for full details
Cat. QM-1475
$179

SPECIAL NOTE

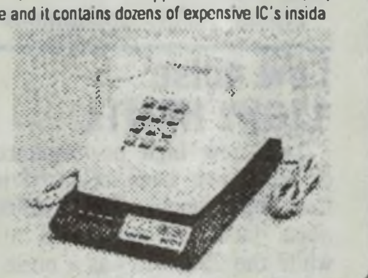
Although both modems are capable of operating on Telecom lines they are NOT Telecom approved. They may be used on private telephone line systems. These units are basically being sold as surplus items for the valuable parts they contain.
LIMITED QUANTITIES

Racal Brand VA212LC Modem

1200 Baud Full Duplex (Compatible with V.22 Aus)
NOT TELECOM APPROVED
This stand alon modem is made by Racal-Vadic in the USA. It is capable of full duplex asynchronous operation at 0-300bps (low speed) and 1200 bps (high speed). It has Bell 103/212 (V.22 compatible) capability and has either manual or auto answer capability. It also has auto diagnostics and comes with Australian made approved power supply.
The price we are asking, of course, is ridiculous. The approved 9-0-9V 13VA (AC) power supply is worth $20 alone and it contains dozens of expensive IC's insida stylish plastic case.
Grab one while they last!
Supplied with Telecom plug.
SEE SPECIAL NOTE:

Cat. XM-5052
$99

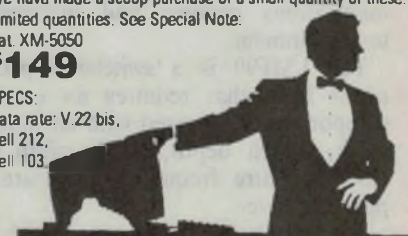
IBM & PC are trademarks of International Business Machines
LIMITED QUANTITIES



Racal "The Maxwell Modem" IBM PC Card Modem #2400PC

NOT TELECOM APPROVED
This famous modem card fits straight into your PC, XT, etc. It is absolutely complete down to the 72 page instruction manual, internal connection leads and "George 2.0" system software supplied on 5.25" floppy and 160+ page book. With "George 2.0" you can do all sorts of wonderous things.
We have made a scoop purchase of a small quantity of these. Limited quantities. See Special Note:
Cat. XM-5050
$149

SPECS:
Data rate: V.22 bis,
Bell 212,
Bell 103.



Jaycar ELECTRONICS

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FACSIMILE (02) 744 0767

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MAIL ORDER VIA
ROAD FREIGHT ANYWHERE IN AUSTRALIA (up to 20kg) $13.50

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Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Flash memory in portable computers

Intel's Flash Memory Operation has announced that Psion PLC (London), a leader in portable, hand-held computer and solid-state disk technology development, has introduced two mobile computers incorporating Intel flash memory technology.

The new 4.3-pound, notebook size computers use Intel one-megabit flash memories, mounted in modules the size of a matchbook, in place of disks to store user files.

The flash memory is said to provide a more durable, compact and higher speed alternative to the traditional disk drive.

Intel's 28F010 flash memory is offered in access speeds from 150 to 200 nanoseconds in both 28-pin CERDIP and 32-lead PLCC packages. All Intel flash memories are available now in volume.

Further information from Intel Australia, 200 Pacific Highway, Crows Nest 2065 or phone (02) 957 2744.

Monolithic elliptic notch filter

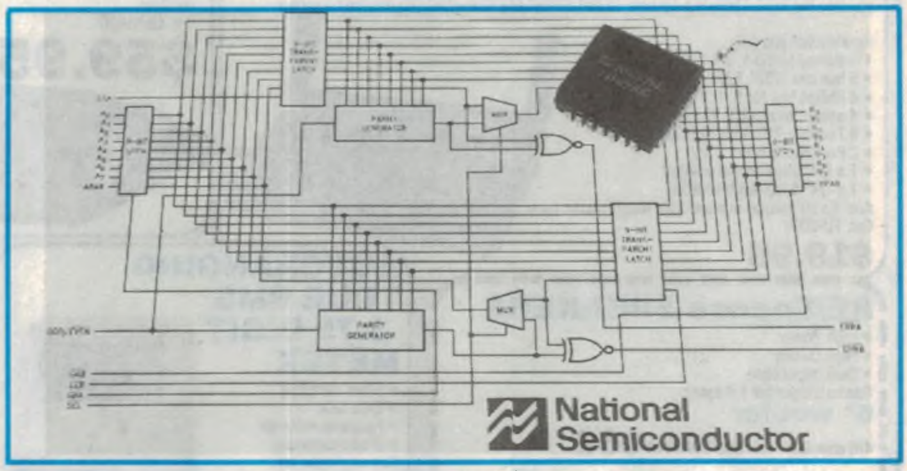
Semiconductor has announced the industry's first monlithic 4th-order elliptic-notch filter, designed for the rejection of power-line interference in electronic systems. It may also be used for communications systems and automotive test equipment.

The LMF90 is a switched-capacitor notch filter that requires no external components when used with an internal clock. Notch depth, notch width and clock-to-centre frequency ratio are all pin-selectable.

The notch frequency range of the LMF90 is 0.1Hz to 30kHz. The device features a low offset voltage of 120 millivolts and high-centre frequency accuracy of +/– 1.5% over temperature.

With a low-cost colour TV crystal and using the internal clock-frequency divider, the LMF90 can provide notch frequencies of 50, 60, 100, 120,150 and 180Hz for line-interference noise rejection.

Further information from National Semiconductor distributors in each state.



FAST transceiver checks parity

National Semiconductor has introduced a new member to its FAST (Fairchild Advanced Schottky TTL) family of bipolar logic ICs, the 74F899 9-bit latchable transceiver. This combines the functions of a bidirectional bus transceiver with parity generation and simultaneous check capability.

By consolidating the transceiver and parity functions in a single package, one 74F899 can replace an assortment of parity generators, octal bus driver/latches, or programmable logic devices (PLDs), simplifying system design and reducing package count and power consumption.

Typical 74F899 applications are systems that can use byte parity instead of the more complex error detection and correction (EDAC) schemes. With word sizes up to 64 bits, byte parity requires less routing of parity information, which results in fewer interconnections, less timing overheads, and lower cost than with an EDAC.

The ability to read-back via the latches further assists software programmers in system debugging, such as diagnosing bus shorts and open circuits. The 74F899 can also initiate a read-back operation for comparison with the original data word transmitted.

Further information from National Semiconductor distributors.

Low noise 12GHz HEMTs

Two new high performance HEMT devices have been released in sample form by Hitachi. The 2SK1617 has a noise factor of only 1dB at 12GHz, while the 2SK1616 has a noise figure of 1.3dB at the same frequency. The devices are intended for the input stages of DBS downconverters.

Both devices use a resin package rather than one of ceramic, although until now the dielectric loss of resin has been too high for satisfactory performance beyond about 1.5GHz. External dimensions of the SMD package used are 2.5 x 1.7 x 1.1mm. The devices are fabricated using MBE (molecular beam epitaxy), with a gate length of 0.25um for the 2SK1617 and 0.35um for the 2SK1616.

Beginners guide to ASICs

Australian Silicon Structures, a new silicon engineering service company, has released a free publication called 'The Beginners Guide to ASICs'. This is an engineers guide to the technology of Custom Silicon, its benefits and how to apply them to a design project.

The guide includes the advantages and disadvantages of Application Specific Integrated Circuits (ASICs), the different varieties, design tools, testability, cost structure, impact upon profitability and more. The guide is available free from Toby Cross, Australian Silicon Structures, 122 Windsor Street, Richmond 2753 or phone (045) 88 5288.

Versatile memory expansion sockets

New double and triple-duty sockets for computer memory devices, just announced by Circuit Assembly gives users a wide option in the selection of memory expansion devices for OEM computers, calculators, printers, automotive devices, electronic spelling checkers and other electronic equipment requiring memory.

The SDLE memory expansion socket series comes in three configurations for 41256, 411000 or 44256 dynamic RAM chips, and in a dual configuration for static RAM applications. On 0.300″ centres, the 34-position socket will accept either a 16-pin or 18-pin DIP; the 38-position socket accommodates either 18 or 20-pin DIPs; and the 54-position SDLE socket can be used for 16, 18 or 20-pin DIPs.

For SRAM chips, Circuit Assembly supplies a 46-position socket which will accept either 22 or 24-pin memory chips.

The sockets feature dual leaf sidewipe contacts to provide consistent low resistance and high reliability, while their stand-off design facilitates board cleaning.

For further information, contact RAE Industrial Electronics, 62 Moore Street, Austinmer 2515 or phone (02) 232 6933.

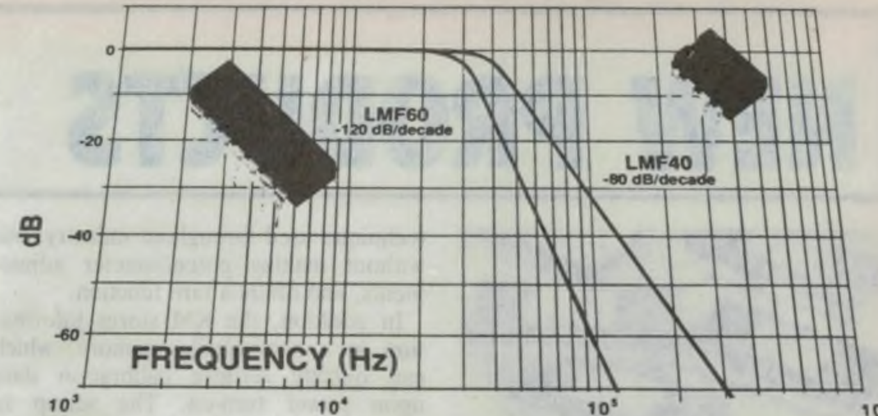
Dual phototransistor optocouplers

The MCT8X optoisolators produced by Microchip Technology have two channels for high density applications. For four channel applications, two packages fit into a standard 16-pin DIP socket. Each channel is an NPN silicon planar phototransistor optically coupled to a gallium arsenide infrared emitting diode.

The devices may be used in applications such as AC line digital logic to isolate high voltage transients; digital logic/digital logic to eliminate spurious grands; and digital logic/AC triac control to isolate high voltage transients. They can also be used in twisted pair, line receivers to eliminate ground loop feedthrough and in telephone/telegraph line receivers to isolate high voltage transients.

Forward current is 60mA, reverse voltage is 3.0V and peak forward current (1us pulse, 300pps) is 3A.

For further information, contact Dice Engineering, 109 Maroondah Highway, Lilydale 3140 or phone (03) 739 5455.



High-performance lowpass filters

National Semiconductor has introduced the LMF40 and LMF60, high-performance 4th and 6th-order switched capacitor Butterworth lowpass filters.

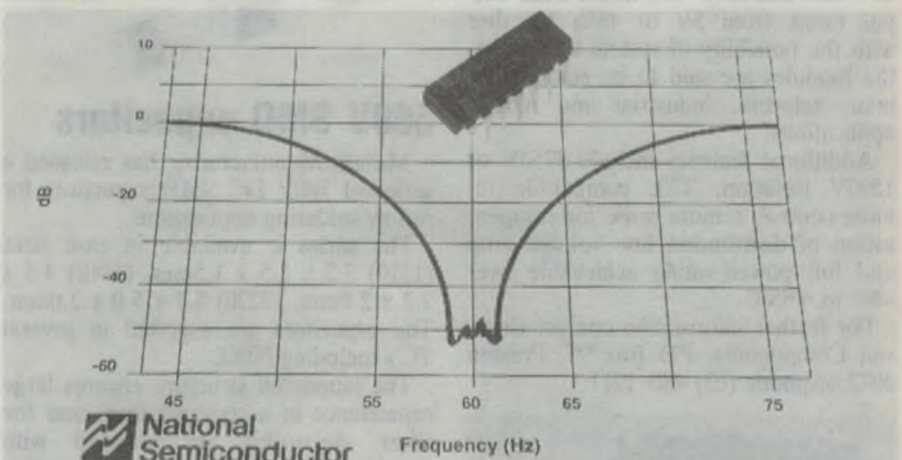
Key specifications include wide centre-frequency operating range from 0.1Hz to 30kHz and low offset voltage of 100mV max.

The devices feature a clock-turnable cutoff frequency set by the internal or external clock.

A maximally flat-passband frequency response together with a DC gain of unity allows cascading of LPF40s and LMF60s for high order filters. Low offset voltage of 100mV max, and low clock feedthrough of 5mVp-p provide a wide dynamic range of 88dB, typical.

Applications include communications systems, high-order tracking filters, and automatic test equipment.

Further information from National Semiconductor distributors.



Positive/negative adjustable regulator

The National Semiconductor LH7001 combines a positive and a negative adjustable regulator in one package. Both can supply 100mA over a 1.2V to 37V output range. It is exceptionally easy to use and requires only two external resistors on each side to set the output voltage.

In addition to high performance, both sides of the LH7001 offer full overload protection. Included are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected.

The LH7001 is intended for voltage and current regulation in systems where both polarities are required.

Normally, for stable operation, no external capacitor is needed on the positive side. The negative side requires only a single 1uF solid tantalum capacitor. On both sides, larger output capacitors can be added to improve transient response.

The positive and the negative regulator are electrically separated and can therefore be used independently from each other. Since each regulator is 'floating' and sees only the input differential voltage, supplies of several hundred volts can be regulated as long as the maximum input-to-output differential is not exceeded.

For further information contact IRH Components, 32 Parramatta Road, Lidcombe 2141 or phone (02) 648 5455.

NEW PRODUCTS

On-card DC converter modules

The PKY series of master and booster DC/DC converters are especially designed for distributed power architectures where high power density is required.

With power ratings from 30W to 200W, input voltages covering 24V DC, 48V DC and 325V DC and a wide output range from 5V to 48V, together with the possiblity of system upgrading, the modules are said to be suitable for many telecom, industrial and mobile applications.

Additional features include 3750V or 1500V isolation, TTL compatible remote control, remote sense for compensation of distribution line voltage drop and full power rating achievable over –40° to +85°C.

For further information contact Ericsson Components, PO Box 95, Preston 3072 or phone (03) 480 1211.

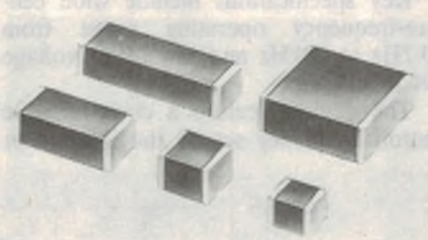
Microprocessor based conditioner/indicator

The Sensotec model KM is a microprocessor based transducer amplifier/indicator. Its RS-232C serial communications port can interface with any computer.

The KM features a shunt calibration technique used throughout industry, but without making potentiometer adjustments, and offers a tare function.

In addition, the KM stores information in a non-volatile memory, which can quickly retrieve calibration data upon power turn-on. The set-up se quence is simplified by using pushbutton programming. The unit is compact (1/8 DIN case) and features a limits-option that allows the user two high and two low digital set points with relay outputs.

For further information, contact Control Devices, PO Box 560, Brookvale 2100 or phone (02) 939 1133.



500V SMD capacitors

Murata Manufacturing has released a series of 500V DC SMD capacitors for reflow soldering applications.

The series is available in case sizes (1210) 3.2 x 2.5 x 1.5mm, (1812) 4.5 x 3.2 x 2.0mm, (2220) 5.7 x 5.0 x 2.0mm. The capacitors are supplied in several TC's including NPO.

The laminated structure ensures large capacitance in a compact form and the inner electrodes are covered with ceramic material, making the capacitor highly resistant to moisture damage.

The leadless construction reduces stray inductance, which makes this series suitable to operate at high frequencies. The capacities may be resin coated after soldering, making them suitable for hybrid use.

For further information contact IRH Components, 32 Parramatta Road, Lidcombe 2141 or phone (02) 648 5455.

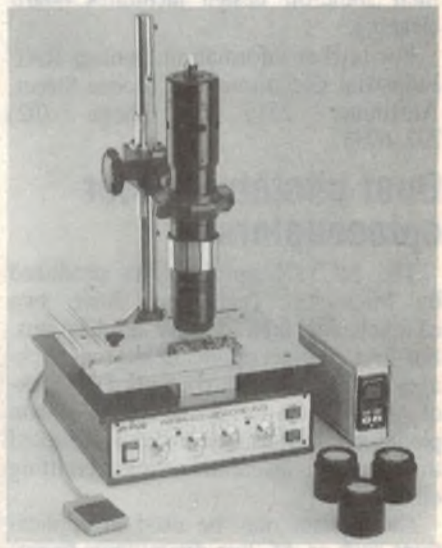
Melbourne training centre

Compuskil ITeC, in Footscray, Melbourne is part of a national network of non-profit centres partly funded by the Commonwealth Government and partly sponsored by private industry. The centre has been providing training courses and industry services in computers and electronics since the mid 1980's.

Government funding is used to run full-time courses in electronics and computers, of 18 to 20 weeks in duration, for people who have been unemployed for at least six months or who are classified by the CES as disadvantaged. The emphasis in the courses is on practical skills that will lead to employment or further training. The centre is proud to boast an 80% success rate for its graduates.

A range of electronics courses are provided by the centre, including a short course designed especially for women with an interest in the field, but unsure of 'where to start'.

The centre is also involved in product R&D, PC maintenance and contract assembly work. Further information is available from John Charles on (03) 689 3833.



Infra red soldering unit

Motorola's infra red SMD rework unit provides a novel solution to the problems encountered with conventional 'hot gas' methods.

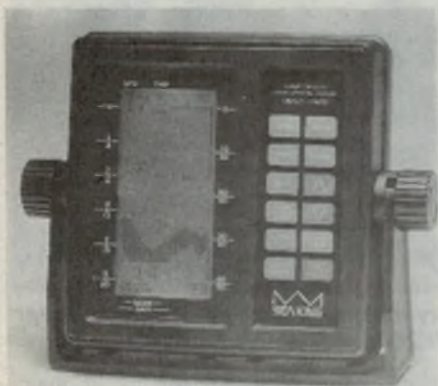
The infra-red beam is directed with pin point accuracy onto the desired component, while the 'back heater' gently aids heat transfer from below the circuit board. The infra-red spot being visible, is easily aligned with the component and a simple foot switch can be used to give maximum hands-free operation.

As the desired temperature is

reached, single components can be gently removed. The infra-red beam automatically lowers in intensity, preventing disturbance to surrounding components, or damage to the circuit board.

By changing the lenses, an almost limitless number of variations in spot-size can be achieved.

For further information, contact Motorola Australia, 666 Wellington Road, Mulgrave 3170 or phone (03) 566 7927.



Sounder has LCD screen

The Sea King DMLC-2500 liquid crystal display sounder is an 80 metre compact, lightweight depth sounder which utilises a 109 x 83mm LCD screen instead of the usual 4" chart paper to display the sea bottom, reefs and fish beneath the vessel.

There are three modes of operation. The first mode displays the seabed and water and a surface water temperature reading.

The second mode is the same as the first mode, except that a speed reading is provided instead of the surface water temperature reading.

The third mode is used to display in digital form the water depth, the boat speed and the surface water temperature and is ideal for use as the navigation mode.

The DMLC-2500 has a dual alarm facility that provides both shallow and deep alarms. These alarms can be set to sound when the water depth becomes deeper than the deep setting and/or when the water becomes shallower than the shallow setting.

For further information, contact Imark Communications, 75 Mark Street, North Melbourne 3051 or phone (03) 329 5433.

Terminal quick-change

Augat/RDI 2S series terminal block makes connections without the use of tools, by simply placing solid or standard 18 - 24AWG wire into the opening and pushing down the lever. This also permits the re-termination of the wire.

The solder-in 2SV and depluggable 2SDV versions both provide 0.200" centre spacing and are available in 2 - 16 positions, featuring end stackability while maintaining centre-to-centre spacing. Rated at 10A/150V, the block has gas-tight connection that surpasses UL and CSA specifications for wire pull-out, security and heat rise.

If a PCB change is required in field servicing, the 2SDV is ideal. Simply unplug the block from the PCB, install the new board and plug on the block which is already wired from the first installation.

The 2ID series, an insulation displacement version, is also available in standard or depluggable forms.

For further information, contact George Brown Group, 456 Spencer Street, West Melbourne 3003 or phone (03) 329 7853.

LCD panels and modules

Liquid crystal display elements and modules feature broad angle of visibility, high contrast and high speed response. Small, light and low profile types are available and will produce whatever display pattern is desired.

Connecting terminals are suitable for various mounting methods such as lead pin, rubber connector, heat seal etc. CMOS driver, LSIs and driver LSIs with controller are built in on all liquid crystal modules.

Rohm also has custom LCDs which are not just limited to use in consumer or industrial machines, but meet the needs of their customers in all aspects of the business world. Rohm promptly develop panels and modules incorporating various types of displays and a full range of connecting terminals to respond to a customers request.

For further information contact Fairmont Marketing, 726 Plenty Road, Preston 3072 or phone (03) 471 0166.

RF directional wattmeters

Latest in the Bird Electronics range of wattmeters is the 4410 portable series, which looks very much like the familiar 43 series. There is the same ruggedness and simplicity of use, plus added features.

The 4410 has an internal amplifier which employs an inherently self-balancing measurement technique. There is also a patented bridge circuit which permits reading accuracies without equal in

a directional wattmeter with a 5000:1 dynamic element range.

The new series elements are used like those of the industry standard model 43. They are plugged into the wattmeter's element socket and are rotated for either forward or reflected measurements. Each element now provides 7 power ranges instead of 1.

Contact Vicom Australia for more details on the Bird Electronics Corp range of products. Their offices are found throughout Australia and New Zealand.

Mega-sound

Continued from page 14

tant that no phase cancellation occurs where the coverage area of speakers overlaps.

At least two arrays are usually employed, to allow a stereo image to be presented. These will be stacked on each side of the stage, or hung from the ceiling, just forward of the stage.

Extreme bass is handled by the sub-woofer enclosures, typically using multiple 45cm (18") drivers. As these bass frequencies are largely non-directional, the subwoofer boxes are often located beneath the front of the stage.

The power amps themselves are mounted in racks, with forced air cooling. Massive amounts of power are required, and the power amps for the bass speakers and sub-woofers will be rated at 500 or 1000 watts per channel.

The total power amp output for the front of house speaker systems varies according to the size of the venue, but 150,000 watts would not be unusual for a moderate size show.

My thanks to David Riddel of The PA People and Peter Flynn from Samuelsons Concert Productions, for their assistance in the preparation of this article. The PA rig featured in the illustrations was provided by Samuelsons Concert Productions for a concert by John Farnham.

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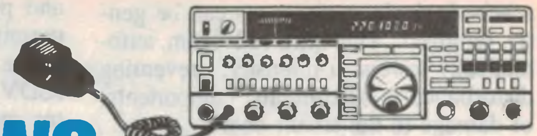
READER INFO No. 40

Amateur Radio News



Candidates sitting for the IARC's history-making exam in March. At rear centre and right are supervisors Roland VK2GAL and George VK2BGV.

IARC runs first private licence exam

Sydney's International Amateur Radio Club (IARC) claims to have been the first to conduct a privately run amateur radio licence exam in Australia, under the new 'devolved' examination system. Held at the IARC's clubrooms in Roseville, the exam was the first of a planned regular series, to be conducted every four weeks. Previously exams have been conducted by the DoTC every three months, and many believe the relatively long gap between exams allowed unsuccessful applicants to 'lose interest' before the next opportunity to try again.

Some 14 people sat for the IARC's first exam on Sunday March 4th, and received their results the same day. Those who were successful were able to obtain their licences at the DoTC office the next day.

Under the new system, any licensed amateur can apply to conduct licence examinations. As IARC's secretary Sam Voron VK2BVS notes, this means that the training, examining and promotion of amateur radio in Australia is now in the hands of all 18,000 licensed amateurs, rather than a government department.

New videotape at WIA NSW

A new tape has recently been added to the extensive videotape library (VHS format) maintained by the NSW Division of the WIA, for use by its members. The new tape consists of two programs, each about one and a half hours in length: 'Grinding Quartz Crystals', by Glen Tilbrook VK5GL, and 'Introducing Microwaves', by Des Clift VK5ZO.

The NSW Division also has available a TVI Kit, consisting of the *Radio Frequency Interference Handbook* together with various filters, chokes, etc. The kit is available to members only for seven days, upon payment of a $25 deposit (refundable), and is useful in solving interference problems.

South-East Radio Group convention

The South East Radio Group Inc is holding its annual convention this month, over the Queens Birthday weekend (June 9,10). The latest state of the art communications equipment will be on display, and there are likely to be bargains on offer for both new and pre-loved amateur gear.

As part of the convention, the SERG will again be hosting the Australian Fox Hunting Championships. These are expected to be even faster and more furious than last year, with the addition of a hunt on 1296MHz.

Those interested in attending this very popular convention are advised to organise accommodation as soon as possible, as Mount Gambier plays host to many functions at this time of year.

Further information and registration forms can be obtained from the Convention Co-ordinator, SERG, PO Box 1103, Mount Gambier SA 5290.

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Channels	2	2
Vertical Range	5mV-5V/DIV	5mV-5V/DIV
Max Sweep Speed	2ns/DIV	10ns/DIV
Delayed Sweep	YES	YES
Digital Storage		
Repetitive BW	100MHz	50MHz
Single shot BW	8MHz	8MHz
Functions Envelope, Averaging, Arithmetic etc		
Options		
Battery Pack	50 mins	50 mins
GP-IB	Available	Available

All the Data is On-Screen

The real mode and storage mode waveforms are displayed on the COM-3000's high intensity and high resolution CRT. The parameters and cursor measured value, as well as the values measured by the DVM and frequency counter in the real mode are all displayed on the screen.

Three Way Power

A choice of three power options (90-250V, external DC or rechargeable Ni-Cd battery pack), also ensures total flexibility.

For more information on the COM-3000 Series contact **Emona Instruments**, 86 Parramatta Rd, Camperdown, 2050 or call **(02) 519 3933.**

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Vintage Radio

by PETER LANKSHEAR

Early tuning indicators

Right from the early days of radio broadcasting, many listeners have experienced difficulty in tuning their receivers accurately to a station. Early receivers used some novel systems to help overcome this difficulty.

A proportion of non-technical radio users have always seemed to experience problems in achieving accurate tuning, but the problem became more widespread in the late 1920's when receivers were fitted with automatic gain or volume control (AGC, AVC) to minimise the effect of fading and variations in received signal strengths. A minor disadvantage of AGC is that it produces an apparent reduction in receiver selectivity, 'spreading out' the apparent position of each station and making accurate tuning more difficult – at least for some users.

An old problem

That this might be a problem was recognised right from the first use of AGC, and today's up-market radios still include fancy LED tuning displays among the 'bells and whistles'. Here we're going to look at early tuning aids, several of which were to be found in Australian made receivers. Some were quite ingenious, although with an element of sales gimmickry.

About the earliest receiver incorporating AGC seems to have been the all triode, mains-powered RCA model 64 superheterodyne of 1928. As was general with valve AGC systems, the gain of the receiver was governed by automatic adjustment of the grid bias on RF and IF amplifying stages. The stronger the signal, the greater the AGC voltage and the corresponding reduction in the anode currents of the controlled valves.

The RCA 64 had a tuning indicator – a reversed scale milliammeter registering the anode currents of the controlled valves. By observing the needle movement, the user could peak the tuning accurately. As AGC became into wider use, these 'tuning indicators' or 'resonance meters' became more common, generally in prestige models. Owners of lesser models presumably had better tuning skills, or uncritical ears!

Although a few large receivers used a separate sharply tuned circuit and detector valve to control the meter, standard practice still was to monitor the anode currents of AGC controlled valves.

Shadow meters

Meters were regarded as looking somewhat too 'technical' for domestic receivers, and by 1933, alternative 'Shadowgraph' and 'Shadow Meter' systems were in use, especially by Philco. These were simple moving iron meter movements with lightweight vanes rather than pointers. Most registered the anode current of AGC controlled stages, but in America, Zenith used a separate metering triode with its grid connected to the AGC line.

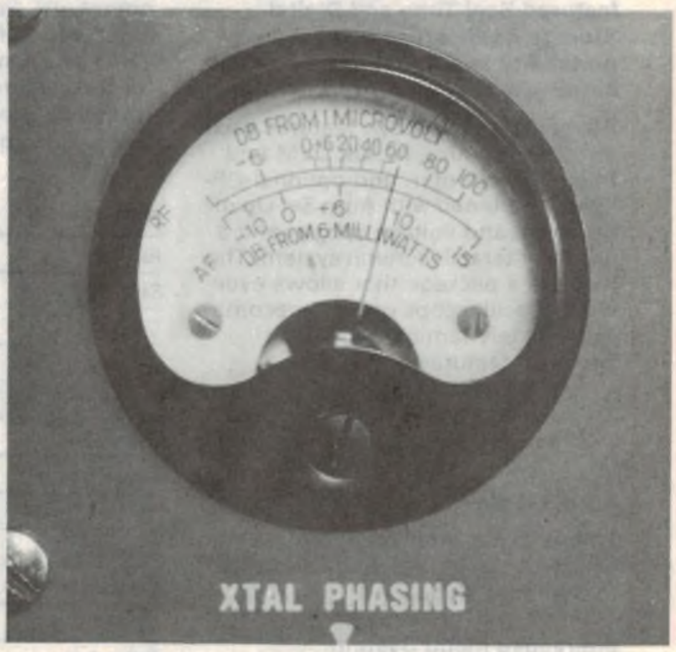
All used a simple optical system, projecting the light from a pilot lamp to throw a shadow of the vane on to a small translucent screen. Resonance was indicated by the narrowing of the shadow.

Although expert operators are quite capable of tuning receivers accurately without assistance from tuning indicators, top grade communications receivers have always used calibrated tuning meters, commonly called 'S' meters. While the beat frequency oscillator (BFO) is far more useful as a tuning aid, the S meter is valuable for judging received signal strengths.

Neon indicators

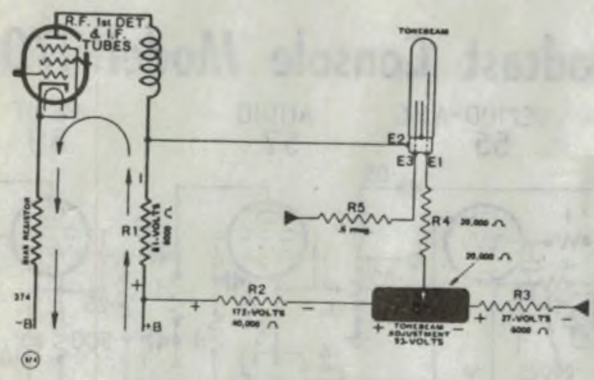
In 1932, an all electronic tuning aid appeared. Given such fancy names as 'Tonebeam' and 'Flashograph', it was a thin neon lamp about 100mm long containing three electrodes. Atwater Kent used the 'Tonebeam' in several models, and their description of its operation is reproduced in diagram 1.

The neon lamp used in the Tonebeam system had an unfortunate tendency for the glass to blacken and become opaque – the condition in which they're usually found nowadays. Unfortunately good replacements are practically unprocurable.



Although the tuning meter dates from the 1920's, this one belongs to a 1960 Hammarlund SP600 communications receiver.

Diagram 1: The 'Tonebeam' system.



Tonebeam Circuit in Model 812.

ACTION OF TONEBEAM

The Atwater Kent tonebeam is a neon light-column that indicates visually when the set is tuned correctly to resonance with the incoming signal.

A typical circuit arrangement for the tonebeam is shown below. This particular circuit is used in Model 812.

The tonebeam requires an initial bias to make the short center electrode (E-2) positive with respect to the long electrode (E-1). The bias is adjustable to take care of different tonebeam tubes, the adjustment being provided by a potentiometer in series with resistors R-2 and R-3 which limit the range of adjustment. In the circuit shown below, the bias voltage across E-1 and E-2 can be adjusted from 91 to 184 volts.

When a signal is tuned in, the automatic volume control increases the negative bias on the control grids of the R.F., 1st-detector, and I.F. tubes, thus decreasing their plate current. This decrease in plate current causes a decrease in voltage across R-1 and a corresponding increase in the voltage difference between electrodes E-1 and E-2. The increase in voltage across E-1 and E-2 causes the neon glow to extend up the long electrode. When the initial bias voltage is adjusted to the correct operating point, an increase of about 20 volts across E-1 and E-2 will cause the neon glow to extend up to the top of the long electrode E-1.

The electrode E-3 and resistor R-5 are used to ensure stable operation of the tonebeam. Resistor R-4 is used to make the tonebeam action more uniform on weak and strong signals.

A fairly obvious method of tuning indication would have been to use a low current incandescent lamp in series with the controlled valves, and Canada's Rogers did just that. They used a 0.5 watt 24 volt lamp which dimmed as resonance was reached, but the wattage was too small for impressive displays. Later, Rogers used a 6F6 power valve solely to drive the tuning lamp.

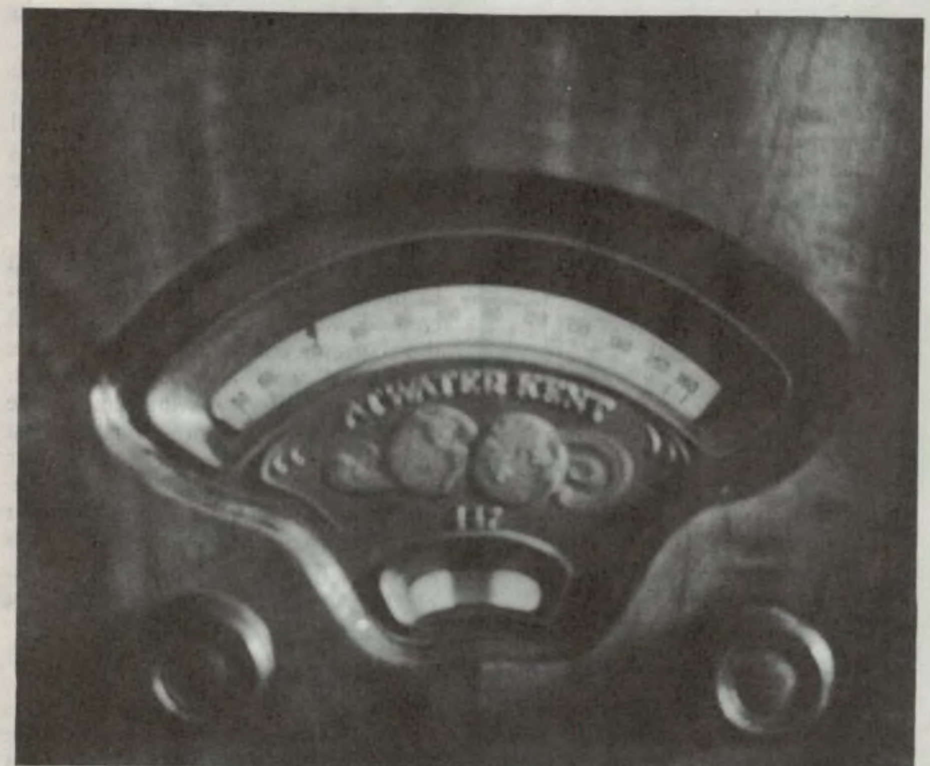
'Hi-tech' lamps

Several methods of using larger lamps were based on transformers with saturable cores. American Majestic's was first used in 1932, and its operation is shown in diagram 2. Anode current for the RF and IF valves passed through the winding on the centre leg. In the absence of AGC voltage, this current was sufficient to create a large magnetic flux, saturating the core. Current to a lamp flowed through the windings on the outer legs. With the core saturated, these windings presented little impedance to the flow of lamp current, which glowed at full brilliance.

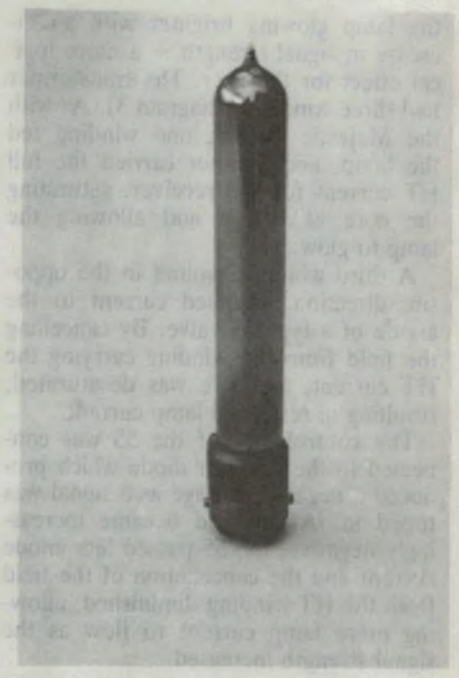
However, when AGC action reduced the valve currents through the centre winding, the core ceased to be saturated and the lamp windings impeded the flow of lamp current, which dimmed in step with the changes in AGC voltage.

It is interesting to note that if all the windings had been on one leg of the core, transformer action would have superimposed a large AC voltage on the anode supply. As it is, the lamp windings were in opposition and there was no transformer effect.

Australia's Tasma reversed the action for their 'Visual Tuning Indicator', with



The dial of an Atwater Kent model 447, fitted with shadow tuning. Increasing signal strength narrowed the shadow visible in the lower window.



The neon lamp from an Atwater Kent 'Tonebeam' tuning indicator. It used a standard small bayonet cap. Like many, this one has become blackened.

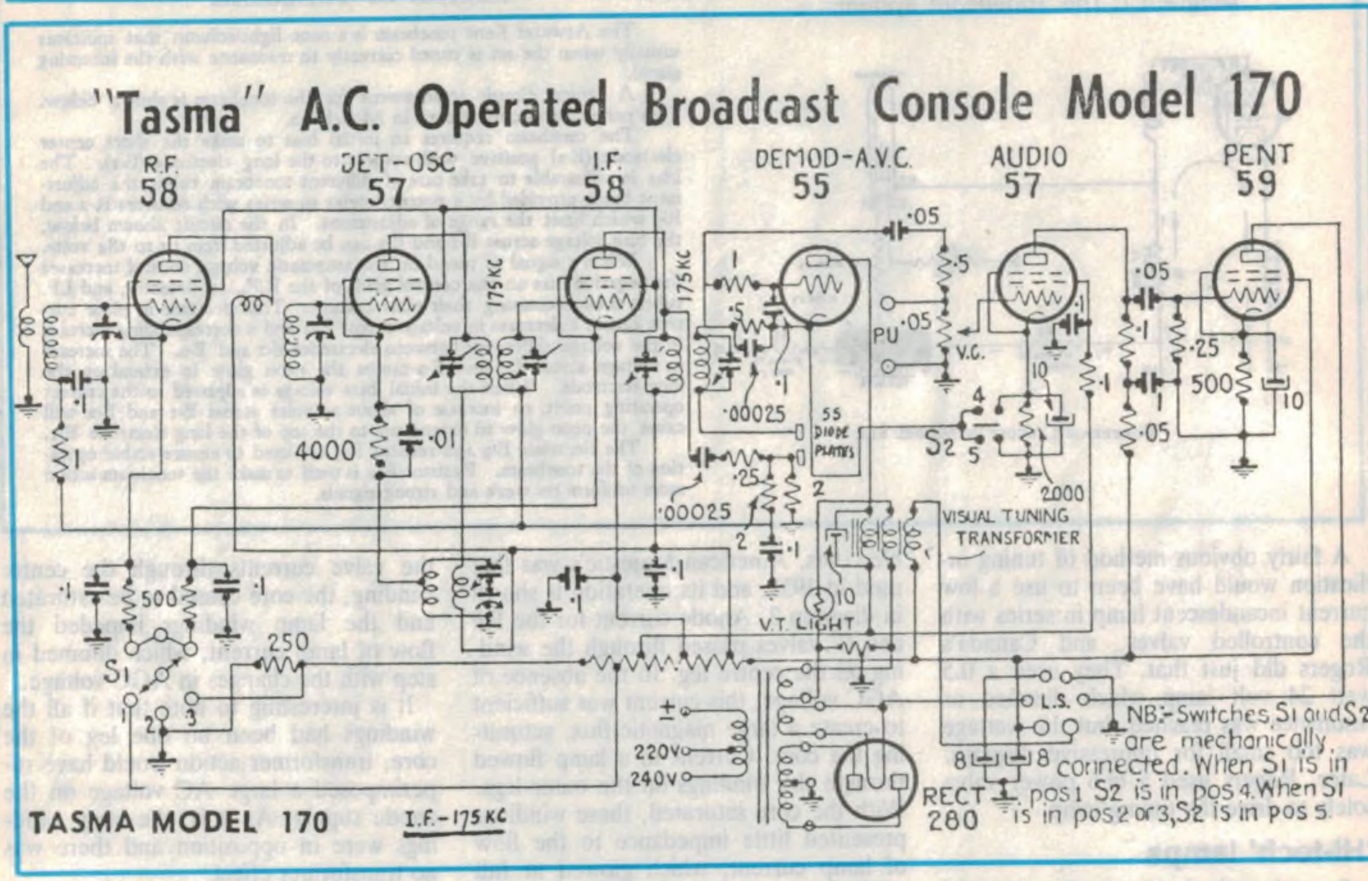


Diagram 3: TASMA improved on the Majestic system by reversing the action. As signal strength increased, the lamp became brighter. Control was via the triode section of the 55 valve.

the lamp glowing brighter with an increase in signal strength – a more logical effect for the user. The transformer had three windings (diagram 3). As with the Majestic system, one winding fed the lamp, and another carried the full HT current for the receiver, saturating the core as before and allowing the lamp to glow.

A third winding, wound in the opposite direction, supplied current to the anode of a type 55 valve. By cancelling the field from the winding carrying the HT current, the core was desaturated, resulting in restricted lamp current.

The control grid of the 55 was connected to the detector diode which produced a negative voltage as a signal was tuned in. As its grid became increasingly negative, the 55 passed less anode current and the cancellation of the field from the HT winding diminished, allowing more lamp current to flow as the signal strength increased.

Midwest flamboyance

Midwest, who favoured large flashy receivers at budget prices, came up with the interesting variation of the tuning lamp shown in diagram 4.

A 3.2 volt lamp was connected to a 6.3 volt source via the primary of a small transformer, whose secondary leads were connected to the anode and cathode of a 6C5 triode. The lamp cur-

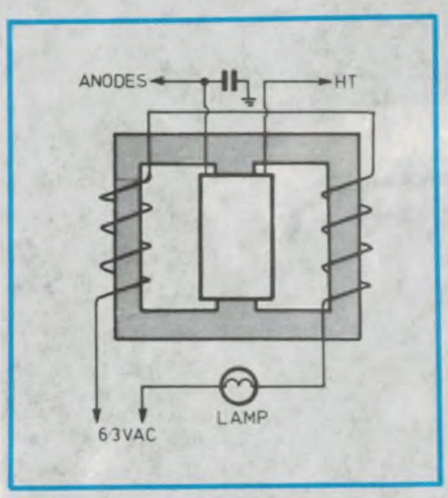


Diagram 2: The Majestic lamp tuning indicator, which was the forerunner of several related systems. Although crude by today's standards, it shows a sound knowledge of basic theory.

rent in the primary induced a voltage in the secondary, and with no grid bias, the 6C5 conducted on the positive going cycles. The resulting primary current flow caused the lamp to light to full brilliance. (As the negative excursions were lost, the lamp could never receive more than half the effective supply voltage).

The 6C5's control grid was connected to the AGC line. As AGC voltage increased with the tuning in of a signal, the current conducted by the valve diminished and the lamp dimmed. Overall, the effect was the same as the earlier Majestic system – but Midwest further refined it to provide dial *colour* changes at resonance! They used a saturable transformer arranged to transfer the display current between two groups of coloured lamps, the operating principle being much the same as in GEC's 'Colorama'.

Colour tuning

GEC's 'Colorama' tuning represents the final development of the lamp-type tuning indicator. Quite impressive, it was an ingenious combination of the previous systems, but with colour as

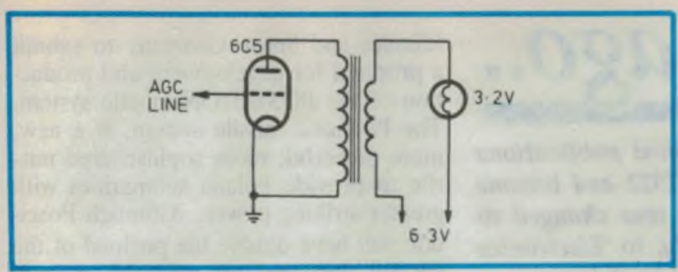


Diagram 4: What, no high tension? The Midwest system used the control valve as a grid controlled rectifier, varying the impedance in series with the lamp.

well as intensity changes.

Four red coloured series-parallel connected and three series connected green coloured 6.3 volt 0.15 amp lamps formed the display. With no received signal, the red group

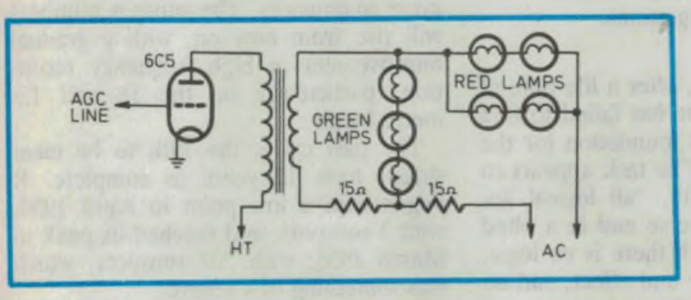


Diagram 5: The slightly more complex American GEC 'Colorama' system. As the signal was tuned in, the display changed from red to green.

was at full brilliance, with the green group invisible. As the signal strength increased, the red lamps dimmed, while the green lamps commenced to glow. When a strong signal was fully tuned in, the red illumination disappeared and the green display was at full brilliance.

The essentials are shown in diagram 5. The grid of the 6C5 valve was controlled by the AGC line. HT current to the anode of the 6C5 was fed via the primary of a saturable transformer, which decreased the reactance of the lamp winding from a high value with no anode current in the strong signal condition, to a low value at maximum current.

At saturation, full current flowed through the lamp winding to the group of four red lamps. As the signal increased, the 6C5 drew less current, the reactance of the winding increased and current commenced to flow through the green lamps shunting the winding. A large AGC voltage resulted in no lamp current flowing through the reactor winding. The green lamps were then lit fully. Although the red lamps were still passing current, their parallel connection meant that they were operating at 50% normal current and consequently their light output was small. The visual effect was quite spectacular, with the dial colour changing from red to green as a station was tuned in.

Final phase

During 1935, the familiar green fluorescent 'Magic Eye' valve tuning indicator was introduced. Cheaper and simpler than previous types, it remained practically unchallenged to the end of the valve era, over 30 years later. But that story will have to wait for another time.

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READER INFO No. 51

50 and 25 years ago..

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

June 1940

Penalties for Illegal Radio:

Heavy penalties may be expected as the result of operating unlicensed radio transmitters at the present time.

Evidently there are still some people who do not realise we are at war, for several transmitters have been silenced in the last week or two.

Breaking Down the Atom:

Dreams of scientists in setting free hidden atomic energy for practical uses have suddenly been brought nearer to realisation by the separation of 'light uranium' at Columbia University, states the New York 'Journal-America.'

It is this rare 'light uranium' of atomic weight 235 which scientists can bombard with neutrons, setting free tremendous power.

Scientists cooperated in using a 'mass spectrometer,' to separate for the first time ordinary uranium of 238 atomic weight and uranium atoms of 235 and 234 weights.

A single neutron particle of slow speed enters the nuclear heart of uranium 235 and an explosion occurs releasing 200,000,000 volts of power. From this explosion neutrons are released which produce similar outbursts in neighbouring atoms.

Universe a Riddle:

Professor Einstein, after a life-time of research, confesses he has failed to find a unified and logical foundation for the material universe. "The task appears to be hopeless," he said, "all logical approaches to the universe end in a blind cosmic alley, in which there is no logic, no sequence of cause and effect, and no possibility to predict events in space and time. All efforts lead to the seemingly inescapable conclusion that the universe is being run as a game of chance."

June 1965

'Improved' Missiles:

The US Navy has asked Lockheed Missiles and Space Company to submit a proposal for development and production of the POSEIDON missile system. The Poseidon missile system, is a new, more powerful, more sophisticated missile to provide Polaris submarines with greater striking power. Although Poseidon will have double the payload of the current 2500-nautical mile A3, it can, with relatively inexpensive minor modifications to existing launcher tubes, be carried by the Navy's fleet of ballistic missile submarines.

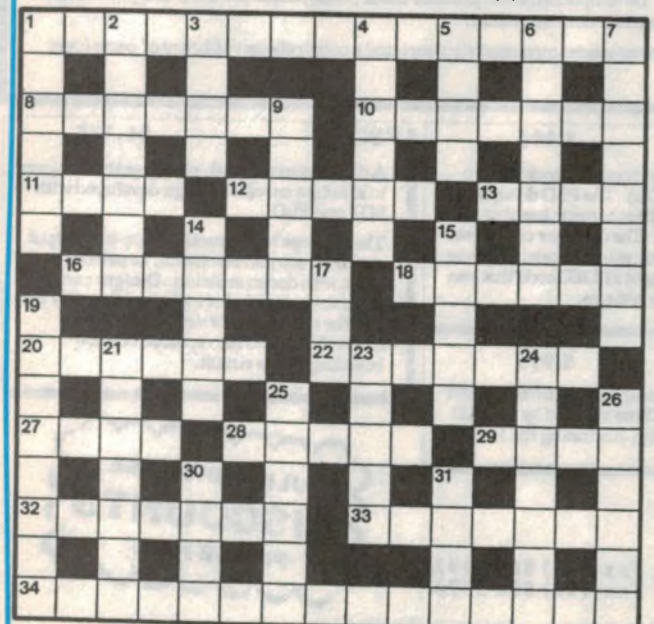
Sunspot Conditions:

During 1965, the present sunspot cycle reaches its 'low' and a new 11-year cycle commences. The sunspot numbers will rise from now on, with a gradual improvement in high frequency reception, particularly on the 16 and 13-metre bands.

The past cycle, the 19th to be measured, took 11 years to complete. It began with a low point in April 1954, with 3 sunspots, and reached its peak in March 1958, with 201 sunspots, which was something of a record.

No differences in reception will be noticed this year but by early next year, some marked differences in shortwave reception will be apparent. In 1968 or 1969, the peak will be reached, with the higher frequencies being widely used by short-wave stations for international broadcasting.

EA CROSSWORD



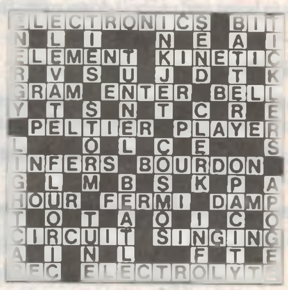
Across

1. Measuring devices. (4,11)
8. Element resembling tantalum. (7)
10. Concerned with current matters. (7)
11. Thing that absorbs electrical power. (4)
12. Sources of galactic radio. (5)
13. Form of energy. (4)
16. Maintenance jobs. (7)
18. Scientific group within United Nations. (6)
20. Repeated showings of TV movies. (6)
22. Radioactive element, number 100. (7)
27. Control units (abbr). (4)
28. Source of ignition. (5)
29. Output of an ATM. (4)
32. Kind of cable. (7)
33. Mega factor. (7)
34. State of identical frequency and phase. (15)

Down

1. Feeling of mild shock. (6)
2. An accumulator is a ---- cell. (7)
3. Control in a camera. (4)
4. Such is the action of some of 27 across. (6)
5. Diagrams of fields. (4)
6. Positive core. (7)
7. Completed correct crossword. (8)
9. One of 1 across. (5)
14. Supply of power. (5)
15. Opposing force. (5)
17. Such is ten thousand megahertz. (1,1,1)
19. Containers for retailing hardware. (8)
21. Teach new trade skills. (7)
23. Memory device. (5)
24. One of a radioactive group of elements. (7)
25. Famous spacecraft. (6)
26. Parallel resistors. (6)
30. Shape of certain antenna. (4)
31. Sign of charge. (4)

MAY SOLUTION



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READER INFO No. 43

Information centre

Conducted by Peter Phillips

Laterally speaking...

There is always another way it seems, and this month I present not one, but three circuits on how to make a flipflop from relays. I've lost count of the number of letters giving methods on how to solve the March What?? question, and nearly all methods are different. As Montaigne wrote in 1580: 'The most universal quality is diversity.' How true!

Lateral thinking is an essential prerequisite in many problem-solving situations, particularly in electronics. For example, a TV set that suffers from no sound, will, according to the owner, need a new volume control. To the technician, no sound means a problem in the audio chain. To the computer programmer, the problem is best solved with a flow chart starting with the question 'is the power on? yes or no'.

But to the lateral thinker, other possibilities arise: it's a silent movie, the TV station has audio problems, I've gone deaf... or just possibly the owner is right.

Perhaps the best example I can think of is the infamous October 1989 What?? question, in which a circuit error made the problem impossible, except for those able to see beyond the problem. To these lateral thinkers, the circuit wasn't a resistive circuit at all... it was an oscillator, with negative resistors!

Which leads me to the first group of letters, those concerning the What?? question posed by Alan Fowler in the March 1990 issue. No, there wasn't a problem with the question – these readers kindly took up my invitation to share their method of solving it, for which I thank them.

The March cube

Judging by the number of letters I have received concerning the cube question we posed in the March issue, it seems the What?? section of these pages is rather popular. In particular, it appears that resistive network questions are the most popular, and I have since received a few more to present in future issues.

Space prohibits me from presenting all the letters I have received on the cube, so I'll summarise them, as some interesting points were made. All the letters gave the correct answer except that from Mr D.L. from Tumblong, NSW, who had a minor transposition error. (D.L. is an old friend and mentor who has also supplied me with a nice What?? question for future presentation. Hi, Don!)

Yes, as many of you pointed out, the question is an oldie, but a goodie. According to K.M. (Urrbrae, SA), the question was posed by Brooks and Poyser in 1920, in their book 'Magnetism and Electricity'. However, as K.M. also writes:

It seems many have considered the problem. C.W. Trigg discussed cubic networks in the November-December 1960 editions of 'Mathematics Magazine' and Martin Gardner of 'Scientific American' fame again finds the links with the past even longer, as he considers the symmetry when he discusses the Five Platonic Solids in his book 'More Mathematical Diversions.' He notes the first systematic study of the five solids appears to have been made by the ancient Pythagoreans.

But the most fascinating aspect of all the letters was the methods used to solve the problem. I would love to be able to reproduce the various 'equivalent' circuits devised by the correspondents, if I had the space. I never knew a cube could be redrawn in so many ways!

However, the letter that really got me was this one...

If you have had the willpower to resist opening Alan Fowler's answer to the resistance cube, take a look at mine! My apologies for suggesting you haven't worked it out yet. (R.B., Cairns Qld).

By now, of course the answer is out, including my method. So the answer supplied by R.B. was no surprise, but – get this – he used a bloomin' computer running PSpice. Time taken was 1 minute, 48 seconds, during which a full analysis of the circuit was undertaken (at 27.000°C no less).

Most of the methods used were far less spectacular, and mainly consisted of Ohm's law variations, although some derivations seemed overly complex. Still, it appears the correspondents enjoyed the question. Thanks again for your letters.

Charging nicads

The following letter asks a fairly reasonable question:

I am not an electronics expert, but I want to be able to charge a pair of NiCad batteries using solar cells. The people at Tandy Electronics (where I would buy the solar cells) don't know the requirements, but I believe a diode and some form of current limiting device are needed in the circuit. Can you help me with information regarding these requirements. (M.M., Chapel Hill Qld).

Charging batteries from solar cells is really no different to charging them from the mains. All you need is a charging voltage higher than that of the battery, a constant current source and a diode, all connected in series. The diode is needed to prevent the battery discharging back into the charger, and the constant current source takes care of voltage variations from the charging source.

Presumably, M.M. wants to trickle charge the NiCads, and the current required will depend on the type of batteries. The NiCad charger circuit presented in the July 1989 edition of *EA* has most of the information required. The constant current source used in this project is ideal as it only requires two components: an LM317 three terminal regulator and a resistor. The resistor value is determined using the equation of 1.25/I, where I equals the required charge current. Connect a diode in series (anode to the current source) and the problem is solved.

The only difficulty with this arrangement is that around three or four volts will be dropped across the regulator, requiring an output voltage from the solar cells of at least this amount higher than the battery voltage. But in the sunshine state of Queensland, this shouldn't be a problem.

Relay flipflops

In the March 1990 edition of these pages, I included a letter from a correspondent anxious to construct a two relay equivalent of a toggle-on toggle-off flipflop. I also presented my idea of such a circuit, with the rider that it was untested. In answer to this query, I have received a number of circuits, as well as criticism of my suggested circuit. OK, at least it served as a catalyst!

I'm presenting three of the circuits, in the hope that R.B. from Scarborough (the seeker of the circuit) will find at least one of them suitable for his needs. The circuits are all shown in Fig.1, and the following descriptions are those supplied with the circuits. My thanks to these contributors.

Your circuit may not work for the following reasons:

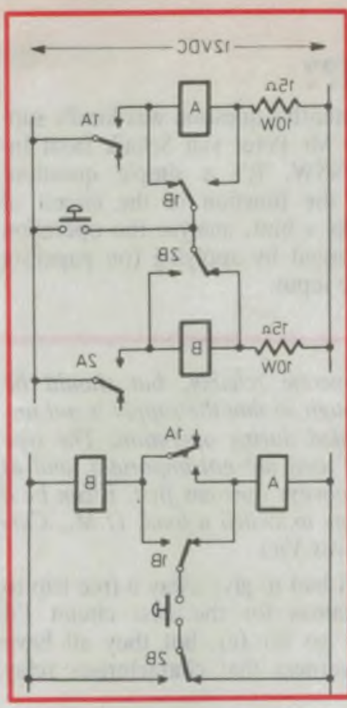
1. *N/C contact 1B will break before N/O contact 1A makes.*
2. *The hold-down period of the push-button is very critical, as R2 may release before the button is released.*

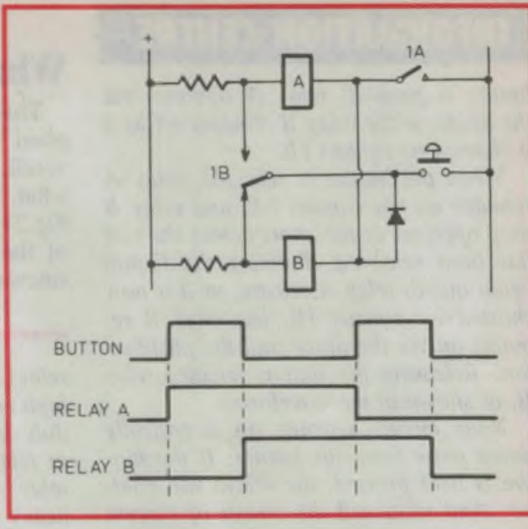
My circuit will work, providing the pushbutton is held down for around 1 second. The circuit operates like this:

On the first operation of the pushbutton, relay A operates and latches via contact 1A, as relay B is locked out by 2B. Releasing the pushbutton allows relay A to operate via contact 1A. On the second operation of the button, relay A releases as it is shunted via contact 1B and the closed pushbutton, while relay B now operates via the button and contact 2B. (G.G., Pendle Hill, NSW).

The circuit offered by G G., is shown in Fig.1(a). Next is a rather simpler circuit with a bit of history and a mild complaint.

Many years ago I was so proud of this circuit that I offered it (unsuccessfully as it transpired) to your 'A Reader Built It' section. Be assured that it has given many years of faithful service as a circuit able to select one of three combinations of bedside appliances, as well as the 'all off' fail safe condition. Note that it does not need a timing capacitor, although a suppression capacitor across the push-button is a good idea.





The change impulse was provided by a pushbutton under my pillow, allowing a complete cycle through the four possible combinations of the relays by two operations of the button. The circuit relies on the ability of relay 2 being able to operate reliably on about half the chosen supply voltage. This was achieved by selecting a suitably sensitive relay, which did not overheat when the full voltage was applied continuously.

I could launch into a full explanation of the circuit, but I'll refrain from doing so, firstly because it is fairly obvious, and secondly because it will probably meet the same fate as my original contribution all those years ago. (T.C., Glen Waverley Vic).

Yes, T.C., it is a most elegant circuit, and one that I'm pleased to present, albeit years after its inception. I wish you had given more details however, as I'm a bit perplexed about the 'two operations of the switch giving all four combinations'. However, the faithful service testimony is evidence enough of its functionality, and, as shown in Fig.1(b) it looks simple to build.

Finally, the circuit of Fig.1(c), which appears to be the simplest of the lot. It must be a good one, as two different contributors sent the same circuit. The following letter describes its operation...

There are a number of ways of constructing a relay flipflop, but this one is my favourite. When power is first applied, neither relay operates. When the

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button is pressed, relay A operates via the diode, while relay B remains off as it is shorted by contact 1B.

When the button is released, relay A remains on via contact 1A, and relay B now operates as the short across the coil has been removed. Pressing the button again makes relay A release, as it is now shorted via contact 1B, but relay B remains on via the diode and the pushbutton. Releasing the button releases relay B, as shown in the waveforms.

Your circuit depends on a critically timed pulse from the button. If the button is held pressed, the relays will chatter. And what will the inrush of current to the capacitor do to the contacts? Hmm... (G.L., Clayton Vic)

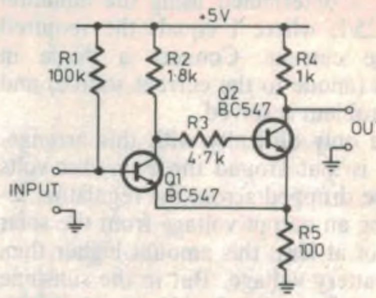
Hmm...indeed! Oh well, G.L. is from Telecom, and relay circuits are their speciality. Further insight into this circuit is provided by our next correspondent, who is currently using it to control blower and pump motors in a spa bath:

I have used this circuit many times in the past, and in its present application, relay A is a heavy duty type, and relay B is a miniature relay. The values for the resistors should be chosen so that the relays operate reliably, but should be high enough so that the supply is not unduly loaded during operation. The type of relays used are not important, and as relay A always operates first, it can be a heavy type to switch a load. (J.M., Carrum Downs Vic)

So, if I had to give away a free trip to the Bahamas for the best circuit I'd probably go for (c), but they all have that cleverness that characterises relay circuits.

What??

This month's question was kindly supplied by Mr Peter van Schaik from Inverell, NSW. It's a simple question: what is the function of the circuit of Fig.2? As a hint, analyse the operation of the circuit by applying (on paper) a sinewave input.



Answer to last month's What??

The answer to last month's What? is that the problem itself doesn't give enough information. No! This isn't a drawing error, it was intended. The missing information concerns the internal resistance of the batteries. If we assume each battery has an internal resistance of 0.1 ohms, then the circuit can be redrawn as shown.

Kirchhoff's law now gives:

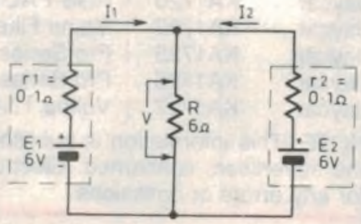
$$R(I1+2) = V,$$
$$I1 = (E1-V)/r1,$$
$$\text{and } I2 = (E2-V)/r2,$$

which can be readily solved.

For the values given, I1 = I2 = 0.4672A, the current in R = 0.9524A and the voltage V = 5.714V.

If the internal resistances of the batteries are reduced to zero, we can no longer determine the currents as the last two equations are now being divided by zero. So the answer to the original problem is that the current in R is less than 1A, but the values of I1 and I2 cannot be determined from the information given.

Blame Mr Jack Middlehurst for this one, all I did was present it!



NOTES & ERRATA

PC-BASED FRAME GRABBER

(August 1989): Further to the errata published in November 1989, the parts list should be altered in the following manner:

DELETE: 1 x 10pF ceramic cap, 2 x 1nF metallised polyester caps, 1 x 0.15uF metallised polyester cap, 2 x 680 ohm resistors, 1 x 22k resistor, 1 x 4016 IC.

ADD: 1 x 150pF ceramic cap, 1 x 0.22uF metallised polyester cap, 1 x 5 to 60pF miniature trimmer cap, 1 x 3.9k resistor, 1 x 56k resistor.

CHANGE: 5 x BC549 to 8 x BC549, 1 x 4066 IC to 2 x 4066, 1 x 74LS240 to 1 x 74LS368, 1 x 33pF ceramic to 1 x 22pF ceramic, 1 x 1.5nF metallised polyester to 2 x 1.5nF metallised polyester, 20 x 0.1uF monolithic to 17 x 0.1uF monolithic, 20 x 22uF tantalum to 14 tantalum, 2 x 100 ohm to 3 x 100 ohm, 2 x 560 ohm to 4 x 560 ohm, 1 x 10k to 2 x 10k, 2 x 22uH inductors to 2 x 47uH inductors.

Also, the line labeled 'SYNC' in Fig.6 should read 'HSYNC', and '/OE' in Fig.8 should read '/R-WRAM'. In Fig.10, pins 15 and 16 of U32 are transposed. On the component overlay, C8 next to U34 should read C18, and the unmarked capacitor between U26 and U27 should read C42. In Fig.7 the 0.1uF capacitors in the range C36 to C39 don't actually exist on the PCB. Note that the labels C17 and C18 are used in both Fig.3 and Fig.7. (File 2/CC/107)e 2/CC/107)

TV-DERIVED FREQUENCY STANDARD

(July/October 1989): The parts list on page 101 of the July article gives incorrect identification codes for the three PCB patterns used in this project. The correct ID codes are 89tvf7a, 89tvf7b and 89tvf7c for the main board, oscillator and power supply boards respectively.

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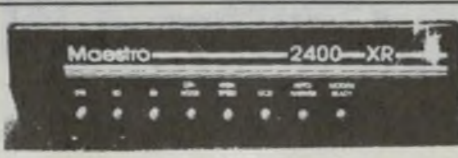

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Choosing a DMM

Nowadays there's a bewildering range of digital multimeters available, from low cost models that slip into a shirt pocket to much more pretentious and costly bench-type instruments. Here's some helpful advice on choosing the right model for your particular needs...

by JIM ROWE

The Fluke model 45, a dual display 5-digit bench type DMM with 0.025% accuracy on the basic DC voltage ranges.

The old analog multimeter with its fragile moving-coil meter movement is now almost a thing of the past, and in many ways that's just as well. Its modern digital equivalent the 'DMM' is fully electronic, and tends to be more rugged physically as well as providing higher reading resolution and lower circuit loading. Many of today's instruments are also considerably more accurate, and capable of a much wider range of measurements.

But DMMs are also somewhat more complex instruments than the old analog multimeters, and have more in them to 'go wrong'. Needless to say they also have ideosyncracies of their own – including a tendency to lull the user into making unwarranted assumptions about the accuracy and reliability of the readings they provide.

It's also true that for certain specialised applications, they can actually be rather less suitable than a old-type analog instrument.

Quite apart from these considerations about DMMs in general, there's also a huge and somewhat confusing range of instruments available to choose from – all the way from limited-range shirt pocket models costing less than $50 to lab-grade bench models costing well over $1500. This can make it surprisingly difficult to select the right class and model of instrument for a given application, even for professionals.

My aim here is to offer some helpful advice on finding your way through the DMM forest, by evaluating the factors you need to consider when choosing one for your particular needs.

DMM basics

At the heart of virtually all modern DMM's is a digital DC voltmeter, consisting essentially of an analog-to-digital converter (ADC) driving a digital counter. In most cases the ADC employs the so-called *dual-slope integration* technique, which allows it effectively to generate output pulses whose length is very closely proportional to the input DC voltage, with very high linearity and low zero drift. It generally does this by comparing the input voltage with an internal voltage or current reference – typically based on the voltage drop of a temperature-compensated zener or 'band-gap' diode junction.

The output pulses from the ADC are fed to the counter, which measures their length and therefore produces a count reading directly proportional to the input voltage.

In many current DMM's the operation of the ADC and counter are controlled by an inbuilt microcomputer, which can automatically switch in input voltage dividers, to prevent ADC overload and/or counter overflow. This is the kind of instrument which provides the so-called *auto ranging* function. The microcomputer is generally arranged to select the lowest range possible without causing overflow, so that the highest meaningful count is produced. This also gives the highest reading *resolution*, and generally the best working accuracy.

Other instruments simply provide a conventional manually controlled input divider system, so that it's up to the user to select the range which gives the highest resolution and accuracy.

Note that in both autoranging and manual DMM's, the ranges are generally arranged to have 10:1 ratios.

It is this basic digital voltmeter (DVM) system which determines the overall *resolution* of the DMM: the smallest change in value that it can indicate, on any particular range. This is related in inverse fashion to the full-scale reading (FSR), or maximum count that can be registered by the counter section. The larger the FSR, the smaller the input voltage represented by one count in the least-significant-digit position, on any range; and the finer the resolution.

Related to resolution, but not quite the same is *sensitivity*, which essentially describes the smallest *absolute* change in voltage that the DMM can indicate, i.e., it is the resolution of the instrument's basic DVM system. For a typical 3.5-digit instrument with an FSR of 200mV on the lowest range, the sensitivity will be 100uV.

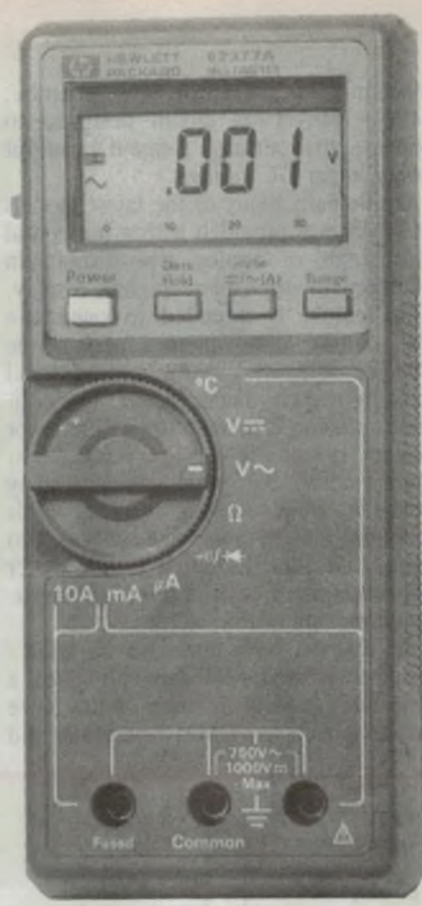
The performance of the basic DVM system also determines the fundamental *accuracy* of the instrument. This is largely a function of the linearity of the ADC section.

The basic DVM in most current DMMs uses a counter which can count up to 1999, giving what is generally called a '3.5-digit' instrument – i.e., three full digits covering 0-9, plus one 'half' digit covering 0-1. This gives a basic resolution of 1/2000th of the FSR on each range, or 0.05%.

Smaller 'pocket' models may use a counter with a full count of only 199, giving a rather more modest '2.5-digit' instrument having a resolution of 1/200th the FSR, or 0.5%.

On the other hand, more serious bench-type DMM's tend to have a counter with a full count of 19999, giving a '4.5-digit' instrument and 10 times finer resolution than a 3.5-digit model: 0.005%. But note that this improved resolution doesn't necessarily mean that the instrument will have a correspondingly higher *accuracy*. In fact the ADC in such an instrument must be considerably more linear and more stable than that used in a 3.5-digit DMM, if the finer resolution is to be matched by higher accuracy. More about this later, but suffice to say it's one of the reasons why 4.5-digit instruments tend to be rather more expensive.

Incidentally although the above maximum count and resolution figures are those most commonly provided, a few instruments provide 'intermediate' maximum counts such as 3200, 3999 or 4999. These offer a useful improvement in resolution compared with the more usual 1999, although this may or may not be accompanied by a matching increase in accuracy. The term '3.75-digit' is often used to describe such instruments, although strictly speaking they're really 3.5-digit instruments, and the usual 1999 instruments should really be described as having 3.1 digits.



Hewlett-Packard's E2377A, a compact 3200-count '3.75-digit' handheld unit with a basic DC volts accuracy of 0.3%.

To this basic DC digital voltmeter (DVM) system are generally added various *conversion circuits*, to adapt it for measurement of DC current, AC voltage and resistance. More pretentious instruments will frequently also add circuitry to measure AC current, capacitance, and possibly things like frequency, diode and transistor parameters, temperature and so on.

As you might expect, DC current ranges generally involve only the addition of various low value *shunt resistors* to the front of the basic DVM, to effectively convert current into voltage. In most cases the shunts are arranged to produce a voltage drop equal to the FSR of the basic DVM, when passing the full current for the range concerned. So if the basic DVM circuit has a sensitivity of 200mV for FSR on its lowest range (fairly typical), this will tend to be the maximum voltage drop or 'burden voltage' for the current ranges.

Providing the AC voltage and current ranges is rather more involved. Here a precision rectifier system must be switched in ahead of the basic DVM, to convert the incoming AC voltage into the equivalent DC voltage for measurement.

Many of the lower cost DMM's use a precision op-amp rectifier circuit which essentially responds to either the *peak* or *average* value of the incoming AC waveform, although it is actually calibrated in terms of the equivalent RMS value for a sinewave. This system produces accurate enough results for many purposes, but does tend to give significant errors where the AC waveform is not a pure sinewave – i.e., with a different form factor.

Because of this, a proportion of DMM's are fitted with a special kind of rectifier circuit which gives a DC voltage output closely proportional to the *true RMS* value of the AC input voltage, for waveforms whose form factor can vary over quite a wide range. Currently this 'true-RMS reading' feature tends to add significantly to the price, but it may be worth paying the extra if you need to know the effective value of AC signals having many different kinds of waveform.

As with the DC current ranges, if the instrument provides AC current ranges these are generally achieved by a set a current shunts. In fact the same set of shunts may be used as for the DC current ranges, only for AC they are switched in ahead of the rectifier circuit. For higher AC current ranges a *current transformer* may be used to step the current level down, or alternatively a current-to-voltage transducer making use of the Hall effect.

The conversion circuit used to allow the basic DVM system to measure resistance consists essentially of a constant current source, arranged to produce a selection of accurately known currents. The DVM then measures the voltage drop of the resistance to be measured, when passing one of these known current levels. By Ohm's law, this voltage will be directly proportional to the resistance.

Note that the voltage drop produced across the resistance under test, during the measurement, will depend upon the effective sensitivity of the DVM circuit

Choosing a DMM

for these measurements. This is a significant point when you want to use the DMM to check diode and transistor junctions, or to make measurements on resistors when they're 'in circuit' with semiconductor devices. Again we'll discuss this further, shortly.

A similar constant-current circuit is generally used for measuring capacitance, except that here the ADC circuit may be switched out, and the DVM's counter simply used to measure the time taken for the capacitor be measured to charge to a defined level, when fed from the constant-current source.

The counter section may also be made available directly, with timed input gating, to provide some ranges for frequency measurement. In the case of most DMMs this function is fairly limited, covering little more than 'audio' frequencies.

Temperature measurements are generally made in conjunction with a thermocouple or thermistor sensing probe, with a conversion circuit designed to convert the sensing element's output into a linear DC voltage.

Incidentally many of the latest models of DMM are provided with a horizontal 'bar graph' or 'analog' type display, in addition to the main digital display. This feature is intended to overcome one of the disadvantages of a basic DMM, compared with a traditional 'moving needle' analog meter: the difficulty in using it to monitor a voltage or current which is being 'peaked' or 'nulled'. The bar graph/analog display certainly goes a long way towards removing this disadvantage, although in many cases the resolution is still rather poor compared with that of a conventional moving needle meter.

So that's a basic rundown on what's inside a typical DMM. Now let's look a little more closely at some of the more subtle aspects of DMM operation and performance, which you need to know in order to be able to select the right instrument for your needs.

Working resolution

As we saw earlier, the resolution of a DMM is generally stated as a proportion of its FSR, either by quoting its maximum count or giving the significance of its least significant digit (LSD) as a percentage of FSR. So the resolution of a typical 3.5-digit instrument will generally be given as either 1999, or 0.05%.

But it's important to realise that this is the *minimum* resolution, effective only when you're measuring values close to the FSR for the range being used. The actual *working resolution* will often be rather higher (poorer), because it varies directly as the ratio between the value you're measuring and the FSR.

The best way to show this is by an example. Let's say you're making measurements on a 3.5-digit meter, switched

FEATURE CODES

A.	Autorange	F.	Frequency measurement
B.	Bargraph	H.	Data hold
C.	Capacitance	P.	Automatic polarity
d.	Digits	Q.	Transistor test
D.	Diode test	R.	True RMS reading
E.	Battery tester	T.	Temperature
		X.	Logic test
		Z.	Continuity test

Unless otherwise specified the meters are digital and/or hand held.

MODEL	DESCRIPTION/FEATURES
Altronics (1)	
Q1070	3.5d, 27 range – X, D, C, F, Q
Q1066	3.5d – D, C, T, Q
Q1075	3.5d – A
Q1062	30 range – LCR meter, D, Q
Q1060	Pocket size – Z
Q1056	17 range – E, D
Q1018	Analog – E, Z
Q1013	Analog, pocket size
Q1050	Analog, center zero pointer
Appa (12)	
23	3.5d – tach, dwell, duty cycle, P, D, Z
35	3.75d, clamp type – A, Z, H
76	3.5d – C, Q, D, E, SCR & LED test
91	3.5d – D, Z
93	3.5d – P, D, Z, F, C
93T	3.5d – P, D, Z, F, C, Q
96	3.5d – A, B, D, Z, H
98	3.5d – A, B, D, F, C, H, Z
Arista (2)	
DMM4	3.5d – E, D, P
DMM5	Bench – A, D, Z, P, Q, H
AMM1	Analog, pocket size, 15 range
AMM2	Analog, 20 range – E, Z
AMM3	Analog, 41 range – E
DMM1	3.5d, pocket size – A, P, Z
DMM2	Pocket size – A, Z, H
DMM3	3.5d – A, B, H, Z, P
AVO (8)	
M2004/5	3.75d – A, B, P, D, Z
M2006/7	3.75d – A, B, P, H, D, Z
M2008	Above plus R
M2035	Folding, 4.75d – A, B, P, H, D, Z
M2036	Above plus R
	And more sophisticated meters
Black Star (7)	
3210	3.5d, bench – R, D, Z, P
3225	3.5d, bench – D, Z, P
4503	4.5d, bench, data logger – R, A, H, D, Z, P
Dick Smith (3)	
Q1000	Pocket size, analog, 15 range
Q1015	Analog, 18 range – E
Q1022	Analog, 19 range – E, Z
Q1445	3.5d – Q, D, Z, E
Q1143	Analog – p-p and R measurements
Q1524	A, Z, H, D, F
Q1526	3.5d, 30 position – Q, Z, C, B, D, F
Q1528	4.5d – C, D, Q, F, H
Q1440	D, Q
Q1516	3.5d, memory – Q, H, A, P, Z
Q1500	C, Q, D, Z
Emona (5)	
EDM1177	3.75d, 14 function – A, B, F, C, H, Z, D, min-max
EDM1155	3.75d, 12 function – A, B, C, H, Z, D, X
EDM1133	3.75d, 8 function – A, B, Z, D
EDM 168	3.5d, 10 function – F, C, Q, D, Z
EDM 166	3.5d, 8 function – Q, D, Z
EDM 162	3.5d, 7 function – A, D, Z
EDM1100	3.5d, pocket size, 7 function – D, Z
EDM1111A	3.5d, 9 function – C, Q, D, Z
EDM1122	3.5d, 11 function – F, C, D, Q, Z, X
EDM 55	Pen type – A, Z, D, H
EDM1341	4.5d, 9 function – R, F, H, Z, D
EDM 72B	3.5d, pocket size, 8 function – C, D, Z, Q

EDM1346A	4.5d, 9 function – R, F, H, Z, D
EDM 70H	3.5d, 6 function – D, Q
EDM 70B	3.5d – D, Z
DM6012D	3.5d – data bus, D, Q
3487A	3.75d – A, P, B, H, Z, D, F, min-max & rel
3487B	Above plus R
3487C	3.75d – A, P, B, H, Z, D, F, min-max & rel RS-232C interface
3487D	Above plus R
3486A	3.5d – A, D, Z, H
GDM8034	Bench, 3.5d – C, D, Z
GDM8035F/G/T	Bench, 3.5d – D
GDM8045G	Bench, 4.5d, 6 function – D, R
EDM2116	Bench, 3.5d – C
EDM2347	Bench, 4.5d – F
CD-1	Bench, 4.75d – A, F
CD-3	Bench, 4.74d – A
	There are also 15 analog meters and many high precision digital bench types.

Fluke (7, 9)

83/85	3.75d – B, F, C, H, Z, D, duty cycle, min-max
87	Above plus 4.5d mode and R
73	3.5d – A, P, B, D
75	3.5d – A, P, B, Z, D, range hold
77	3.5d – A, P, B, Z, D, H, range hold
21	A, B, P, D, Z
23	A, B, P, D, Z, H
8021B	3.5d, 24 range – D, Z
8020B	Above plus conductance
8026B	Above plus R
8024B	3.5d, 24 range – D, Z, X, T, conductance
8060A	4.5d – R, Z, D, rel
8062A	4.5d – R, Z, D, F, rel
25	A, B, H, Z, D, min-max
27	Above plus relative mode
45	5d, bench – R, F, H, Z, D, min-max & rel RS 232 interface
37	Bench – A, B, H, D, Z, min-max & rel
8010A/12 A	3.5d,bench – R, D, conductance, rel
8050A	4.5d, bench – R, D, conductance, rel
8840series	5.5d, bench – R, IEEE-488 control

Goldstar (4)

DM7143	4.5d – D, Z, H
DM8135	3.5d – A, D, Q, H, rel
DM8243	4.5d – A, C, F, D, Q
DM8433	4.5d - A, C, T, D, Q
DM6335	Pocket size, 3.5d – A, H, D, Z, rel
DM7241	Bench, 4.5d – Z, H

Jaycar (6)

KC5058	Kit, analog, 23 range – Z, E
QM1410	3.5d, 20 range – D, P
QM1400	3.5d, 34 range – C, F, D, Z, X, P
QM1420	Probe type, 3.5d – X, H, A, D, Z
QM1555	C, Q, F, D, Z
QM1500	3.75d – A, H, D, Z, F
QM1475	3.75d, 39 range – L, C, F, T, X, D, Z
QM1560	4.5d – F, Q, C, H
QM1001	Analog, economy model
QM1015	Analog, 18 range
QM1022	Analog, 23 range – Z, E
QM1050	Analog

Metrix (4)

MX 40 series	A, H, D
MX 47	A, H, D, T, R
MX 50	B, D, Z, X
MX 51	B, D, Z, X, rel, memory
MX 52	B, D, Z, X, F, R, rel, memory
MX573	Analog and digital, 35 range – P, R
MX200/1200	Clamp-on – A. R
MX545	Bench – A, H
MX547	Bench – A, H, T, R
MX579	Bench, 4.5d – D, R, IEEE 488 interface

Micronta (11)

22-9600	4.5d – B, F, C, Q, H
22- 194	30 range – Q, C
22- 195	Bench – B, Q, D, Z
22-9560	3.5d – tach, dwell
22- 185	23 range
22- 188	A
22- 165	Probe style – H, Z
22- 214	Analog, 43 range
22- 211	Fold up, analog, 25 range
22- 201	Analog, 18 range
22- 212	Pocket, analog

Normameter (8)

MP11	4d – A, B, P
MP12	4d – A, B, P, Z, H, min-max & rel
MP13	4d – A, B, P, Z, H, T, min-max & rel
MP14	4.5d – A, B, P, Z, H, T, timer, min-max & rel

Parameter (8)

7025	3.5d, 33 range – P, C, D, Z
7060	3.5d, 32 range – P, Q, X, Z, C
7035	3.5d, 32 range – P, Q, X, Z
7040	3.5d, 33 range – D
7080	3.5d, 37 range – D, C, Q
7080B	3.5d – D, Z
8040	4.5d, 31 range – D, Z, Q
2010BZ	Analog, 24 range – Z
5050E	Analog, 43 range
244701/2	3.5d – Z

Philips (9)

PM2518	B, T, D, Z, R, rel
PM2618	B, T, F, X, D, Z, R, rel
PM2718	B, T, F, X, D, Z, H, R, min-max & rel
PM2505	Analog, 62 ranges – D, P, Z
PM2504	Analog, bench – R

Rod Irving (10)

Q91530	3.5d, 30 position – Q, P, D, Z
Q91540	3.5d, 30 position – C, Q, P, D, Z
Q91550	3.5d, 30 position – F, C, Q, D, Z
Q91560	4.5d, 30 position – H, Q, Z, D
Q11020	Analog – Q
Q11001	Analog, 11 range

Simpson (12)

487	3.75d – A, B, D, H, Z
488	Above plus R
470	3.5d – D, Z
474	4.5d – D, Z
360-2	3.5d & analog, 28 range
360-3	3.5d, 28 range – D, Z
	There are 22 analog models and 10 digital bench models from Simpson, of high reputation, covering all kinds of industrial applications

Solartron (4)	Sophisticated bench type

SUPPLIERS

1. Altronics, 174 Roe Street, Perth 6000.
2. Arista Electronics, 57 Vore Street, Silverwater 2141.
3. Dick Smith Electronics, P.O. Box 321, North Ryde 2113.
4. Elmeasco Instruments, 18 Hilly Street, Mortlake 2137.
5. Emona Instruments, 86 Parramatta Road, Camperdown 2050.
6. Jaycar Electronics, 115-117 Parramatta Road, Concord 2137.
7. Obiat, 129 Queen Street, Beaconsfield 2015.
8. Parameters, 1064 Centre Road, Oakleigh South 3167.
9. Philips Scientific & Industrial, 25-27 Paul Street, North Ryde 2113.
10. Rod Irving Electronics, P.O.Box 620, Clayton 3168.
11. Tandy Electronics, 91 Kurrajong Avenue, Mt.Druitt 2770.
12. Tecnico Electronics, 11 Waltham Street, Artarmon 2064.

to the 20V range. With a maximum count of 1999, its LSD will be indicating tens of millivolts. So when you're measuring voltages close to 20V, the working resolution will indeed be close to the minimum of 0.05%.

But when you're measuring a voltage of say 3V, on the same range, the LSD still indicates in tens of millivolts. So the *working* resolution rises to only 1/300, or 0.33%.

This effect is more significant that you might think, because of the way most DMM's have ratios of 10:1 between ranges. The result is that over each range, the working resolution varies from the minimum, at FSR, up to 10 times that value at the effective bottom of the range concerned. So the *average* working resolution will tend to be around five times the nominal figure.

If you're going to *need* low resolution, then, you should choose an instrument with a rather lower figure again – say 1/10 of your target measuring resolution.

It's worthwhile remembering that although low resolution doesn't guarantee high accuracy, you can't achieve the latter without the former. Unless an instrument has suitably low resolution, it can't even *indicate* small changes in your measured voltage – let alone do this accurately.

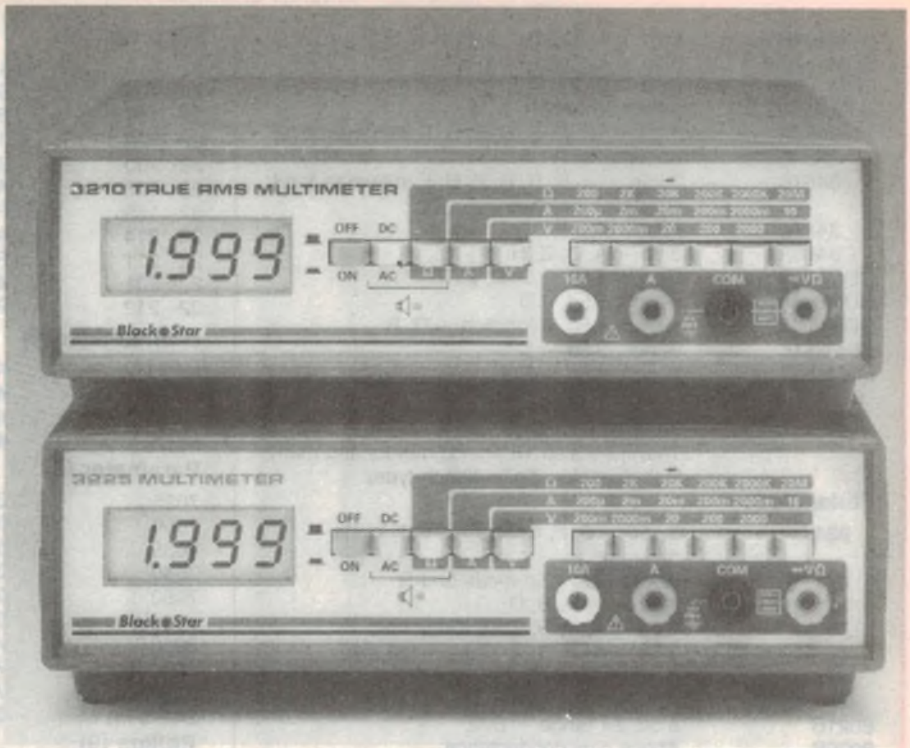
Note that at certain points in their ranges, usually at the multiples of 10, most DMMs have a sudden change in the number of effective digits. For example when you're using a 4.5-digit instrument to measure 10.1 volts, it provides a reading with five significant digits; but for measuring voltages just a little lower, say 9.9V, it provides only four digits. There's no sudden change in *resolution*, but the sudden loss of a digit can be a little disconcerting.

Another point to remember is that low resolution doesn't necessarily mean high sensitivity. A 4.5-digit DMM with a minimum FSR of 2V will have the same sensitivity (100uV) as a 3.5-digit instrument with a minimum FSR of 200mV, so it's important to consider the minimum FSR as well as the resolution.

Accuracy

Because of their relatively high reading resolution, and because they give readings directly in digits, DMMs have the appearance of being much more accurate than earlier analog instruments. But appearances can be deceptive.

The actual accuracy of a DMM depends upon such things as the linearity



The British-made Black Star 3210 and 3225 models, featuring a basic DCV accuracy of 0.1% and 0.25% respectively.

of its ADC, the precision of the resistors used in its input range switching divider, the stability of its internal voltage or current reference source, and so on. In general, it is far harder to achieve a particular level of precision and stability with these components, than to simply make a basic DVM system with comparable resolution. So in most cases, the accuracy of a DMM tends to be somewhat poorer than the potential represented by its resolution.

For example although the minimum resolution of a 3.5-digit DMM is 0.05% (1/2000), as we've seen earlier, a typical medium-priced instrument has a rated accuracy on the basic DC voltage ranges of between +/–0.5% and +/–1%.

Note that this figure *should* represent a proportion of the reading itself, but occasionally with one of the cheaper instruments it will in fact represent a proportion of the FSR for the range concerned. The distinction is often easy to miss, but quite important: if the figure quoted is a proportion of the FSR, then the *working* accuracy will be as much as 10 times worse, depending upon the value you're measuring.

To this basic accuracy must generally be added a digital 'bobble' or gating error component, of at least +/–1 and possibly +/–2 digits in the LSD position. So the typical working accuracy of a 3.5-digit DMM, on its DC voltage ranges, will be properly quoted as say +/–(0.7% + 1 digit).

As you can see, this is rather poorer than even the average working resolution, which will vary from the minimum of 0.05% at FSR up to 0.5% at the bottom of a range.

Buying a 4.5-digit instrument will certainly get you 10 times better resolution, as we have seen (0.005% of FSR), but the accuracy may or may not improve as well. It will probably do so with a high quality instrument, which will typically offer a working accuracy of say +/–(0.03% + 2 digits), again for the basic DC voltage ranges. But a typical cheap 4.5-digit instrument may well offer a working accuracy of +/–(0.3% + 3 digits) for the same ranges – still an improvement, to be sure, but only by a factor of two.

Note that even for a better and rather more expensive 4.5-digit instrument, there's still about a 10:1 difference between the resolution and accuracy figures, while for the cheaper instrument the ratio is even greater at around 50:1. The moral here is that resolution comes relatively cheaply, but if you want high accuracy as well, you'll have to be prepared to pay for it!

Note too that so far, we've been talking about the accuracy of an instrument on its basic DC voltage measurement ranges. Needless to say, the accuracy often tends to be significantly *poorer* on the other ranges. Typically it may be only slightly poorer on the DC current and resistance ranges, but the error tolerance will rise more noticeably for the DC voltage and current ranges due to rectifier linearity errors.

In fact the working accuracy on some AC ranges may be up to 10 times poorer than that for the DC voltage ranges, even for quite high quality (and expensive) instruments. So if you need to make particularly accurate AC voltage or current measurements, you'll need to study the specifications very carefully before you buy.

Stability

Like any piece of electronic equipment, the calibration accuracy of a DMM will tend to vary due to variations in the value and performance of its components with such factors as temperature, humidity and supply/battery voltage, and also over time due to ageing.

Most common DMM's are rated to operate normally and with rated accuracy between about 18° and 35°C, and at relative humidity levels below about 75-80%. If you want an instrument to operate reliably outside this range, you may have to pay considerably more.

Similarly most instruments give readings within their rated accuracy specification providing the supply/battery voltage is within about 10-15% of its rated figure.

Generally a 'Low Battery' indication will be given on the display before the supply voltage falls below the threshold for degraded accuracy, but this isn't always the case. With some of the cheaper instruments, accuracy has been found to deteriorate quite significantly before any indication is given – a nasty shortcoming. If you are going to use your DMM away from the AC power, and must have known accuracy, this is a good point to watch.

Long-term stability of DMM calibration is rather more problematic. Even with the best instruments commonly available, the calibration is rarely specified for longer than 12 months, while with most cheaper instruments it generally isn't specified at all!

Ideally you should have a DMM re-calibrated every 12 months or so, and this is highly desirable if you buy a high-quality instrument and will be relying on its accuracy. But for many applications, and with the cheaper grade of instrument, re-calibration may be neither feasible nor economically justified.

A practical alternative, for many purposes, is to maintain a higher grade 4.5-digit instrument which is kept primarily for reference purposes, plus lower cost 3.5-digit models which are used for the majority of day-to-day measurements. This makes it possible to allow somewhat longer periods between re-calibrations of the reference instrument – say every 2 years or so.

Resistance ranges

Because a DMM measures a resistance by passing a constant current through it and measuring the resulting voltage drop, there will always be a voltage present across the resistance being measured. The maximum voltage for FSR will depend upon the effective sensitivity of the DMM for resistance measurements, and is important to know when you're making certain kinds of measurement.

For example if the voltage applied is below 300mV, the DMM won't be able to turn on typical semiconductor junctions, so it won't be able to check diodes or transistors. But it generally *will* be able to check the value of resistors in transistor bias circuits, without needing to disconnect one end.

On the other hand, if the DMM applies over 700mV for resistance measurements, it *will* be able to turn on diode and transistor junctions, and can be used to check them. But in this case it *won't* be able to make in-situ measurements on resistors in circuits where they're shunted by diodes or transistors.

You can't have it both ways, at least not at the same time. But some of the better DMM's do give you a choice, by having one or two ranges where the applied voltage is below 300mV (say 200mV), and others where it is above 700mV (say 2V). So some ranges can be used for in-situ testing, and others for checking diodes and transistors. A handy feature!

Circuit loading

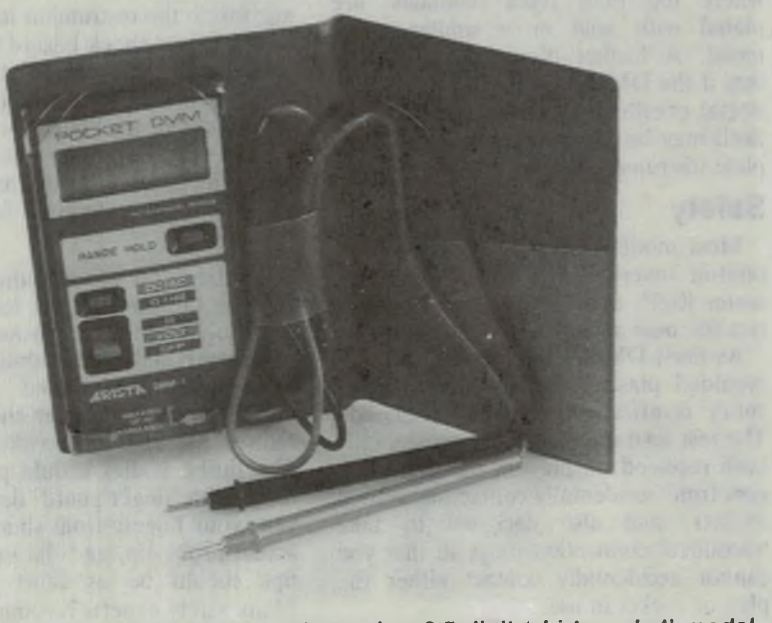
Most modern DMMs have an input (loading) resistance of around 10 megohms on the DC voltage ranges. For the majority of measurements in solid state circuitry, this is high enough to ensure that the meter doesn't load down the circuit under test, and cause reading errors. In that respect, a typical DMM is very similar to one of the old 'valve voltmeter', VTVM or 'electronic voltmeter' analog instruments.

However there will be some circuits which operate at such a high impedance that even the 10M imposed by a typical DMM will cause significant shunting and reading error. To make accurate measurements in these circuits, you'll need an instrument with much higher input resistance.

Few instruments offer very high input resistance on all ranges, but there are a few higher grade instruments available which offer very high input resistance on at least one DC voltage range – usually the lowest. Typically this range will have an input resistance of say 10,000M (10 gigaohms), giving negligible loading even in circuits handling very low currents.

Construction

Most modern DMMs are made in one of three forms. There is the compact



Arista's DMM-1 is a very compact autoranging 3.5-digit 'shirt pocket' model, smaller than many pocket calculators.

'pocket' type, generally much the same size and shape as a pocket calculator, and often housed in a similar vinyl-covered wallet. Then there is the 'hand-held' type, similar in overall shape to the pocket type but roughly twice the size – a little too large for most pockets! And finally there are the 'bench' models, typically more like a digital frequency counter in their size and shape.

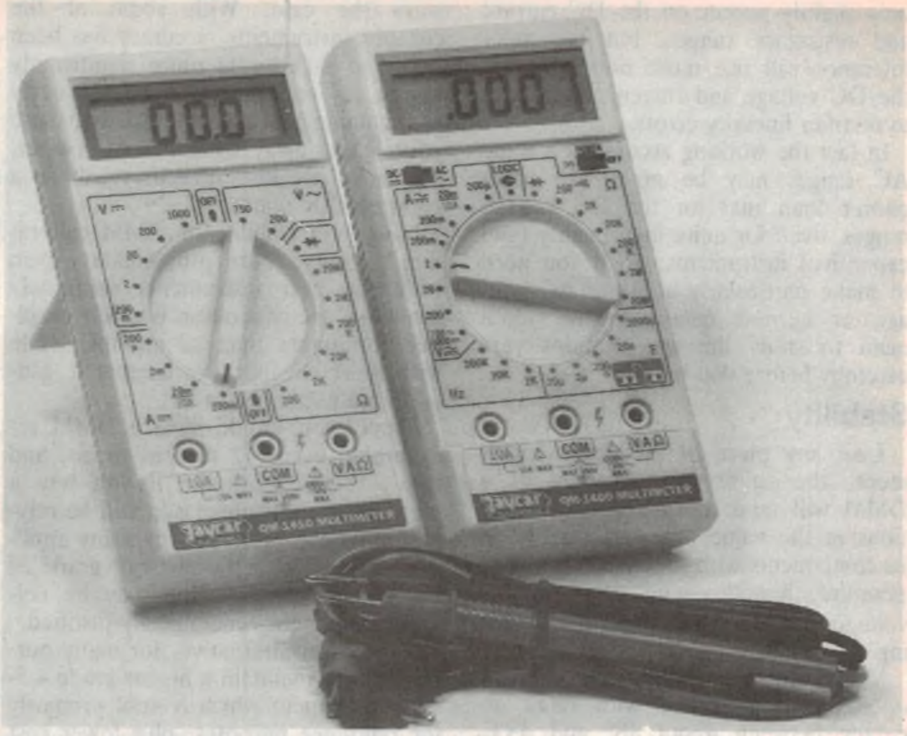
All three types of DMM are generally housed in moulded plastic cases, often using a material with high impact resistance such as polycarbonate.

Like other digital instruments with a display, the readout of a DMM is generally via either an LCD panel, a row of 7-segment LED displays, or a similar vacuum fluorescent display. Virtually all of the pocket and hand-held models use LCD panels, because of their lower current consumption and higher readability in high ambient lighting conditions. Many modern 'bench' models also use an LCD display, although some use LEDs or vacuum fluorescents – both of which offer high readability in an indoor environment.

Some of the LCD panels used in earlier DMM's had a relatively short life, and after a couple of years became dark and unreadable. However LCD technology has steadily improved, and most manufacturers will assure you that the displays in their current models will last for many years. Only time will tell, of course, although it would be reasonable to assume that the LCD's used in the more expensive brands will have a longer life than those in the cheaper models.

In the area of general construction, most DMM's use either a set of push-button switches or a multi-position rotary switch to select the various measurement functions and ranges. In principle either of these approaches should be fine, and capable of the same performance and reliability. However in practice, it has become common for push-button switches to be used for the higher performance models, and rotary switches for those with the emphasis on economy. Some manufacturers have claimed that it is easier to make push-button switches with greater reliability and consistently lower contact resistance.

More importantly, there are significant differences in the kind of rotary switch used, especially in the cheaper models. The preferred approach is to use a standard high quality rotary switch, which is simply mounted on the PC board used to support the rest of the DMM circuitry. However some makers of low-end models save money by integrating the switch with the PCB itself, using the actual PCB tracks as the switch contacts.



Jaycar's QM1410 and QM1400 are attractively priced 3.5-digit handhelds, yet the latter features capacitance and frequency ranges.

This latter approach often results in a switch with a 'spongy' feel, where there is no distinct mechanical detent to indicate the correct position for each range. It may also give relatively high contact resistance and poor reliability, even where the PCB track 'contacts' are plated with gold or a similar noble metal. A further disadvantage can be that if the DMM is subjected to an accidental overload, the main circuit board itself may be so damaged that the complete instrument is a write-off.

Safety

Most modern DMM's are fitted with built-in overload protection for the meter itself, as well as features to protect the user against accidental shock.

As most DMM's are now housed in a moulded plastic case, the internal circuitry is effectively 'double insulated'. The test lead input sockets are generally both recessed, to prevent the user's fingers from accidentally contacting unused sockets, and also designed to take 'shrouded' connection plugs so that you cannot accidentally contact either the plug or socket in use.

These features are now almost universal, but may be worth checking when you're considering a purchase, as some of the cheaper models may not be up to scratch.

Another important safety feature is fusing. As part of the internal overload protection, many DMM's are fitted with fuses – especially for the current ranges. When these fuse or 'blow' due to excessive current, this can result in the formation of an arc if the instrument is connected into a high voltage circuit. Such an arc can both cause damage inside the instrument itself, and present a fire or shock hazard to the user.

Generally this risk is rather higher with open or glass-encased fuses, than with those of the 'HRC' variety. So it's a good idea to get an instrument fitted with the latter type of fuse, or to replace any other type of fuse with this type.

A final safety consideration is with regard to the meter's test leads. As well as being fitted with shrouded plugs at the meter end, these should be fitted with suitably shrouded test probes and/or clips at the other end – again to reduce the risk of accidental contact. The probe bodies should preferably be fitted with 'finger guard' flanges, to prevent your fingers from sliding up to the actual probe tip, and the exposed metal tips should be as short as possible. Many safety experts recommend as little as 1-2mm of exposed metal, for the highest safety.

Bells & whistles

Many modern DMM's offer a variety of additional features, designed to add to measuring convenience and flexibility. The most common of these are:

Reading Hold: This is generally a button which lets you halt the DMM's cycle of taking new measurement samples, so that the last reading taken is 'frozen' or held indefinitely on the display. A handy feature if you're working in confined or awkward places, and can't simultaneously apply the test probes to the correct places, and also read the display.

Relative Reading: This is a feature which allows you to switch the DMM from making normal *absolute* measurements, to making *relative* measurements. Pressing the appropriate button while you're making a measurement results in the instrument taking the current reading as its reference, rather than the usual absolute reference. Further measurements taken while in relative mode then produce readings showing the *difference* between the new values and the one taken as the 'relative reference'. This facility is convenient for measuring things like power supply regulation, or frequency response; by effectively 'nulling out' the main reference value, it allows any changes to be read with greater resolution and accuracy.

Continuity Buzzer: Many ofthe newer DMM's provide an internal piezoelectric 'buzzer', which operates on the resistance ranges and sounds when the resistance between the test probes is lower than a preset value – typically 100 ohms or so. A handy feature when checking cables, PCB tracks, etc.

Max/Min Hold: Some of the higher-performance instruments provide a facility for automatically saving either (or both) the highest and lowest values for the voltage or current you're measuring, when the DMM is left hooked to the circuit to monitor any variations. You can then recall these maximum and minimum levels at your convenience – a useful feature if you're trying to track down intermittent faults, or checking for power line voltage variations. In some cases, the DMM can also be programmed to calculate the *mean* or average of the variations, as well as the maximum and minimum.

Summary

I hope the above information helps clarify any confusion you may have had, about the way DMMs operate. I've also tried to explain the points you should bear in mind, when attempting to select the right DMM for your needs.

The modern DMM can be a most useful and reliable instrument, providing it's from a reputable manufacturer. And its measurements will be considerably more accurate than those possible with many analog multimeters, providing you are aware of its limitations and take these into due consideration.

To help you in selecting the right DMM for your particular application, we have prepared a listing of suppliers and models, with details of their basic features. But as it hasn't been possible in the listing to give comprehensive information on the performance of each model, we suggest that you select the most likely models first, and then try to obtain more information from the supplier before making a final choice. All DMM's are not the same, even though many may seem that way on the surface!

Our thanks to all of the suppliers concerned, for sending us the information on their models for the listing. My thanks also to Mr Len Altman of Obiat, who very kindly sent additional information to help make this article more comprehensive.

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Test Instrument Review:

Sadelta's TC-400 VHF/UHF field strength meter

A field strength meter can be a very handy tool – not just for antenna installers, but for service technicians as well. The Sadelta TC-400 is a new addition to the modest range of FSM's available in Australia, being imported all the way from Spain.

by JIM ROWE

Considering just how handy an FSM can be, for both antenna installation and troubleshooting, it's somewhat surprising that they aren't in wider use. A relatively small proportion of service technicians seem to use them, while even many antenna installers seem to prefer relying on 'guess and good luck' rather than using an FSM to ensure the best results.

Perhaps it's been the relative scarcity of the instruments that has dampened their popularity; or the fact that until recently, they've been fairly pricey. Both factors may have caused many potential users to decide they were a 'luxury', which could be done without.

This isn't really true, though. Finding the exact location and height of an antenna for optimum TV or FM reception can be very tricky and time consuming, without an FSM to guide you. Particularly at UHF, varying the antenna position by only a few feet (sorry, few hundred millimetres!), either horizontally or vertically, can make a very significant difference. In a fringe-area situation, it can mean the difference between 'good' and 'totally unacceptable' reception – yet finding the right position without an FSM is very difficult.

An FSM can also save loads of time in tracking down the real cause of a reception fault. It can very quickly tell you if the trouble is in the antenna, the cable system, or the receiver itself. How many technicians have spent half an hour looking for a fault in the tuner, only to discover that the down-lead or balun has fallen off the antenna?

I had a very good example of this myself, while checking out the Sadelta TC-400 for this review. My parents live in a fringe area at the southern tip of Sydney's metropolitan area, and their TV reception suddenly deteriorated – with weak, snowy pictures and poor sync on all channels. Not surprisingly there was a phone call to ask if I could call down at the weekend, with 'a meter and a few tools', to check it out and hopefully fix the fault.

Would it be the antenna, the downlead, or the set's own tuner? There was no way to tell in advance, so I decided to take the Sadelta FSM with me, as well as the usual DMM, soldering iron and assortment of hand tools.

I was very glad I did. Before I did anything else I simply unplugged the coax antenna lead from the back of the set, and into the Sadelta. In less than two minutes, it told me that the signals reaching the set were way down in the mud, on all channels. They were around the 15-20uV level, way below the usual recommended minimum of about 500uV-1mV.

So it certainly wasn't the set; it was getting virtually no signals. But were the signals present at the wall socket? Another quick check with the Sadelta and a co-ax test lead I had brought 'just in case' showed that yes, all signals were present at the wall socket at a much higher level – between 300 and 500uV, which is about the best available in that fringe location.

This ruled out the antenna and main downlead, too. The fault was obviously in the 1.5m co-ax lead connecting the wall socket to the set. After that, it took only a few more minutes to discover that the inner conductor of the lead had broken off inside the plug at the wall socket end. This was easily remedied, and yours truly was soon being congratulated on a fast and successful repair job.

The point is, of course, that tracking down the trouble would probably have been a lot harder without the FSM. I might well have found myself up on the roof checking antenna connections, and/or exploring inside the set itself, before finding the real cause of the trouble. The Sadelta made the whole process much more efficient and effective.

And if an FSM can do this for an amateur serviceman like myself, how much more time would it save for a professional? Not to mention a professional antenna installer.

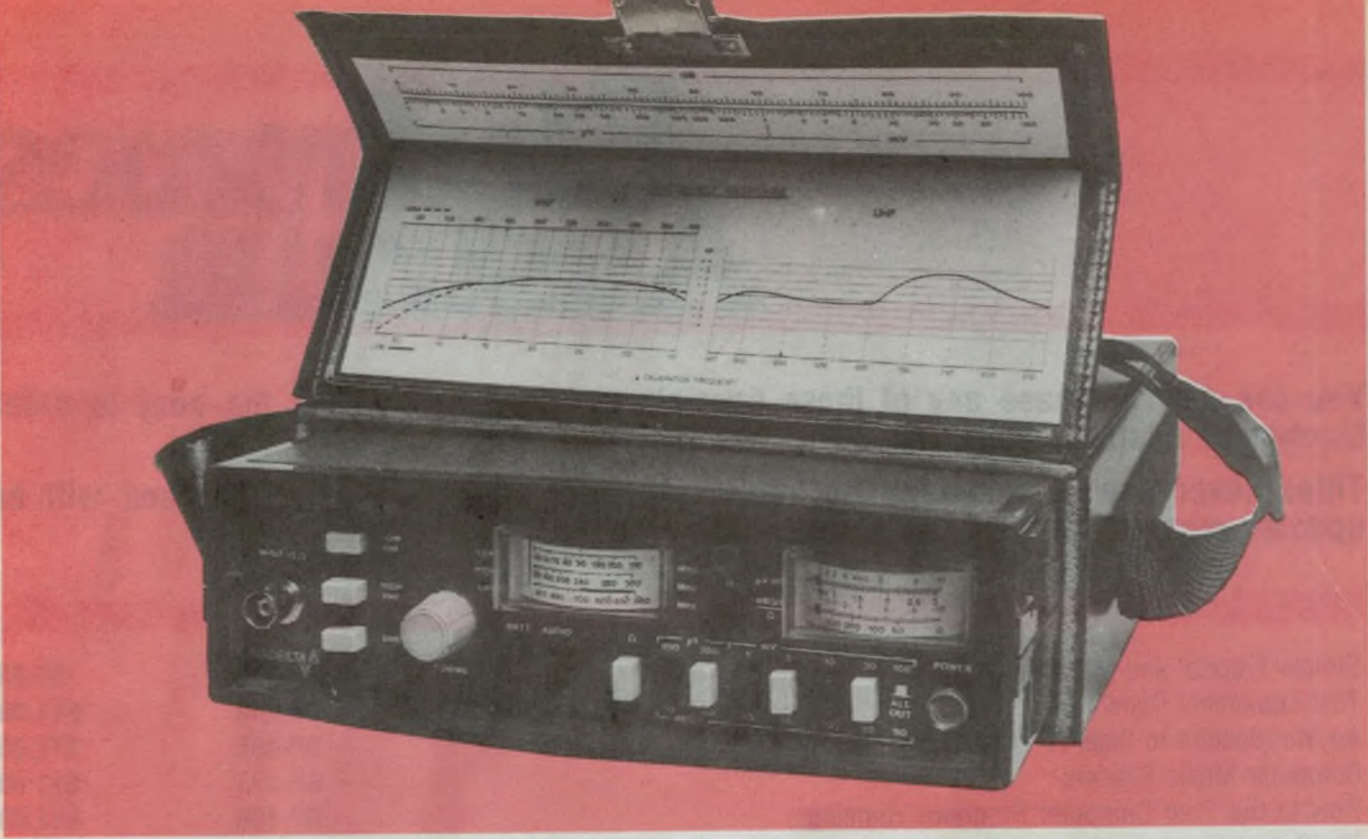
From Barcelona

The Sadelta TC-400 is a recent addition to the modest range of FSM's available on the local market. Like Manuel, the waiter in TV's *Fawlty Towers*, it hails from Barcelona in Spain – not exactly a place renowned for its electronics manufacturing, to be sure, but the TC-400 seems none the worse for that. In fact it gives every evidence of being a well designed and made unit.

Built into a fairly standard two-piece plastic instrument case, it measures a modest 216 x 235 x 68mm and weighs 1.9kg including the eight AA cells which fit inside the rear of the case to provide power.

A nice feature is that it's supplied in a protective leather carrying bag, with a shoulder strap and accessory pouch, making the overall package very practical for servicing or installation work.

It covers all of the VHF and UHF TV channels, with the FM band thrown in as well for good measure. There are three bands, covering low band VHF/FM (45-110MHz), high band VHF



(110-300MHz) and UHF (470-862MHz). The bands are selected by pushbuttons, with a 10-turn pot for tuning and a small edgewise-reading meter to serve as the tuning indicator. This has a separate scale for each band, marked directly in MHz.

For measuring signal level, there is a second edge-reading meter calibrated in both uV/mV and dBu (dB relative to 1uV). A set of six further pushbuttons provides a total of seven measurement ranges, from 100uV to 100mV FSD (the highest range is achieved by having all buttons in the 'out' position). On the lowest range the minimum measurable level is around 20uV, corresponding to +26dBu, while the top range limit of 100mV corresponds to +100dBu – giving an overall 74dB measuring range.

In addition to these ranges for measuring signal level, the TC-400 also provides a range for low resistance/continuity measurements, with a further scale on the signal level meter. This measures from 0 to 500 ohms, making it very handy for checking antennas, cables, connectors, baluns, splitters and the like without having to use a separate multimeter. Resistance measurements are made via two separate pin jacks, using a set of test leads provided.

Another nice little feature is a built-in audio detector, capable of demodulating both AM and FM, and feeding an internal 200mW amplifier and miniature speaker. So if there's any doubt as to the TV channel or FM station signal you're measuring, you can easily check this audibly. A pushbutton allows the audio to be switched on or off as required, so that it doesn't distract (or add to battery drain) when not wanted.

A final pushbutton (momentary-contact) allows the tuning meter to be used to check battery condition, so that the batteries can be replaced before they cause trouble.

The RF signal input is via a standard BNC socket, with a 'Belling-Lee to BNC' adaptor supplied as an accessory. Input impedance is 75 ohms, as used in most domestic TV systems.

The instrument's current drain from the internal 12V battery is around 90mA, so that one needs to be careful about not leaving it on accidentally. To help in this regard the power switch (another latching pushbutton) is fitted with an internal passive orange indicator. This maintains its visibility even in bright sunlight, while at the same time making no contribution itself to current drain.

Quoted accuracy of the TC-400 for level measurements on the two VHF bands is +/–2dB, with a corresponding figure of +/–4dB for the UHF band. To allow for the varying frequency response of the TC-400's tuner over each band, it comes with a set of charts to allow correction for the resulting errors, where the highest accuracy may be needed. The charts slip into a plastic envelope attached to the inside of the leather carrying case, along with a uV/mV-to-dBu conversion scale – also handy.

Performance

Basically, the sample TC-400 seemed to perform very well. The electronic tuning scheme is quite convenient, and thanks to the 10-turn pot it only gets a little critical at the upper end of the UHF band.

Basic level measurements are quite easy to perform, and the audio function makes it easy to make sure you're measuring the desired picture or sound carrier. Similarly we found it quite easy to make resistance and continuity measurements, using the test leads supplied.

Checking the level calibration against our signal generators, it turned out to be comfortably within the quoted specs – using the correction charts.

We also opened up the case, and looked inside. There were no skeletons in the closet – it gave every evidence of being well designed and solidly made using quality components.

So all in all, the Sadelta TC-400 seems a very useful and practical instrument. For the quoted trade price of $699, plus 20% tax if applicable, it should pay for itself quite fast in a servicing or antenna installation environment.

Further information on the instrument is available from the local distributor, Peter C. Lacey Services, of 74 Fulton Road, Mt. Eliza 3930 or phone (03) 787 2077.

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Advantest R4131B spectrum analyser

Designed to monitor and examine RF signals up to 3.5GHz, this top of the range analyser from Advantest features advanced signal processing, plus full digital control of its display and front panel functions.

At first glance, a spectrum analyser bears a striking resemblance to an ordinary oscilloscope, with its front panel format, screen and cabinet shape appearing to be identical. In practice that's about as far as the similarities go, since the functions and circuitry of the two instruments are really quite different.

For those who aren't aware, the essential distinction between the two is that a scope's screen is arranged to show signal amplitude versus *time*, while the spectrum analyser's screen represents signal amplitude versus *frequency*. As simple as this difference might sound, an RF spectrum analyser such as the Advantest R4131B achieves this type of monitoring with a rather distinctive circuit arrangement, as shown in simplified form in Fig.1.

This system is based on a swept-tuned superheterodyne receiver, where its detected output drives the vertical axis (Y) of a display CRT (Cathode Ray Tube). To control the frequency sweeping function, a ramp generator is arranged to sweep both the frequency of the receiver's local oscillator, and the screen trace in the horizontal (X) axis. So as the receiver is automatically 'tuned' through the band, the CRT displays an X-Y image representing the instantaneous signal strength of all signals with frequencies within that tuning range.

The Advantest R4131B covers the frequency spectrum up to 3.5GHz by sweeping its local oscillator between 4GHz and 7.5GHz, which in turn produces an IF signal of 4GHz, as you would expect from the heterodyning principle. The oscillator itself is rather a specialised beast, featuring a Yttrium Iron Garnet (YIG) resonant device controlled by an electromagnet.

The advantage here is that the YIG element's resonant frequency is very stable, yet linearly proportional to the surrounding magnetic field supplied by its associated electromagnet. In the analyser's case, a ramping current from the sweep generator is applied to this electromagnet, which then produces a varying field and ultimately, a swept oscillator frequency. So thanks to the YIG-tuned oscillator (which has an optional AFC function), the analyser can be accurately tuned over an extremely wide range by a simple ramp waveform.

While only one mixing stage and local oscillator (the YIG device) is shown in Fig.1, the R4131B in fact passes the resulting 4GHz signal through no less than three more IF stages. These have fixed local oscillator frequencies of 3.77GHz, 200MHz and 30MHz, and are arranged to ultimately shift the IF frequency down to a more manageable figure of 3.58MHz. From this point the signal is applied to quite a complex IF strip, which features programmable amplifying and filtering stages. As you would expect, the gain of these amplifiers will set the sensitivity of the instru-

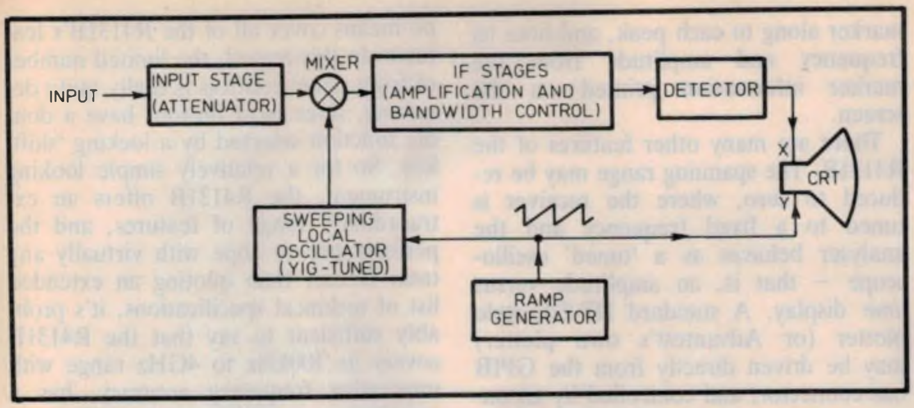

Fig.1: The R4131B takes advantage of the frequency conversion properties of a swept-tuned heterodyne receiver, and uses a rather unusual local oscillator.

ment, while the filters will control the final signal bandwidth.

After that, the signal is detected and applied to the CRT's drive circuits as the vertical video information. To offer a more flexible display system, the R4131B passes the video through a high-speed analog to digital (A/D) and digital to analog (D/A) stage, which incorporates a memory buffer capable of holding one full screen of information. This is stored as 9 bits of vertical (Y) data and 10 bits of horizontal (X) information, and may be rewritten to the screen at any time.

Digital features

Actually, the digital processing functions of the R4131B go much further than its ability to retain a display image. In fact its entire operation is controlled by a central processing unit (CPU), which takes command of the various digitally controlled function blocks (YIG oscillator, ramp generator, IF strip, etc). To put it simply, the CPU interprets any adjustments made at the front panel switches, and applies the appropriate settings to each of the analyser's stages and the screen readout.

Now, since all of the unit's functions are under digital control, a 'map' of the front panel controls may be stored in memory and recalled at a later date. The R4131B is able to retain and reload four complete versions of its current status via a simple on-screen menu, and the 'store' and 'recall' buttons. The memory itself is non-volatile, and will hold the data even when the unit's power is off.

The overall digital control also allows the analyser to perform a number of automatic adjustments, in order to maintain the optimum display quality. For example, if the user is scanning a very large area of the radio spectrum, the 'receiver' bandwidth is increased to provide a more general and uncluttered view of the signal peaks. On the other hand, the CPU automatically selects a much narrower bandwidth when a small frequency span is selected for a more detailed view of a signal. Of course, the overall automatic function can be deselected (by the 'auto' button), or the parameters can simply be re-adjusted in the normal fashion.

If the analyser's task involves signal surveillance, the R4131B offers a neat auto-tracking feature which locks onto the strongest signal, within the screen (scanning) range. With this function, the strength and frequency of the signal can be quickly identified, even if it periodically shifts in tuning.

Further to this, a horizontal 'display line' can be superimposed on the screen as an amplitude reference marker. This adjustable line may be used for simply reading the peak level of a given signal, or as a programmable detecting threshold for the signal tracking feature. In this case, the R4131B will only seek signals appearing above the line – or in effect, transmissions above this pre-set signal strength.

Like most digitally controlled test instruments on the market today, all of the above (and more) control facilities are available via a General Purpose Instrument Bus (GPIB) connector, located on the unit's rear panel. This allows other test instruments and suitably equipped computers to communicate with the R4131B in a relatively standard manner. In short, the GPIB system opens up a whole range of general networking, mass data logging and remote control applications.

The test drive

Fortunately, the R4131B is quite straightforward to operate, and we only needed to refer to the operator's manual for a couple of the unit's more complex functions. This was indeed fortunate, since we found that many sections of the manual's text were quite confusing and difficult to interpret. Nevertheless, the Advantest is certainly not alone in this regard – we've found that many of the manuals from Asian climes seem to lose something in the translation.

On power-up, the R4131B performs an internal self-check routine, and immediately adopts the front panel settings for memory number one – the first of the four user defined memories mentioned above. This is quite a handy feature, as it can be programmed to switch the unit into an initial configuration that suits the analyser's installation, and general use. It could be a wide scanning sweep as a broad starting point, or quite a particular adjustment that corresponds to the analyser's most common application.

Once this initial condition is established, most further adjustments become self-evident. Need to look at a different frequency? – just rotate the data wheel, while watching the 'centre frequency' readout on the display. In fact, we found that all of the common 'controls' (span, bandwidth, resolution, input attenuation and reference level) operated in quite an intuitive manner.

The R4131B provides a versatile frequency marker, which appears on the screen trace as a small (highlighted) diamond shape. When this mode is selected (by pressing 'marker'), the data wheel controls the marker's position across the trace, and its frequency and relative amplitude readings are printed on the screen. This allows the user to quickly measure the peak amplitude and frequency of any signal appearing in the display range – like the harmonic frequencies or side-bands of a main signal for example. The amplitude readout (in dBm) is also ideal for finding a transmission peak's –3dB points, and its resulting bandwidth figure.

As a further feature, the marker spot will move to the frequency of the strongest signal within the scan (screen) range, as the 'peak' button is held. If you find a particular signal of interest, the 'marker-cf' button will then adjust the analyser's centre frequency to that of the marker, which effectively retunes the receiver to this new area of interest. In fact, the abovementioned signal tracking facility is simply an automatic version of these two operations.

Advantest have used this style of automation in a large number of areas of the R4131B. For example, there is a fully automatic frequency calibration routine, which locks onto a signal derived from its third local oscillator. You just couple the 200MHz 'cal out' signal to the analyser's input, and press the 'zero cal' button. The unit then tunes into this signal, increases its frequency sensitivity and calibrates the internal tuning system.

Another automated function that's worthy of note is the 'max hold' display option, where the current screen trace is updated *in respect* to the display stored in memory. At any point during the tuning sweep, the screen's vertical information (amplitude) will only change if the incoming signal is *larger* than the equivalent point in the stored sweep. In practice, the trace creeps up in amplitude with each sweep, as new and stronger signal peaks are encountered.

To try this function out, we scanned the 100MHz to 130MHz section of the VHF band, which has intermittent aircraft communications at a number of different frequencies. In a short time, the 'max hold' screen had built up a large number of discrete peaks through our band of interest. These corresponded to the transmitting frequencies and relative signal strengths (at our location) of the aircraft channels in use. We could then move the analyser's marker along to each peak, and note its frequency and amplitude from the marker information printed on the screen.

There are many other features of the R4131B. The spanning range may be reduced to zero, where the receiver is tuned to a fixed frequency and the analyser behaves as a 'tuned' oscilloscope – that is, an amplitude versus *time* display. A standard HP-GL style plotter (or Advantest's own plotter) may be driven directly from the GPIB bus connector, and controlled by an on-screen 'plot' menu. The R4131B's video signal can be accessed via a rear panel connector, for alternative displays. The list goes on and on...

Conclusion

While we only had a brief testing period to try out the R4131B, it soon became apparent that it easily fits into the category of 'user friendly' machines. The designers at Advantest seem to have a clear notion of how a spectrum analyser is mostly used, and the most effective way to arrange and automate its functions. In short, we never felt bogged down or indeed, restricted by the unit's powerful range of options.

The points discussed in this review by no means cover all of the R4131B's features. In this regard, the limited number of front panel controls is really quite deceiving, since most buttons have a double function selected by a locking 'shift' key. So for a relatively simple looking instrument, the R4131B offers an extraordinary range of features, and the performance to cope with virtually any task. Rather than quoting an extended list of technical specifications, it's probably sufficient to say that the R4131B covers its 100kHz to 4GHz range with impressive frequency accuracy, has a maximum resolution bandwidth of 1kHz, and a dynamic range of 116dB.

All in all, it's a versatile and accurate instrument that would grace the test equipment stable of any workshop or lab. And as you might expect, such a formidable instrument has a substantial price – at $14,640 (excluding tax), it certainly represents a sizable investment. However in the arena of high performance spectrum analysers, potential buyers should find that the R4131B offers excellent value for money.

The review instrument was kindly supplied by the NSW office of Elmeasco Instruments, who can be contacted at PO Box 30, Concord 2137, or on (02) 736 2888. (R.E.)

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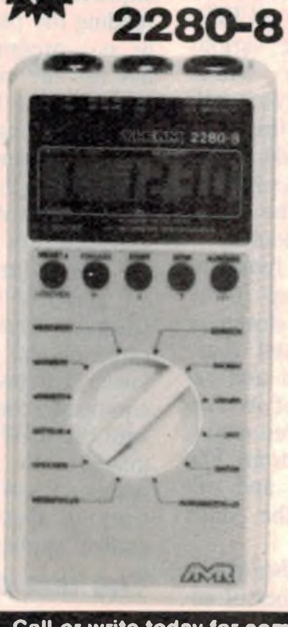

Measuring inputs: 2 6-pole round jacks for 2 measuring channels each.
Measuring method: Integrating dual slope
AD transducer: Resolution: 15 bit
Measuring rate: 3 measurements per second
Input Impedance: 20 M ohm
Source impedance: Max error 1 micro Volt/100 ohm
Zero point and Gain correction: Continuous autocalibration
System accuracy: ± 0.03% of reading, ± 1 digit
Temperature drift: 0.005%/°C
Nominal temperature: 22°C ± 2° Kelvin
Reference junction compensation: Effective in range -30 . . . +60°C accuracy ± 0.2 Kelvin ± 0.01K/°C
Microprocessor: HD 6303 Y
Memory: 32 KB, battery buffered, life of buffered battery about 5 years
Display: 6-digits LCD, height 13mm
Displaying time: About 2 secs per measuring channel
Outputs: 8-pole round jack:
Analog output: 0.1 mV/Digit (-0.5 . . . 2.75 V)
V24/RS232 interface: TXD, RXD, DSR
Data 8 bit serial, ASCII code, 1 start bit, 1 stop bit, baud rates: 150, 300, 600, 1200, 2400, 4800, 9600 selectable.
Limiting value: Transistor switch open collector
Averaging: Across measuring sequence or time interval
Measuring cycle: Adjustable up to 99 min, 59 secs, through V24/RS232 up to 59 h, 59 min, 59 secs.

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READER INFO NO. 47

Innovation in Test Instrumentation

Long before the Hewlett-Packard company became active in computers, it was highly regarded around the world for its innovative and high quality test instruments. And the firm, founded back in 1939 by Bill Hewlett and Dave Packard in a rented garage in Palo Alto, is still a leading innovator in test instrumentation.

by DOUG FORSYTH
PR Manager, Hewlett-Packard Australia

It was a mere 51 years ago that HP helped launch the test equipment business, with the sale of eight audio oscillators to Walt Disney studios. By today's standards, that may seem like a 'Mickey Mouse' deal, but it was a beginning. And since then, there have been literally thousands of innovations in test instrumentation.

Like most companies in the early days, Hewlett-Packard had its fair share of failures. First, there was a lettuce thinner based on an electric eye. Unfortunately, the vacuum tubes proved incompatible with the farmland environment, and the machine wiped out rows and rows of perfectly healthy plants. The test engineers on site were reported to have barely escaped a wrathful Japanese farmer.

HP founders Bill Hewlett and Dave Packard shown working in the company's first lab, probably not long after WW2. Their first sales were audio oscillators, sold to Walt Disney for use on 'Fantasia'.

Then HP developed a foot-fault detector, which their market research convinced them would be successful in the fast-growing bowling industry. It too proved to be an electronic lemon.

HP engineers then capped that with an oscillator whose terminals were placed across the temples of an animal. The aim of the device was to replace the use of anaesthesia in the veterinary trade. Those present at the time, who witnessed its trial run, reported that while the machine didn't put the animal to sleep, it did have an unfortunate relaxing effect on its digestive system.

Of course, the reason HP and others had so many false starts was that there really wasn't an electronics industry in the early days. Test equipment suppliers had to help it grow, by providing the tools that would make it possible for engineers to develop and apply electronics technology.

Some years ago when HP introduced their 3065 board tester, some engineers thought of it as the ultimate doomsday machine, but the technology manufacturers needed to test didn't stand still. Surface-mount technology posed new measurement challenges. Custom chips made the task of developing test programs much more difficult and time consuming. So, HP engineers had to develop a new board tester aimed at meeting this new set of needs. In trying to get one step ahead of requirements, they developed a board test system that contains something like 53,000 surface-mount devices on a fully-loaded system; more than 1000 custom ICs; and a million lines of software.

Building on the basic HP 3070 system architecture and software, the new board tester, which is still the state of the art, provides integrated in-circuit and functional test capability for advanced digital and analog PC boards. An associated sophisticated mechanical-fixturing system with powerful test-development tools has been designed

The latest HP 3070 Board Tester, which integrates in-circuit and functional testing for advanced digital and analog PC boards.

specifically to test PC boards loaded with SMT devices. The new tester is for use in environments that are automated or semi-automated as it can be quickly linked to conveyers, AGVs and magazine loaders.

While some Surface Mount Test (SMT) tools have been available individually, HP believes the new HP 3070 MST series combinational board tester is the first to create a fully integrated SMT test system that addresses SMT manufacturing test problems.

Just recently, HP has introduced a new vector-network analyser that brings low-price, precision baseband network analysis to R&D and Manufacturing engineers.

The HP 3577B network analyser (5Hz to 200MHz) provides the performance of the firm's 3577A network analyser, at a lower price and has several new features that increase productivity. Two and three-channel versions of the instrument are offered for a 10% to 28% lower list price than the standard HP 3577A.

Device test times are reduced to a minimum using the HP 3577B's new discrete sweep mode, an alternative to the standard linear and log sweeps. The analyser is programmed to test only at user-defined frequencies, optimising speed and providing high-resolution frequency coverage only where it is needed.

The HP 3577B's automatic-limit testing and a general-purpose input/output port for interfacing directly with a device-handler make low-cost automation possible for high-throughput production testing. Higher levels of automation are available with optional HP 'Instrument BASIC,' a standard subset of HP BASIC language. This runs inside the analyser and provides measurement automation and instrument control without an external computer.

The HP 3577B can write its own BASIC control programs with the keystroke-capture feature that eliminates the need to hunt through manuals for the right mnemonic. HP Instrument BASIC also automates repetitive measurements and allows untrained operators to use the analyser.

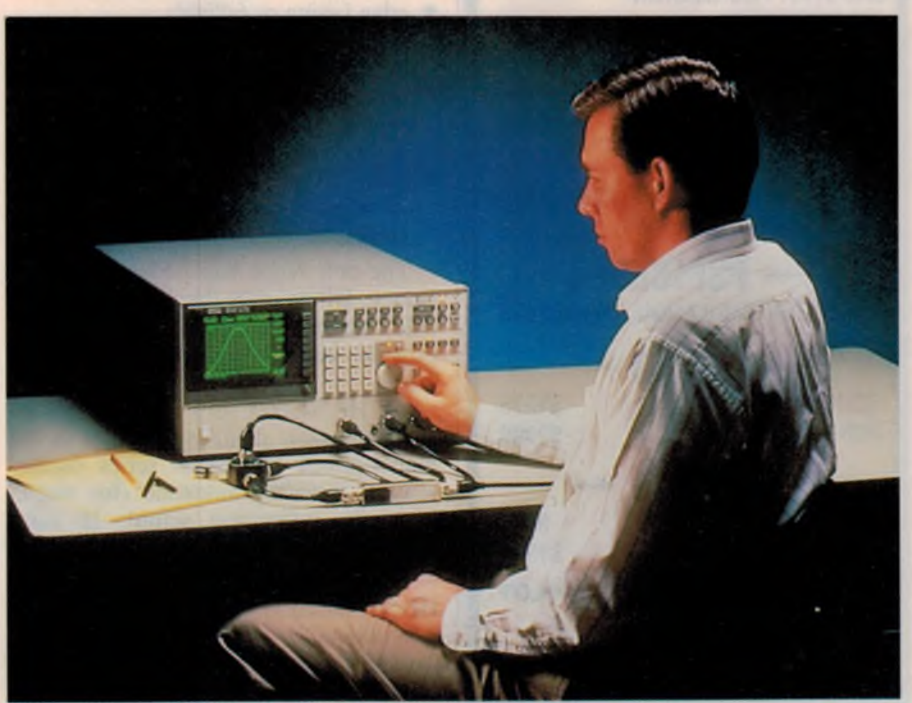
Accuracy is up to 0.02dB and 0.2°, while resolution is 0.001dB, 0.001°, and 0.001Hz. The HP 3577B also is fully compatible with the HP 3577A and its accessories, including test sets, active probes, impedance-test kits, calibration kits and software.

400MHz digital scope

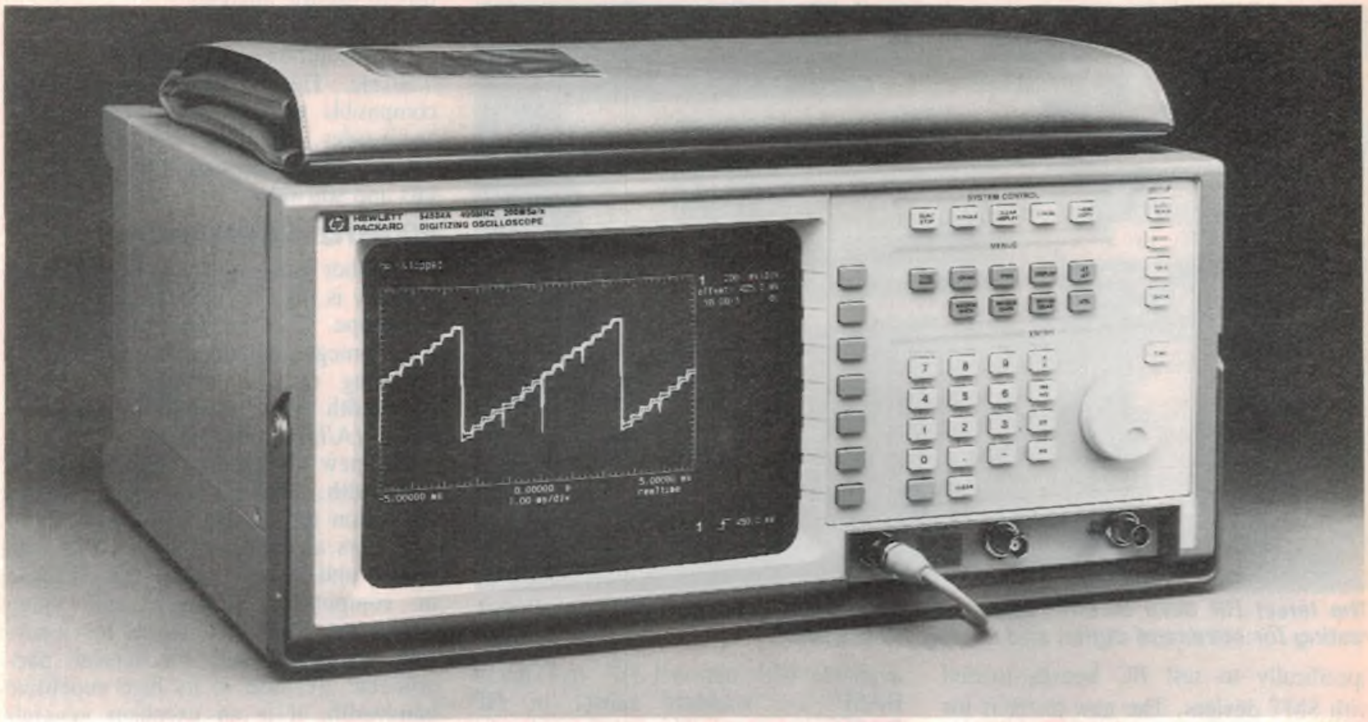
Another new instrument introduced recently is the HP 54504A digitising oscilloscope. This provides two channels, a 200-megasample-per-second (MSa/s) digitising rate, a 400MHz repetitive bandwidth and dual eight-bit analog-to-digital (A/D) converters.

The new instrument's combination of bandwidth, sample rate and vertical resolution makes it a valuable tool for engineers and technicians working with analog and mixed signals such as those in computer peripherals and video equipment. It is also useful for analysing acoustical and mechanical phenomena. Because of its high repetitive bandwidth, it is an excellent general-purpose tool for users working with digital designs and data communications.

Each of the HP 54504A's vertical channels simultaneously digitises incoming signals at a real-time rate of 200MSa/s. A low-noise design and dual eight-bit flash-A/D converters yield effective resolution that HP believes exceeds that of competitive instruments, which have up to 10 A/D bits.



HP's 3077B Network Analyser, which can be easily programmed in 'Instrument BASIC' to perform comprehensive and accurate tests on both devices and subsystems, over the range from 5Hz to 200MHz.



The HP 54504A digitising scope, which provides two channels each with 8-bit sampling at 200MSa/s.

In the HP 54504A's real-time mode, the instrument's front end is limited to a bandwidth of 50MHz, or one-fourth of the digitising rate. Placing such limits on single-shot bandwidth suppresses aliasing and preserves waveform fidelity.

The instrument also has a repetitive sampling system that provides a 400MHz bandwidth with 50-picosecond timing resolution on repetitive signals. It includes HP's advanced logic-triggering feature that lets users trigger on, capture and display elusive glitches. This provides the ability to trigger on:

- edge (rising or falling);
- pattern (three-bit patterns of high, low or 'don't care');
- time-qualified pattern (pattern present for less than, greater than or within a range); and
- state (trigger on a pattern using one of the scope's three inputs as a clock).

The new scope has 1.5% vertical accuracy. HP believes this is the first portable, single-shot digital oscilloscope to provide vertical accuracy superior to 2%.

All HP 54500A series instruments include the same digitising features as the higher-priced HP 54100 series oscilloscopes, including autoscale (for single-keystroke instrument setup); 16 automatic pulse-parameter measurements; advanced logic and glitch triggering; an HP-IB (IEEE-488) interface for fully programmable data acquisition and control; and pushbutton hardcopy output to HP graphics printers or plotters.

The HP 54500A family also has capabilities that are new to HP oscilloscopes, including: automatic measurement statistics; user-defined measurement-limit testing; dual-time-base windowing; and TV/video triggering (line and field for NTSC, PAL and user-defined video format).

The new oscilloscope is the fourth instrument to be added to HP's family of high-performance, low-price portable digitising oscilloscopes.The family now includes the HP 54501A, HP 54502A, HP 54503A and HP 54504A.

The HP 3577B network analyser is priced at $31,532. Option prices are $5766 for the third input channel, $1421 for the high stability frequency reference and $1588 for the HP Instrument BASIC/640K byte memory. The HP 3577A to HP 3577B upgrade option is $8273.

The HP 54504A digitising scope costs under $11,000 and includes a three-year warranty.

Today, Hewlett-Packard is an international manufacturer of measurement and computation products and systems, recognised for excellence in quality and support. The company's products and services are used in industry, business, engineering, science, medicine and education in approximately 100 countries. It has 95,000 employees and had revenue of $11.9 billion in its 1989 fiscal year. And as you can see, the emphasis on innovation is stronger than even.

(Editor's note: Further information on the instruments described above may be obtained by calling (008) 033 821.)

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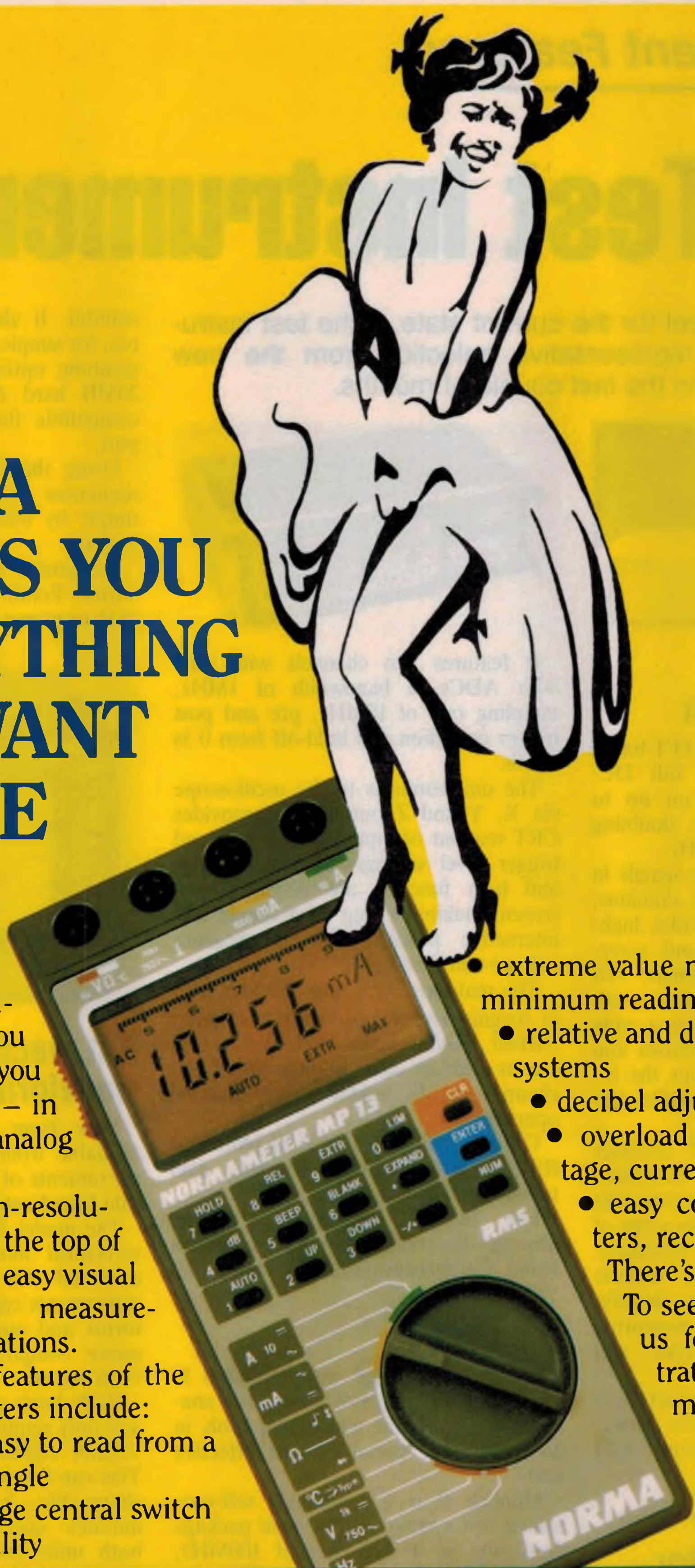

The new range of Norma multi-meters gives you the information you need at a glance – in both digital and analog form.

Its special high-resolution bar display at the top of the screen allows easy visual appreciation of measurements and fluctuations.

Other special features of the Norma multi-meters include:

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PARAMETERS
PERFECTION IN MEASUREMENT

READER INFO No. 49

New Test Instruments

To give you a good feel for the current state of the test instrument art, here's a representative selection from the new instruments released in the last couple of months.

FFT analyser doubles bandwidth

The Tektronix 2642 is an FFT-based analyser which provides a full DC-200kHz analysis bandwidth on up to four channels simultaneously, doubling the previous standard of 100kHz.

Designed to analyse analog signals in both the time and frequency domains, the 2642 simultaneously provides high-quality spectrum, network and waveform analysis on applied signals. For stimulus/response measurements, an optional signal generator provides a wide array of standard output functions and arbitrary signal generation over the instrument's complete DC–200kHz frequency range.

In addition to typical FFT analyser functions such as frequency response, power spectra and time records, the Tektronix 2642 provides a wide array of standard and optical analysis functions. Available realtime functions include auto and cross correlation for identifying periodicity in signals and measuring time delay, 1/3 octave analysis, and spectral maps.

For further information, contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113 or phone (02) 888 7066.

Transient recorder oscilloscope adaptor

The ODB 0101 is an adaptor that provides any general oscilloscope with the capability to capture, store and analyse transient phenomena.

It features two channels with dual 8-bit ADCs, a bandwidth of 1MHz, sampling rate of 10MHz, pre and post trigger operation and hold-off from 0.5s to 50s.

The unit connects to the oscilloscope via X, Y and Z outputs and provides CRT readout of input, sample rate and trigger level settings. Menus, message and help function are displayed on-screen, making setting up a simple and interactive process. Cursors measure voltage and time.

The real-time clock and calendar help in logging recordings, while the batter backed RAM saves all five set-up menus and last data. Memory is 1K per channel or 2K under single channel operation.

Outputs include XY and Xt plotter or RS-232 for computer control, data transfer or HP-GL plotter.

For further information, contact Emona Instruements, 86 Parramatta Road, Camperdown 2050 or phone (02) 519 3933.

Omnilab II

Orion Instruments' new Omnilab II provides a new level of automated analog and digital test and debug tools in an integrated, portable, cost effective unit.

Monilab II is a completely self-contained test system, with a base package consisting of a dual-channel 100MHz, 204 megasample/sec digital oscilloscope; a time-aligned logic analyser (up to 96 channels); an arbitrary analog function generator; a 24-channel digital stimulus generator; and a 500MHz frequency counter. It also comes with Omnimacros, for simple, automated test sequence creation; optional IEEE-488 support; a 20MB hard disk; a 1.2MB MS-DOS compatible floppy disk; and a printer port.

Using the Omnimacros facility, test sequences can be created interactively simply by using the normal instrument controls.

For further information, contact Warburton Franki, PO Box 14, Lidcombe 2141 or phone (02) 648 5455.

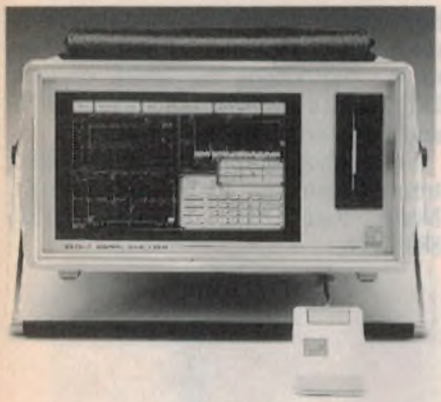
PAL vectorscope, waveform monitor

New from Leader Electronics and available from AWA are two portable instruments of particular interest in outside broadcasting and ENG situations.

The model 5857 vectorscope and 5867 waveform monitor are small, battery operated and lightweight (1.2kg each) instruments capable of displaying waveforms and amplitude/phase of chrominance components in PAL composite video signals.

Both have a 75mm rectangular tube and only require 12V DC at 840mA and 720mA respectively for full operation. This can be provided by an optional rechargeable battery pack giving 90 minutes continuous operation when both units are energised or longer if they are used separately.

For further information, contact AWA Distribution, 112-118 Talavera Road, North Ryde 2113 or phone (02) 888 9000.



Waveform analyser

The Bakker 2570 waveform analyser is a fully self-contained data acquisition, analysis, and control system which can be configured with up to 64 channels operating at speeds up to 50 megasamples per second. Various modes of triggering are available including pre and past triggering, window, sequence, and alarm triggering.

The unit is equipped with a floating point processor for high speed arithmetic processing and analysis of captured waveforms. Typical waveform operations provided by the 2570 include integration, differentiation, smoothing, averaging, and FFT.

The 2570 includes an inbuilt 30cm screen and mouse which are used to control all functions of the instrument by a pull down menu system. The unit may also optionally be controlled from a keyboard or remote computer via an RS232C or GPIB interface. Data acquisition, processing, and control sequences can be learned or programmed, and sequences may be saved for later use on one of the built in 3.5″ disk drives or optional hard drive.

The 2570 is also available in a portable version (2570P) which allows the unit to be used in field applications.

For further information, contact Nilsen Instruments, 200 Berkley Street, Carlton 3053 or phone (03) 347 9166.

Programmable data acquisition unit

The programmable measuring data acquisition unit Therm 2280-8 is capable of monitoring four measuring channels, as well as storing and/or printing their values or evaluating them with theaid of a personal computer. It provides a wide variety of standard measuring ranges: five thermocouple types, capacitive humidity detectors, air velocity sensors (rotating vane anemometers), as well as for current and voltage signals.

In addition, the 2280-8 offers two measuring channels for averaging. A seventh channel may be used to monitor battery voltage. When measuring, a real time clock with data allows the start time and date, as well as end time and date to be selected at will.

Further information from Australian Metrosonics, 37 Benwerrin Drive, Burwood East 3151 or phone (03) 233 5744.

AC power analyser

Voltech's PM1000 makes all of the AC line measurements needed by a user in one compact, low cost product. It measures true RMS voltage and current, irrespective of wave shape and gives accurate measurement of AC and DC power.

The PM1000 gives direct reading of volt-amperes and displays the true power factor, not only due to phase displacement but also due to distorted waveforms. It will display the frequency of the AC supply and will measure the harmonic content of the current and voltage form, and will thereby verify the level of distortion.

The special feature of the PM1000 is the display of crest factors of the voltage and current waveshapes. Crest factor is the ratio of peak to RMS, and by knowing this value the user can then ensure that components in his system such as fuses, diodes, power line filters etc., can reliably sustain this peak.

The PM1000 can also measure the peak inrush current that follows when a load is first turned on. The measurement can be made using ordinary electromechanical switches or relays, and where more precise switching is required PS1000 SCR switch can be used.

For further information, contact Westinghouse Brake & Signal, 80-86 Douglas Parade, Williamstown 3016 or phone (03) 397 1033.

RF power and VSWR meter

Imark Communications has released the PM1000 RF power and VSWR meter, for use in the two-way radio industry. It is an inexpensive test meter designed for standard inclusion with

every service vehicle and workshop.

The PM1000 is designed using stripline technology to operate at frequencies from 25MHz to 1GHz. Insertion loss is low, permitting the equipment to be left 'in line' during normal use.

Dual striplines are employed to cover this frequency range in two steps, i.e., 25 – 150MHz and 150 – 1000MHz. UHF type connectors for 25 – 150MHz and 'N' type connectors for 150 – 1000MHz are used on the rear panel for easy connection to equipment.

Twin meters are used to show both the FORWARD and REVERSE power simultaneously and to allow direct reading of VSWR.

For further information, contact Imark Communications, 75 Mark Street, North Melbourne 3051 or phone (03) 329 5433.

150MHz scope has screen readout

Hitachi's V1150 oscilloscope has on-screen readout of frequency in the range of 10HZ to 150MHz, with a resolution of 0.1Hz and a five digit display. It also has an event counter within a delay time or a delayed sweeptime and measures AC volts, AC relative (reading expressed in dB) and DC volts.

Two lines of 30 characters can be displayed in one of six positions. These allow the user to define comments using numerals (0-9), capital letters (A-Z), lower case (d, i, k, m, n, o, s, v, z) and a variety of 16 relevant symbols. With this feature, information of each waveform can be dated, identified and photographed for record keeping.

The scope features four channels with eight traces, with a sensitivity of 2mV/div to 5V/div for ch1 and ch2 0.1V and 0.5V/div for ch3 and ch4. The bandwidth of 150MHz applies on all four channels, with a risetime of 2.3ns. There is a 20MHz band limit switch for low frequency operation.

A built in signal delay line permits viewing of the leading edge of the waveform and single shot triggering.

For further information, contact IRH Components, 32 Parramatta Road, Lidcombe 2141 or phone (02) 648 5455.

Optical power meter

Hewlett-Packard has introduced a handheld optical power meter/loss test set, the HP 8140A which can be used for the installation and maintenance of optical links or for component characterisation.

The HP 8140A's modular construction includes a lightweight mainframe and a number of plug-in sensor and LED source modules that are easily interchangeable in the field. Because of these features, only one instrument is needed to perform both power and loss measurements.

As a power meter, it precisely measures the output power of transmitters and the power levels at the fibre end as well as checks for dark fibres and fibres where no signal is being received. As a loss-test set, it measures both total link loss to check for power budgets, and insertion loss of passive optical components.

All commonly used wavelengths in datacom LANs and telecommunication networks are covered.

The power meter has high sensitivity that is available in two sensors for long or short wavelengths: a wavelength range of 400 to 1100nm, with a measurement range of +10 to -70dBm; and a wavelength range of 750 to 1700nm, with a measurement range of +3 to -70dBm. Sources offering wavelengths from 850 to 1550nm are available.

For further information, call HP on (008) 033 821.

Peak voltmeter

The MD587 from Schaffner is a handy, small peak-reading voltmeter for the measurement of non-periodic voltage spikes. Of particular interest are the instrument's high input impedance and low input capacitance.

The voltage range of 0 to 200V enables measurements to be made in the high voltage field using a commercially available attenuator (100:1). The peak values that are measured are digitally displayed directly in kV.

A plastic housing ensures no danger from contact with live parts and the battery supply prevents errors being caused by earth potential shifts in high voltage laboratories. The polarity reversal switch enables either positive or negative peak values to be measured without having to change the cabling.

The MD587 is well matched to the NSG587 surge voltage generator. The voltage divider and shunts incorporated in the generator enable a direct evaluation to be made of the peak surge voltages and currents that are applied to the device under test.

For further information, contact Westinghouse Brake & Signal, 80-86 Douglas Parade, Williamstown 3016 or phone (03) 397 1033.

DSO modules

The new 30DSM and 1230DSM digitising scope modules introduced by Tektronix are each a complete dual-channel, 8-bit digital storage oscilloscope on a card.

It takes just a few minutes to install one of the modules in a Tektronix 1230/1230B or Prism 3002 series logic analyser. The result is full logic analysis capability completely integrated with the high quality oscilloscope measurement features.

The 30DSM card module provides high performance waveform capture and measurement for digital hardware design and debug applications, and the 1230DSM offers a wide range of general purpose capabilities. State-of-the-art waveform acquisition is done with 8-bit digitising at real time sample rates to 500MS/s with the 30DSM and 100MS/s with the 1230DSM.

The sample rates are pushed to even higher effective rates with an equivalent time capture mode.This equivalent time mode allows repetitive signal capture up to the full analog bandwidth of each DSM, which is 300HMz for the 30DSM and 100MHz for the 1230DSM.

For further information, contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113 or phone (02) 888 7066.

Improved sound level meter

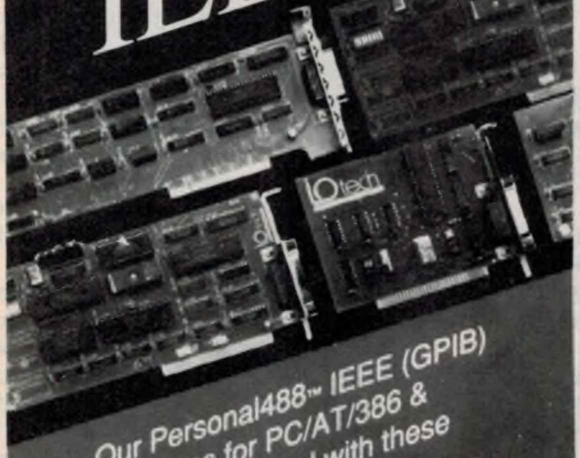
Bruel & Kjaer's Modular Precision Sound Level Meter Type 2231 is now more versatile, with new features and an addition to its large family of application modules – the integrating SLM module BZ7110.

The 2231 now has improved data-storage and interfacing capabilities, making communication with other RS232C-compatible equipment (for example, a printer or computer) quicker and more comprehensive. With the BZ7110 module loaded, the 2231 is a complete integrating sound level meter for general sound measurements.

The improved 2231 has a 64kbyte RAM for storing application programs, measurement records and set-ups. With the BZ7110, this means up to 99 measurement records can be stored. Measurement set-ups can be stored, ready for recall whenever required. The real-time clock marks measurement records with the date and time of measurement – a useful feature when storing data for future review.

Further information from Bruel & Kjaer Australia, 24 Tepko Road, Terrey Hills 2084 or phone (02) 450 2066.

IEEE-Z



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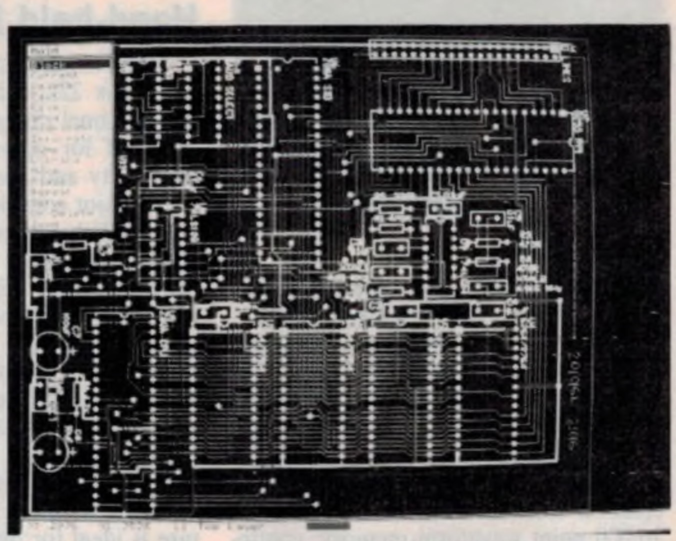

Protel-Easytrax, is a new, low-cost design package for PC users that includes everything required to produce professional-quality Printed Circuit Board artwork.

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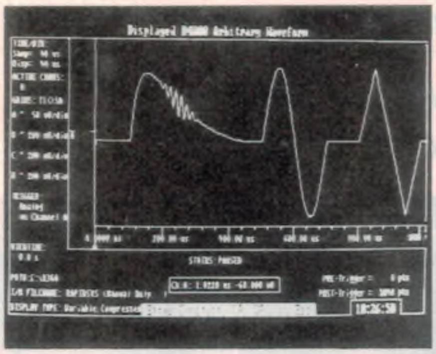

PC-based waveform generator

The Rapid Systems R4010 is a personal computer based product which allows a user to visually create any waveform with a mouse and then output the electrical waveform from a 10MHz 12-bit advanced arbitrary waveform generator.

Features include colour waveform creation software with free demo disk; 16,000 point waveform memory; continuous, sweep and burst output modes; and programmable output voltage to 10V p-p.

The unit is designed for physical, education, transient, biological applications, and comes with a built-in library of waveforms including sine, square, triangle, ramp, pulse, noise and telephone ring.

For further information, contact Warburton Franki, 32 Parramatta Road, Lidcombe 2141 or phone (02) 648 5455.

Hand-held DSO

Tech-Rentals now has available the Tektronix 222, a lightweight, handheld, dual channel digital storage oscilloscope designed for operation in areas where portability and absence of mains power are a major consideration.

The 222 has a bandwidth of 10MHz, a vertical sensitivity of 5m/V to 50V per division and a vertical resolution of 8 bits with a dynamic range of 10.24 divisions.

The digitising sample rate is 10MS/s at 5us/div, which gives a single shot bandwidth of 1MHz or a repetitive bandwidth of 10MHz.

Up to four front panel setups can be stored in memory and the Autoset feature is ideal for displaying first time applications. A rear panel RS232 port enables connection to a PC or plotter.

For further information, contact your nearest Tech-Rentals office, or phone (03) 879 2266.

LCR meter with direct-Q measurements

Hewlett-Packard has introduced a digital LCR (inductance-capacitance-resistance) meter capable of automatic and direct-Q measurements from 75kHz to 30MHz, with six digits of resolution.

The new HP 4285A LCR meter is a versatile tool for engineers in R&D, production, quality assurance and incoming inspection. For improved testing efficiency, 10 error-free instrument setups can be quickly loaded from an external memory card. The large LCD display is easy to read and softkey menus simplify operation.

The HP 4285A can test components and materials to commercial and military RF standards, particularly MIL STD 15305D. Direct quality-factor measurements can now be performed in fractions of a second with the HP 4285A and HP42851A precision-Q adaptor, yielding 5% accuracy at 30MHz. To test inductors under operating conditions, the new LCR meter uses the HP 42841A bias-current source to test a device under test (DUT) up to 30MHz at 10A DC of bias.

For further information, call HP on (008) 033 821.

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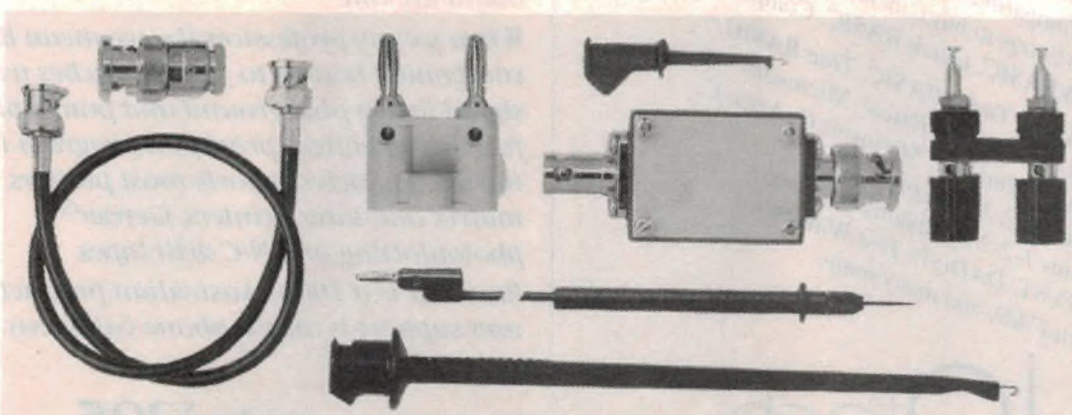

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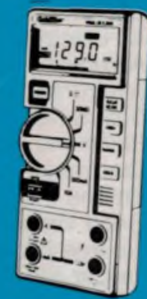

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