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ETI

SPECIAL ANNUAL DIGEST - 180 PAGES

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PROJECTS: DIGITAL SPEEDO FOR YOUR CAR, 5W/25W FM TRANSMITTER FOR 144MHZ, MORE

Wide Band Receivers...

has broken the barriers with it's new line of wideband receivers built to go the distance. Introducing the IC-RI handheld receiver, the IC-R72 HF receiver and the IC-R100 multi-purpose receiver.

The smallest wideband handheld available today, the IC-R1 continuously covers 100kHz-1300MHz (Specifications Guaranteed 2-905MHz) with AM, FM and Wide-FM modes. This tiny receiver measures just 241mmW x 94mmH x 229mmD.

Easy operation is a snap with the IC-R1's Dual Frequency Selection (direct keyboard and rotary tuning). 100 memories and a 24-hour clock completes the world's smallest full-featured handheld receiver.

Install the IC-R100 at home or in your car. Listening pleasure is guaranteed with continuous coverage from 100kHz-1856MHz (Specification Guaranteed 500kHz-1800MHz) in AM, FM and wide FM modes. Monitor VHF air and marine bands, emergency services, government as well as amateur stations. 121 fully programmable memory channels, multiple scanning system, an automatic noise limiter, built-in preamplifier and attenuator, clock with timer and built-in backup lithium battery make the IC-R100 the perfect package for mobiling or base operation.

The IC-R72 continuously receives 100kHz-30MHz in SSB, AM and CW modes with very high sensitivity. An optional UI-8 provides FM reception. Additional features include: Noise blanker, five scanning systems, AC/DC operation, internal backup battery, built-in clock and ICOM's DOS System. The IC-R72 boasts a 100dB wide dynamic range while an easy-to-access keyboard provides convenient programming versatility. The easy to operate IC-R72 is superb for short wave listeners.

The IC-R1, IC-R72 and IC-R100 join ICOM's current line of professional quality receivers... the IC-R71A, IC-R7000 and IC-R9000. ICOM... expanding the horizons to bring you better technology, today. See the complete line of quality ICOM receivers at your local authorized ICOM dealer today.

ICOM

First in Communications

...That Go The Distance.

Electronics Australia WITH eti '91

Telepoint's CT2 cordless phones

The CT2 digital cordless phone system is already operating in the UK and France, and is likely to begin here soon. Here's how the system operates. (Page 26)

A review of Listening Post II

After much badgering, Tom Moffat has finally produced an upgraded PC version of his very popular fax/RTTY/Morse decoder. He's selling it as a low-cost kit – Jim Rowe put one together and tried it out (page 80).

On the cover

A representative collection of today's electronics technology. Top left is IBM's new 486-based PS/2 model 55LS (courtesy IBM); top right, Polar Instruments' new T3000 in-circuit component analyser (courtesy Emona); centre left, H-P's E237X series of DMMs (courtesy Hewlett-Packard); lower left, LeCroy's new 9430 digital storage scope (courtesy Scientific Devices); and lower right, Canon's new L770 laser fax (courtesy Canon Australia).

Entertainment Electronics

Features

News and Comment

Volume 53, No.1
January 1991

ANNUAL DIGEST

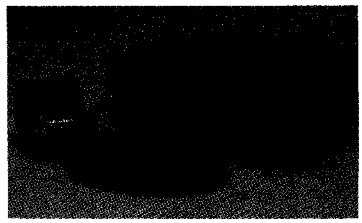
Departments

Projects and Technical

Workstation

GREAT PROJECTS TO BUILD:

New 144MHz FM Transmitter



Loaded with features: full PLL frequency synthesis, 24 memory channels with repeater shifts, selectable 25W or 5W output, inbuilt protection against excessive SWR and more. Yet it's also easy to build and get going – and the kit is much cheaper than commercial units. (Page 94)

Digital Speedo for your car

Wish your car had a digital speedo like the latest models? Now it can. This design also 'beeps' if you exceed one of the selectable speed limits, to help you avoid a ticket. (Page 106)

Hardware display for your PC's clock

How many times have you discovered that your PC's real-time clock/calendar was set to some time on January 1, 1980? Here's a low cost project that lets you check the time (and with an AT, the date as well) at a glance. Make sure your files are date/time stamped correctly... (Page 162)

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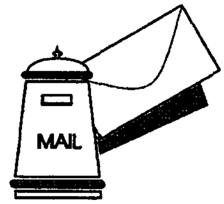
LETTERS TO THE EDITOR



Sexist advertising?

Let me pre-suppose that you might take the view that it is not entirely up to you or your advertising staff to moralise to your clients on how not to be sexist in the advertisements they propose for the general public.

Therefore let me ask this question — would you dare let an advertisement with a man wearing 'Speedo's", thrusting his pelvis in come hither fashion with the exclamation 'perfect measurements' emblazened across an advertisement for merchandise on a page in your magazine.

I would think not!

Please let me suggest that you exercise your right as editor of a reputable magazine and deny advertising space for sexist advertisements such as that on page 25, *EA* October 90. Otherwise an excellent magazine.

S. O'Cathmhogha,
South Hedland, WA.

Comment: Your opinion is noted and respected. However if you check page 71 of the December 1989 issue, on the inside back cover of the September 1989 issue, you'll find ads for 'Jockey' underwear that disprove your assertion. In fact our powers to deny space to any advertiser are very limited.

Phone mods

Regarding the Circuit and Design Ideas for July 1990, I have been waiting for some feedback, which has not happened up until now.

The item 'Improving a low cost phone' will surely encourage tinkerers to mess around with the internal workings of telephones. You must surely know that telephones on public lines have to be Telecom approved, and are not to be tampered with.

I am very pleased indeed, generally, wiith your magazine; that is why I took out a 2-year subscription. I am sorry, but I feel compelled to voice my surprise that your reputable publication would print this item.

T. Mitchell,
Bendigo, Vic.

Comment: Thanks for your warning, Mr. Mitchell. Perhaps if the relevant authorities had not allowed the importation and sale of substandard phones, technical people like the contributor concerned wouldn't have been driven to find ways to lift performance to an acceptable level. It's really also wrong to assume that our readers are all 'tinkerers' who would 'mess around' — a great many are experienced technicians or engineers.

Earth leakage breakers

Having read the correspondence and editorial comment of the above article, the Energy Safety Branch of this Department finds it necessary to correct certain assumptions and in particular, a potentially dangerous recommendation concerning ELCBs and bathtubs.

As.many readers may be aware the severity of an electric shock is dependent upon the magnitude and duration of a current passing through the human body.

As many readers may be aware the severity of an electric shock is dependent upon the magnitude and duration of a current passing through the human body. The presence of water, absence of protective clothing and footwear, degree and position of contact with 'live' parts, and presence of an 'electrical earth' are all factors which contribute to an increase in the shock current and therefore likelihood of electrocution.

At first glance it might appear that an energised hairdryer immersed in a bath might result in a high shock current through any person occupying the bath. However, as pointed out in your article, in many modern bathroom situations the bath water and bath are frequently isolated from an electrical earth. In simple tests performed by the Branch and others, it has been established that the current likely to flow through parts of the body in such an 'earth free' situation would be in the order of 5 to 10mA; not the 'intense field' referred to in paragraph 12 of the letter. This current is considerably below the level of which serious consequences such as electrocution via fibrillation are expected. This does not suggest that no shock or muscular pain would be felt, but rather that the ability to release or move away from the current source would not be overridden. The shock current in this circumstance is not necessarily an earth-leakage current.

If this information is correct why then do electrical fatalities occur from the combination of hairdryers and children in bathtubs? While there is an understandable absence of first hand or eyewitness accounts, it is believed that a principal cause would be contact occurring with taps or similar metal parts of the plumbing system which are connected to an 'electrical earth'.

Under the circumstances where a bath occupant is sitting in energised bath water and contacting an earthed part, the current through the body parts would be considerably higher. It is under these situations that an ELCB/Residual Current Device (RCD)/'Safety Switch' would operate as the shock current would effectively be an earth-leakage current.

In addition Mr Thomas' proposal to introduce an earthed chain into the bath should not go uncommented. It is our opinion that such an approach would, by increasing the shock current, be more dangerous and, if a 'Safety Switch' was not installed on the appropriate circuit, perhaps disasterous.

The abovementioned physiological effects and shock current limits are well documented.

Further information on this and other aspects such as 'Safety Switches' and double-insulated appliances, may be obtained by contacting the Department's Energy Safety Branch on (02) 901-8888.

G. Rose, Director-General,
NSW Dept of Minerals and Energy,
St Leonards, NSW.

Comment: Since the August issue, we have published a good deal of additional material on this subject — correcting, hopefully, any possible misapprehension.

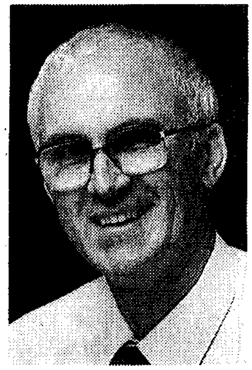
Audio cables

The controversy about special audio cables reminds me of the advertising campaign staged by our oil companies many years ago. Each company claimed their petrol additives would do wonders for your car engine; some of the claims were beyond belief. Finally someone declared that all of the companies were basically using the same two additives, from memory they were called 'foolemall' and 'bullemall'.

It seems to me a highly refined form of the above is being used in the promotion of special audio cables.

E.G. Baker, VK2ABW
Bathurst, NSW. ■

EDITORIAL VIEWPOINT



Never mind technology or standards, will it make enough profit?

One of things that distinguishes we electronics people (along with most people in science and engineering) from other folk is our enthusiasm for the pursuit of technical excellence. If a new technology does a job better or more efficiently, we're generally the first to advocate its adoption — immediately, if not sooner. Why fiddle around with yesterday's technology when you can take advantage of a new development, right?

Another thing we tend to be unusually keen about is standards. We don't like situations where one group of people does a thing one way, or using one kind of technology, while another group does it using *different* technology. To an engineer's or scientist's mind, this is messy and inconsistent. Why can't everyone sit down and thrash out which is the 'best' or *right* way of doing things, and then we can ALL do it that way?

Of course both of these characteristics *are* extremely important (if not essential) for people engaged in engineering and science. Without a bunch of people who have been driven to find new technological solutions, and then advocate their use, we'd probably still be living in caves. And without the establishment and adoption of standards, our technology-based society would become chaotic and unworkable.

But all the same, in our enthusiasm for excellence, efficiency and technical standards we can become blind to the fact that much of the rest of society doesn't regard them nearly as highly. In fact it often gives them very little thought at all. Consider, for example, what was planned for satellite TV and radio broadcasting in Europe — and what has now happened, with the recent merger of Rupert Murdoch's Sky Television with its competitor British Satellite Broadcasting.

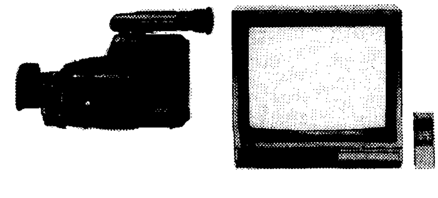
Europe's technical experts had got together and developed the MAC (multiplexed analog components) transmission system, which not only provides better present performance than the existing PAL, NTSC or Secam, but also provides a smooth upgrade path to high- definition TV (via HD-MAC). It looked as if the MAC system would become the basis for a new pan-European system of satellite broadcasting, rationalising the existing chaos and providing a foundation for development of a thriving manufacturing industry (based on local control of the MAC and EuroCypher scrambling technology patents).

When BSB was granted its licence, this was on the basis that it had to use the MAC system. It therefore had the challenge of not only sponsoring the development of MAC decoders and 'squarials', but of persuading the public to buy them. But for various reasons Sky wasn't required to do this, and adopted the older PAL system (with VideoCrypt scrambling).

Now that the two have been merged, it looks as if they will be using PAL/VideoCrypt, rather than the technically superior MAC/EuroCypher system — largely because of its lower costs, and hence greater current profitability. So the dream of a common European path to a best-technology HDTV future is crumbling. Obviously in the day-to-day world of business and politics, technical excellence and standards are rated much less highly than we like to think...

Jim Rowe

What's New in VIDEO and AUDIO



Looking back – and ahead

Traditionally we take the opportunity in each Annual Digest issue to review what has happened in the video and audio product marketplace during the past 12 months, and also to attempt a few predictions about likely events in the coming year. Here, then, is this year's review and predictions.

At this time last year, we predicted that 1990 would be a fairly quiet year for video and audio electronics; in this we turned out to be right. Perhaps it's a result of the continuing economic recession in Australia and other countries, for not a great deal has happened in terms of actual products. It's been a period largely characterised by 'more of the same'.

One area where we were wrong with last year's predictions is DAT (digital audio tape). Since agreement had been reached on the SCMS limited-copy system back in last 1989, we predicted that DAT recorders and decks would appear on the Australian market during 1990. They didn't, although quite a few manufacturers have announced new SCMS-fitted models in Japan. Perhaps we'll see these soon, although DAT is beginning to look as if it will be confined largely to the professional market.

On the other hand we didn't predict any action from eraseable/recordable CD's either in 1990, and here we were right. There are still rumblings from both Japan and the USA, but over-the-counter products still seem as far away as ever.

We also predicted that CD-video (CD-V) seemed unlikely to take off in 1990, and here again we were right. The hardware manufacturers seem to be blaming the lack of software, and the software people seem to be blaming problems with CD-V disc production. But the nett result is that CD-V still seems to be languishing on the water; unless the problems are solved really soon now, it may well be a dead duck.

The newer and somewhat more flexible 'CD-interactive' (CD-I) technology still hasn't taken off, either, but this seems more likely to take off soon – combining CD video with computer games and learning. There are rumours that it might finally reach the market during the coming year, at least overseas.

In the area of domestic video, our predictions were largely correct although we may have been slightly off-target with some of the specifics. We expected 'enhanced' video systems like S-VHS, ED-Beta and Hi-8 to grow only slowly in 1990, because of their relatively high cost and the generally high level of consumer satisfaction with existing 'regular' systems. And this turned out to be true: all of the enhanced systems together still only account for a small percentage of the market (about 5%).

We were pretty right about video-8 continuing to grow in the camcorder market, too. It now accounts for slightly over 50% of the overall market, having pulled slightly ahead of VHS-C and full-sized VHS. But the VHS camp is fighting back strongly, and perhaps we'll see a reversal of this position in 1991. VHS is still the undisputed winner in the home VCR market, and seems likely to remain so.

Other areas where we predicted little or no growth were in standard TV receivers, and HDTV. As we were basically right, in both cases. Standard domestic TV receivers changed little, apart from a small growth in 'digitally enhanced' receivers and large-screen sets. And HDTV is basically still waiting for the Europeans, Japanese and Americans to reach some kind of agreement on standards. We don't expect this to change much in 1991.

How about satellite TV broadcasting? Well, this continues to grow in Europe and the UK – although not dramatically, but as yet there's no sign of any likely action in urban Australia. This is largely because of the lack of decisions on satellite/pay TV by our Federal Government. The technology is obviously available, but our prediction now is that we probably won't see any action in Australia until late 1992 at the earliest.

On the radio scene, we predicted that 1990 wouldn't see any real success for AM stereo, and again we were right. We also thought it unlikely that the Radio Data System (RDS) would reach Australia in 1991, and again this was correct.

So last year's predictions turned out to be fairly right. Our only real 'bomb' was in expecting the belated arrival of DAT – but perhaps that will happen this year.

Our basic predictions for the current year, then, are that 1991 will again be a year of slow growth, with little or no major surprises. We don't expect a dramatic surge in enhanced video systems, or a sudden flowering in CD-V, or HDTV or satellite TV. And although DAT may finally appear, we expect its arrival to be quite low key and of major interest to professionals. The same would apply for eraseable/recordable CDs.

CD-I may arrive and make more impact, but even here we predict a relatively quiet launch and quite slow initial growth.

One other area that might be worth watching closely is CD-ROM, and in particular the Sony 'Data Discman'. Released in Japan only in mid-1990, it has apparently taken off like the proverbial 'hot cakes', and the company is apparently considering its release in other countries. With a price of around $500 for the handheld CR-ROm player/display and discs priced between $20 and $65, it could well make quite an impact if there's enough support software.

The dark horse in the high-quality audio recording area may well be a new technology from Philips, just peeking over the horizon.

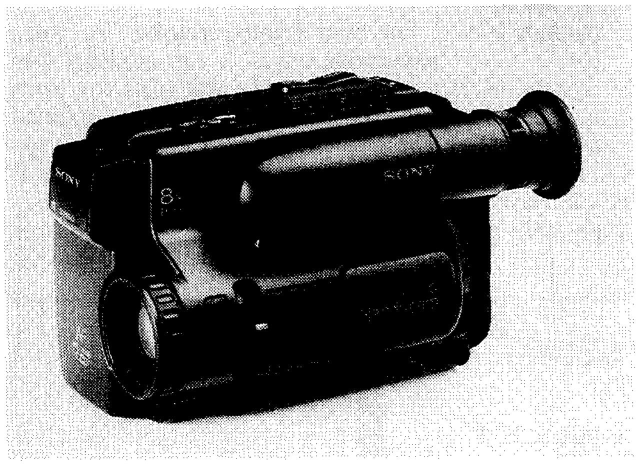
As well as developing the 8-hour 'long play' CD for background music applications (see later), Philips has apparently developed a new digital compact cassette (DCC). This uses a tape cassette very similar to a conventional analog compact cassette, but with a sliding cover like 3.5" floppy disks. The tape travels at the same 4.75cm/sec used for compact cassettes, and a DCC machine will apparently also replay analog tapes.

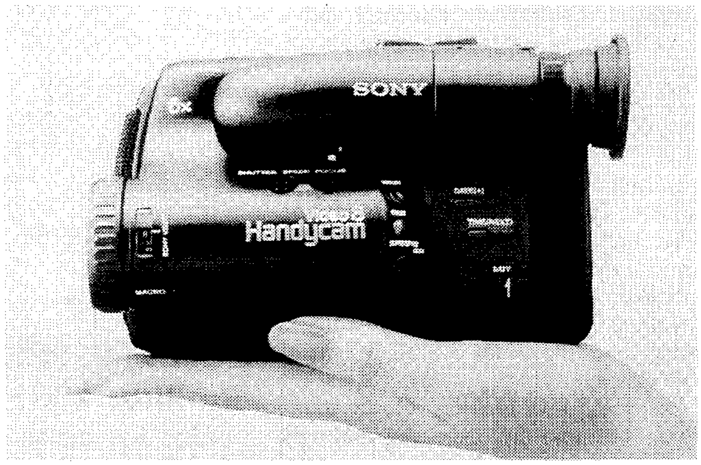
Instead of the rotating heads used by DAT, DCC uses a fixed solid-state head which records and plays back the digital data in 16 separate parallel tracks – 8 tracks for each stereo channel. To allow these 8 tracks to record what is claimed to be CD-quality sound, DCC apparently uses 'precision adaptive sub-band coding' or PASC; this is a technique where the number of bits used to encode each digital sample is varied, according to the signal level.

So far only Tandy in the USA has committed itself to backing Philips with the DCC system, but Japan's Matsushita is rumoured to be keen to do so.

With much simpler deck mechanics than DAT, DCC obviously has the potential for both lower price and higher reliability. If this potential can be realised, and the inevitable copyright hassles sorted out, DCC may well provide the long-awaited digital recording technology for domestic use.

Philips says the DCC system is 'still under development', so we probably won't see it on the market in 1991. But it may not be much further away, and it may begin to have a pre-emptive effect on further DAT development.





Sony release five new 8mm camcorders

As further testimony to consumer acceptance of the 8mm camcorder format, Sony has released five new models.

Heading the new lineup is the CCD-V5000, a Hi8 'Pro' model with digital timebase corrector and digital noise reduction for broadcast-like quality reproduction. By shifting the luminance carrier signal up the frequency spectrum to 7MHz, the Hi8 is able to record more picture information than conventional systems. The result is a picture with horizontal resolution in excess of 400 lines.

The V5000 also features dual AFM HiFi and PCM digital stereo recording capability, plus a whole range of digital special effects that can be added when shooting or at post-production. These include digital still picture, strobe, flash motion, display of nine smaller individual screen pictures, pictures in still, variable speed electronic shutter with six speeds and a 2x digital zoom which allows the 8x power zoom lens to be stepped up to 32x zoom power. The Hi8 Pro also comes with wireless remote control, as well as an impressive range of optional editing equipment.

The V5000 incorporates Sony's 495,000 gross pixel CCD image sensor, which combines high resolution with a minimum illumination of only 4 lux.

Next in the new lineup is the CCD-V700, another in the Hi8 range with an impressive list of features to suit both first-time users and semi-professional enthusiasts.

It too features the 495,000 gross pixel CCD plus an 8x power zoom lens with macro and a variable speed shutter with settings from 1/50th of second to 1/10,000 of a second. There is also a two page digital superimposer with scroll and reverse, as well as AFM stereo recording capability.

Next is the CCD-F550E, again fitted with the 495,000 pixel CCD. This has stereo AFM HiFi sound, with a built-in one point stereo mike, and comes supplied with a wireless remote commander for hands off operation on location or playback in the comfort of the home entertainment area. Other features include 8x power zoom with macro, manual and auto operation with two settings, sports and portrait. A variable speed digital shutter with 8x settings from 1/50 of a second to 1/4000th of a second and a two title digital superimposer with scroll and reverse.

The remaining two releases are two new 'Handycam Traveller' models, the CCD-TR45 and CCD-TR75.

Smaller than the original CCD-TR55, the new TR45 ultra compact Handycam is the world's smallest and lightest camcorder. This remarkable size has been achieved by miniaturising the CCD and mounting it directly on the camera block, resulting in an overall weight of only 690gm.

The TR45 also features 'Quick start', which reduces the time lag between pressing the record button and actual image recording to an almost instanteous 0.2 seconds. Also incorporated are a 6x zoom lens with dual speed and a variable speed digital shutter with speeds up to 1/4000th of a second and for adding titles, an eight colour superimposer.

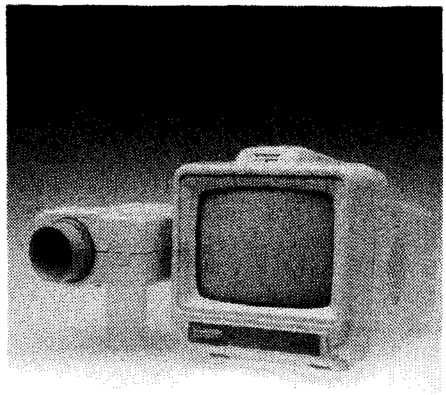
While the TR45 has been targeted at the consumer who requires simple operation and ease of use, the new CCD-TR75 offers advanced features for the more serious videographer.

A precision CCD imager (470,000 pixels) provides superb picture quality and stereo sound offers equally impressive audio capability. In addition it includes an 8x power zoom lens, a variable speed digital shutter up to 1/4000th of a second, plus the 'Quick start' function and a built-in stereo microphone equipped with special circuitry to enhance separation.

As will all 8mm camcorders all of these new Sony models can be easily connected to any television or home video recorder for direct playback or transfer.

All new models are already available from Sony dealers. Suggested retail prices are $4999 for the CCD-V5000, $3149 for the CCD-V700, $2599 for the CCD-F550E, $2099 for the TR45 and $2499 for the TR75.

Even lower price for home video monitor system



Dick Smith Electronics is now offering the Uniden VM100 video monitor system at a lower price than ever before – $199 – thanks to an astute scoop purchase. The VM100 comes complete with black and white monitor, camera, cable and power supply and can be mounted inside or outside.

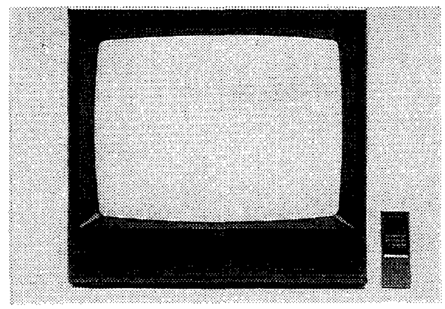
The system is expandable with optional extra cameras, monitors and video switches that allow you to monitor several places at once. A weather shield is sold separately for outdoor installations.

Other advantages of the system include low power consumption, wide 60° viewing angle, large depth of field (20cm – infinity), and a hi/lo brightness selection with a built-in Neutral Density filter, to compensate for high ambient light levels.

For even greater security, the video monitoring system is also available with a built-in intercom which lets you listen and speak to the area being monitored. The Uniden VM200 video monitor system retails for just $269 – again this is unbeatable value.

Further information is available from all Dick Smith Electronics retail outlets.

High resolution 62cm monitor-style CTV



Akai has introduced a 62cm high resolution monitor, the CTK-260.

It offers the new 'European' design with overall greater height and less depth than its eastern counterparts and offers up to 30 pre-set channels including facility to tune both UHF (channels 21 to 69) and VHF (channels 0 to 11) bands. Main city channels will be pretuned before despatch from national Akai distribution centres.

The resolution on the new monitor is claimed to exceed that which is offered by our own broadcasting industry and far exceeds the resolution specification for most VCRs.

The CTK-260 comes complete with a 24-button infra-red remote control. It has a recommended retail price of $999, is covered by Akai's three year nationwide warranty and is available at Akai dealers and selected department stores.

New 8mm and Hi8 video tapes

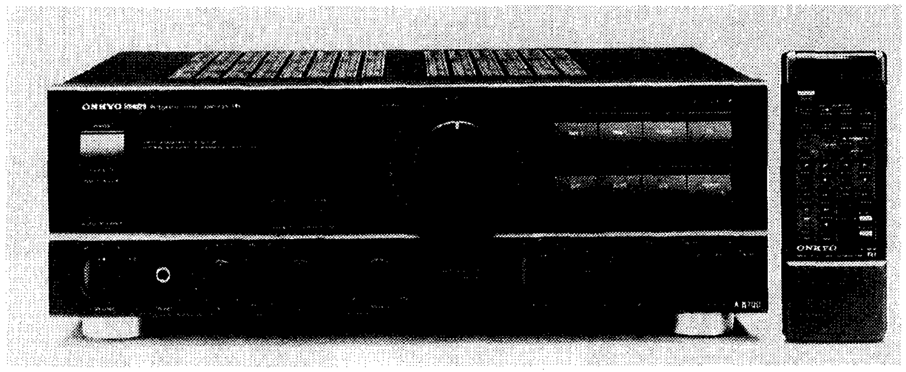
TDK has introduced two new grades in the 8mm video format; HS (High Standard) and E-HG (Extra High Grade), with both grades available in 30, 60 and 90 minute playing times. The new Hi8 ME (Metal Evaporated) tape is now also available in 60 and 90 minute playing times.

The development behind the upgrades has been twofold. Firstly, camcorder technology has been steadily improving, with image quality now exceeding 400,000 pixels – nearly twice that of just a few years ago. This has meant that video tape development has had to meet, if not exceed, such specifications.

Secondly, as camcorders reach a larger market, combined with being subject to varying environmental conditions, tapes have had to be both more durable and rugged.

TDK claims both the HS and E-HG grades meet these requirements with a newly developed version of their high output pure metal formulation 'Finavinx', advanced coating technologies and improved cassette mechanisms.

High-end amplifier has IR remote



Onkyo claims its Integra A-R700 105 watt/channel integrated amplifier offers the discerning listener sonic performance rivalling the top of its range integrated amplifier the Integra A-G10, together with the operating convenience of infra-red remote control.

Offering over 105 watts continuous per channel into 8 ohms, from 20Hz to 20kHz, and with a dynamic power rating of over 300 watts per channel into 2 ohms, the R700 can confidently drive the most inefficient of today's speakers.

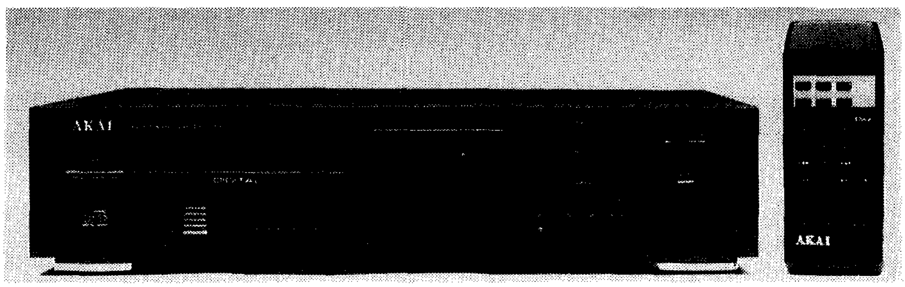
To obtain sonic purity of the signal Onkyo have employed high quality motors to drive both the volume control and input selectors. The motor driven volume control and rotary switch are free of the non-linearity to which conventional semiconductor switches and volume controls are susceptible.

The Integra A-R700 offers inputs to accept phono (gold plated for both MC and MM), tuner, CD (gold plated), tape and auxiliary with a 'source direct' switch to all inputs to bypass the tone circuitry.

A 32-button infra-red 'RI' remote control is provided which can also control other Onkyo RI-compatible units such as CD, cassette decks, tuners, or even some turntables.

The Integra A-R700 integrated amplifier is covered by a five year parts and labour warranty and has an RRP of $1399. It is available only at Onkyo dealers.

Multi-disc CD player from Akai



Akai's CD-A510 multi-disc player provides up to seven hours of uninterrupted music, employing a six disc magazine and offering a 22-program memory control. The infra-red remote control enables any tracks of any of the six discs to be programmed in any order. Further, a repeat mode enables any disc or any number of tracks to be repeated. The CD-A510 also offers a 'random play' mode that enables the listener to play the discs completely at random.

It uses three beam laser technology and features 16-bit, four times oversampling digital filtering. All modes of operation are clearly displayed on a large fluorescent display indicating track time, number of tracks and total playing time.

The CD-A510 is covered by a 12 month nationwide parts and labour warranty, has a recommended retail price of $399 and is available at Akai dealers and selected department stores.

Improved 'digital ready' tapes from TDK

Continuing in the vein of its well received 'digital ready' range, the high position/type II tapes SF, SA and SA-X and the metal/type IV, MA-X and MA-X6 have had major formulation and cassette design improvements.

The SF, SA and SA-X have undergone improvements in particle size, orientation and higher packing density, giving the high position tapes higher MOL (maximum output level) and lower bias noise (inherent to some degree in all tape) characteristics. Both these important parameters determine the dynamic range of an audio tape and the wider dynamic range the better. This is because digital sources can so effortlessly produce a wide dynamic range and this places enormous demands on a tape.

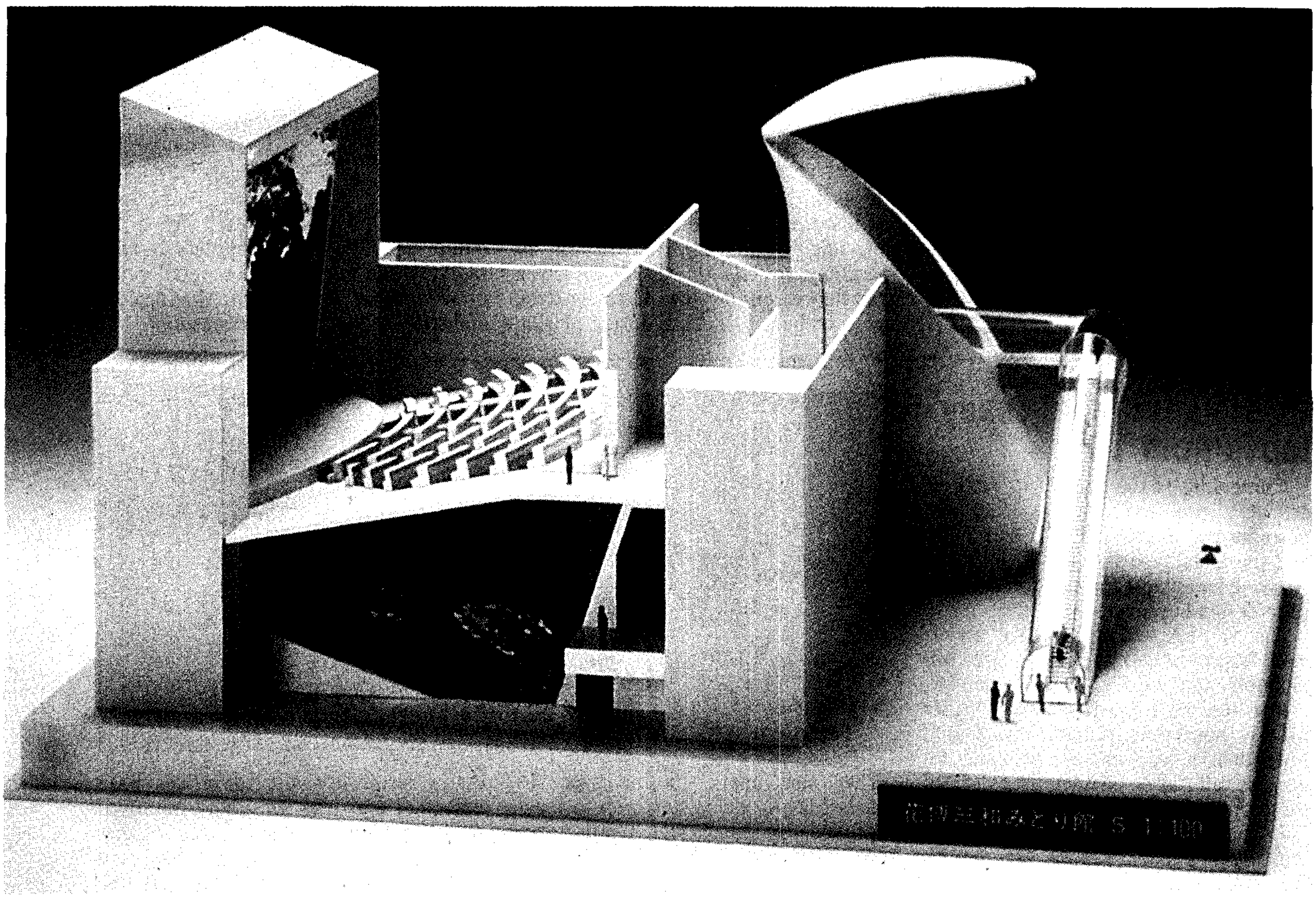
The new metal position/type IV grades MA-X and MA-X6, use a much improved version of TDK's proprietary pure iron particle formulation 'Finavinx'. By using a newly developed high-dispersion binder system and improved particle technology, TDK have improved MOL and lowered bias noise. As a result dynamic range has been extended and also sensitivity improved over previous grades. TDK further claim calendering techniques have improved tape smoothness and at the same time improved the consistency of the magnetic properties, ensuring low modulation noise.

More impact for the movies:

A MAGIC CARPET - AND 3D WITH LCD'S

Not content with developing equipment to show the largest flat-screen and wrap-around movies, the Canadian IMAX company has come up with two new systems: one which provides even wider wrap-around images to create the illusion of flying, and the other the best 3D effect yet achieved. And like IMAX and OMNIMAX before them, both new developments are based on the rolling loop system invented by Australian engineer Ron Jones...

by BARRIE SMITH



A model of the IMAX Magic Carpet theatre at Osaka Expo 90. The projection box at right and the two screens at left – one in vertical position, other beneath a clear plastic floor.

It all began in Brisbane: in 1969 Ron Jones, a Brisbane engineer, delivered a paper to the SMPTE on his revolutionary 'rolling-loop' movie projector. In place of the traditional Maltese Cross movement yanking the film in a stop-go motion, Jones' plan moved the film across the projector's gate as a series of waves. The film perforations were used solely to settle each film frame onto fixed registration pins for its burst of illumination – and not to pull the film intermittently. The wave shape is formed by air pressure, with each frame being held against the lens' rear by a vacuum; the result is image steadiness of the highest order.

Mr Jones is now deceased, but his revolutionary invention lives on – and today is the heart and muscle of Canada's mega-screen 70mm IMAX/OMNIMAX motion picture format.

The company itself is now 23 years old – IMAX being first shown publicly at the 1970 World's fair in Osaka. The company now designs and builds not only the horizontally running projector, but also the camera – and is totally responsible for the layout and construction of the purpose-built theatres, now totalling 65 in 15 countries. There are three in Australia – at Townsville, the Gold Coast and Perth.

IMAX is the basis of the system: the camera negative is 65mm wide (or 'high' in IMAX terms, as the film runs transversely), and travels at 103 metres a minute. Bordered on each side by 15 perforations, each frame of film image measures 70 x 50mm – a ratio of 1.4 to 1, and hence a far more square picture than Panavision's 2.35 to 1 frame, but nearly 10 times the area of the latter.

Such a huge frame size allows a large image to be projected, with some screens exceeding 500 square metres in area. The projectors use 70mm prints; the light source, depending on the theatre, is in excess of 15kW.

The matching sound system is conceived and reproduced in appropriately large scale terms – using a separately slaved six channel magnetic reproducer.

OMNIMAX appeared in 1973, and transformed the flat screen IMAX into a spherical format by using 'fish eye' lenses, both at the taking and projection stages – the audience sitting in an 'enveloping' auditorium, with the viewers' peripheral vision totally encircled.

Around 1985 the company added 3D OMNIMAX to its list of achievements by showing the computer-generated *The Universe – We Are Born of Stars* at Tsukuba's Expo 85 in Japan. The system used polarising glasses to separate left and right eye images.

Here we are in 1990, and Expo returned to Osaka. And IMAX was with it – 20 years after the system's first showing. Almost as though it had to be seen to prove it had 'arrived', IMAX ran at the show in four theatres – each with a different format.

In one theatre a 20 minute, Japanese-produced 'straight' IMAX film *Flying Raft* carried the audience over South America in an airship.

Across the park was IMAX 3D, showing *The Last Buffalo* – viewed with high-efficiency polarising spectacles.

But immediately adjacent were two theatres purpose-built for the showing of not just one, but two new IMAX processes: IMAX Magic Carpet, and IMAX SOLIDO.

IMAX Magic Carpet

The Magic Carpet system uses two electronically-synchronised IMAX projectors, each illuminated by 15kW Xenon light sources. One, in standard configuration, projects an image onto a conventional screen 18 metres wide by 25 high. The other machine is in modified form, and points downwards to cover a slightly wider screen beneath the floor of the theatre itself.

The floor itself is made from transparent, strengthened plastic – as are the seat support panels. The spacing between the aisles and the seats themselves is in excess of a conventional theatre, to allow an unobstructed view of the underfloor image. The overall intention of Magic Carpet is to give the audience a feeling of flying.

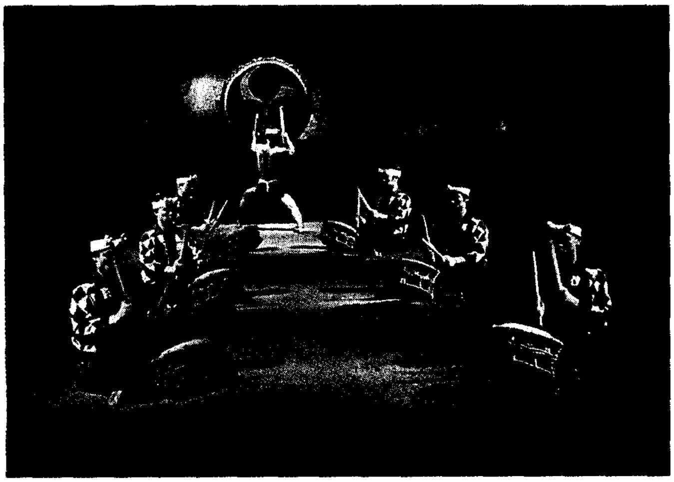
The first film made in the system was *Flowers in the Sky*, a 15-minute study of the life cycle of the Monarch butterfly, following millions of the winged creatures on a regular migration from North America to Mexico.

Fortunately for the film-makers, the butterflies' route crosses directly over Niagara Falls – allowing a two-screen aerial shot to be made over the cascade that surely must go close to being the ultimate tummy-twister.

Producer Roman Kroitor, however, claims "We could have done some real

Magic Carpet crew filming in Mexico. Note the Monarch Butterflies surrounding the technicians.

Magic Carpet, 3D



Japan's famous Kodo drummers – one of the live action vignettes intermixed with computer animation in IMAX SOLIDO 3D film Echoes of the Sun.

A sculptor working on a life-size model during shooting of The Last Buffalo, filmed in IMAX 3D.

gut-wrenching filming, but we didn't want to terrify everyone".

To shoot *Flowers* two cameras were rigged together, synchronised to operate whilst pointing in different directions. With this dual 'Cyclops' arrangement, one can only wonder where the camera crew put their feet!

Sound was reproduced in six channels from an Otari tape machine, electronically synched to the two projectors. One channel carried a supplementary 'sub-bass' track to give the audience a 'feeling' sensation.

IMAX SOLIDO

The patents on this second new system are still pending, so extracting information from the company was a very touchy affair.

It seems IMAX have plans to open a SOLIDO theatre to the north of Tokyo in late 1990, and an ambitious scheme to 'roadshow' the format with a portable system in Europe in 1992 – with Seville in Spain the first stop on the tour.

Most of us have seen 3D movies, and many unfortunates remember the eye-strainers that passed for stereoscopic movies in the 1950s – *Creature From the Black Lagoon*, *House of Wax*, *Kiss Me Kate*, et al. These were made with one of two methods: red and blue anaglyph projection with bi-coloured glasses – or polarisers on projectors and audience spectacles.

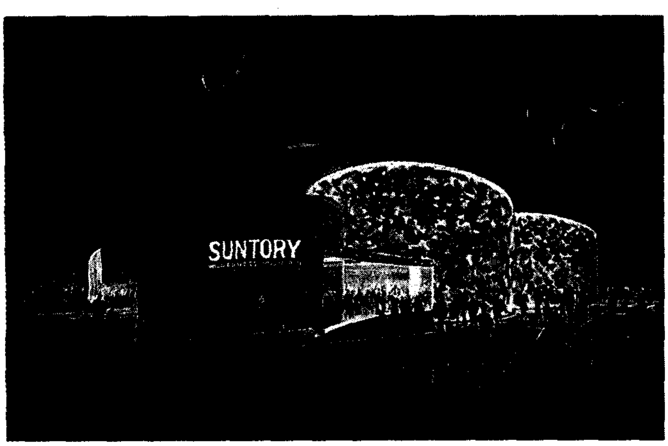
Misaligned images, projector weave and lack of focus tended to help these '50s attempts pull the eyeballs in directions that nature never intended. Coupled with this was a severe limitation on screen size, due to inadequate projector illumination and heavy light losses through the anaglyph and polarising spectacles. The 3D effect at best was always that of looking through a window at the 'solid' subject.

What makes SOLIDO unique in stereoscopic cinema is its presentation of a high quality colour motion picture on a wide-field, wrap around screen. The 3D image extends to the front, above and to the sides of the viewer – you feel as though you are inside the image itself, and images can move by you, and through you.

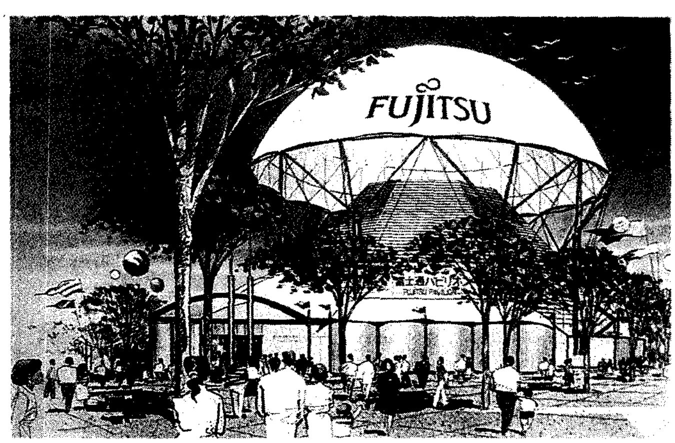
Two synchronised projectors are again used, both equipped with short focal length, fish eye lenses. The screen is domed, in accepted OMNIMAX peripheral mode: the picture extends 180° vertically and 123° laterally, across the 24-metre diameter expanse. Because of the wrap-around shape of the screen, audience size is limited to 330 people.

The light source is 33kW in output. Audio is digital, six track.

To receive the stereoscopic effect,



A model Suntory's pavilion at Expo 90 – one of four IMAX presentations, in this case housing polarised IMAX 3D.



A model of Fujitsu's Expo 90 pavilion, which was a theatre presenting the new IMAX SOLIDO 3D process.

From Echoes of the Sun: Fujitsu's computer team created this scene in 3D, depicting energy transfer inside human muscles.

viewers must still wear special glasses. But IMAX has developed new ones, using LCD technology. These work as electronic shutters: as the projectors throw upon the screen their 'left' and 'right' streams of 24 frames in each second, so do the LCD spectacle lenses open and shut in synchronism. There is a 0.02 second differential between each side – too fast to be observed, but slow enough for the brain to fuse the information.

Power to activate the liquid crystal shutters in the spectacles is supplied by small built-in batteries. The clear/obscure signal for each LCD is generated by an in-theatre IR signal, transmitted from the projector station.

The first film shown in SOLIDO is *Echoes of the Sun*. Lasting for 20 minutes, the film combines computer-generated graphics with live action vignettes, and shows the process of photo-synthesis as it converts the sun's energy into stored energy in plants, then to provide energy in animals and man.

Computer giant Fujitsu backed the original 1985 IMAX 3D film – which was only in black and white – but also undertook to underwrite a full colour version. This is *Echoes*.

Kroitor comments: "The interior structure of a muscle cell is fascinating when you're in it". So, 20 minutes of stereoscopic muscle cell – and friends – has cost $A37 million. The computer graphics section of the production totals 30,000 frames; Fujitsu reckoned each one cost about 40,000 Yen ($A330) – or around $A1,000,000 a minute to create!

When the company did a preproduction comparison of the 1985 mono version to the current effort, they discovered there would be a need for 17 times more computing power. To achieve this they enlisted one VP-200 super computer full time for two years, plus a second, more powerful super computer for six months, and a 256-processor cellular array (parallel microprocessor) machine. No fewer that 40 computer programmers worked full time for 21 months to complete the movie.

By the time Expo closed in September, Fujitsu estimated they had spent 3.6 billion Yen to produce the film and stage the show. As the computer writer for the *Japan Times* saw it, with that amount you could buy 'a quarter of a Van Gogh at today's prices'.

One can only hope the SOLIDO audiences' understanding of photo-synthesis is suitably expanded!

After seeing *Echoes*, *Time* magazine made the point that it is the 'wide, umbrella-shape screen that provides the breakthrough in SOLIDO.' And that 'the 3D effect is unusually crisp, because the projectors are extremely stable, the separation of right- and left-eye views is precise, and the movie frames are 10 times as large as those of a typical 35mm movie film'.

So, what's next in IMAX? When asked would the public perceive 3D SOLIDO as just another gimmick, Roman Kroitor revealed a disarmingly reply, resigned to audience fidelity:

"People get used to things so fast. After a while they ask, 'Where's 4D?"

Tiny US VCR maker challenges Japan Inc.

When the founder of a small firm from Scottsdale, Arizona came up with an innovative design for a new dual-deck video recorder, the logical way to get it manufactured was to approach one of the big Japanese firms. But they refused, and so did their competitors. Undaunted, he struck a deal with a Korean firm — and the product is now selling like hot cakes. But at the same time he's also taking the major Japanese VCR makers to court, claiming US$1 billion damages in an anti-trust suit.

by LEWIS M. SIMONS

In a classic David and Goliath confrontation, the upstart producer of America's only videocassette recorder is soon to step before a US jury and do battle against Japan's mightiest electronics giants — charging them with conspiring to block his tiny company from competing in the United States.

The case, in which Japanese corporations will face American jurors, could help loosen Japan's steely grip on the moribund US consumer electronics industry, encouraging others to challenge that industrial juggernaut. It also carries strong overtones of what some might call patriotism and others might consider Japan-bashing.

Terren Dunlap, chairman of Go-Video, defines his struggle in terms of the US -vs- Japan, or, as he puts it, 'the free enterprise system -vs- the cartel system'.

Go-Video, a Scottsdale, Arizona company that employs 22 people, needed a manufacturer for its product and alleges that top officials of the Japanese giants along with their powerful industry association, sat down together and decided, 'as a cartel,' not to produce Go-Video's innovative dual-deck VCR.

Because American's VCRs are all produced abroad and the great majority by this handful of Japanese manufacturers, such a decision makes it almost impossible to get the product on store shelves in the United States.

First of its kind

The patented machine, called the VCR-2, is the first of its kind. It lets users record two TV programs simultaneously, record one while viewing another, duplicate tapes with no loss of clarity and edit in ways that simply can't be done with any other VCR on the market. It can't be used to copy most prerecorded tapes, however, such as rental films.

Dunlap got his product onto the US market by striking a deal with the South Korean firm Samsung, which is now manufacturing the VCR-2. That company was originally included in the suit for joining the Japanese agreement against Go-Video.

Go-Video's innovative new VCR-2 dual-deck video recorder, complete with multi function remote control. It's manufactured for the firm in Korea, by Samsung.

Like his product, the 45 year old Dunlap is an American original, not the sort readily accepted by starchy, corporate Japan. The other day, chatting in the lobby of Tokyo's up-market Hotel Okura, he was dressed entirely in black — shirt, tie, trousers and hightop sneakers. The offbeat look is deceptive, though; Dunlap holds degrees in business administration and law. He firmly believes that Japanese business methodically conspires against the US. "These guys meet regularly, sometimes right here in this hotel, to discuss strategies, fix prices, exchange licences and to keep Americans out," he said.

San Francisco attorney Joseph Alioto, an antitrust expert who represents Dunlap, said he plans to convince jurors that the alleged conspiracy against Go-Video was shaped by the Japanese manufacturers' fear that a patented American invention could erode their control of the US market. "We can prove that meeting took place," Alioto said in a telephone interview.

Dunlap and Alioto were buoyed by a recent Arizona court's denial of the Japanese defendants' efforts to have the case dismissed. "This is the first time a case of this kind has come so far," said Alioto.

Others agree

The conspiracy theory has supporters among Americans who compete directly with Japanese industry. "Of course we weren't at any meeting," said John Stern, Tokyo-based vice president of the American Electronics Association, "but circumstantial evidence certainly points to the fact that Japanese companies want control of all competition in the manufacturing of VCRs."

In its antitrust suit, which Alioto anticipates will go to trial in Arizona shortly, Go-Video is seeking US$1 billion in damages from Sony, Sanyo Electric, NEC, Matsushita Electric Industrial, makers of the Panasonic and National brands and Victor of Japan, which produces the JVC brand.

Under customary trebling awards, Go-Video, which began business in 1983 with total capital of US$60,000 drawn against 10 personal credit cards, could walk away $3 billion richer. Go-Video settled recently for $2 million with several other Japanese VCR makers, including Mitsubishi, Toshiba and Hitachi, as well as the Electronics Industry Association of Japan.

Japanese scoff

But spokesmen for several of the companies involved in the current suit dismissed the conspiracy allegation.

Dunlap's first sense of a conspiracy emerged after he met in Tokyo with representatives of NEC, at their invitation, in January 1985. He had tried earlier to have the VCR-2 manufactured in the US, but after calling on three companies he found that none had the ability to produce it. "They all told us the same thing," he recalled morosely. "Go to the Japanese."

Dunlap took to his NEC meeting the patented 'brains' of the Go-Video VCR-2, a microcontroller on a circuit board from a personal computer, with seven other semiconductors.

The tiny device is manufactured by Santa Clara-based Intel, at a plant in Arizona.

"Go-Video programmed the controller with 5000 lines of information and that's what we've got under patent," Dunlap said.

As is not uncommon when unitiated Americans first make proposals to Japanese business executives, Dunlap left Tokyo believing he had closed a deal, with NEC agreeing to produce the dual-deck machine for Go-Video.

"But a few weeks later," he said, "NEC met with the others at EIAJ headquarters and they reached a 'voluntary restraint agreement' that no Japanese company would make a dual-deck VCR for us. I couldn't believe it — they were in violation of US antitrust law. I decided to sue."

According to the AEA's Stern, the decision to sue is 'extremely significant' in itself. "Until this case, American companies didn't realise the US antitrust law gives them the right to sue even for something that happens in a smoke-filled room in Tokyo," he said. "Now the court has ruled that Go-Video has a case and, if they can prove it, it will be a major step forward for all American companies."

The VCR-2 appears to be off to a strong start, despite its relatively stiff US$1095 price — more than double the cost of a standard VCR. The Sharper Image, a San Francisco-based, 68-store chain specialising in upscale electronic products, featured it on its catalog cover late last year.

"We can't keep up with the demand," said Dunlap. "We've delivered 10,000 to the States since the start of the year and expect to deliver between 20,000 and 30,000 by the end of the year." European distributors just ordered 25,000, he said.

Although there's 'great interest' among smaller Japanese companies, Dunlap claimed Go-Video is 'blacklisted' with Japan, effectively barred from doing business with would-be distributors and suppliers.

A source at one Japanese firm, who spoke on condition of anonymity, denied this allegation. "The fact that no one will do business with Mr Dunlap is not because of a conspiracy," he said. "It's because no one in Japan likes to do business with people who sue." ■

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AST	Bravo/286, Premium 386, 386C, 386/16, 386/25, 386/33, 486, Workstation 286, 386	CuSIMM
HEWLETT PACKARD	Vectra RS/20, RS/20C, RS/25, QS/16, 486 Laser Jet II, IID, IIP, III	CuRAMJET
APPLE	Mac II, Mac Plus, Mac SE, SE/30, Mac CX, Ci, Mac Portable	CuSIMM, Xceed™
AT&T	6286, 6386 WGS	CuSIMM
EVEREX	Step 16, Step 20, Step 25	CuSIMM
ZENITH	386/25, 386/33, 386SE, Z-248/12	CuSIMM
CANON	LBP-811, LBP-811R	CuRAMJET
EPSON	Equity IIe, 386SX, 386/20	CuSIMM
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The Challis Report

MEYER'S HD1 RECORDING MONITOR

Many up-market loudspeaker systems are described by their makers as 'monitor speakers', but the requirements for a true recording monitor are quite stringent. This month Louis Challis looks at Meyer Sound's HD1 high definition monitor system, which features inbuilt amplifiers and equalisation.

Anybody who is anybody in the loudspeaker game today seems to be offering one or more 'monitor speakers', which may be regarded as either being a status symbol, or as a straight marketing exercise. The prices for these 'monitor speakers' seem to range from somewhere in the vicinity of $1000 at the lower end of the market to figures in excess of $15,000 a pair at the other extreme. Many of these monitors are physically large, a few are small, and of course, there are plenty which are neither one nor the other.

If I asked any self-respecting recording engineer what attributes he (or she) would look for when selecting their new monitor speakers, most would opt for the following list of parameters (which you may treat as a shopping list::

1. A flat frequency response, preferably covering as wide a frequency range as possible — and preferably down to a 3dB point of 30Hz.
2. A flat phase response, with the smoothest possible phase linearity over the range 500Hz to 10kHz.
3. Small physical dimensions, which will then facilitate their convenient placement on the front walls of the monitoring suite or control room.
4. Special options, such as self-powering, abuse resistance (foolproof overload protection), and the ability to handle outputs comparable with the 'life-like' sounds which they are intended to replicate.

Now while most so called monitor speakers fulfill one, or even two of these performance requirements, there aren't many that I can think of that claim to fulfill all four — and of course there is a market just waiting to be tapped by the product that meets all of these requirements.

The design team at Meyer Sound in California set out to develop just such a speaker for their own internal use some years ago. They wanted a small self powered loudspeaker which was either 'bookshelf' sized, or if it had to be a trifle bigger, which could then handle rock music and reproduce the high level peaks of the sound when used for their comparative subjective evaluations — or alternatively used as a professional monitor in a studio situation.

As most of us are now well aware,within limits, it is possible to achieve any degree of frequency and phase linearity that you may desire, subject only to the degree to which you are prepared to extend yourself in the use of special equalisation circuitry in order to fulfill your ultimate goal.

Different approach

The design approach the Meyer Design team adopted was markedly different from any other speaker which you or I have previously seen (or tested). Although they decided to use only two drivers, each with its own dedicated power amplifier, these amplifiers were then cunningly preceded by an unbelievably complex array of amplitude and phase equalisation circuitry (see photo). This circuitry, together with the power supplies, toroidal transformer, power amplifiers and equalisation circuitry are then cunningly squeezed into a shallow space between the back of the speaker cabinet and the rear metal cover, which cleverly doubles as an effective heat sink.

The low frequency driver appears to be an unconventional 200mm long throw driver with a 50mm diameter voice coil, and what appears to be a fairly massive magnetic circuit. The low frequency driver is then vented by a pair of 50mm diameter venting ports which are each 230mm long and which are symmetrically located at the two lower corners of the front face of the speaker.

The choice of two ports in lieu of one is not necessarily a marketing ploy as there are good reasons for keeping the port diameters down in order to achieve an appropriate 'inertance', whilst still achieving an appropriate air mass flow capability by doubling the available cross-sectional area.

The low frequency driver covers the frequency spectrum all the way up to 1kHz, and is powered by its own 150-watt power amplifier. The upper end of the frequency spectrum (from 1kHz to 20kHz) is handled by a special 25mm diameter soft dome tweeter. The tweeter dome is an intriguing green coloured fabric, which I am assured is woven from pure silk. The tweeter has its own separate 75-watt power amplifier, and of course, its own special protective circuitry so that you cannot blow it up, even if you should inadvertently try.

Although the front panel has plastic inserts into which you may think the protective grill face would be clipped, you would be wrong. Meyer Sound neither markets nor provides such protective grills as the physical presence of most speaker grills generally has some (adverse) effect on both the frequency linearity and dispersion characteristics of the drivers.

Near the bottom of the front panel is a little green bezel light, which lights up when the speaker is powered and the colour surreptiously changes to red if the speaker if overloaded. It stays red as long as the overload condition is maintained.

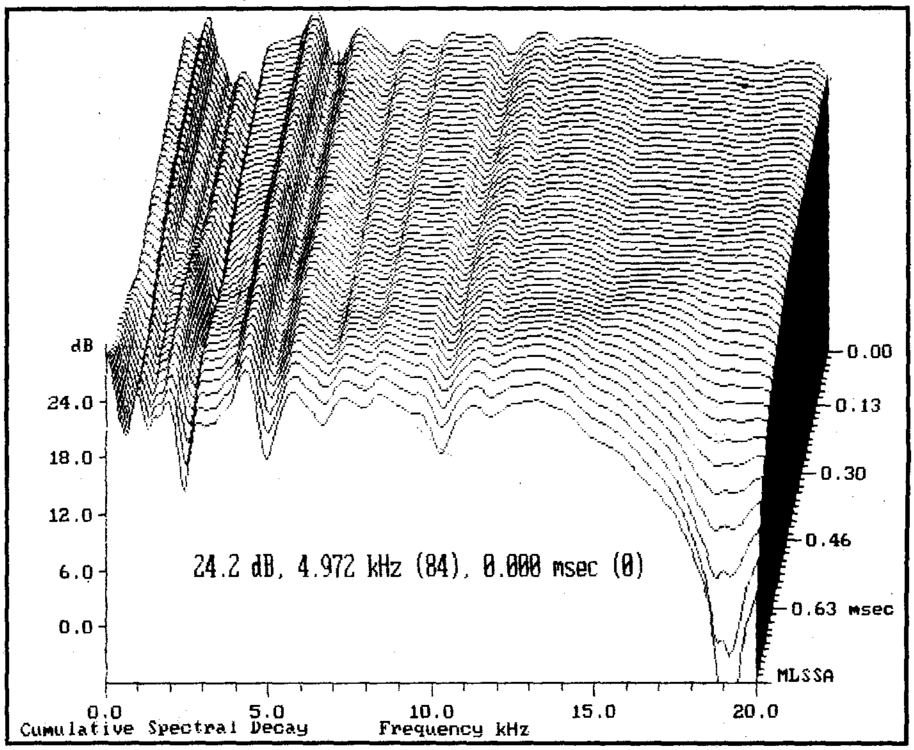
As I discovered, the threhold level is thermally dependent so that if you drive the speaker long and hard, with say organ music or with 'hard rock', the overload activates at sound pressure levels as low as 110 to 112dB at 1m. With lighter loading and cooler voice coils this may occur at levels of the order of 118dB at 1m.

Ultimately it is the back panel of the speaker which tends to catch your interest, for this panel and most particularly its contents are quite unlike any that you have ever seen before. It is only when you open up the panel (by removing a considerable number of special screws), that you discover just why the HD1's are so different.

After removing the back cover, I faced a bewildering array of printed circuit boards with masses of transistors, capacitors, resistors and trim pots, which are adjusted with the loudspeaker positioned in Meyer Sound's small anechoic room inside their factory. Whilst the circuitry is remotely connected to the speaker during the frequency and phase alignment, I was intrigued to find that the microphone is positioned 0.5m away from the speaker face for such alignments. The reasons for such a small and unusually close dimension are obviously practical (because a decent size anechoic room requires an awful lot of space — and as I discovered many year ago, a significant financial investment). Nothwithstanding, it has been

MEASURED PERFORMANCE OF MEYER SOUND LOUDSPEAKERS Serial No. D900299

1. Frequency response	30Hz TO 20kHz +/-6dB				
2. Crossover frequencies	1kHz				
3. Sensitivity	Line input to amplifier = 220mV for 90dB @ 2m (4dBu)				
4. Harmonic distortion @ 1m		96dB	96dB	96dB	
		100Hz	1kHz	6.3kHz	
	2nd	-35.9	-60.4	-44.4	dB
	3rd	-36.8	-67.4	-68.2	dB
	4th	-65.4			dB
	5th	-47.8			dB
	THD	2.2	0.1	0.69	%
5. Line input impedance	4.8k ohms				



my observation that the frequency response that you measure at 0.5m is different to that which you will record at 1m, and which is also marginally different to that which you will record at 2m (or even greater distances from the speakers).

This may seem to be a rather obtuse issue, but in practical terms, it really isn't. It only raises its ugly head, if and when you also have an anechoic room in which to perform such measurements, as I do. The reason that I raise it, is because the frequency responses that I have measured on the sample Meyer HD1, are not what I would have expected and HD1 to provide, particularly in view of the extent of equalisation circuitry which it incorporates, with the specific and expressed intent of providing an ultra-flat (or ultra-linear) frequency response.

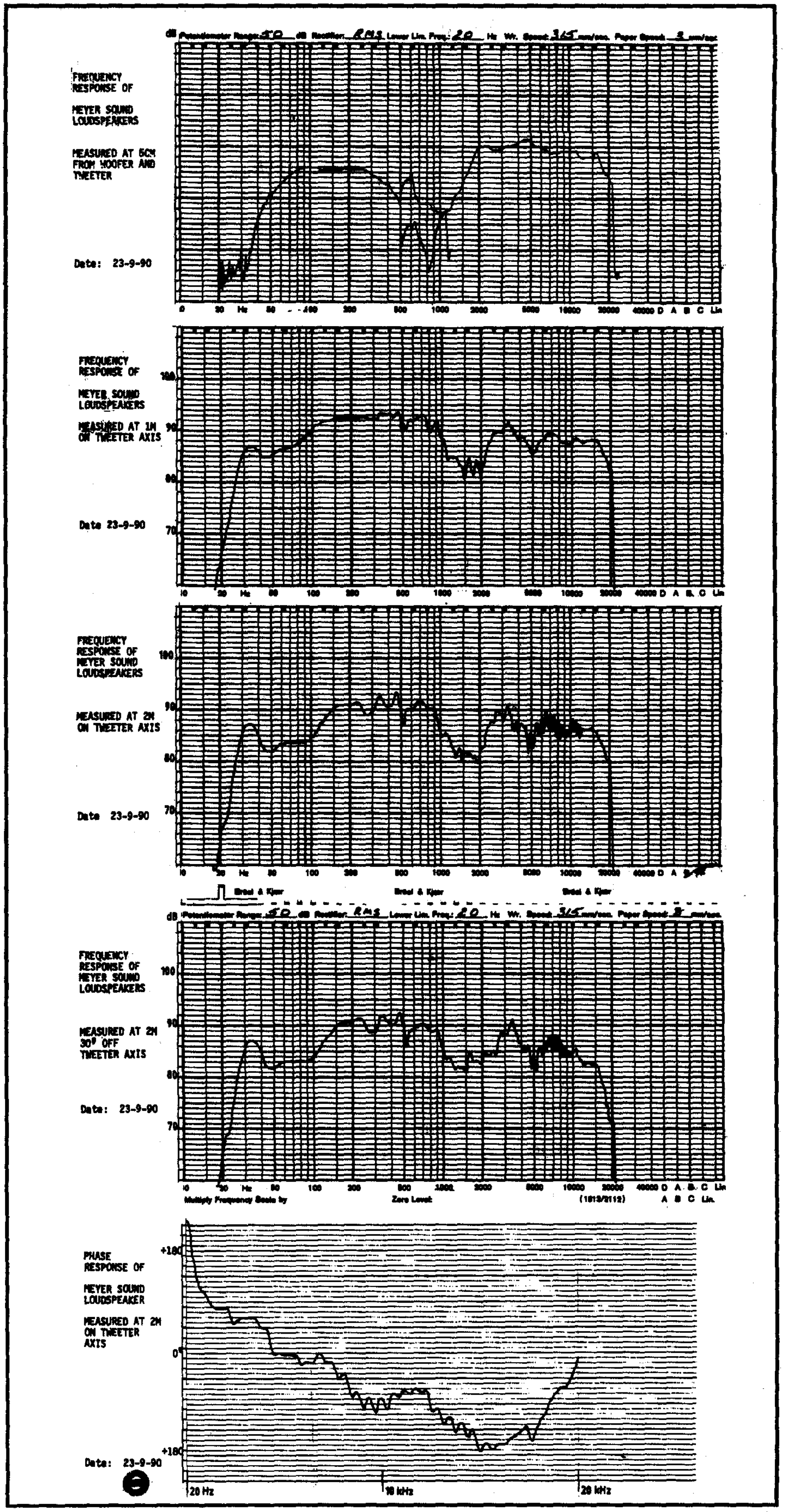
Now is it possible that the speaker I selected had been de-ranged during shipping, particularly, when it is noted that each Meyer HD1 comes fitted with its own vibration impact detection system carefully mounted on the speaker's back panel. In the case of the speaker which I tested, the vibration detection system had already been tripped indicating that the speaker may well have been subjected to excessive vibration with unknown results. In the limited time provided to me for my evaluation I was not able to carry out additional testing to determine whether other HD1's exhibit the same characteristics.

Test Results

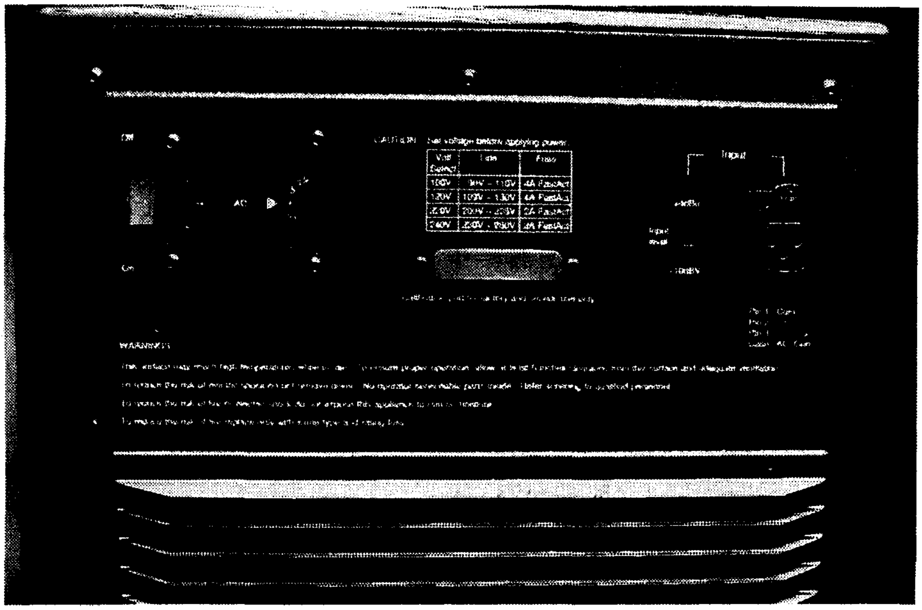
The measured frequency response at 1m is nonetheless relatively smooth from 30Hz to 1kHz, but exhibits a significant droop in the response between 1kHz and 2kHz, which I tentatively attribute to the proximity of the measurement microphone to the tweeter — on whose axis it is aligned during the equalisation program. In these circumstances, the interaction effect of the low frequency driver is skewed relative to the characteristics which I have observed occur at greater spatial separations — i.e., 1m or 2m, which are more typical listening, monitoring or measurement positions.

I discussed this factor with Paul Kohut from Meyer's production department in California, who assured me that this has been taken into account in their alignment procedure, which incorporates appropriate correction factors which they have previously derived in free-field 'out-of-doors' speaker testing. Nothwithstanding his assurances, I am not convinced, and will remain so until such times as I have a chance to retest a pristine set of HD1's. The frequency response from 2.5kHz to 16kHz is still reasonably flat and basically remains so, even at 30° to the main axis.

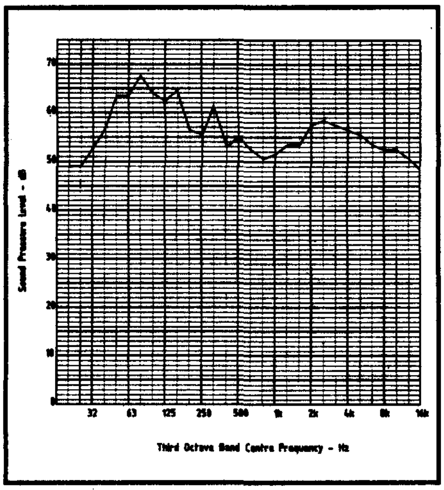
The phase response of the HD1's is also particularly smooth, all the way out to 16kHz, and exhibits a remarkable degree



Frequency response curves for the Meyer HD1 monitor, taken at different driver-microphone distances. At bottom is the phase response 2m from the tweeter, on axis.



Rear view of the monitor enclosure showing the controls and connectors above the large extruded heatsink.



The third octave band listening room response of the HD1 for pink noise.

of uniformity with some obvious equalisation bumps and dips within that range of frequencies. The polar plots are exceptionally smooth and even at 10kHz, the uniformity of response is within a 6dB range over a 90° arc. You need that sort of spatial dispersion for a monitor speaker, and the Meyer HD1's most certainly deliver the goods. The harmonic distortion characteristics of the HD1's are relatively low above 100Hz, but in the 30Hz to 100Hz range, are greater than 2% for sound pressure levels of 96dB at 1m. Distortion levels of this magnitude must be expected when a 200mm driver is placed in a vented enclosure and the low frequency output linearity is then achieved by means of frequency equalisation. Total harmonic distortion of 2% at low frequencies is not readily audible, but higher magnitudes of distortion do make their presence readily felt, and the HD1's are no exception to this cardinal rule.

The tone-burst testing, although not normally a critical issue, revealed the presence of significant resonant carry-over, particularly at 1kHz and still quite noticeable at the 6.3kHz, which in hindsight I guess was to be expected with the extent of electronic equalisation circuitry that these speakers contain.

The decay response spectra, which I note the Americans describe as a 'waterfall' response, exhibits a significant 'carry-over — well beyond the normal 0.5 to 1 millisecond range that I would have expected in such circumstances. I attribute this characteristic to the inbuilt 'group delay' characteristics, which are a common feature resulting from the adoption of electronic phase equalisation circuitry. As many of us have observed, such circuitry all too often has the capability of providing an overall delay characteristic of the type which I encountered.

The group delay characteristics of these speakers is by no means a serious problem, as neither you nor I, nor a studio engineer would normally be expected to be able to detect the presence of such a characteristic during either instrumental measurements, nor as part of a normal subjective evaluation. However, this particular phenomena sidetracked me for many hours as I tried to work out what was wrong with my equipment, which I initially believed was misbehaving. It was only after I sat down with the test results and scratched my head long and hard enough, that I realised what was really happening.

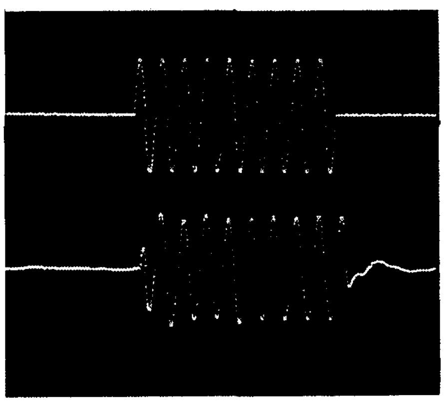
Listening Tests

Having satisfied myself that there was absolutely nothing wrong with the speakers, I progressed to the relatively short but pleasant subject evaluation, which I conducted in my listening room.

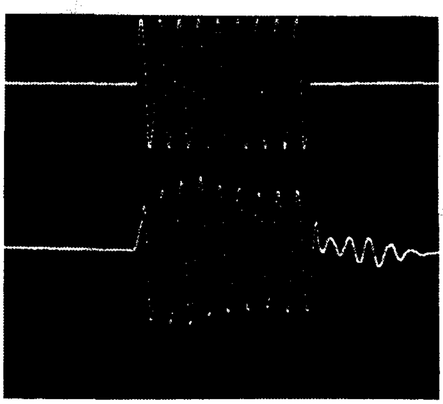
The first objective/subjective evaluation which I carried out was to evaluate the one-third octave band pink noise room response. This confirmed that the HD1's have an exceptionally wide response over the frequency range 30Hz to 16kHz. As I noted, the room response is a trifle peaky over the frequency range 50Hz to 160Hz, and this is primarily attributable to the

Tone Burst Response of Meyer Sound Loudspeakers

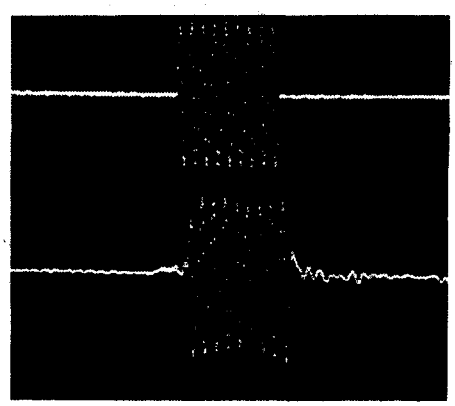
(Upper trace is electrical input, lower trace is loudspeaker output).



100Hz (20ms/div).



1kHz (2ms/div).



6.3kHz (0.5ms/div)

natural room modes (eigentones) rather than to the speakers themselves.

Although the Meyer HD1's are configured for balanced inputs, they are quite happy when operating in the unbalanced mode. Under these conditions the normal 100dB(A) signal to noise ratio does not appear to be impaired.

The monitoring system I normally use at home is unbalanced from input to output, and I noted with some satisfaction that, even when using 8m long cables with RCA coaxial plugs at one end and unbalanced XLR connectors at the other, there was no adverse impact on the quality of the system's response and specifically in terms of its signal to noise characteristics.

This is likely to prove to be particularly important in many studio situations where the output of the control console may be unbalanced, and consequently this could otherwise impact on the performance of the monitor speakers.

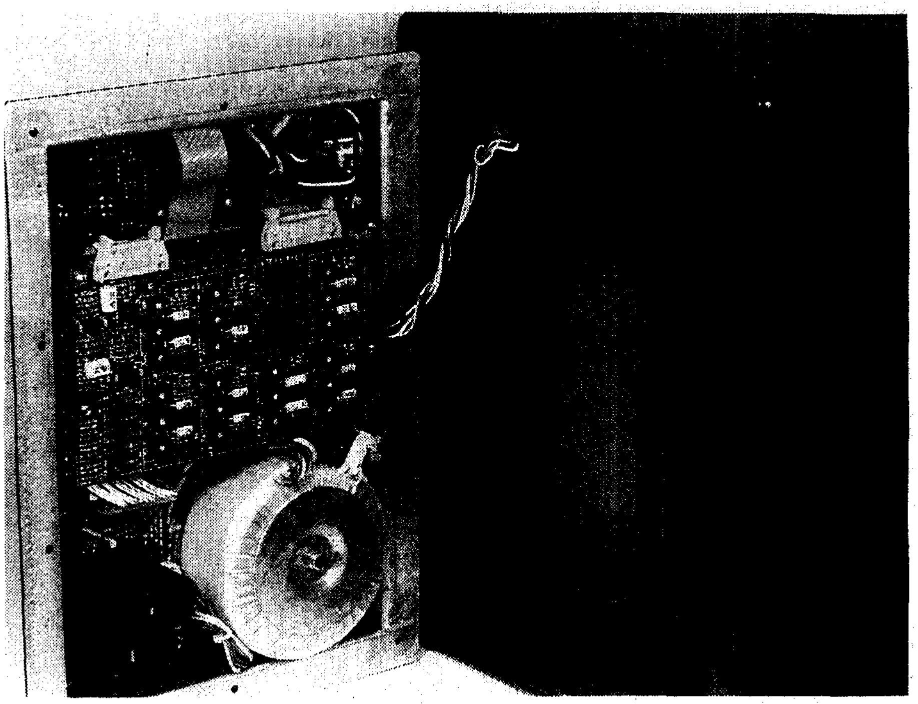
The first disc that I used in my subject evaluation was 'Wynton Marsalis in Standard Time Volume 3 — The Resolution of Romance' (CBS 4668712). This disc features the inimitable Wynton Marsalis on trumpet, for which he is internationally renowned, as well as singing for which he most certainly is not. He is supported by his talented father Ellis Marsalis on piano, Reginald Veal on bass and Herlin Riley on drums. Wynton Marsalis is one of the finest trumpeters in the world, and this disc provides a delightful potpouri of beautiful love songs and popular music to gladden the heart of the young and not so young alike. This is a particularly fine disc, and it provides 21 delightful tracks with which I was readily able to evaluate the full range of transient performance of the HD1's — with peak listening levels which I deliberately ranged from as low as 60dB(A) to as high as 115dB(A) at my normal listening position.

I noted that the trumpet was remarkably true to life, the drums displayed virtually all the realism and dynamic brilliance that I would expect from a live recorded show, that the voice reproduction was not as true to life as I would like and that the transient performance of the snare drums and bass was most impressive. So far so good!

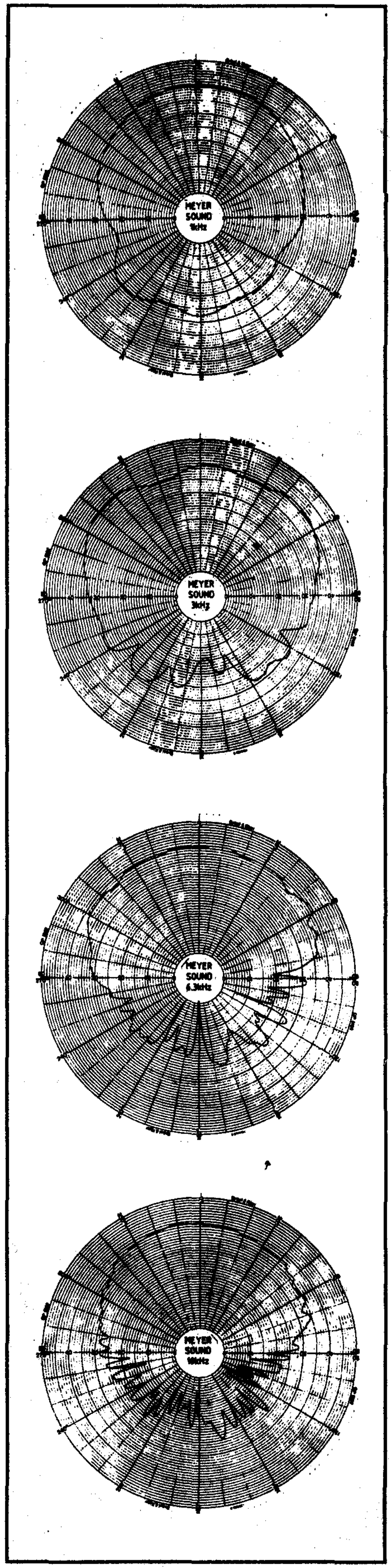
I progressed to a somewhat more difficult disc of 'Music for a Grand Organ' with David Drury playing the Grand Organ of Sydney Town Hall, (ABC Classics 432 527-2). This is a brand new disc released by Polygram with the support of the Council of the Sydney Town Hall. It's an unusual disc, cleverly recorded in a Town Hall which was never designed (nor I note subsequently enhanced) to provide a recording environment. I was able to hear Council workers or others moving around the body of the Hall during the recording and this does detract a little from what is otherwise an outstanding disc.

Notwithstanding the limitations of the Town Hall, the ABC engineers have achieved meritorious results, and David Drury's playing of the famous William Hill & Son's organ is masterful. Of the pieces contained on the disc, Richard Wagner's Tannhauser 'Pilgrams Chorus' is a truly outstanding rendition, as is Saint-Saens 'Danse Macabre'. Few loudspeakers are able to competently reproduce organ

(Continued on page 133)



Inside the rear of one of the HD1 monitors. In addition to the inbuilt power amplifier, it also contains comprehensive equalisation filters.



Polar response plots for the HD1 at 1kHz, 3kHz, 6.3kHz and 10kHz.

The new CT2/3 personal cordless phone systems

TELEPOINT: SET TO TAKE OFF?

New technologies will soon put the world in your pocket, — with a digital cordless telephone system already operating in the UK and France, and about to begin operation in Australia. Here's a look at how the new systems operate.

by DAVID VIZARD

In less than two decades, we could find ourselves in a world where almost everyone carries a truly pocket-sized telephone with them, and where the one phone number will reach you at home, in the office or on the street. Holding it all together will be an integrated network of fibre-optic landline cables, satellites and microwave relay transceivers.

The first step into this brave new world is CT2, the second- generation digital cordless telephone system. CT2 is already up and running in the UK, and is planned to begin in Australia early this year. The phones will be affordable, perhaps as low as $200 per handset, and flexible.

CT2 is actually three systems in one; at its heart is a single handset — the shape of things to come. Used with a personal base station attached to a conventional telephone socket, CT2 replaces the analog cordless phone found in millions of homes and small businesses around the world. The key advantages are that by encoding speech digitally, the CT2 unit has a consistent signal quality to the edge of its range (around 100 metres), rejects interference and cannot be overheard on conventional equipment.

For additional security the CT2 handset is 'enrolled' or registered with the base, so there is no chance for 'phreaks' — the latest slang for phone pirates — to make unauthorised calls from your number. And because each base selects a free channel from any of the 40 allocated, there will be no interference from neighbours using the same system.

In a medium or large-sized office, this concept is extended to form the 'cordless PABX' by installing a series of base stations located on each floor, through which you can use the same handset as you do at home.

But it is the final application of CT2 technology, the 'Telepoint' system, which captures the imagination and illustrates the way ahead. A network of public base stations can be established, through which any number of CT2 users can make (but not receive) telephone calls when within range of a Telepoint base — distinguished by bright signs and located in convenient places where people need to make calls. Typical sites would include shopping centres, railway stations, airports, pubs and clubs, restaurants and other key locations in any CBD or town centre. Just make your way to a Telepoint, key in a PIN unique to your handset, and dial away.

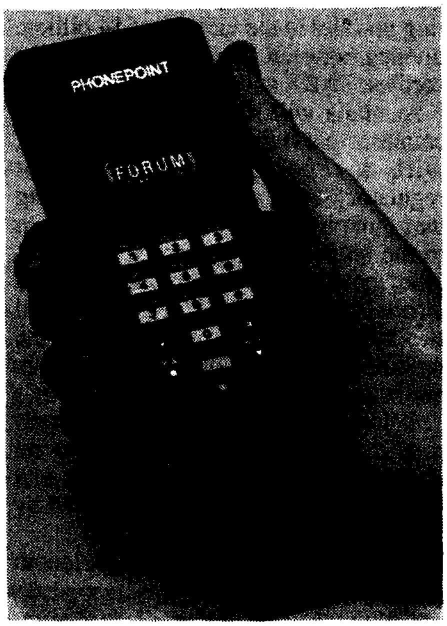
Some people have blithely labelled Telepoint as a 'poor mans' cellular' service, and in such a comparison CT2 has obvious flaws — a range less than line of sight, with only a limited facility to receive calls and no provision for automatic 'roaming' between bases. These factors however are what makes Telepoint a system in its own right; more like a personal portable phone box, but far more versatile.

The limited transmission range is due to a low power output of only 10mW (milliwatts). This keeps the CT2 handset compact, down to the size of a pocket notebook; lightweight, 150 grams or less; and conserves battery life. The low power also allows every channel to be re-used in very close proximity, so increasing the number of subscribers Telepoint can support — an estimated 5000 per square kilometre. The lack of auto-roaming also reduces the handset in size and complexity, and more importantly in price. Partnered with a pager, CT2 becomes a very cost-effective medium indeed.

Compact handsets

The handsets themselves are a thing of beauty and a joy to behold. With its flip-open design and inbuilt antenna inside the casing, British Telecom's 'Forum' model bears more resemblance to a Star Trek communicator than a telephone of any sort (few first- time users can resist muttering "Beam me up, Scotty!"). The 130-gram unit is powered by your choice of a replaceable lithium cell or rechargeable battery.

A handset developed by GEC Plessey Telecommunications (GPT) exhibits similar advances, beginning with a number of facilities such as multiple memories and last number redials. A liquid- crystal display identifies the features being used and indicates line or handheld status such as battery level, and can also be used to prompt the user through each stage of a Telepoint call.



The Phonepoint 'Forum' model CT2 cordless phone, produced by Shaye Communications in the UK.

Telepoint was first trialled in the UK by Shaye Communications, which combined the strength and resources of Finnish computer and communications group Nokia with the initiatives of doyen computer entrepreneur Sir Clive Sinclair. Four licences were issued in 1989 to establish public Telepoint networks, and although each began with an individual communications protocol — meaning that the handset of one system could not be used on the Telepoint base of another — the services are now swinging over to a mandatory 'common air interface' (CAI). This means that the same handset can be used in any of the British networks, and also paves the way for the unit to be used in other countries where Telepoint has been established.

Technically, the CT2 standard uses an exclusive slice of the UHF spectrum from 861-865MHz, divided into 40 channels at 100kHz spacing. Handsets are restricted to a 10mW output power with frequency-division multiplexing (FDM) for transmission, using a 'ping-pong' technique adapted from military radio to obtain full duplex communications on a single channel.

The speech is first time-compressed, so that every 2ms is squeezed into a 1ms 'packet'. Having cut the time factor into half, the packets are then cross-fired from alternate ends of the link, re-assembled and stretched into normality. The total data rate is 75kbit/s, divided into two slices of 32kbit/s for each end and a further overhead for the time-division duplexing.

Each Telepoint base station can be configured to allow six simultaneous calls, which in all likeliehood is sufficient for most sites. Where need exists, additional stations can be co- sited to increase this figure to support up to 40 calls at once.

Once a caller is in range of a Telepoint, the handset is switched on and a key pressed to access the station. The base responds by allocating a free channel and automatically 'interrogating' the handset for a set of stored authorisation details. It also requests the user to enter their PIN. Once verified, the user is asked to dial the desired number, which is routed through the conventional public switched telephone network (PSTN). The base station electronically stores the call details including authorisation information, date and time, destination and duration. These are later 'dumped' onto the computer of a central system for pricing and billing.

The UK regulations prohibit Telepoint handsets from 'roaming', seeing this as too great a threat to the established two-carrier cellular network, but this is a limit imposed not by technology but by politics. Telepoint systems can now provide a form of manual roaming, whereby the user logs onto each base as they come within range. This will still have no serious impact on cellular, as the very limited range of each base would require the CT2 user on foot to carry out endless log-on procedures every few minutes in a city hopefully crowded with Telepoint bases. It will however make life easier for those with a more defined, more localised territory.

Cordless phones

UK's Phonepoint

One of the most exemplary Telepoint operations is the UK's 'Phonepoint'. Like most of the licensees the Phonepoint group involves major British and European communications concerns — in this case British Telecom, STC, American telephone operator Nynex, France's Telecom and Germany's Deutsche Bundespost. There is no better illustration than this of the international confidence and expectations of Telepoint. Launched in August 1989, sites are being developed in London and a dozen major cities in UK including Birmingham and Manchester.

By the middle of last year the network had expanded considerably along the heavily-populated south-east to north-west corridor, with an estimated 1000 sites at that time and 4000 within four years, working towards a final target of 36,000. 'Soon', promises the company, 'there will be Phonepoint signs spaced at 500-metre intervals in most High Street areas'. Many stations will be mounted atop conventional BT public payphone boxes, and the consortium has already signed site agreements with the Midland Bank, Nationwide Anglia Building Society, Granada Motorway Services, the Automobile Association and British Rail. However no group can hold sole rights to operate from any site, and combined with the CAI this will ensure that Telepoint base sites develop into a single coherent network.

A similar selection of site providers have been arranged between the UK's other Telepoint licensees. Industry giant Philips heads the BYPS consortium, partnered by Barclays Bank and Shell, thus giving automatic and immediate access to banks and service stations in key locations across the UK. It is not surprising that BYPS, the first system with the CAI, have stated that by the end of 1990 they would have a fully national service in operation.

CT2 has proved a success across the Channel, too. Early resistance to CT2, based on the desire to design a new specification common to all of Europe rather than adopt one perceived as being forced upon them by an industry after the UK market, quickly waned as Telepoint gained strength. France has now trialled their 'Pointel' network through 750 base stations, with a national web almost certain to follow.

The Canadian government has begun consultations with the local communications industry and was also expected to carry out trials in late 1990, while an American company has been formed to establish Telepoint in the USA. Full services will shortly commence in Germany, Spain and Finland and, closer to home, a pilot scheme for New Zealand is being prepared by GPT and Telecom Wellington.

Projected market

The potential market for CT2 and associated developments is tipped to be one of telecommunications' biggest 'little earners', following a study by consultants Arthur D. Little of Geneva. The numbers are staggering: an estimated 14 million users of digital cordless telephones throughout Europe alone will ring up sales in the vicinity of $4 billion, divided between the domestic unit, the cordless PABX and Telepoint systems.

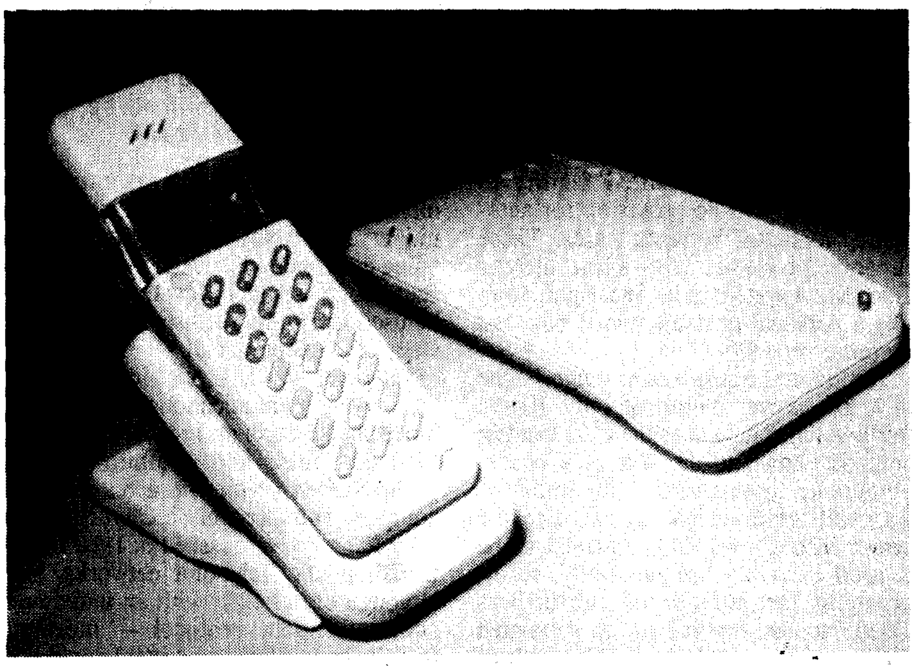
Australia will soon join the ranks of countries providing a Telepoint service, with a report from Government regulatory body Austel recommending that three licences be granted, one each to the holder of the proposed three cellular mobile telephone services — that is, one Telepoint permit for Telecom, and two more for the new entrants into the mobile market. This may be modified in accordance with the Government's decision on competition for the telecommunications market, but there is no doubt that Telepoint, like cellular and VAS, will be a slice of the pie shared by all carriers.

Despite early feelings in Telecom Australia that CT2 should remain part of their monopoly, it later became generally accepted that Telepoint would be offered by a number of networks run by competing service providers. It was more than prudent for Telecom to give some ground in the increasingly liberalised market. CT2 calls still make their way through the PSTN, so the system will in fact increase Telecom revenue — rather like having a thousand new payphones installed at someone else's expense.

"CT2 is an access technology" says Kevin Phillips, National Manager for Telecom Mobile. "It does not bypass the phone network, it is making the phone accessible to more people. Nobody is suggesting that only Telecom operate this service."

The Department of Transport and Communications (DoTaC) had already reserved the relevant CT2 frequencies in a 1989 draft bandplan, and has issued three test permits to date. The first trials were held in Melbourne by Telecom during late 1989. In March of last year, Qantek (the information technology arm of Qantas) held a series of tests at Cairns International Airport. OTC has also been issued with a permit to trial CT2 through two base stations and 20 handsets. "The purpose of the trials will be to evaluate market reaction to Telepoint service and assess the technical performance of CT2 equipment", said a spokesman for OTC.

An influential force behind the future of CT2 in Australia is British Telecom, whose experience with Telepoint in the UK makes it a key player in establishing



GEC Plessey Telecommunications' pocket sized CT2 handset shown together with its 'parking' stand and domestic base station. Features include multiple memories, last number redial and a liquid crystal display.

BT's Australia's Anna Pollard demonstrates the Shaye Communications 'Forum' handheld. She's right alongside a Telepoint base station, but operation is possible within a radius of around 100 metres.

a local network. Through its Australian office, BT partnered Qantek in the Cairns Airport trials, and dismisses claims that CT2 could not compete with cellular.

"The market for mobile telephony is growing at a very fast rate", says BT Australia's Anna Pollard. "Telepoint would provide a service for people who see the advantages of conventional cellular telephones but cannot justify the cost, or require a small pocket-sized phone for the home, office and street. Telepoint offers the customer convenience at a price that is affordable, and is the first step towards personal communications for everyone."

This is a key towards marketing CT2 — that it will quickly lose the likely tag of being a yuppie toy, in the same way that mobile phones moved from the executive limo into the realm of the small business and tradesman. Behind this fall two other provisos — that CT2 handsets and calls be realistically priced, and that there are enough bases spread across the city. The CAI is considered essential, allowing each handset to operate from any base rather than limit users to their own proprietary network. This will reduce the number of sites which each operator must establish, but increase the total number (divided between all licensees) available to the CT2 user.

Promoting CAI

Leading the CAI field is GPT, who demonstrated the first CT2 handset running under the standard interface at the *CeBit 90* Hanover Fair in March. These units will be used in three of the world's largest Telepoint networks — the UK's BYPS, Pointel (France) and the new Finnish CT2 system. GPT sees Telepoint going well beyond present expectations; already there are plans to equip aircraft and even rail transport with credit card-operated base stations, feeding back into the PSTN through additional wireless systems.

Hotels will also offer CT2 facilities to guests, providing communications throughout the building — in any room, conference hall or restaurant in the establishment. Also on the drawing board are plans to integrate a paging receiver into the CT2 handset. The combination of wide-area paging and Telepoint will ensure that messages are received and acted upon in short time.

One of the barriers preventing CT2 from becoming a world-wide or even pan-European standard is that the frequencies used are not readily available in all countries. This is where the third generation or 'CT3' comes into the picture.

CT3 is also known as DECT, the Digital European Cordless Telephone. This standard has been adopted by most EC member nations and is backed by major telecomm suppliers including Philips, Ericsson and Alcatel. The frequencies used fall in the 1.6GHz band, and are now being cleared by each country as they prepare for the introduction of CT3 towards the end of this year.

Although DECT uses much the same philosophy as CT2 it also offers significant improvements. The most important is that DECT invokes full roaming and allows calls to be received from any public base station, thus being a step closer to bridging the gap between cellular and CT systems. While the necessary technology almost doubles the weight of a CT2 handset, twice 150 grams is still lightweight in anyone's measure. The potential for a market the size of Europe will ensure that large-scale manufacturing of DECT units is possible and can keep costs to a minimum — so the handsets are still pocket-size and far more affordable than a cellular phone.

Impressive as they are, CT2 and CT3 are merely the beginnings of a trend towards micro-cellular systems which will eventually see almost everyone wearing a handset no larger than a pack of cigarettes, with a single telephone number which can reach you wherever you may be.

The UK has already issued licences for an advanced Personal Communications Network (PCN), using the same handset through an overlaid grid of mobile 'macro-cells' and micro-cells, connected through radio links rather than cable. Motorola recently unveiled their plan for a web of 'micro satellites' specialising in global telephony. And more than 20 of the world's leading telecommunications companies have combined to develop the UMTS — a Universal Mobile Telecommunications Service which by the year 2000 will pack all the delights of ISDN into a handset.

As a prophet might say, "I've seen the future — and it's cordless!" ■

SPECTRUM

Communications News & Comment

JUMP IN TRANSMITTERS

Figures released by the DoTC show that during 1989-90, the number of transmitters used for broadcasting throughout Australia increased by 285, to a total of 1559.

This includes ABC and commercial radio and TV, SBS TV and public radio services. It also includes 84 transmitters licensed under the SBRS (Self-help Broadcasting Reception Scheme).

HDTV PIONEER WINS IBC AWARD

Takashi Fujio, Director of the Matsushita HDTV Development Centre in Japan, has been awarded the prestigious IBC Award for 1990 for his innovative work over many years in the field of high- definition TV.

The Award was presented at the recent International Broadcasting Convention in Brighton, UK, and was accompanied by a prize of 5000 pounds.

Dr Fujio received his doctoral degree in electrical engineering in 1967 from the University of Tokyo, and worked for NHK (Japan Broadcasting Corporation) from 1954.

He held the position of Director-General of NHK's Broadcasting Science Laboratories upon his retirement in 1986.

He is credited with almost 70 patents and utility models concerning HDTV and television transmission.

POWER BOOST FOR 4RPH

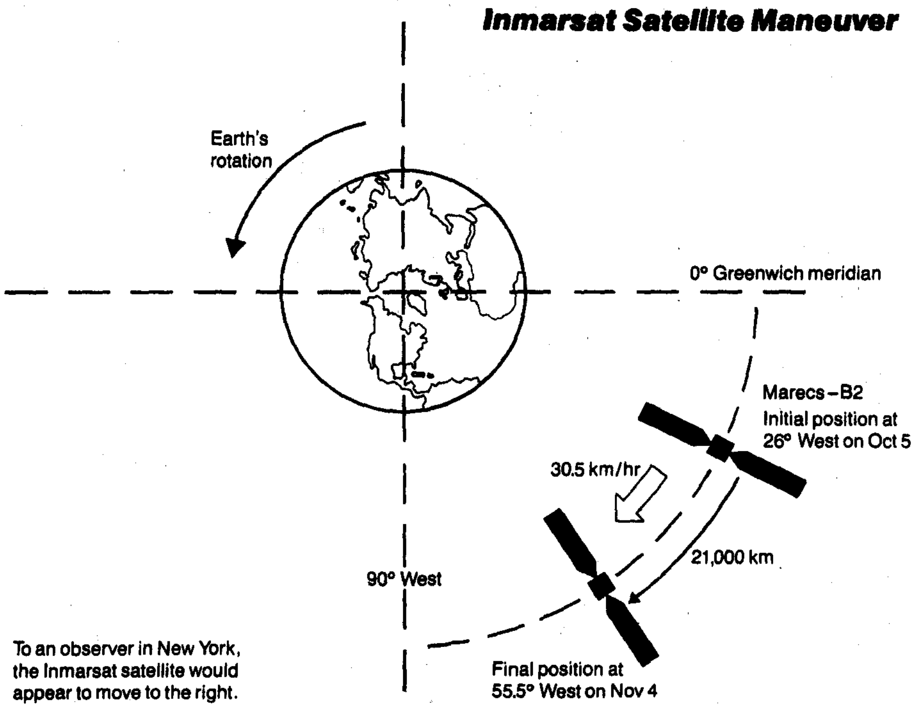
Brisbane's Radio for the Print Handicapped station, 4RPH, has received a boost in transmitting power and shifted to 1296kHz on the AM broadcasting band. It has also changed its callsign to 4WM.

He said the Brisbane station was the second RPH service, in Australia to shift to the broadcasting band.

The first, 3RPH (Melbourne) in August, signalled an honouring of the Government's pledge to license all RPH services under the Broadcasting Act and increase their broadcasting range.

Other RPH stations around Australia are to follow suit over coming months.

Inmarsat Satellite Maneuver



INMARSAT MAKES FOURTH SAT. REGION

A complex space maneouver which sent a satellite on a 21,000 km orbital drift has resulted in improved service for Inmarsat's maritime, aeronautical and land mobile communications users.

The move was to create a fourth satellite communications coverage zone in the global Inmarsat system and, as each zone covers about a third fo the earth's surface, has eliminated a coverage gap which existed over the North American continent and the eastern Pacific Ocean.

It has also improved and extended coverage of Europe and provided double coverage for large areas of the globe. It will also make additional communications capacity available to Inmarsat's rapidly growing number of users.

In effect, Inmarsat has replaced its existing single Atlantic Ocean coverage region (AOR) with two regions by moving one of its AOR satellites, Marecs B2, from 26° west longitude to 55.5° west.

ITU FREQUENCY LIST ON CD-ROM

Taking advantage of new technologies available in the field of information retrieval, the International Telecommunication Union (ITU) is now publishing the International Frequency List (IFL) on CD-ROM. The computer readable edition is an improved version of the existing IFL on microfiches.

The IFL dates back to 1928, when the ITU published for the first time, a list containing alll frequencies used in ITU Member States. It was referred to as the 'Berne List'. Following the decisions of the Atlantic City Conference of 1947 and the Extraordinary Radio Conference of 1951, it changed name and format to become the International Frequency List. The new IFL reflected the realities of the post-war situation in radiocommunications — increased number of radio services, frequencies already used but not previously notified to the ITU, registered frequencies no longer in use... It also reflected a new mechanism established by the Atlantic City Conference: frequencies were no longer merely notified but their notification was examined by a

Board mandated to act as the international custodian of an international public trust and to ensure that they were being used free from harmful interference and in accordance with an internationally agreed Table of Frequency Allocation which had become binding on all Members.

From the first edition of the Berne List to the latest edition of the IFL produced on paper, the number of frequencies increased from 1700 to about 1,100,000, representing an increase in the number of pages from 24 to over 6000! This led the Union to cease the publication of the List on paper and to adopt microfiches as from 1985. The CD-ROM list is yet another step to make this publication more flexible and useful than ever.

The compact disc is used with the CD-Answer information retrieval software delivered on the accompanying diskette and can be accessed by frequency, country code of station location, notifying adnubustration, class of station, station name, geographical coordinates or geographical area and region code. It also enables users to process any extracted subset of the database in local application systems.

The IFL on CD-ROM is the first in a series of optical disc publications in preparation at the ITU. It is planned that all these publications will use the ISO standard optical disc format and the same CD-Answer information retrieval software.

Hardware and software requirements are an IBM PC/XT/AT or 100% compatible with at least 512Kbyte memory and with one 3.5" or 5.25" high density diskette drive, one CD-ROM drive with appropriate controller and interface cable from Hitachi, Sony, Philips or any other CD-ROM drive with High Sierra or ISO 9660 compatible device driver. The operating system is MS DOS version 3.0 or higher.

Further information is available from the ITU General Secretariat, Sales Service, Place des Nations, CH-1211 Geneva 20, Switzerland.

FINLAND CHOOSES ORBITEL CT2

Orbitel Mobile Communications of the UK has won an order for the first digital cordless (CT2) telephones to be supplied to Telecom Finland.

The orders are for the Orbitel range of CT2 digital cordless telephones which can be used in the home, the office and on the telepoint network planned for Finland. These products will be launched in the UK an Germany this year and are also supplied to Televerket in Sweden. The equipment will conform to a enw interim European telecommunications standard (I-ETS).

According to Orbitel's marketing director, Richard Mendelsohn: "We see Finland as a key market for digital cordless telephones. We are delighted that our CT2 productions have been selected by Telecom Finland, and are confident that this will lead to further international orders."

"Orbitel forecasts that there will be 10 million CT2 subscribers in Europe by 1995, with annual equipment sales in the region of 400 million at end-user prices."

AUSSAT PROVES TELEMETRY RX'S

Satellite telemetry receiver equipment bought by Aussat to monitor and control the launch and operation of tis B series satellites in 1991 and 1992 has already been installed and proven itself during the recent launch of the second British Satellite Broadcasting (BSB 2) spacecraft. The receiver used in the BSB 2 launch support mission was one of eight purchased from Scientific-Atlanta under a $500,000 contract.

Graham Brown, Aussat's manager of satellite operations said, "Our engineers took advantage of the early arrival of two of the receivers to run tests on one of them alongside our existing equipment, and the results were spectacular."

"The receiver performed so well in the mission role we feel very confident that it and the other new receivers on order will perform extremely well in the Aussat B missions."

NYNEX SETS UP IN AUSTRALIA

Nynex Corporation of New York has formed a new subsidiary in Sydney, to consolidate and extend its Australian operations, and has appointed American Ms Ruth Zisko to run it.

As managing director of NYNEX Australia, Ms Zisko will be responsible for the development of major new business opportunities, including a potential bid for a second national carrier licence.

Nynex already plays a major role in Australia where its BIS Group employs 150 people in a range of marketing, information, software and related services. Other existing Nynex operations include marketing consultancy services for Telecom and the development of specialised port and customs services by Lamarian Systems.

Before taking up her Australian appointment, Ms Zisko was vice-president of the Nynex mobile telecommunications division of New York and headed its international business unit. Previously Ms. Zisko was director of sales, distribution and marketing for Nynex Mobile Telecommunications in the New York metropolitan market.

HONG KONG'S TRUNKED MOBILES

Hong Kong's new Mobile One system is now claimed to represent a major breakthrough in mobile radio communications for the Territory.

The service began in December 1989 and now has Territory wide coverage, thanks to the addition of a radio site on Mount Kellett, which extends the network to the south side of Hong Kong Island.

The very first Hong Kong territory-wide public trunk mobile radio service, it

was inaugurated by Legislative Councillor, the Hon Andrew Wong Wang-fat.

Mobile One Ltd, a joint venture of Philips Hong Kong and Hong Kong Telecom CSL, now covers the whole of the territory through an extensive network of radio sites.

Advanced Intersite Call Technology provides fast and wide area site-to-site communication without operator intervention or complicated manual steps. At a press of a button, users can enjoy fast call connections and clear communications in privacy.

"Within a short span of time, Mobile One has already gained the support of a diverse range of business in Hong Kong. The fact that if offers a timely solution for more efficient and flexible vehicle fleet management for local companies is the main reason for its success." said Mr Wong, who is also a member of the OMELCO Standing Panel on Transport. ■

FREE PACK & POST ON ALL ORDERS OVER $25.00 IN JANUARY. EXPIRES MIDNIGHT 31-01-91.
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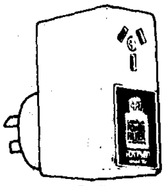


CPF CONTINUOUS POWER FILTER SPIKE ARRESTOR

The Fortron CPF Filtered Electronic Spike Protector provides a protective electronic barrier for microcomputers, printers, telephone systems and modems electronic typewriters, audio and stereo systems and other sensitive electronic equipment.

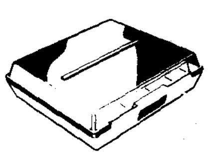
The CPF provides protection from dangerous electrical spikes that can cause anything from obvious damage (like immediate equipment failure) to less obvious harm that can drastically shorten a system's life.

CPF's superior circuitry design and semi conductor technology responds instantly to any potentially damaging over-voltage, ensuring safe trouble free operation.

Additionally, CPF's filtering capability helps eliminate troublesome and annoying interference, general hash created by small motors, fluorescent lamps, and the like that threaten the performance and shorten equipment life of unprotected electronic components.

SPECIFICATIONS:
Electrical rating: 220-260 volts (AC) 50Hz 10 Amp
Spike/RFI Protection: 4,500 amps for 20m/second pulses.
Maximum clamping voltage: 275V differential mode.

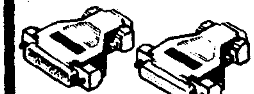
Cat.X10088 .... **$69.95**



ENCLOSED PRINTER STAND

- Keeps your paper and print-outs neat and orderly
- Transparent cover makes it easy to check on paper supply
- Paper can be fed from the centre or the rear according to the design of the printer
- Removable drawer which allows paper to be changed without moving the printer
- Retractable rear basket makes print-out collection fast and convenient
- Suitable for most printers

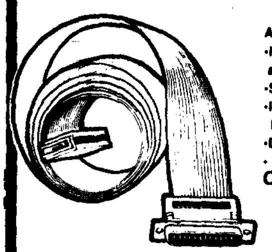
$69.95



9 PIN TO 25 PIN CONNECTOR ADAPTORS

NEW! The ideal solution! Features gold plated pins

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



5¼" FLOPPY DISK DRIVE EXTENSION CABLE

- IBM* compatible
- DB37 Male to 34 way edge connector
- Length 0.5 metres

P19045 .... **$99.95**

3½" FLOPPY DISK DRIVE EXTENSION CABLE

- IBM* compatible
- DB37 Male to 34 IDC connector
- Length 0.5 metres

P19046 .... **$99.95**

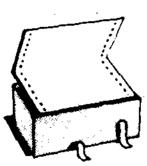
☆☆☆☆☆

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 .... **$99.95**



COMPUTER PAPER

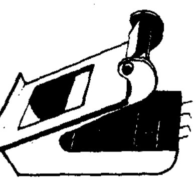
Quality paper at a low price! 2,000 sheets of 70 gsm bond paper.

Cat. C21003 11 x 9½" ... **$41.00**
Cat. C21005 15 x 11" ... **$67.95**

KEYBOARD EXTENSION LEAD

5 Pin Din plug and socket

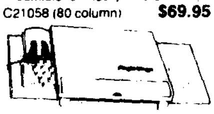
P19038.................. **$9.95**



DELUXE PRINTER STAND

- Restores order to your work area without occupying extra space
- Feeds and refolds paper under the printer automatically
- Adjustable paper deflectors ensure smooth flow of paper
- Made of moulded plastic
- Suitable for most printers

C21058 (80 column) **$69.95**



MAGIC STAGE

A working bench for your Mouse.
- **High quality ABS plastic and anti-static rubberised top**
- **Stationary holder**
- **Includes pull-out shelf for Mouse**
- **Dimensions: 280 x 260 x 25mm**
- **Fits over keyboard**

C21080............ **$15.95**

SURGE BUSTER

6 PROTECTED POWER OUTLETS
Ideal for protecting personal computers, video equipment, colour TVs, amplifiers, tuners, graphic equalisers, CD players etc

SPECIFICATIONS:
- Electrical rating: 240V AC, 50Hz, 10A
- 3 x Metal Oxide Varistors (MOV)
- Maximum clamping Voltage: each MOV: 710 volts at 50 amps
- Response time: Less than 25 Nanoseconds.

X10086.................. **$69.95**

THE BUTTON SPIKE PROTECTOR

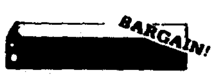
Surges and spikes are caused not only by lightning strikes and load switching but also by other equipment being switched on and off, such as fluorescent lights, electric motors, fridge freezers, air conditioners, etc.

For effective protection such spikes must be stopped before they reach your equipment. Simply plug The Button into an outlet and it will protect all equipment plugged into adjacent outlets on the same branch circuit. The Button employs unique metal oxide varistor technology and will dissipate 150 joules of electrical energy. (nearly twice that of comparable surge arresters.)

SPECIFICATIONS:
Voltage: 240V Nominal
Total Energy Rating: 150 joules
Response Time: 10ns
Protection Level: 350V peak

.... **$36.95**

RIBBONS



PRINTER RIBBONS TO SUIT:

- CP80, SX80, DP80, BX100, BX100, MB100

	1-9	10+
C22036	$19.95	$17.95

- MX80, FX80, RX80, FX800, MX70, MX80, LX800

	1-9	10+
C22031	$16.95	$15.25

- MX100, FX100, RX100, LQ1000

	1-9	10+
C22002	$19.95	$17.95

- LX80

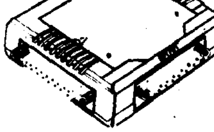
	1-9	10+
C22003	$12.95	$11.95

- C ITOH 8510-1550

	1-9	10+
C22051	$13.95	$12.50

NATIONAL PANASONIC KXM110 PRINTER RIBBON

C22034................. **$19.95**



POCKET AUTO AB SWITCHES

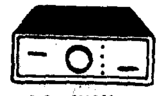
- Pocket size, auto-scanning
- Allows 2 PCs to share one Printer

Serial model:
MS-201 - Host-powered
X19150................. **$79.95**
Parellel model: MP-201
Protocol transparent
X19155................. **$89.95**

RIPPER STRIPPER

Remove ugly paper feed edges quickly and cleanly with this simple little gadget

C21085................. **$14.95**



2 & 4 WAY RS232 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

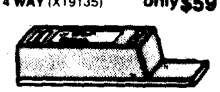
2 WAY Cat.X19120 only **$39**
4 WAY Cat.X19125 only **$49**

2 & 4 WAY CENTRONICS DATA TRANSFER SWITCHES

Save time and hassles of constantly changing cables and leads around with these inexpensive data transfer switches. These data switches support the 36 pin centronic interface used by Centronics, Printronics, Data Products, Epson, Micronics, Star, and many other printer manufacturers.

- 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
- Bale locks are standard

2 WAY (X19130) only **$49**
4 WAY (X19135) only **$59**



UV EPROM ERASER

Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less time for less chips)
- **Chip drawer has conductive foam pad**
- **Mains powered**
- **High UV intensity at chip surface ensures EPROMs are thoroughly erased**

Without timer
X14950.................. **$129**
With built-in timer
X14955.................. **$159**

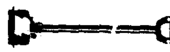
DUST COVERS

DUST COVER

Keep your computer and accessories free of dust and grime while not in use

XT* Cover Set
C21066................. **$14.95**
AT* Cover Set
C21068................. **$16.95**

LEADS

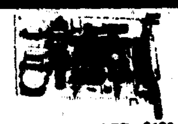


PRINTER LEAD

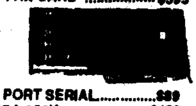
- **Suits IBM* PC/XT, compatibles**
- **25 pin "D" plug (computer end) to Centronics 36 pin plug**

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

IBM* CARDS

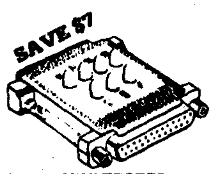


XT HD CONTROLLER	$129
AT HD CONTROLLER	$199
RS232/ SERIAL/ CLOCK	$59
MONO/ COLOUR CARD	$96
MULTI I/O	$99
512K RAM	$59
DIAGNOSTIC	$849
TTL/ PRINTER	$89
RAM 2M AT EXT/EXP	$225
8M AT EXT/EXP	$325
FAX CARD	$595



4 PORT SERIAL	$89
VGA 256K	$199
VGA 512K	$299
VGA 1MEG	$495

VOICE MAIL	$245
PRINTER CARD	$35
EGA CARD	$139
2 WAY FDD CONT. (360K)	$49
RS232 SERIAL/ CARD	$49
GAMES	$29
AT S/P GAMES	$35
4 WAY FDD CONT. (360-1.44M)	$129
2 WAY FDD CONT. (360-1.44M)	$80
CLOCK CARD	$49
SMART DRIVE ADAPTER IDE/FDC	$99
SMART DRIVE ADAPTER IDE I/O /FDC	$119

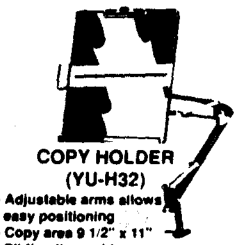


RS232 MINI TESTER

- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

T.D. Transmit Data
D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
R.T.S. Request to Send
D.T.R. Data Terminal Ready
C.T.S. Clear to Send

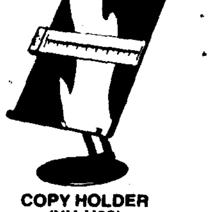
Cat. X15656 .... Normally $39.95
SPECIAL, ONLY $32.95



COPY HOLDER (YU-H32)

- **Adjustable arms allows easy positioning**
- **Copy area 9 1/2" x 11"**
- **Sliding line guide**
- **Clamp mounting**

C21062........... **$39.95**



COPY HOLDER (YU-H33)

- Copy area 9½" x 11"
- Sliding line guide
- Flat metal base

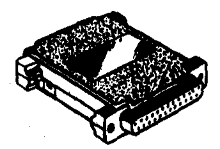
C21060 .... **$39.95**

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



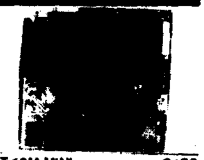
RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

Cat. X15650 **Male to Male**
Cat. X15651 **Male to Female**
Cat. X15652 **Female to Female**

Normally $14.95 each
Only $8.95

MOTHERBOARDS



XT 10M MINI	$120
XT 31M	$199
XT 12M STD. SIZE	$199
SUNTEC AT 12M	$375
80386-25... W/CACHE	$2,695
80386- 33... W/CACHE	$2,995

ROD IRVING ELECTRONICS

SYDNEY: 74 Parramatta Rd. Stanmore. 2048.
Phone (02) 519 3134
Fax (02) 519 3868

MELBOURNE: 48 A'Beckett St.
Phone (03) 663 6151

NORTHCOTE: 425 High St.
Phone (03) 489 8866

CLAYTON: 56 Renver Rd.
Phone (03) 543 7877

MAIL ORDER & CORRESPONDENCE:
P.O. Box 620, CLAYTON 3168
Order Hotline: 008 33 5757
(Toll free, strictly orders only)
Inquiries: (03) 543 7877
Telex: AA 151938
Fax: (03) 543 2648

MELBOURNE DEALERS

MICRODOT
177 SPRINGVALE ROAD
NUNAWADING. Ph.894 1255

GREENSBOROUGH COMPUTERS
67 GRIMSHAW ST
(cnr Howard st) Ph: 434 6166

BRISBANE DEALER

VRC COMPUTER SERVICE
647 LUTWYCHE RD
LUTWYCHE, 4030

ADELAIDE DEALER

MICROTRONICS
306 MORPHETT ST
ADELAIDE, 5000

All sales tax exempt orders and wholesale inquiries to:
RITRONICS WHOLESALE.
56 Renver Road, Clayton.
Phone: (03) 543 2166 (3 lines)
Fax: (03) 543 2648

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MasterCard VISA

FREE PACK & POST ON ALL ORDERS OVER $25.00 IN JANUARY. EXPIRES MIDNIGHT 31-01-91

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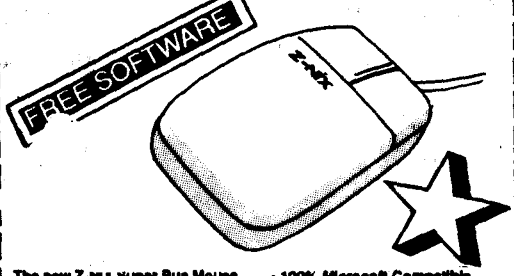
FREE PACK & POST ON ALL ORDERS OVER $25.00 IN JANUARY. EXPIRES MIDNIGHT 31-01-91.

SUPER BUS MOUSE 2



The new Z-NIX super Bus Mouse 2 allows you to get the most out of your computer and enhance your productivity. It gives you the ability to expand the versitility of your computer through the use of graphic software such as paint, draw and CAD programs. The Super Mouse 2 allows you to run programs like GEM and Windows which makes all operations of the computer easier and faster. Many popular Spreadsheets, databases, word processors and other programs can also be worked with the Super Mouse 2.

- 100% Microsoft Compatible
- IBM or APPLE Family Computer Compatible.
- Free Software with Pop-up Menus.
- Life time Warranty.

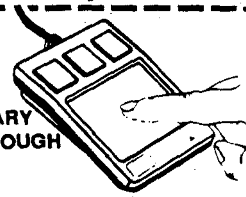
Also supplied with the Super Bus Mouse are two FREE Telepaint disks which allows the user to perform high resolution graphics with the mouse.Great Value!

X19951........................$119

HURRY! THIS OFFER CAN'T LAST

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.

FREE SOTWARE INCLUDED!
- MOUSE DRIVER
- TEST PROGRAM
- DEMO PROGRAM
- HIGH LEVEL LANGUAGE INTERFACE ROUTINE: Microsoft C, Microsoft Fortran, Quick Basic, Turbo C Pascal ...etc.
- POP-UP MENU

DR. HALO III GRAPHICS SOFTWARE

X19960..$149.00

MICE

FREE MOUSE HOUSE & MOUSE MAT $20 VALUE

INCREDIBLY POPULAR

QUICK MOUSE
...OFT COMPATIBLE! ...and auto- ... system ... mode and ... mouse mode
- Microsoft Serial Mouse ... 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................. $79.95

EVER POPULAR LOW BUDGET

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......... $39.95

BARGAIN

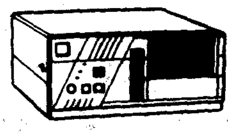
FREE........CATALOGUE NOW AVAILABLE

MAIL ORDER HOTLINE 008 33 5757....TOLL FREE

MOTHERBOARDS

BARGAIN

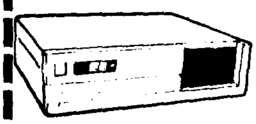
COMPUTER CASES



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



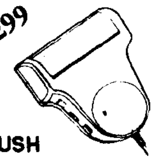
IBM* XT COMPATIBLE CASE WITH AT* STYLING

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

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

BARGAIN

HS - 3000 HANDY SCANNER



INCLUDES *FREE SOFTWARE!* PC PAINTBRUSH & IMAGE TOOL

- WIDE 4.13" (105mm) scan width
- 100/200/300/400 switchable DPI resolution.

Four encoded modes: B/W and three half tone patterns.
- Thrity-two shades of grey.
- Built-in scanner view window for accurate scanner placement.

X19945..................................$299

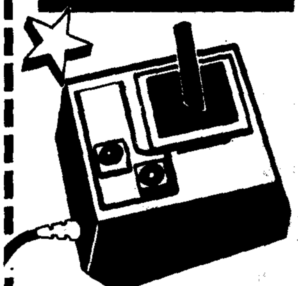
THE CHEAPEST XT TURBO MOTHERBOARD IN THE SOLAR SYSTEM

This mighty little XT motherboard has 8 expansion slotsand uses 5 low cost RAM chips to provide a full 640K memory.
The ASIC chip well known for its reliability is also used.
The CPU is a state- of the art NEC V20 running at 4.7/ 10 MHz (switchable) with zero wait states.
Size is just 208 X 161mm.
"GOOD THINGS COME IN SMALL PACKAGES"

MEMORY SIZE	D RAM	$99
128K bytes	424256 x 1	
256K bytes	424256 x 2	
384K bytes	424256 x 3	
512K bytes	424256 x 4 or 421000 x 4	
640K bytes	424256 x 5 or 421000 x 4 + 424256 x 1	

CAT X18037

JOYSTICKS



JOYSTICK FOR IBM*

Features selectable "spring centring" or "free floating". Electrical trim adjustments on both axis. 360 degree cursor control

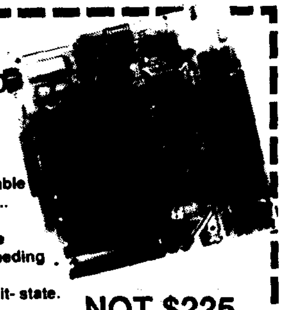
C14205.................$49.95

APPLE* COMPATIBLE JOYSTICK

Ideal for games or word processing. Fits most 6502 "compatible" computers.

C14200................ $29.95

THE FASTEST XT TURBO 31MHz XT MOTHERBOARD



We are offering to you the FASTEST XT on this Planet. It features 31MHz compared to 4.77MHz on the standard XT.
The board is fully XT compatible and runs with all standard XT cards. Speed is switchable between standard 4.77MHz and turbo speed..
Up to 1 MB of RAM can be fitted on board.
For even faster operation the memory above 640K can be used as "shadow" RAM for speeding up BIOS operations or as a RAM disk.
The board provides software selection of wait- state.

X18036...$199

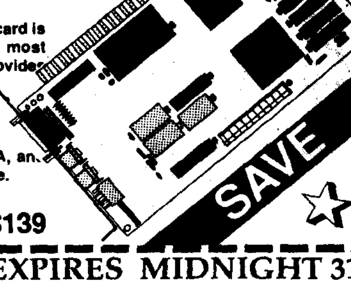
NOT $225

PERFORMANCE INDEX NORTON'S SI, V- 4.0

	1	2	3	4	5	6	7	8	9	10	11
X18036											
IBM XT											
IBM PS2 MODEL 30											
10 MHz XT											
IBM AT											

MAIL ORDER HOTLINE 008 33 5757....TOLL FREE

CHEAPEST EGA CARD IN THE WORLD!



For quality and a great price this EGA video card is the cheapest in the world. Using the most advanced paradise chip technology, it provides reliability and maximum performance.
FEATURES INCLUDE:
Full compatibility with XT, AT, 386
Full 256K display memory
Completely backward comp. with CGA, MDA, and Hercules with intelligent switching software.
480 line extended EGA mode.

ONLY...... $139

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"NEW"
AUTOMATIC TELEPHONE ANSWER/ CALL CARD

TURN YOUR IBM* PC, XT, AT INTO A FULLY FUNCTIONAL ANSWERING MACHINE!!!

- A Sophisticated Voice coil mail system
- Auto answering / Dialing
- 100 voice mail boxes
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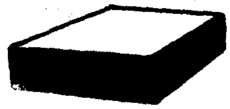
- Message mailing
- Auto redialing
- Beeperless remote control
- Toll saver
- Call screening
- Electronic phone book
- Works in background
- Menu driven software
- Simple and concise operation

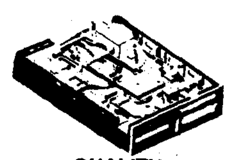
Traditional telephone answering machines are obsolete with the release of the NEW Voice Mail Card.
Not only can this card turn your computer into a 24 hour personal receptionist, but can answer with different phone messages for particular callers.

X19084............ONLY $245



APPLE* COMPATIBLE SLIMLINE DISK DRIVE
Compatible with Apple 2+
Cat. X19901 . Only $179
FREE PACK OF S/S DISKS WITH EACH DRIVE!

APPLE* IIC COMPATIBLE DISK DRIVE
(including cable ..... only $189
FREE PACK OF S/S DISKS WITH EACH DRIVE!
(*Apple is a registered trade mark)



QUALITY JAPANESE DRIVES!!

5¼" 360K DRIVE
- 500K unformatted.
- IBM* XT* compatible

Cat.C11901 .... $175

5 1/4' 1.2 M/BYTE COPAL DRIVE
- 1.6 M/Byte unformatted
- IBM* AT* compatible

C11906................$195

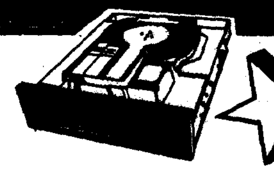
3½" 1.44 M/BYTE DRIVE
- Switchable 1.44 M/Byte formatted or 720K formatted
- Double sided, double density
- Power supply adaptor provided
- 5¼" mounted

Cat. C11911 .... $195

CONTROLLER CARD TO SUIT
X18009 .... $139

FREE CATALOGUE WITHEVERY MAIL ORDER!

$ SAVE SAVE SAVE $
HARD DISK SCOOP PURCHASE



TOP BRAND WESTERN DIGITAL

20 MEG HARD DISK WITHOUT CONTROLLER.............. $399

20 MEG HARD DISK WITH CONTROLLER $499

40 MEG HARD DISK
28ms ACCESS WITH IDE/FDD CONTROLLER............ $495

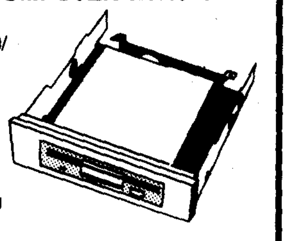
80 MEG HARD DISK
28 ms ACCESS WITH IDE/FDD CONTROLLER.......... $895

UPGRADE YOUR COMPUTER WITH A 3 1/2" DRIVE KIT

Y.E DATA 3.5" 1.44/ 720/ 360 DRIVE

- 5 1/4" Mounting bracket
- Power supply adapter
- Floppy Disk controller card which controls 1.44/ 720/ 360/ drives
- Cable adapter

Complete instructions to install a 3.5" drive in your existing computer. Enjoy the higher density and easy handling of 3.5" Floppy diskettes.

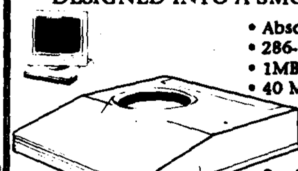


C11915...... $295

STOP PRESS !!!

SIMPLY BEAUTIFUL TECHNOLOGY!
INTRODUCING THE ELEGANT & COMPACT RITRON EXECUTIVE BASE STATION.

BUILT-IN FUNCTIONALITY & FLEXIBILITY DESIGNED INTO A SMOOTH COMPACT CASE

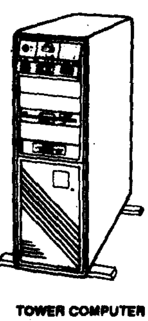


- Absolute IBM compatability
- 286-12 MHz 0 WAIT
- 1MB RAM
- 40 MB Hard Disk/Cont.
- VGA Card
- 2 x Serial/Parralel/games ports
- Real Time Clock/Calander
- Dynamic Speed Control provides Turbo Speeds
- Keyboard speed select
- Small Footprint 304 x 330mm

At home, on your desk or in the network, the Base Station is today's reliable and stunningly beautiful computer solution.

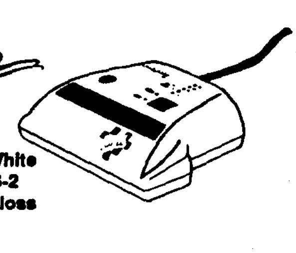
X20090........................(requires monitor)........ $1,995

NEW FREE CATALOGUE OUT NOW!



TOWER COMPUTER CASES..............$249
POWER SUPPLY TO SUIT(220W).......$225

COLOUR YOUR WORLD WITH THE GeniScan



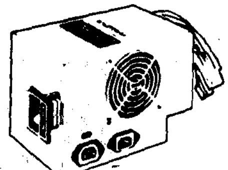
COLOUR SCANNER
The GS-C105 Colour scanner scans any colour or Black & White image into your IBM PC AT, PS-2 or compatible system without loss of hue.

FREE SOFTWARE!
The powerful Colour Maestro allows you to scan an image and then do colour editing in colours you can create yourself! You can draw different shapes, modify objects, alter colours and edit a palette of 256 colours by using the commands on your pop-up menus. You can even design your own font type size.

SPECIFICATIONS:
- 105mm scan width, multi-scan up to 300mm
- 100-400 DPI selecable in steps of 10 DPI for 2,8, & 16 colours
- 64 shade levels
- Scanning speed: 3.5 ms/line

....$995

POWER SUPPLIES



150W SWITCH MODE POWER SUPPLY FOR IBM* PC/ XT* & COMPATIBLES
DC OUTPUT:
+5 13A -5V 0.5A
+12V 4.5 - 12V 0.5A
X11096 .... NOW $99

200W SWITCH MODE POWER SUPPLY FOR IBM* AT* & COMPATIBLES
DC OUTPUT:
+5 16A, -5V 0.5A
+12V 5A -12V 0.5A
X11097 .... $199

180W AT*....................$169
200W XT*....................$169
180W UPS....................$449
230W UPS....................$499

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RITRON EXECUTIVE COMPUTER SYSTEMS

TOP QUALITY, GREAT VALUE

CHEAP 40M HARD DISK SYSTEMS

40 MEG AT.
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- MINI CASE & P.S
- M RAM • G7 CARD
- 101 KEYBOARD
- IDE/ FDC CARD
- 40M HD/ 28MS
- 12 MB • 1.2M FFD

monitor extra **$1,149**

EGA 40 MEG AT
- 16 MHZ LANDMARK
- MINI CASE & P.S
- 1.2M FDD • 1M RAM
- 101 KEYBOARD
- IDE/FDC CARD • 12M MB
- EGA CARD
- 40M HD/ 28MS

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VGA 40 MEG AT
- 16 MHZ LANDMARK
- MINI CASE &P.S • 1M RAM
- 40M HD / 28MS • 12M MB
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- IDE/ FDC CARD
- VGA 256K CARD
- 1.2 FDD

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20 MEG XT
- MINI CASE • 20 MEG HD
- 101 KEYBOARD
- FDC / HD CARD • 360K FFD
- 640K RAM • G 7 CARD

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- MINI CASE & P.S • 12M MB
- 101 KEYBOARD • 1 M RAM
- FDC/ HD CARD • 1.2M FFD
- EGA CARD • 20 M HD

$1,159 monitor extra

20 MEG AT
- MINI CASE & P.S • 1 M RAM
- 101 KEYBOARD • 20M HD
- FDC/ HD CARD • 12M MB
- G 7 CARD • 1.2 M FFD

$975 monitor extra

VGA 20 MEG AT
- MINI CASE & P.S • 12M MB
- 101 KEYBOARD • 1 M RAM
- FDC/ HD CARD • 1.2M FFD
- VGA 256 CARD • 20 M HD

$1,179 monitor extra

SUPER SPECIAL!!!

PRICE BREAKTHROUGH ! OKILASER PRINTER

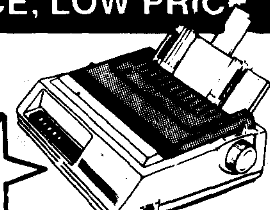
ONLY...$1695 (inc. tax)

Introducing the new generation in page printers, the OKILASER 400.
The affordable LED page printer designed for the small business.
Reliable and compact, the OKILASER 400 fits neatlt into the smallest of offices.
Highly reliable due to the latest LED imaging technology, the OKILASER 400 offers excellent print quality, superior paper handling, and a variety of fonts which revival some of the more expensive laser printer on the market.

SPECIFICATIONS OL400:
Printing speed: 4 pages p.m
Resolution: 300 x 300 DPI
Emulation: HP laserjet series II
Data Buffer: 512K byte (standard)
1 M/B expansion (option)
2 M/B expansion (option)
Max. 2.5M/B
Interface: Centronics Parallel or RS232 Serial
Resident fonts: 25 various
Standard paper input: 200 sheets
Standard paper output: 200 sheets face up
100 sheets

HIGH PERFORMACE, LOW PRICE

24 PIN MICROLINE 380



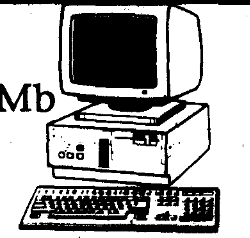
The Microline 380 is the perfect letter quality printer, ideal for the small business or home.
It's size allows it to fit on the smallest desk in the smallest of offices. The microline 380 is a 24 pin dot matrix which is fast and reliable with a MTBF of 4000 hours and a printhead life of 12000 hours.
Combine this with the high quality of print and you've got a printer that will work with you for many years to come.

SPECIFICATIONS:

Technology, Speed and Print Characteristics.
Print Method: 24-pin (20 mm diameter) Impact Dot Matrix
Graphics Resolution: 90 x 72 dpi minimum, 180 x 360 dpi maximum
Feed rate : 2.2 ips
Character Sets: Standard ASCII, Epson Charater Set, IBM Set I and II, Foreign Language sets, Zero/Slashed Zero
Vertical Line Spacing: Fixed 6 lpi, 8 lpi; Veraible n/60", n/180"
Print Direction: Bidirectional, short line seeking
Letter Quality: 60 CPS 30 x 18 @ 12 cpi
Utility: 180 CPS 9 x 17 @ 12 cpi
Print features:
3 L Q Resident Fonts
Emphasized Enhanced
Italics
Double height Double Width
Continuous Underlining
Super/Subscipt Outline/Shadow
Reliability:
MTBF:4000 hours (25% duty cycle 35% page density)
MTTR: 15 minutes
Printhead life: 12000 hours (25% duty cycle 35% page density)
Printhead Life : 200,000,000 characters avg in 10 cpi draft mode @ normal 25% duty 35% page density (user replacable)
Net weight: 7.7 kg (17lbs)
Power consumtion: Operating 86 VA, Idle 22 VA
Size : 15.7" (w) x 13.6" (d) x 4.7 (h) [39.8cm (w) x 34.5 cm (d) x 12.0 cm(h)

.... **$495**

ROD IRVING'S SPECIAL VGA 40Mb PACKAGE !



- 80286- 12 MOTHERBOARD (Extremely reliable Japanese Suntec Technology)
- 16 MHZ LANDMARK SPEED TEST
- EXPANDABLE TO 8 MEG OF RAM ON BOARD
- EMS LIM 4.00 SUPPORTED (Essential for Desktop Publishing)
- FREE DOS 4.01
- 2 MEG RAM
- SERIAL, PARELL AND GAMES PORTS.
- 1.2M FDD 5 1/4" JAPANESE DRIVE
- HIGH QUALITY 101 KEY KEYBOARD
- VGA CARD
- VGA COLOUR MONITOR
- IDE INTERFACE AND FDD CONTROLLER CARD (The new standard)
- 40M 28MS HARD DISK DRIVE (Western Digital)

ALL THIS FOR ONLY $1,795

"OPTIONAL EXTRA'S FOR THIS PACKAGE !"
- 1.4M FDD 3 1/2" JAPANESE DRIVE ADD $195
- 9 PIN DOT MATRIX PRINTER ADD $289
- 24 PIN DOT MATRIX PRINTER (OKI) ADD $525
- OKI LASER PRINTER ADD $1695

***** REMEMBER
THAT WE HAVE BEEN IN THE ELECTRONICS BUSINESS SINCE 1977...
WE HAVE GROWN UP WITH PERSONAL COMPUTERS *****
WE ARE ALSO 100% AUSTRALIAN OWNED AND MANAGED
- WE THOROUGHLY SERVICE OUR OWN PRODUCTS AND DON'T LEAVE THE PROBLEMS FOR ANOTHER COMPANY.
- ALL SYSTEMS ARE ASSEMBLED AND TESTED IN AUSTRALIA.

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FREE ON/SITE WARRANTY FOR 12 MONTHS (within a 50km radius of our Melbourne service center)

FREE TELEPHONE HELP AND INFORMATION LINE 9am- 5pm - From our "Technical Service Manager" Valid for 12 months after date of purchase.

FREE 5% V.I.P CUSTOMER DISCOUNT VOUCHER (valid for 12 months after date of purchase of all systems valued over $2,000)

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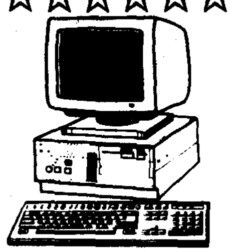
RITRON EXECUTIVE 386-25



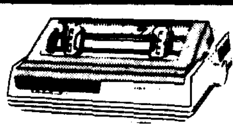
$2,795

Incl. sales tax & 12 months warranty

- 80386-25 CPU
- 1MB RAM
- 1.2 MB Floppy Disk Drive
- 40 MB Hard Disk Drive.
- 12 Month Warranty
- VGA Colour monitor (1024 x 768)
- 101 Key Keyboard • MS DOS 4.01

MICROLINE 172

CAT. No. S15210 • 180 CPS PRINTER • NLQ30 CPS



AUSTRALIA'S CHEAPEST PRINTER only $269

Finally, a Dot Matrix printer for under $300. But don't let the price fool you. The Microline 172 offers you the perfect combination of performance and advanced engineering at a price which is extremely economical. The Microline 172 has everything you'd expect in a quality printer, advanced paper handling, speed and print versitility. The Microline 172 is ideal for the small business or home office being compact, reliable and having the speed to meet your needs.
And you won't find it cheaper than at Rod Irving Electronics.

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

LOOK! FREE PACK AND POST FOR ORDERS OVER $25 OFFER EXPIRES MIDNIGHT JANUARY 31 1991.

PRECISION

	1-9 Boxes	10+
3 1/2"DD	$19.95	$18.95
3 1/2"HD	$39.95	$37.95
5 1/4"DD	$9.95	$8.95
5 1/4"HD	$19.95	$17.95

MEMOREX

	1-9 Boxes	10+
3 1/2"DD	$19.95	$18.95
3 1/2"HD	$45.95	$42.95
5 1/4"DD	$14.95	$12.95
5 1/2"HD	$23.95	$22.95

LIFETIME WARRANTY

"NO BRAND"

BOXES OF 10 DISKS LIFETIME WARRANTY

	1-9	10+	50+	100+	500+
5 1/4"DS/DD	$4.95	$4.80	$4.70	$4.60	$4.40
5 1/4"DS/HD	$10.50	$9.95	$9.50	$9.25	$8.75
3 1/2"DS/DD	$9.75	$9.50	$9.25	$9.00	$8.50
3 1/2"DS/HD	$19.00	$18.75	$18.50	$18.00	$17.90

SAVE ON NO BRAND

All Verbatim disks are preformated Please ask for IBM or APPLE format.

DYSAN

	1-9 Boxes	10+
3 1/2"DD	$22.95	$21.95
3 1/2"HD	$39.95	$37.95
5 1/4"DD	$19.95	$18.95
5 1/4"HD	$31.95	$29.95

XIDEX

	1-9 Boxes	10+
3 1/2"DD	$29.95	$27.95
3 1/2"HD	$49.95	$47.95
5 1/4"DD	$19.95	$17.95
5 1/4"HD	$29.95	$27.95

VERBATIM

	1-9 Boxes	10+
3 1/2"DD	$28.50	$27.95
3 1/2"HD	$53.50	$52.50
5 1/4"DD	$22.95	$21.95
5 1/4"HD	$24.95	$23.95

TDK

	1-9 Boxes	10+
3 1/2"DD	$39.95	$37.95
3 1/2"HD	$69.95	$67.95
5 1/4"DD	$19.95	$18.95
5 1/4"HD	$39.95	$37.95

ALL PRICES PER PKT/BOX OF TEN

AUSTRALIA'S BEST PRINTER PRICES!

SAVE $400

"8 PAGES PER MINUTE!" OKILASER 800

Fast, accurate and reliable! Just three ways to discribe the Okilaser 800. High quality printing, sturdy construction and compact design in one printer. Reliablity is a major feature of the Okilaser 800. By using its intergrated light emitting diode (LED) technology-which uses no photo-optical moving parts -reliablity and accuracy are greatly increased and servicing is made easier. Unlike most laser printers, the OL800 uses a separate light sorce for each image dot on a printed page. This produces razor sharp images, even for complex graphic shapes and fine lines.

This quiet printer is powerful enough to be shared by several users. Printing text or full page graphics, it gives you the power to produce the very best printed output on all medium and heavy printing tasks. A range of paper cassettes are available for all popular paper sizes plus additional font cards to augment the range of printer reasident fonts.

SPECIFICATIONS:

Printer Type:
LED laser printer
Printing speed: 8 page/minute
Warm up time: 48 seconds
Resolution: Max 300 x 300 dots/inch
Automatic paper feed
Standard: 200 sheets
Option: a futher 200 sheets
Paper formats (automatic feed):
A4, A5, A6, B5 (weight 60-90g/m2)
Manual paper feed :
Envolopes, Self-adhesive labels
Overhead transperancies
Typefaces
36 font (with HP emultion)
8-14.4 points
IC font cards
Downloadable soft fonts
Interface:
Centronics parallel or serial RS-232 C/V.24
2 x Centronics parallel (option)
2 x serial RS-232 C/V.24
High resolution (300 x 300 dpi)
Single and Dual bin

Modular memory to 4.5 MBytes

C22063.. $2,295

OKILASER 840 POSTSCRIPT

PAGE PRINTER

- 8 PAGES PER MINUTE
- 35 POSTSCRIPT FONTS
- 26 HP COMPATIBLE BIPMAP FONTS
- STANDARD MEMORY 2M BYTES UPGRADABLE TO 4M BYTES
- APPLE AND IBM COMPATIBLE

This Postscript printer is very versatile for its size.Both IBM and Macintosh are compatible and can both be connected to the printer at the same time. All it takes is a few resetting depending on the user. These instructions are user friendly and easily understood.

........................$4,495 Tax inc.

........................$3,750 Tax ex.

EXPANDED DYNAMIC RAM RANGE

4164- 10	(64K X 1)	$4.95	$4.50
4464- 10	(4 X 64K)	$5.50	$4.95
4464- 08	(4 X 64K)	$5.95	$5.50
41256- 10	(256K X 1)	$4.50	$3.95
41256- 08	(256K X 1)	$4.95	$4.50
44256-10	(256K X 4)	$10.95	$9.95
44256- 08	(256K X 4)	$11.95	$10.95
1M- 10	(1M X 1)	$10.95	$9.95
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New range of low cost electronics kits for schools

In the last few years, many more schools have been adding basic electronics courses to their curricula. However it's often hard to provide students with much practical 'hands-on' instruction in such courses, because of the complexity and cost of most conventional construction kits. Melbourne firm Kalex has produced a new range of simple low-cost kits designed to solve this very problem.

Aware of the problem facing schools in teaching practical electronics, Kalex's Ken Laird decided that there *had* to be a way to provide them with low cost, easy to use teaching kits. And he came up with an imaginative answer: kits based on the projects described back in the very early 1980's, first in *ETI* and then in its spinoff publication *Hobby Electronics.*

The *Hobby Electronics* projects were extremely popular — so popular, in fact that they prompted a certain well-known electronics entrepreneur to come up with a similar and equally successful series of books and mini-projects, soon after (imitation is the sincerest form of flattery!).

Be that as it may, the original *HE* kits were pitched at just the right level for school electronics courses. They're easy to assemble and get going, yet demonstrate lots of basic electronics principles. They also tend to provide useful and practical gadgets, when completed. And being based on simple basic circuits using discrete components, in most cases they haven't really dated — they're still just as relevant now as when they were first described.

But Ken Laird didn't just stop there. Realising that schools needed to be able to buy kits in quantity, but at the lowest possible cost, he decided to package the kits in packs of 10. By packaging each kit simply in a plastic bag, without any fancy colour printing and with simple photocopied instructions, this has allowed considerable economy of scale.

And as if that wasn't enough, he also realised that rather than have a kit with a PCB fully etched and drilled, it would be more educational to provide a PCB that was merely silk-screened with etch resist. Then the students could have the experience and satisfaction of etching and drilling their own boards, to learn at first hand how it's done. So in one step, the kits could be made not only *cheaper* (by saving the cost of etching and drilling), but more educational as well.

The nett result of all this is a new series of kits, not only well suited for the needs of schools but with unit prices that are surprisingly low: from $3.50 to $6.95, for the first five to be released. This is when bought in packs of 10, of course.

The simplest of the new kits is that for a simple 'heads or tails' electronic coin or decision-maker circuit. This consists of a simple two-transistor multivibrator, with a LED in each collector circuit. When a pushbutton is pressed, the circuit oscillates; when the button is released, it stops with one or other of the LEDs lit.

Then there's a 'LED Dice' kit, with a simple 555 oscillator driving a 4017 counter, with six LEDs connected to the outputs and feedback so it becomes a modulo-6 counter.

Next is a 'Two Tone Doorbell' kit, with a 555 connected so that it operates at two frequencies for a more interesting 'ding-dong' sound.

The fourth kit is for a simple 'Electronic Siren', with a pair of 555 oscillators connected so that one modulates the other in frequency, and a power transistor to drive the speaker. A miniature 57mm speaker is supplied as part of the kit, but needless to say more volume can be obtained using a larger speaker (perhaps one of the horn types).

Finally (at present) there's a simple 'Car Alarm' kit, of the type which detects a voltage drop in the vehicle's electrical system. This uses three 555's, with one connected as a voltage transient detector, one as a 1Hz oscillator to drive the 'armed' LED and pulse the relay when the alarm is triggered, and the third as a monostable to reset the circuit after approximately 45 seconds.

They're all interesting and useful little circuits, which can be used to illustrate a lot of basic circuit functions. And the Kalex kits provide all of the components needed to build them up.

In short, Ken Laird seems to have come up with a well thought-out solution to the problems faced by schools in teaching electronics at a practical level.

Incidentally, I gather further kits are in the pipeline — including some based on the application of solar cells. Ken Laird is apparently also prepared to produce low-cost kits for projects that schools have developed themselves.

Further details are available from Ken or Sue at Kalex, 40 Wallis Avenue, East Ivanhoe 3079, or phone (03) 497 3422. ■

SMD Technology in NSW's TAFE

There was a time when the 'T' in 'TAFE' was said to mean 'ten years behind the times'. But now it means Technology, if Sydney's Lidcombe TAFE is anything to go by. Imagine a complete SMT manufacturing centre, a robotics section and a computer integrated manufacturing training area — not for whiz kids, but for training you and me.

by PETER PHILLIPS

The buzzword these days is 'restructuring', and industry throughout Australia is looking at ways to become more competitive by this process. In short, restructuring means producing a better product more cheaply. And that usually means high technology...

But the problem with high technology equipment is training the workforce to cope with it. All kinds of people need to be retrained, such as operators, technical staff, tradespersons, engineers and so forth; the problem of providing retraining is a challenge for both private and public training institutions.

Perhaps the biggest training provider for industry in Australia is NSW TAFE, with Victoria's TAFE not far behind. Recent government initiatives in both states have resulted in the 'restructuring' of their TAFE systems, with the aim of obtaining a greater involvement between industry and TAFE. Sounds good, as hopefully it will mean less cost to the taxpayer and a greater commitment from the main beneficiaries: industry itself.

But it's a two-sided process, as this article will show. The main objective is to help Australia get its technological act together and become more competitive on the world market, and the prospect of TAFE becoming a leader, rather than a follower of technology is one that deserves publicity and recognition.

The concept

Although this article is about one college in particular, NSW TAFE is aiming to set up a number of colleges that incorporate Advanced Manufacturing Technology (AMT) centres, to provide training in contemporary technology for Australia's manufacturing industry. In fact, an elaborate computer integrated manufacturing centre (CIM) has been in operation for some time at Sydney Technical College and students can learn about injection moulding, robots, NC machining and how all this is integrated as a flexible manufacturing centre.

The reason for the development of AMT centres in TAFE is to allow NSW TAFE to take a more active role in helping to improve the competitiveness of Australian industry. Obviously, the participation and commitment of employers in supporting these centres will therefore be critical in fulfilling that purpose.

Lidcombe TAFE college

Lidcombe is close to the geographical heart of Sydney, and is the location of one of the largest, most sophisticated TAFE colleges in Australia. And that doesn't just mean it has more computer rooms than other TAFE colleges. This place has the *lot* — particularly in the areas of electronics, robotics, and CAD/CAM.

Lidcombe TAFE will be the key centre in NSW for high- technology courses, and will have a student enrolment of up to 15,000. Because computers have invaded almost all types of industry, the college has buildings devoted to the fashion industry and the cabinet making industry and also includes a complete production line integrated with a sophisticated warehouse facility.

Of particular interest to readers will be the AMT centre within the college, housed in a two-story building that contains approximately 1000 square metres of unencumbered workshop space (50m x 20m) on the ground level. Two levels of laboratories, computer rooms, lecture rooms and offices take up approximately 800 square metres of floor space adjacent to the workshop. The computer rooms overlook the workshop, to allow students to observe the relationship between design and manufacturing.

Computer network cabling has been installed at convenient points throughout the building, effectively networking offices and laboratories to any device in the manufacturing hall.

Some readers may remember the time when even the chalk was rationed, and to read about this kind of megadollar expenditure in a TAFE college may seem unbelievable. It's a big story, so to keep it confined we'll concentrate on the electronics section; but a brief overview of the AMT centre will show the magnitude of this joint Federal and State government project.

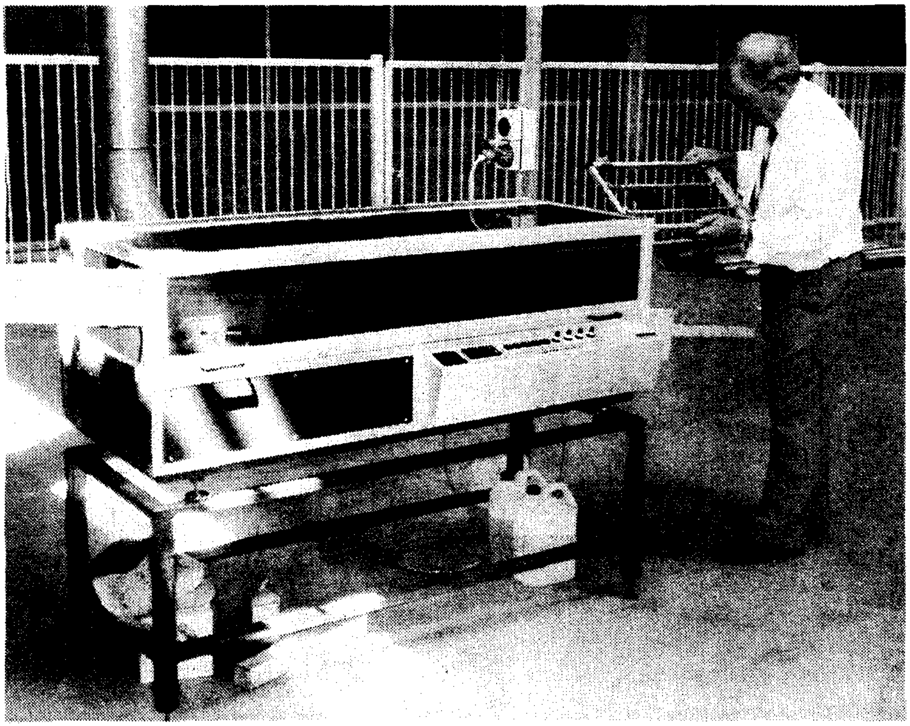
The AMT centre

The AMT centre started accepting students in August 1990, and has been equipped under a $3.5 million prime contract awarded to Balfour Beatty Systems Engineering. The centre will have seven major training areas, that can be used in stand-alone mode or integrated with others to simulate integration.

The computer training area has four classrooms linked to a central Sun file server/host computer. Two of the classrooms are fitted with 16 Apricot MS-DOS CAD workstations, while the others have nine Unix based CAD workstations. Integration will be provided by Balfour Beatty's own integration software 'Greenway', which will allow the CAD and manufacturing resource planning (MRP) software to communicate with the manufacturing cells. This will initially comprise upload and download of machine programs and updates of the MRP database.

Manufacturing hall

The focal point of the AMT centre is the large manufacturing hall, divided into several areas covering various aspects of manufacturing technology.



Though small compared to some used in industry, this wave soldering machine has all the usual facilities. Instructor Rory Donohoe is shown here loading the machine with a rack of PCBs for soldering.

The machine training area includes a twin spindle, twin turret six-axis Nakamurra CNC Turning Centre, a three-axis Maho CNC Vertical Machining Centre, and a six-axis ASEA IRB 2000 machine tending robot on a 10.75m floor mounted track.

The machines can be used for training on an individual basis, with air skates moving them through 90° away from the robot track, or they can be linked up as a manufacturing cell to be tended by the ASEA robot. Another area provides training in assembly and will allow the large ASEA robot to interact with a smaller assembly robot.

A hi-tech welding area is also incorporated, equipped with a six-axis Hitachi M6100 robot fitted with pulsed area welding equipment. There are two fixed-bench work positions and a roll- over manipulator included in this self contained area.

To link the areas, a TNT Jung Heinrich automatic guided vehicle is used to transport raw materials, work in progress and finished goods around the different areas.

A warehouse for storage of materials is fitted at one end of the hall and is accessed with a manually operated storage rack system.

The electronics assembly area comprises a range of surface mount technology (SMT) equipment, mostly sourced by Suba Engineering. This is probably the area of greatest interest to readers, and one I was lucky enough to visit on the day it was commissioned.

The SMT section

Ask anyone involved in electronics to define state of the art, and they would have to include the acronym for surface mount technology: SMT. This technology is becoming more popular as industry gets used to it, and these days PCB's stocked with surface mount devices (SMD) are fairly common.

In my training days at a TAFE college, the best we could do was to scratch the pattern for a PCB onto a piece of laminate, usually with a Dalo pen, then etch the thing in a container of ferric chloride. But at Lidcombe, virtually all the facilities for SMT printed circuit board manufacturing are available. Let's start at the front end of the line, as this will also explain the process.

The very first requirement in PCB manufacture is the actual design, and Dalo pens are definitely 'out' at Lidcombe, while computer aided design (CAD) is 'in'. As yet the PCB design package has not been chosen, but it can be either a UNIX- or DOS-based package as both computing systems are ready and waiting.

Once the PCB design has been completed, the next step is to make a prototype for testing the design. The traditional photographic and etching process is one way, but the method at Lidcombe TAFE is to feed the PCB design into a CAD/CAM station, where CAM stands for computer aided manufacturing. Here a computer takes the CAD design representing the PCB pattern and turns it into a pattern suitable for driving a 'PCB plotter' (Gerber).

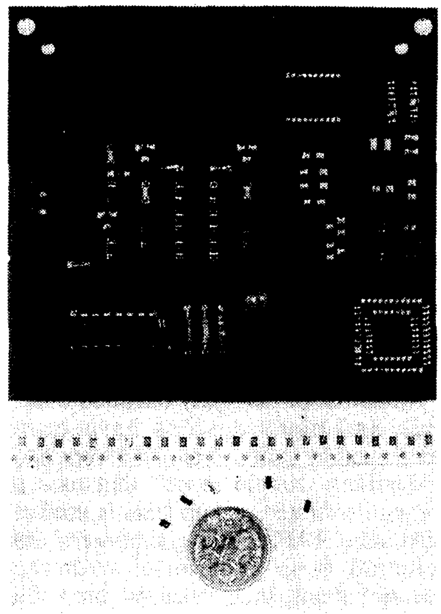


Fig.1 (top): This shot shows a PCB for a 555 timer, routed by the Centre's Gerber compatible PCB plotter. Above: surface mount and conventional leaded components on the same PCB.

The plotter contains a router bit that spins at 13,000rpm, cutting away copper as it traces around the outline of each track. The photo of Fig.1 shows the end result for a PCB pattern for a 555 timer. Notice how each track is isolated by the cutaway around it.

The time taken to produce the board in this way varies from a few minutes to half an hour or so, depending on the complexity of the board. This method is not suited for mass production, but is ideal for a one-off, as a PCB is produced straight from the computer screen, eliminating many of the traditional time consuming processes normally required.

Once the board has been cut, the surface mount components can be installed and soldered in place.

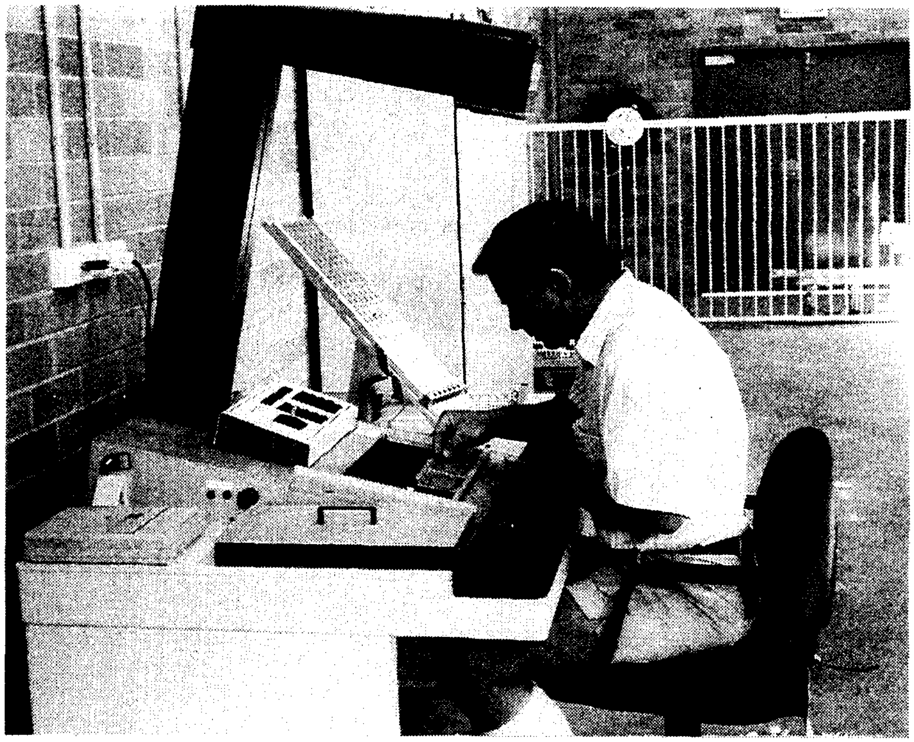
Anyone who has seen this type of component will quickly realise that conventional mounting and soldering techniques are definitely out. SMD's are simply too small!

The first task with an SMT board is to place blobs of solder paste on each pad of the board. In a production run this is done with a mask, but for a prototype, an air-operated syringe containing the paste is the easiest way. The paste accomplishes three tasks: to hold the component on the board, to act as a flux and to provide the solder.

Once the paste has been applied, the actual SMD components need to be put in place. Although there is a fully-fledged high speed 'pick and place' machine in the centre, for a small prototype it's easiest to fit the components manually.

A number of manually operated SMD pick and place devices have been developed by various manufacturers, and a relatively simple device that uses a vacuum-operated pickup head is used at Lidcombe TAFE. The components are selected from a carousel with the vacuum head, then released onto the board once the location has been determined.

Soldering the components in place is achieved either manually in a 'rework station' or by running the board through the reflow soldering machine. This machine is virtually a conveyor belt running through a range of infrared heated temperature zones. The tricky bit is to get the temperature profile of the machine correct for the board being soldered, and this is really only suitable for a production run.



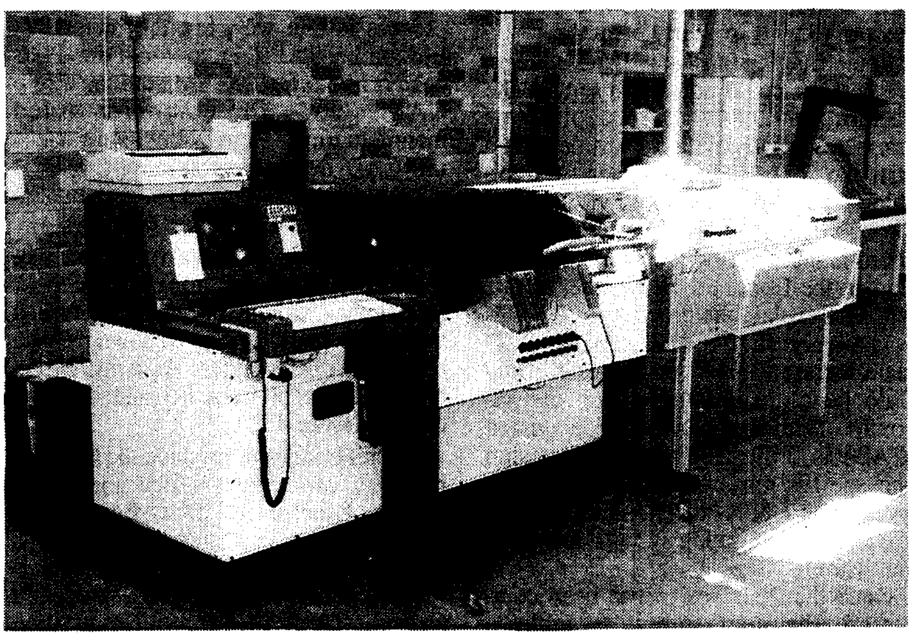
This Laserlite machine being operated by Technical Officer Kevin Page is used to assist the operator install conventional components onto a PCB.

Production runs

While making a prototype board is part of the process, mass production is what industry wants its workforce to learn. To facilitate this, the SMT section has a $300,000 Heeb HM-60 computer based pick and place machine, the previously described SMT reflow machine (Seho) and, to allow conventional components to be included on the SMT board, a fully fledged wave soldering machine.

The pick and place machine needs to be programmed so that each component is correctly placed on the board. Approximate co- ordinates derived from the original PCB design are used to position the head over the board for each component, and fine tuning of the position is achieved by observing the board with a camera-TV monitor arrangement. Once each location has been finalised, the component type and its position on the board are fed into the machine.

When the pick and place machine has been programmed and a few test runs have been successfully completed, the next task is to set up the reflow soldering machine. The reflow soldering machine accepts the boards at one end, and hopefully spits them out at the other end with all components soldered in place. However, as already described, the temperature profile of the reflow machine has to be adjusted to ensure successful soldering. This is achieved with a mix of experience and test runs. Once correct, the temperature profile can be printed out and kept on file, along with a disk containing the component co-ordinates for that PCB. This way, the machines only



The SMT pick and place machine is installed to the left of the reflow machine. Put the board in one end and the finished product comes out the other.

need one setting up procedure for that particular PCB.

Once the machines are successfully producing stocked and soldered boards, it remains to test them. The usual way is to place each board on a test jig (bed of nails) and then run a computer based test program. The equipment installed at Lidcombe is from Binary Instruments, of Brookvale NSW. Learning how to program and use this type of equipment is all part of the process, and already TAFE staff from other colleges are being trained on this gear.

Wave soldering

Although SMT is coming of age, there is still a big need for training in the more conventional methods of PCB soldering. Because this technology is well established in industry, it was decided to support training in this area to a lesser extent than for SMT. To this end, a Seho wave soldering machine has been installed, and the boards are stocked manually using a Heeb 'Laserlite' assembly table.

The assembly table holds the board in place, and the operator presses a foot switch to cause the overhead laser beam to point to the location of the next component. This method is useful for small production runs, and is commonly used in industry. It is common to have a combination of SMD and conventional components on the one PCB, often requiring the board to undergo both processes. Glue is needed to hold the SMD components in place so they don't fall off during the wave soldering process, and if the SMD components are fitted to one side and conventional components to the other, one pass through the wave soldering machine is all that's required.

Using the equipment

The prime educational objective of the Lidcombe AMT centre is to provide an environment for education in modern manufacturing technologies and the integrated management of those technologies. For TAFE students, Lidcombe may be a college they visit for a part of a course being studied at another college.

But this equipment is not for the sole use of TAFE students. As already pointed out, TAFE is trying to provide leadership for industry, and a projected use of the equipment is to offer specialised training courses for particular industries. This way, industries with this type of gear can arrange through the college management for a special training program for their employees. However, what about smaller manufacturers who don't have robots, SMT production lines and the like? Let's say you manufacture a product that would benefit from SMT, as it could be smaller, more competitively priced and generally better. All you lack is the equipment and knowledge to use it.

An envisaged use of the AMT centre is to allow smaller manufacturers to not only learn the techniques involved, but also use the equipment at Lidcombe to actually produce their product. This way, smaller industries can enter the technology race without massive financial outlays. Then, once the product becomes successful, that manufacturer might decide to purchase similar equipment and even expand the product lines.

It's an exciting concept when you think about it, and one foreign to the traditional operation of TAFE. But it's reality at Lidcombe.

It is hoped the college will be officially opened early this year by the Prime Minister, and with a bit of luck this event should attract wide media attention. Good one, TAFE!

Incidentally the Manager of the new AMT Centre is Mr Aian Soden, who can be contacted on (02) 749 3375. Or you can fax him on (02) 749 3374 for futher details ■

NEWS HIGHLIGHTS

WINNERS OF OUR DSE/ACER SUBS PROMOTION PRIZES

The three lucky winners of our Dick Smith Electronics/Acer Computer Subscriptions Promotion, held in the July-September 1989 issues, were:

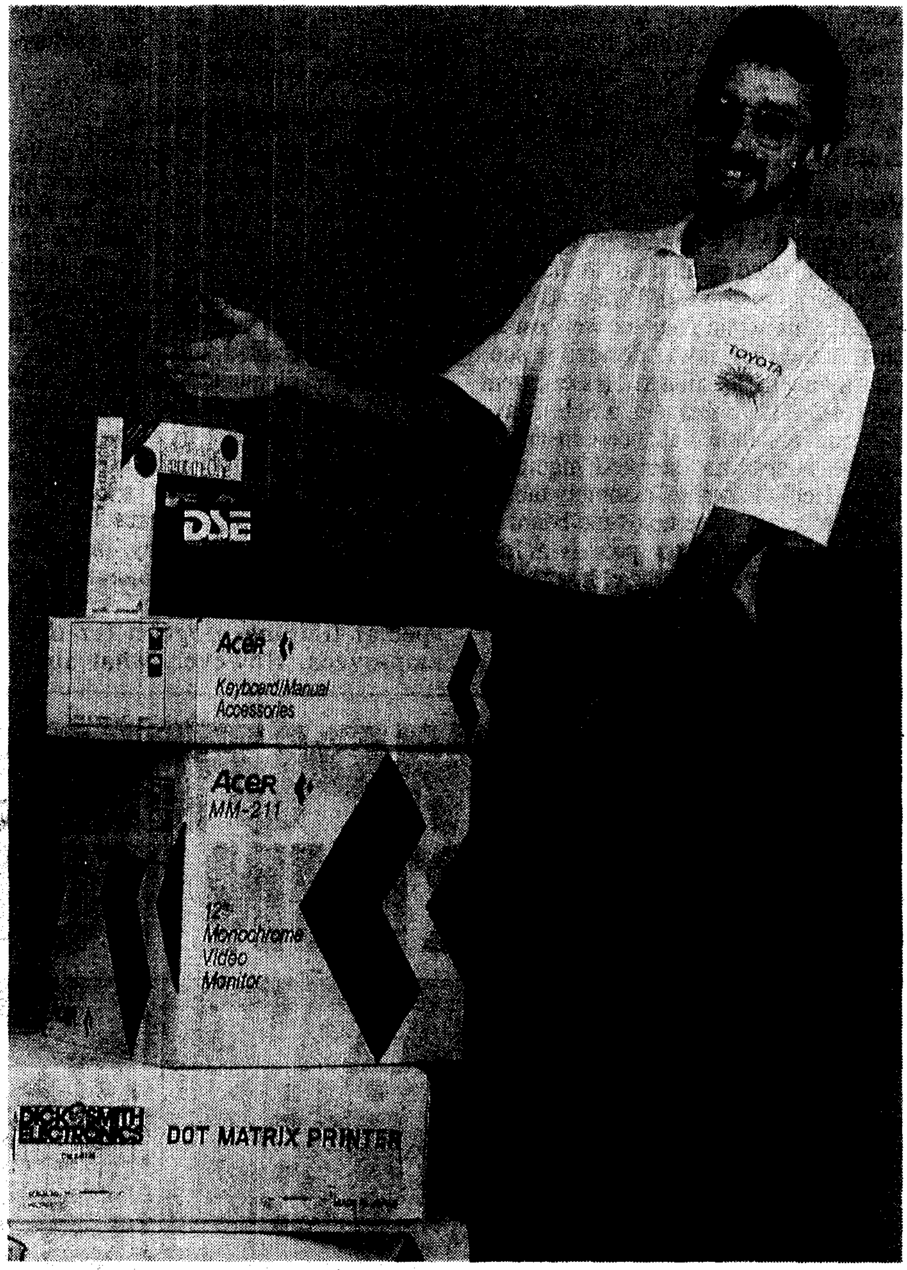
* Mr Shane Elson, of Merrylands in NSW;
* Mr W. Smith, of Mulgrave in Victoria; and
* Mr M. Tregenza, of Cowandilla in South Australia.

All three winners have received their Acer 500+ computer systems from Dick Smith Electronics, featuring a computer with dual floppy disks, 30cm monochrome monitor, 9-pin 135cps dot matrix printer, 300/1200bps modem, Eight-in-One integrated software package, plus cables, paper and floppy disks. Each price was valued at $1995.

NSW winner Mr Shane Elson (pictured) is a sound engineer who runs his own company, providing sound reinforcement for corporate events and similar functions. He told us he plans to use the computer for writing correspondence, preparing invoices and also for assisting in the design of sound systems. He and his wife have three children, so he said it's also likely to be used for games and education.

Mr Elson's first reaction on hearing of his win was "So people DO actually win these prizes!"

Congratulations to all three winners, and thanks to all of the readers who entered the draw by taking out a subscription during this period.



LOCAL FIRM MAKES 5KVA TOROIDAL TRX

Sydney transformer specialist Tortech has announced the successful local manufacture of a single-phase toroidal transformer rated at 5000VA. The transformer has two 120V windings and four 35V windings, and was produced for a remote inverter power supply operating from a 48V battery.

Weighing 30kg, the transformer measures 280mm in diameter and 105mm high. It has a 130°C temperature rating, withstands 3.5kV between primary and secondary and conforms to manufacturing and testing standard AS 3108-1984.

Based in North Strathfield, Tortech is able to make toroidal transformers with ratings up to 7500VA. It can be contacted by phoning (02) 743 6067.

CSIRO BUYS ZETA HELIOMETERS

Science Education Centres in Adelaide, Brisbane and Perth have recently purchased a new Australian product for use in innovative educational programs.

The instruments, called Heliometers, measure ultraviolet radiation in regions harmful to human health. The Heliometers are manufactured in Sydney by a specialised design company, Zeta Electronics.

Mr Rick Daley, Manager of the CSIRO's Adelaide Science Eduction Centre devised the experiment in August of this year. The Heliometer is used in conjunction with a low wattage UV tube in a safe and simple bench top experiment which enables students to measure the effectiveness of different sunscreens, sunglasses and clothing.

"Visiting student groups can calculate how much protection they are getting from different preparations or how little", Mr Daley said. "There are some surprises – water is transparent to UV, so you can still get a tan while swimming. Some cheap plastic sunglasses are also more effective than expensive glass models."

Zeta Electronics has prepared a data sheet on UV and the Ozone hole, and a list of experiments that students can perform. These will be supplied free to interested callers. Contact Zeta Electronics, Unit 3, 16 Denning Street, Drummoyne 2047; phone (02) 81 4805.

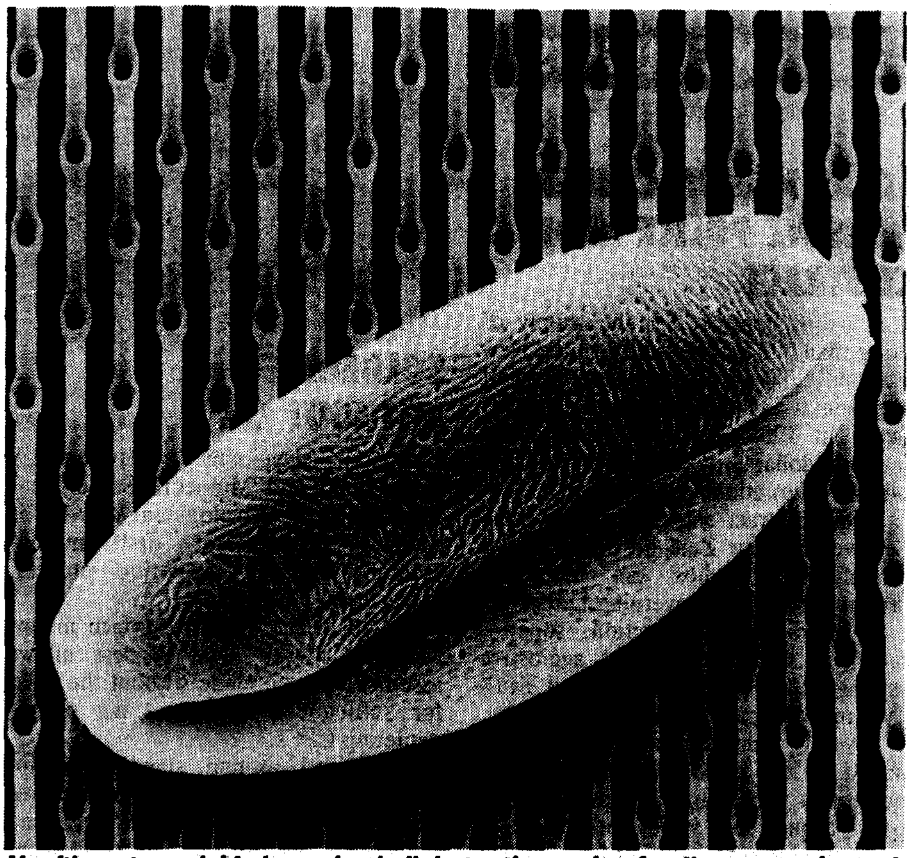
BURSARIES TO ATTRACT MORE WOMEN ENGINEERS

Asea Brown Boveri has taken a positive step to attract more young women to the engineering profession.

The ABB group, in association with the University of Sydney Faculty of Engineering, has sponsored four bursaries for girls to study electrical engineering at the University. The four bursaries of $3000 each will be awarded to Year 11 girl students in 1991. Each pupil winning the bursary will be paid $1000 while the school will receive $1000 and the parents $1000.

The bursaries will be renewable in Year 12, with an additional $1000 allocated to each student. In addition, ABB is offering work experience to each bursary winner for two weeks including a $100 weekly allowance to cover expenses.

Information regarding the bursaries has been circulated to 100 girls schools and co-educational colleges.



No, it's not a wrinkled cowrie shell, but a tiny grain of pollen measuring only about 17 microns (micrometres) long. In this scanning electron micrograph taken by the Siemens research laboratories, it's shown resting on the surface metallisation of Siemens' new 4Mb DRAM memory chip. Each 'hole' in the 1um-wide tracks connects to an individual memory cell in the chip below.

EDUCATIONAL VIDEOS FROM NZ FIRM

A new range of educational video tapes has been announced by New Zealand firm Electronics Assembly Company, designed for people who are just starting out in electronics. The videos are claimed to make learning electronics both easier and more enjoyable than studying from textbooks.

Currently eight different tapes are available, covering the following topics:

PART 1: DC (VT201), series and parallel circuits, how to use a DMM;

PART 2: AC (VT202), coils, transformers and capacitors;

PART 3: SEMICONDUCTORS (VT205), basic semiconductor theory plus 15 different devices;

PART 4: POWER SUPPLIES (VT206), a step by step look at how they work, trouble shooting;

PART 5: AMPLIFIERS (VT207), basic amplifiers and configurations, op amps;

PART 6: OSCILLATORS (VT208), LC and crystal circuits for both digital and linear applications;

VCR MAINTENANCE & REPAIR (VT203), an introductory course for the average user, including deck cleaning and remote control repairs;

INTRODUCTION TO VCR REPAIRS (VT204), a more advanced course for the service technician.

Parts 1-6 are computer animated, and run from 47 to 75 minutes. They are available in both PAL and NTSC versions, and sell for between A$75 and $80. VT204 runs for 120 minutes and costs A$115. These prices include packing, insurance and surface air lifting from New Zealand.

Further videos are planned on topics such as AM and FM radio, TV, digital electronics, computers, microprocessors, robotics, microwave communications and lasers.

For further information contact Electronics Assembly Company, PO Box 21191, Christchurch NZ or phone (3) 79 5570.

NEWS HIGHLIGHTS

LOCAL MANUFACTURER WINS NZ POLICE RADIO CONTRACT

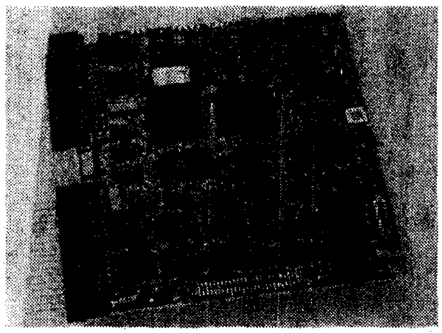
A major contract for the supply of more than 500 mobile radios to the New Zealand Police has been won by Tait Electronics Ltd in Christchurch with its new Tait T700. Worth in excess of $1 million dollars, it was won against intense international competition.

"This contract shows just how competitive our New Zealand designed and manufactured radios can be" said Angus Tait, Tait's Governing Director.

"The rugged construction, superior technical specifications and aggressive pricing all led to the win," stated Tait's Systems Manager, Andrew Woodfield.

Several enhancements have been added to the radio for the Police requirement, including a special front panel display and various interfaces to allow the radio to easily fit into existing Police systems.

Tait Electronics Ltd is a New Zealand owned company with its Head Office and Manufacturing Plant located in Christchurch. Along with nine branches around New Zealand and subsidiaries in the UK, Australia, Singapore, Hong Kong and USA, Tait Electronics Ltd now employs in excess of 500 people, and exports mobile radios and systems all around the world.



SOLDERING WITHOUT CFC'S

A joint development between US firms BOC and Multicore Solders has resulted in the development of what is claimed as the world's first 'environmentally friendly' soldering process: Nitraclean.

Aimed at the growing surface mount assembly market, the process allows assemblies to be made without the need for subsequent cleaning using ozone-depleting CFCs.

Configured around standard equipment already installed in the majority of manufacturer's facilities, the Nitraclean process involves the use of a nitrogen-based reactive atmosphere in the solder-ing oven, in conjunction with a proprietary solder paste – Multicore BX32 – which cleans the solder joint at the same time as it is made.The reactive atmosphere decomposes the organic binder in the paste into gases, leaving behind only solder and a clean circuit board. There are therefore no residues left to remove and no need for CFC solvents.

INTERNATIONAL RECTIFIER AWARDED POWER MOSFET PATENT

International Rectifier Corporation has been awarded a US patent that provides additional broad protection for IR's power MOSFET and IGBT power transistor technologies.

US Patent 4,959,699 covers all cellular structures for power MOSFETs (Metal Oxide Silicon Field Effect Transistors) and IGBTs (Insulated Gate Bipolar Transistors).

According to Dr Alexander Lidow, President of IR's Electronic Products Division, "This one casts a long shadow because we believe that virtually every power MOSFET and IGBT on the market uses the structure protected by this patent."

IR's other major power MOSFET patents cover basic elements of device design, structure and processing. International Rectifier has been granted more than 30 power MOSFET patents throughout the industrialised world, and additional patent applications are pending.

In April 1990, a Federal District Court in Los Angeles held that five of IR's key power MOSFET patents are valid and infringed by Siliconix Incorporated.

To date, five manufacturers have negotiated royalty-bearing licences under the company's previously issued power MOSFET patents: they are Hitachi, Toshiba, Matsushita, Siliconix and Unitrode.

PIRELLI CABLES WIN $4 MILLION EXPORT ORDER

Following extensive negotiations through Cablexport, a Milan based company which handles contract negotiations for the various Pirelli affiliates around the world, Pirelli Australia have won a $4 million export order.

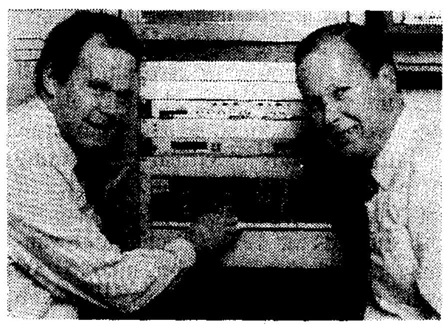
Pirelli Australia are supplying copper telephone cable in various lengths and sizes to Romania, a country which is currently in the process of extending its national telephone network.

Improving the balance of payments to the tune of four million dollars, Pirelli Australia succeeded in winning this huge export order because they were right on price, on quality and on delivery time. The cable had to be manufactured and delivered within two months.

MELBOURNE FIRM DEVELOPS ENHANCER FOR TELECINE

AAV Australia has developed a unique telecine enhancement kit, KINESIS, which enables optical film rotation by (plus or minus) 45°. The system also offers De-strobe on panning shots and De-focus options which can be fitted to any Rank Mark IIIC Digiscan Telecine chain.

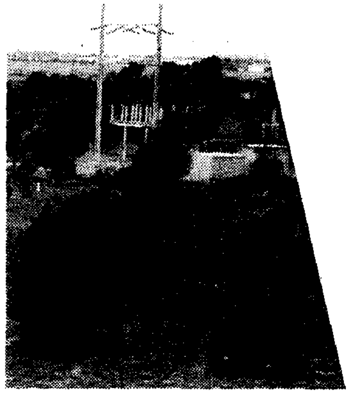
After field tests in Melbourne, Kinesis was launched to the world market recently at the International Broadcasting Conference (IBC) in Brighton, England. The first northern hemisphere order came from Europe's most respected facilities house, the Moving Picture Company. Within the first two days of IBC, three of London's major video post-production houses had placed orders. Other orders followed from facilities companies in New York,



Chicago and Los Angeles.

The Chief Executive of AAV Australia, Ted Gregory, said "This is a great tribute to David Edgar's Kinesis development unit, led by Tony Corcoran and Ian Small." The Kinesis adds yet another option to AAV's telecine chain and has also resulted in a product that has been immediately endorsed by major facilities houses throughout the world.

SAIT OPENS NEW HIGH POWER TEST LAB



The opening in November of the Australian Electrical Testing Centre's High Power laboratory is claimed to provide for the first time anywhere in the world, a high power electrical testing facility closely associated with a tertiary teaching institution. The laboratory, at the South Australian Institute of Technology's Levels campus, is an exciting venture into a previously somewhat neglected 'high technology' area.

Both the SA Government and the Electricity Trust of South Australia (ETSA) have provided major funding for the Centre, the placement cost of which is already $3 million. The laboratory will provide testing services on a commercial basis. The only other laboratory in Australia with comparable facilities is that operated by the Sydney County Council. For many yea ever, that laboratory has been booked; queuing times are lon manufacturers of switchgear and s gear assemblies away from Sydne significantly disadvantages.

At present Australia relies largel imported heavy current switchgear related equipment, and it is expec

...atory is ...e Sir Charles Todd ... occupied by the Schools of Electrical and Electronic Engineering at the Levels. Next to the laboratory is the ETSA substation, containing 132kV switchgear, circuit-breaker and two 18MVA 132:11kV transformers. The transformers are connected in parallel to provide an 11kV supply from which currents of 2500A can be drawn for short periods. Data from tests is recorded on an 8-channel digital recorder with an in-built thermal printer, which allows waveforms of test quantities to be available for evaluation within seconds of completion of a test. The recorder chosen for the new laboratory features a General Purpose Interface Bus (GPIB) which allows all data gathered in a particular test 'shot' to be transferred to a computer for further processing.

NEWS BRIEFS

- ***Ericsson Australia*** has appointed Chris Sheahan as International Product Manager for its Australian-designed and manufactured ACP1000 automatic call distribution system. Mr Sheahan was a member of the original design team for the system, which is estimated to have a US$300 million global market.
- US based supercomputer manufacturer ***Convex Computer*** has expanded its Australian operations with the opening of new offices in Melbourne. Mr Robert Hain has also been appointed managing director, and will head up the company's Australian operations from Melbourne.
- Sydney's ***University of Technology*** is offering a part-time intensive course in software project management, for software engineers, analysts, programmers and those who need to manage, lead or influence projects containing a significant software component. The course begins from February 19, and involves two nights per week for 11 weeks; it costs $3300. Further details are available from UTS Continuing Professional Education, (02) 281 8563 or 218 9531.
- Sydney-based PC enhancement board manufacturer ***Hypertec*** has appointed Ms Desiree Lim as national support manager for its products. Ms Lim was previously manager of PC and network support at Westpac.
- Transwitch Corporation of Connecticut in the USA has appointed Sydney-based ***Alkira Electronics*** as its exclusive representative for Australia, NZ and P-NG. Transwitch claims to be the first company to produce commercial ICs for SONET (synchronous optical network), the new international standard for optical communications.
- Mr John Hodgkinson has been appointed general manager for the industrial batteries division of ***GNB Australia*** (a Pacific Dunlop subsidiary). Mr Hodgkinson was previously corporate personnel manager with Kimberly-Clark.
- US semiconductor manufacturer Siliconix has appointed ***IRH Components*** as an Australian distributor. IRH will be carrying a comprehensive range of the firm's analog switches, multiplexers, FETs, power MOSFETs, switch-mode controllers and regulators.
- The long-running battle in the US courts between ***Motorola*** and ***Hitachi***, over intellectual property and technology disputes concerning the Hitachi H/8 and H/16 microcontrollers and Motorola's 68030 and 88000 microprocessors, is over. The two firms have reached a settlement out of court, details of which were not disclosed.
- ***NSD Australia*** has been appointed Australian distributor for US manufacturer Samtec, which produces a range of IC sockets, custom connectors and high quality PCB interconnections.
- An entertaining and educational exhibition is being held this month at Sydney's Darling Harbour Exhibition Centre, from January 20-27. ***ENERGY '91*** will be all about energy, and how we use it. Admission is free.

PCB/PROJECT INDEX ON DISK FOR PC'S

Long established local PCB manufacturer RCS Radio, which makes boards for virtually every construction project described in *EA*, *ETI* and other Australian magazines, has produced a comprehensive index for its board range – available on floppy disk. The disk includes both the index database plus custom accessing software, which runs on any IBM-compatible PC. The software provides for a variety of search keys, allowing fast and convenient lookup of PCB details.

RCS principal Mr Bob Barnes says that the index will be updated every six months, to ensure that it remains current. Further details are available from RCS Radio, 651 Forest Road, Bexley 2207 or phone (02) 587 3491.

...hen I Think Back...

by Neville Williams

...ney Newman: pioneer ...adio amateur-turned-engineer

Every whit a typical wireless enthusiast and amateur operator, Sydney Newman neverthless helped to shape the history of commercial radio in Australia. He was the first person to bridge the Tasman with radiotelephony, fitted out Australia's first radio-equipped police patrol car and supervised the installation of several early medium- and short-wave broadcast stations.

Sydney M. Newman was born in Waverley, Sydney, in 1898 but moved with the family to Melbourne shortly afterwards, being educated at Melbourne Grammar School.

Unwittingly, the school helped shape his career when it awarded him, as a prize for winning a race, a cash voucher redeemable at any shop in the City. With it, young Syd bought an assortment of second-hand telephone bits and pieces, and set up a private line on which he could talk to the kids next door.

His next step was to build a simple wireless set, using a crystal and 'catswhisker' to listen to code transmissions from ships in and around Port Melbourne.

In the process, he became proficient at Morse and managed to qualify for an amateur station licence in 1912 at age 14. For him, the highlight of those early days was reception on a crystal set from Melbourne in 1914 of a signal from the German liner 'Scharnhorst' when it was still one day west of Perth. Syd recalls that the signal from the Telefunken 'singing arc' transmitter was particularly clean and readable.

All this makes him a close contemporary of Raymond Allsop in Sydney (*EA*, January '90) — also born in 1898, and a licenced amateur at 13.

Unlike Ray Allsop, however, Syd did not have Father Shaw as a technical mentor and had to be a good deal more self-reliant.

He recalls that, in those days, technical literature to do with wireless was in very short supply.

He neverthless managed to assemble a spark transmitter using an interrupter and induction coil, and made his presence

Sydney M.Newman in the mid '20's aged about 28.The skills he had learnt as an amateur radio operator were by now being put to good use at an engineering level for AWA.

felt on the air using the callsign (as he remembers) POZ.

Joins AWA

In 1920 Syd Newman joined AWA, taking up his duties at the Melbourne branch under L.A. Hooke - a group that was destined to play a vital role in the development of wireless in south-eastern Australia. He was also issued with a commercial operator's licence, on the strength of the skills acquired as a licensed amateur.

In the following year, on behalf of AWA, Syd Newman organised a demonstration of wireless telephony at the Melbourne Town Hall to an Old Melbournian 'smoke concert' - an audience comprised predominantly of former students of his old school.

To a quite different audience, during a visit to Sydney in 1921, he delivered a lecture to members of the NSW Division of the WIA (Wireless Institute of Australia), of which Ernest Fisk was a member and office bearer. His subject 'European Signals Amplified by Twenty Valves' must have sounded somewhat mind- boggling, at a time when valves were more commonly used in ones and twos.

When I said as much to Syd, in a recent phone conversation, he tended to pass it off as more a gimmick than a serious technical exercise. AWA, it seems, had imported a number of Marconi 'Seven' long-wave communication receivers which used six RF amplifier stages ahead of a detector. He had simply borrowed three of the receivers from stock and connected them in tandem, such that the incoming signal had to negotiate 18 RF amplifier stages before finally reaching a detector!

If that hasn't made the Guiness book of records, maybe it should have...

1921 was also notable as the year when, in early November, US president Harding broadcast a message to listeners around the globe to mark the opening of New York Radio Central, claimed to be the most powerful wireless station in the world. The subject of an 8-page article in the Australian *Sea,* *Land and Air* magazine for February 1, 1922, the project highlighted in no uncertain manner the logistics involved in the construction of a high power long-wave station. (See panels).

Inaugural broadcast

In the context of modern radio and TV services, the pronouncements of people from other countries are everyday fare; but they were certainly not so at a time when international communication depended mainly on undersea cables.

Advised of the pending transmission, AWA managing director E.T. Fisk arranged for the steamships *Riverina*, *Ulimaroa* and *Mataram*, at anchor in Sydney Harbour, to intercept the message, while C.D. Maclurcan was also alerted so that it could be received at his experimental broadcast station at Strathfield, in Sydney's inner west. The information was sent also to Australian and New Zealand coastal wireless stations.

Syd Newman was involved in making similar arrangements in Melbourne, including the Marconi/AWA experimental long-wave station at Kooweerup. P&O's *RMS Narkundo*, en route from Melbourne to Adelaide, was also alerted.

The direct broadcast, reaching Australia 'within one-eighteenth part of a second' prompted considerable comment from the press. Said *Sea, Land and Air* (Dec. 1, 1921):

'It was received simultaneously at all points as loud and distinct as if it had come only a few hundred miles instead of ten thousand miles, the distance from New York City to Australia'.

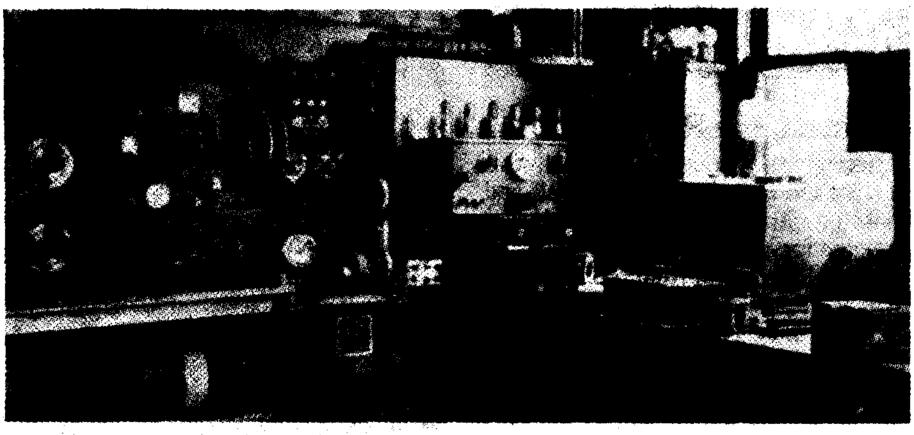
Contrasting this with the existing tedious facilities, the writer added: 'A message from Sydney to London has to be relayed five times to reach Vancouver, and it is then only half way! From Vancouver, it is sent over Canadian landlines to Halifax, thence across one of the Atlantic cables to a point in England, where it is transmitted over the landlines to its destination - London'.

Communications problem

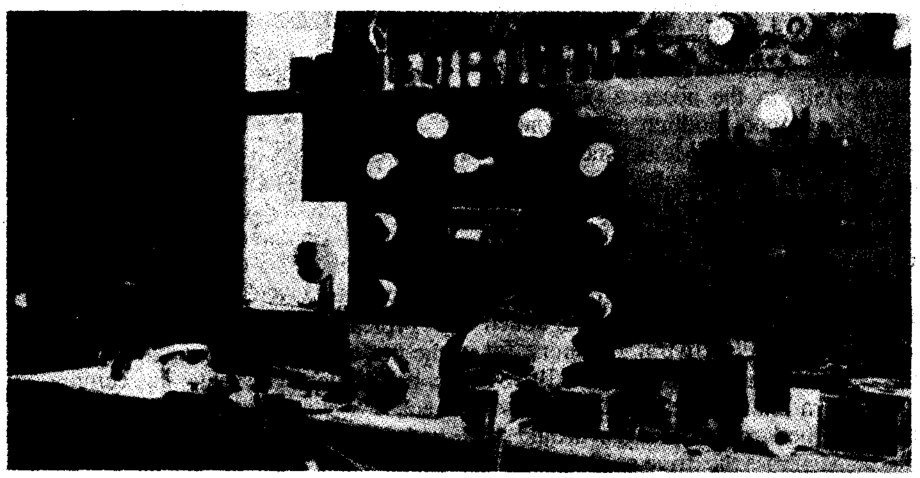
As a result, the magazine explained, 'Our press is insufficiently supplied with international news and Australia is not so well known overseas as might be the case ...

'Another point of view is defence. Quick and reliable communication is absolutely essential. With only two cables linking this country to the outside world, there is nothing to prevent the enemy at sea from cutting the cables and isolating us altogether. With wireless, such a position could not arise.....

'The Commonwealth Parliament will



Reproduced from 'Radio in Australia & New Zealand' in 1923, these pictures show (above) the receiving equipment at Syd Newman's own amateur station and (below) the transmitter.



shortly deal with the matter of Australia's overseas communications - a right retained by Mr Hughes at the recent Imperial Conference.

'A thoroughly complete and modern long distance wireless service and organisation - that will save 60,000 pounds per annum is what Australia needs. When that is in operation, both internal and external isolation will be overcome.

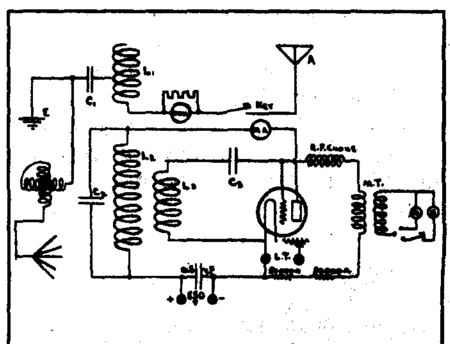
'Then, like New York Radio Central, Australia's Radio Central will be able to communicate to any country in the world'.

Harding's broadcast could not have come at a more opportune time for AWA, who were perceived as the logical organisation to meet Australia's communications needs.

Ernest Fisk had returned to Australia only a few weeks previously on the *RMS Narkunda*, following a visit to Britain. AWA was ready, he said, to set up a worldwide wireless network based on Sydney or Melbourne which would be able to provide a link between state capitals and overseas nations, first with telegraphic message handling but readily adaptable for telephony.

AWA held rights and options from the Marconi Company of England, the Radio Corporation of America, the General Wireless Company of France and the Telefunken Company of Germany.

As a result, said Mr Fisk, "The Australian service will be able to reap full and continuous benefit from the research work conducted by the great wireless companies and the best scientific and technical brains in the world".



Designed around a single Marconi R-type receiving type valve, Syd Newman's amateur transmitter helped re-write the record books for low-power equipment, for both telegraphy and telephony.

WHEN I THINK BACK

A word to the PM

Making very sure that the Prime Minister 'got the message', Messrs Fisk and Hooke provided an appropriate technical diversion for Mr (Billy) Hughes when he was booked to travel from Melbourne to Sydney on the *SS Karoola*. They installed Sydney Newman aboard, complete with an appropriate receiver. Then, as the Karoola headed down the Bay, the PM was able to hear farewells from his wife and daughter Helen, relayed to him via coast radio station VIM.

In the same year, 1922, Syd Newman was given the task of broadcasting over the same station a speech by Prime Minister Hughes delivered in the Bendigo Town Hall. In the absence of suitable microphone and landline equipment to convey the signal to Melbourne, a standby transmitter was installed on the site!

This was only part of the job because, for this novel OB (outside broadcast) Syd also had to erect an appropriate transmitting antenna between the Town Hall spires. And, to put a finishing touch to it, the most effective microphone for the occasion turned out to be a Brown brand horn loudspeaker used in reverse: talk into the horn and a signal would be produced across the drive coil!

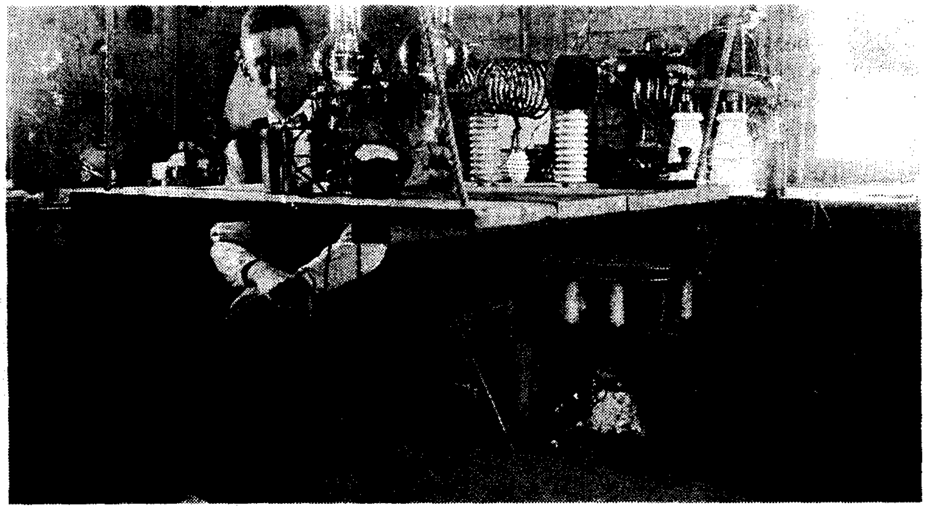
For me, that stirred a chord of memory in that one of the earliest wireless transmissions I ever heard, and certainly the first on a loudspeaker, was on a Brown's horn - often described in those days as a Brown's 'Table Talker'.

Table listener!

In fact, I was told, a similar microphone and transmitter set-up was used for an ambitious demonstration broadcast from Her Majesty's Theatre in Melbourne, as reported in the Melbourne Herald for 31/3/1922. AWA historian Philip Geeves also refers to it on page 53 of *EA* for April 1989. Backed by AWA Melbourne Manager Lionel Hooke, the concert was expressly intended to entertain convalescent ex-servicemen.

On the occasion, Syd Newman used two Brown louspeakers, one at each front corner of the stage, facing obliquely inwards.

By way of interest, a 3-page article in *Wireless Weekly* for August 13, 1926 explained the then problems of 'Transmissions Over Land Lines'. While the telephone network in the early '20s was able to meet normal requirements reasonably well, the procedures necessary to set aside a good quality path from point A to point B for broadcasting purposes had not been established.



Old and faded, this picture nevertheless gives some idea of the 'outhouse' short-wave test centre at Willoughby in 1924/5. More like a makeshift 'ham' rig, the 20-60 metre transmitter was used for scheduled tests with distant centres like Melbourne (600km direct line) and Rabaul (2700km).

Featured in the article was a two-event broadcast organised by 2FC from the Hotel Kosciusko on the occasion of a winter games weekend.

Typically, the path from the Hotel to the transmitter at Pennant Hills involved a half dozen-odd switching centres, to each of which a special PMG technician had to be assigned. In some cases, the line needed for the broadcast was the only one available so that, once the program started, the technicians were isolated, having to rely on their own initiative and what they could or could not hear - on headphones - coming down the line.

Only in 1926, with 2FC, 2BL and 3LO in particular competing for novelty broadcasts, did on-demand landline working begin to develop its own routines for radio stations, the PMG department and their respective technicians.

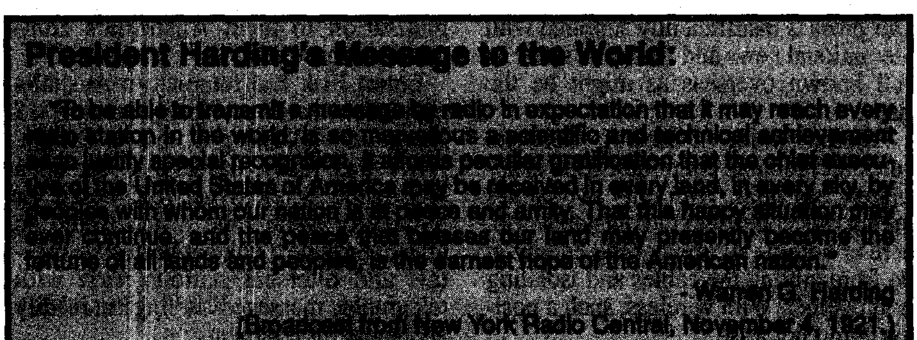
Incidentally, if you're puzzled by the above reference to the 2FC transmitter being located at Pennant Hills, Syd Newman was able to confirm that it had been moved from the original Willoughby site to Pennant Hills, where it remained for several years until transferred to the present site near Liverpool, south-west of Sydney. But, back to the original theme:

A busy year

1922 seems to have been a memorable year for Syd Newman, heralding an event which seems to have brought him more satisfaction, long term, than most others.

One evening in November, using a 6-watt transmitter based on an ordinary French-made receiving valve, he had been 'chewing the rag' with fellow amateurs in Melbourne and Sydney. This was from his home at Canterbury, Victoria, on 400 metres. In due course, he switched off and went to bed.

That was not the end of it, however, because he received a cable shortly afterwards from amateur operator Frank Bell (Z4AA) in Waihemo, New Zealand, reporting reception of his transmissions and suggesting a 2-way 'sched' for the following day. As noted in the *Evening Sun* for 16/4/22 and *Radio in Australia*

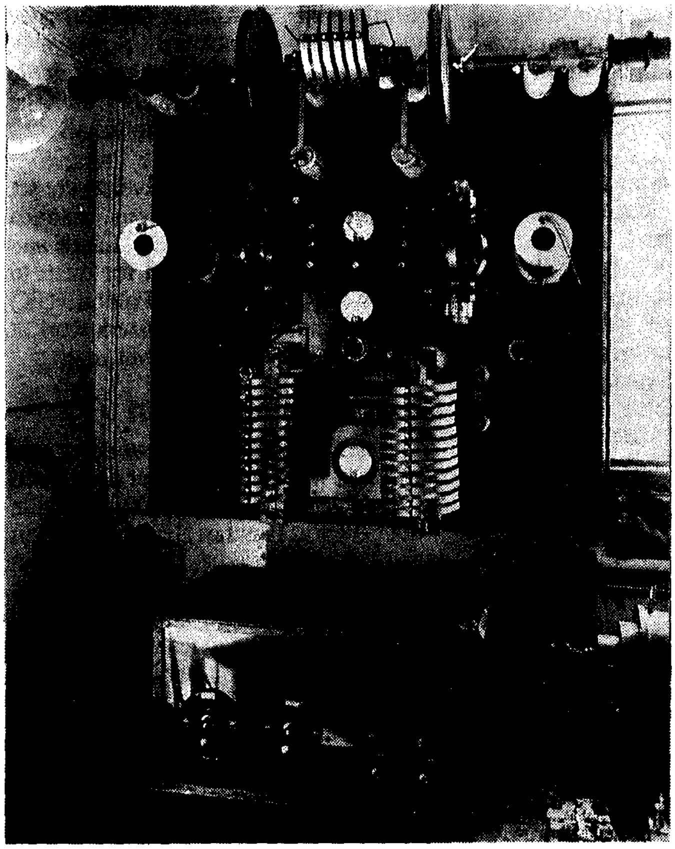


President Harding's Message to the World:

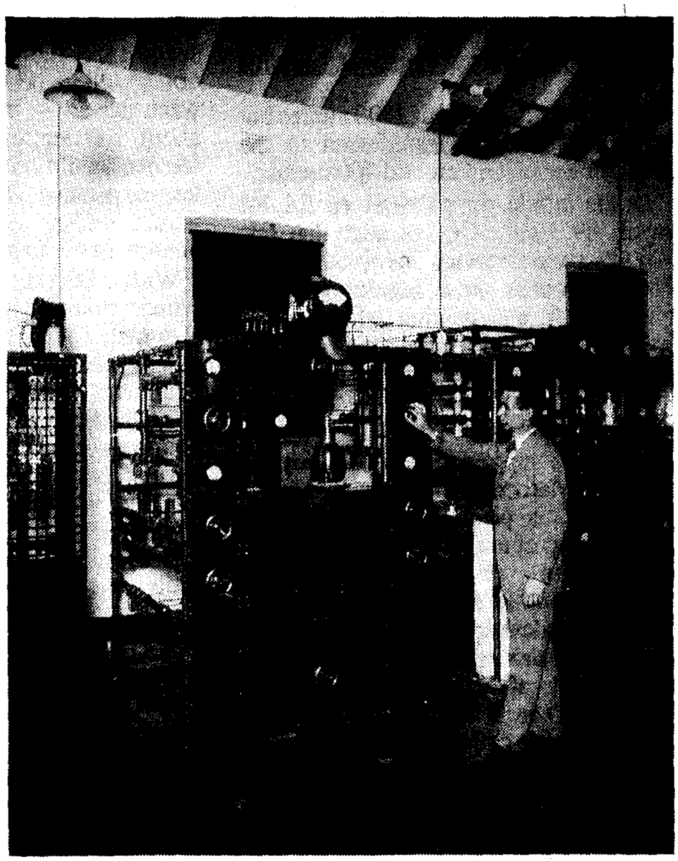
"To be able to transmit a message by radio in expectation that it may reach every radio station in the world, is so marvellous a scientific and technical achievement as to justify special recognition. [illegible] of the United States of America may be received in every land, in every city, by peoples with whom our nation is at peace and amity. That this happy situation may ever continue, and the peace that blesses our land may presently become the fortune of all lands and peoples, is the earnest hope of the American nation."

Warren G. Harding

(Broadcast from New York Radio Central, November 4, 1921.)



Designed by Syd Newman for AWA, this short-wave equipment was installed aboard the steamships 'Jervis Bay' and 'Niagara' and demonstrated its ability to contact Australia from across the world.



Syd Newman and the 20kW short-wave transmitter he developed for use at the Pennant Hills Centre in the late '20s. Used to research international short-wave communication, it also carried short-wave broadcasts under callsign 2ME.

& New Zealand magazine for 27/6/23, this was the first confirmed record of a contact by wireless telephony across the Tasman.

That it was accomplished with such low power was suprising until one reads about the antenna system at the Newman residence, as described in a lecture on his 'rig' to the Melbourne Division of the WIA in early 1923 (ref. *Radio in Aust. & NZ*, 27/6/23).

The antenna comprised two parallel 14-gauge wires, separated by 4m spreaders and supported by two 19m-tall masts 67m apart. Beneath it, as a counterpoise, two wires 10m apart were supported 3m above ground and extending 13m beyond each end. The earth cable attached to a 7 square metre zinc plate, buried and bonded to the water and gas mains and to 150m of buried copper cable radiating under the antenna and terminated by copper plates.

Not to be outdone, a picture of Frank Bell's set-up at Wiahemo shows a large lattice steel tower, three times the height of the household chimneys, supporting a festoon of aerials — one of which stretches horizontally out of the picture to some other unseen support!

The same article mentions that Syd Newman's amateur transmitter was powered by a war surplus aircraft wireless generator, obtained from the UK. Fitted with a small propellor, it had once been bracketed to the side of a WW1 aircraft and driven by the slipstream. Produced by BTH, it originally delivered 600V DC at 3000rpm and 8V for the filament circuit.

In his 'shack', Syd Newman had the option of driving it with an electric motor and pulleys or using it as a standalone converter by feeding DC to the low voltage winding.

Police radio

Another first for Syd Newman in 1922 was the fitting out of a police patrol car in Melbourne with 2-way wireless equipment. In conversation, he mentioned that it was an American Hudson — a relatively large car, noted for its power and speed.

. Mention of fast cars brought the admission from the now venerable wireless pioneer that, in his younger days, he had been a motorbike enthusiast.

Later, when he moved to Sydney, he had switched his interest to cars, his particular love having been a French de-Large. Shades of 'Braith Hull and John Moyle, former editors of this journal, who also seemed equally at home with a hot soldering iron or a hot exhaust!

Long way around

Back to wireless/radio, Syd Newman's career notes contain two other interesting entries for 1922. First off, using a direction finding loop at his home at Canterbury (Vic) he noted that long-wave signals from Europe and America seemed to follow the longer darkness path (typically 14,000 miles) rather than the shorter daylight path (typically 10,000 miles).

Unsure whether it was a purely chance observation, he said nothing about it until he was able to compare notes with one of two Marconi research engineers, whom he knew to have been using similar equipment aboard ship en route from New Zealand to Australia. One of them, Tremellyn by name, confirmed that they had reached the same conclusion.

The other 1922 entry had to do with regular hour-long Monday night broadcasts of phonograph records, which Syd Newman provided from his Canterbury home on behalf of AWA for listeners in the Melbourne area. The transmissions were originally on about 1100 metres but were subsequently transferred to the medium wave band around 400 metres.

In his article on page 51 of *EA* for April '89, Philip Geeves adds that this AWA 'Concert Service' involved playing 78rpm records on a regular wind-up phonograph, and picking up the sound from its acoustic horn on a carbon microphone. While a dubious procedure in terms of sound quality, it was rivetting to the listeners of the period.

Although supported by AWA using a 500-watt Marconi transmitter, Syd Newman took his place, in these activities with a group of amateur station operators who also provided 'wireless entertainment' in the Melbourne area in the pre-broadcasting era. Notable among them were Max Howden, C.Hiam, Ross Hull and Kingsley Love. The AWA/Newman broadcasts, by the way, were under the callsign 3ME.

In 1923, Syd Newman was despatched to the British Marconi laboratory at Chelmsford for best part of a year, to study their technology at first hand. On his way back, he visited RCA and had discussions with their general manager David Sarnoff and other RCA notables. Predictably, he was also shown over New York Radio Central on Long Island.

Short-wave bands

He recalls that, ironically, the emphasis during this whole exercise was on established long-wave technology, whereas evidence was accumulating to suggest that more effective communication would be possible on the true short-wave bands — 'below' or shorter than about 100 metres. Atmospheric interference would be less of a problem and less expensive valve-type transmitters would suffice, along with much less ponderous aerial systems.

With Marconi and his research engineer Franklin pressuring Fisk, Syd Newman found himself installed in a vacant outbuilding at the rear of a block of land at Willoughly, Sydney, on which AWA had already erected the pioneer broadcast station 2FC. (See the article on George Cookson, *EA* September 1990). His brief was to investigate and develop communications equipment for use on the short-wave band - a classic case of being paid to work at one's hobby!

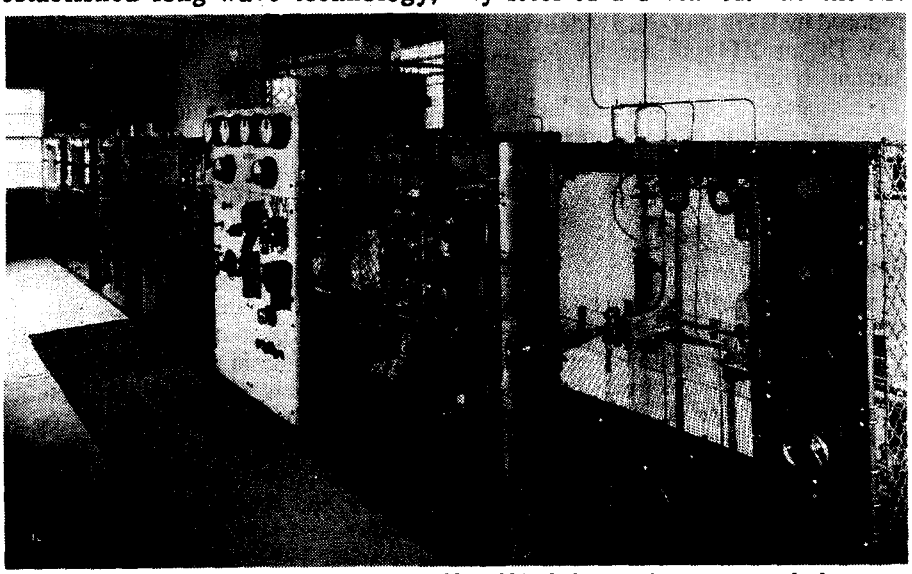
Underneath transmitter

Even so, I could not but wonder how anyone could carry out meaningful experiments within the literal shadow of a 5kW broadcast transmitter. Having in mind Syd's backround as a 'professional' amateur, I should have known better than ask. Much of the work was done late at night, after 2FC had closed down!

Some of the equipment ended up in Ernest Fisk's home at Vaucluse, Sydney, in 1924, where it was used to receive a test transmission from Poldhu (UK) on 92 metres. Subsequently further test transmissions were intercepted at Turramurra on 52 metres.

Thus encouraged, a series of messages was transmitted in code and satisfactorily received and verified. The exercise confirmed that short-wave transmissions to Australia were not only practicable, but at much lower cost than either cable or the long-wave relay system which the British Post Office wanted to install.

Looking back on those days, Syd recalls that short-wave receivers were set up at three different locations, manned by AWA engineers Burbury, Lamb and himself. It was not unusual for them to monitor the signals from Poldhu (UK) from 2 to 5am and then report for work at 9.00am as usual - without overtime!



The short-wave transmitter at Pennant Hills NSW circa 1930, as expanded to cope with a more elaborate antenna system. It broadcast a musical program to a GE station in New York in 1928 and kept in touch with the 'Southern Cross' on its first trans Pacific flight. It was also used to establish the first radio telephone service between Australia and England, in 1930.

Shortwave operation

The merit of short-wave working was confirmed when a transmitter developed by Syd Newman was installed at the AWA centre at Pennant Hills (Sydney) in late 1924. At the time, it was the most powerful short-wave transmitter in the southern hemisphere, and satisfactory reception was reported from the Marconi receiving station at Hendon (UK) and from other overseas locations.

Give or take a few modifications along the way, this was the same historic 2ME transmitter which carried the Voice of Australia to the BBC on 28.5 metres, for re-transmission throughout the UK in 1927. (See George Cookson, *EA* September 1990). In the following year, along with an up-graded antenna system, it played a vital role in establishing basic communication links between the Australian Post Office and equivalent organisations in other countries.

In the meantime, in another 'first' Syd Newman developed 500W maritime short-wave transmitters and receivers and installed them on the *SS Niagara* and *SS Jervis Bay*. Scheduled tests indicated continuous telegraphic communication all the way from Sydney to Vancouver and to London. The stage had been set for the establishment of short-wave 'beam' wireless, for a fraction of the outlay that would have been involved by long-wave technology.

Broadcast transmitters

Oh yes — and this emerged only from sudden recollection, as we talked. Along the way, he supervised the installation of 4QG Brisbane, for the Queensland Government — who were most perturbed when they discovered that he did not, at the time, hold a regular electrician's licence. Then 7LA, Launceston, to a schedule so tight that he commenced installation of the transmitter before the roof was on! He had re-equipped 3LO in the early '30s and set up 3SR Shepparton, studios and all.

That's about where Syd Newman's

Word picture of a giant long-wave station

In the immediate post-WW1 years, the US administration was concerned that, because of its geographical position, London had become the hub of cable-based international communication. Cost what it may, they were determined to secure that role for New York in terms of the new medium: international wireless.

To better mobilise the country's technical resources, the US government encouraged major companies with a potential interest in the project to pool their patents and skills for a 20-year period, and to back a joint effort under the guidance of the Radio Corporation of America (RCA). The organisations directly involved were General Electric Co, American Telephone and Telegraph Co, Western Electric Co, United Fruit Co, Westinghouse Electrical & Mfg Co, and RCA.

The long-term aim was not only to set up Radio Central in New York but to enlist overseas companies to secure cooperative expansion of the 'RCA System' of wireless communication into other countries, including those in South America.

The transmitting site, 112km from New York city was on the northern shore of Long Island, covering an area of about 15 square kilometres or 2600 hectares. On this, twelve 150-ton aerial support towers were to be erected forthwith, each about 125m tall, with a horizontal cross-arm at the top about 45m long. The foundations were to be set some 3 metres into the ground, each foundation requiring just on 700 tons of concrete.

380m apart and strung out over a distance of nearly 5km, the towers would support 16 parallel conductors (or 80km total) of 10mm diameter silicon bronze cable at a nominal 125m above ground. An earth mat underneath called for 720km of copper wire buried underground in a geometric pattern.

The ultimate plan envisaged a total of 72 towers, supporting a much more extensive antenna system in a spokewheel pattern to ensure maximum coverage.

To provide the source signals, the first of a planned ten 'power houses' (20m x 40m) would accommodate two 200kW high frequency alternators and their drive motors, together with ancillary RF equipment. An adjacent cooling pond would provide sufficient circulation through the alternators to permit continuous operation. Covering wavelengths between 20,000 and 15,000 metres (15 — 18.9kHz) each alternator system would have a potential sending rate of 100 words per minute.

Power for the station would be provided by an 11km 23kV supply line direct from a Long Island power station.

To permit multiplex operation, a complementary receiving centre would be set up 25km away at Riverhead, Long Island. Maintenance staff only were to be based at the transmitting and receiving centres. All operators would be based in a centralised control building in New York city, with permanent landlines to handle remote control functions, along with incoming and outgoing signals.

Construction commenced in July 1920, involving a workforce of 100-250 men. The first signals were radiated in October 1921 - one month ahead of the official opening.

technical tales came to an end. "Why so?", I asked.

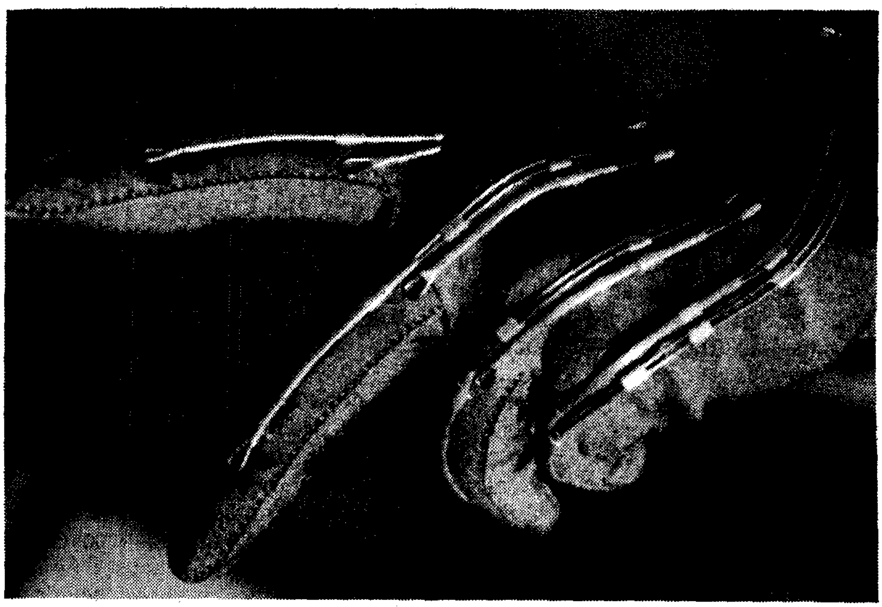
The answer was perhaps predictable. With all that background knowledge and experience, AWA management had decided that the time had come for him to exchange his soldering iron and slide rule for a Parker pen and a pin-striped business suit. He was assigned to the commercial engineering section at Head Office, finding himself in due course at 45-47 York St, Sydney, sorting out problems and tenders for professional broadcasters and communicators.

As such, our paths must unknowingly have crossed many times when I worked in the same building as a very young man, scarcely noticed amongst more mature and experienced engineers.

Syd retired in 1961 but, at age 91 he has seen one whole generation of technology more than most of his contempories - these days strictly as an observer. He plays bowls three afternoons a week and, for good measure, is a life member of Avondale Golf Club and the Lindfield Bridge Club.

It's a long time since he contrived his first 'electric' soldering iron. Tired of fiddling with a blowlamp, he recalls having contrived an electric oven from a discarded toaster, with an asbestos slider to control the temperature. I don't really recommend the idea! ■

Silicon Valley NEWSLETTER



'Cyberspace' is a term that was first coined by science fiction author William Gibson in his 1984 novel 'Neuromancer'. But Gibson's futuristic cyberspace world is now becoming a reality at the University of Washington's newly established Human Interface Technology Laboratory, set up using a US$1.4 million grant from Digital Equipment Corp. Pictured is one of the special motion sensing gloves which allows a user to interact with a computer image.

TI royalties may reach $2 billion

Texas Instruments' already substantial chip patent royalty income may be on the verge of developing into the firm's biggest source for revenue and profits, as the firm is expected to start collecting huge sums from Japanese companies which, to date, have used TI's DRAM and IC patents without licence.

On Wall Street, the price of TI stock has risen unexpectedly, on the strength of reports from Japan that TI is demanding that all Japanese chip makers pay royalties as high as 10% on every integrated circuit product they make.

Earlier last year, Japan's Patent Office, after a 30-year delay granted TI a licence for its invention of the integrated circuit. By law, Japanese chip makers will have to pay TI a royalty on the sale of every chip they make. According to some analysts, the IC patent alone could gross TI some 200 billion yen, about US$1.5 billion a year.

In addition, TI has reportedly asked about a dozen Japanese DRAM producers, including markert leader Toshiba, to pay royalties of up to 10% of the chips manufacturing value. The potential revenues from that could top US$4750 million.

Faroudja to market its HDTV technology

FCC approval or not, a small Sunnyvale company announced plans to go ahead with the marketing of a technology that vastly improves the quality of TV reception in the United States.

The technology, 'Super NTSC' improves existing standard television signal quality to the same level as envisioned by proponents of HDTV. It was developed by Faroudja Research Enterprises and has already won the endorsement of most of the largest broadcasting and cable organisations in the US.

Alfred Sikes, chairman of the Federal Communications Commission said there was little chance the FCC would adopt an EDTV (enhanced digital television) standard, such as Super NTSC. Instead the FCC is looking only at fully digital HDTV.

The FCC is not expected to select an HDTV standard until 1993 and the first products based on those standards may not reach the market until 1996 or '97. By comparison, Faroudja's system could be in production in two years and TV's incorporating the circuitry to receive SuperNTSC could be ready by 1993 as well.

According to Faroudja, his technology would add no more than about US4300 to the cost of a colour TV set, a fraction of what future HDTVs will cost. And the cost to broadcasters will also be very minimal, since the technology is based on the current standard.

In the highly competitive environment, it is expected that broadcasters will quickly adopt Faroudja's technology, allowing TV set makers to quickly realise economies of scale in the production of sets that incorporate SuperNTSC receiving capabilities.

Some analysts believe SuperNTSC will set the HDTV prospects back many years since consumers and broadcasters will no longer feel compelled to spend large sums on the expensive technology. HDTV's main attraction will be in additional features it will be able to offer.

Faroudja said it is able to go ahead with the development of its product because, unlike other EDTV and HDTV proposals, it does not need approval from the FCC to market its technology. This is because Faroudja's system is fully compatible with NTSC.

Sony confirms talks with Apple

Executives of Sony in Japan have confirmed their company is engaged in negotiations with Apple Computer, aimed at allowing Sony to produce a much less expensive laptop version of Apple's popular Macintosh computer. It would represent the first time Apple has allowed another company to manufacture its products.

The alliance with Sony is a natural

one, as Sony has been a long-time supplier to Apple of critical system components, including disk drives and the active matrix flat-panel display used in the Mac portable. The latter system, however, has failed to give Apple its desired foothold in the fast growing market for laptop machines. The system has been criticised widely for its weight and high price.

Apple currently lacks the manufacturing skills to produce a laptop that will be able to compete effectively with a majority of such systems currently on the market. Still, Apple recognises the laptop market as a critical component in the overall personal computer market.

Apparently, the discussions with Sony have only recently begun, and accelerated significantly when top Apple executives and outside board members met in Tokyo for the company's annual board of directors meeting.

So far, Apple officials have refused to discuss details of their talks with Sony. John Sculley, however, used the Tokyo board meeting to state that Apple needs a Japanese partner to achieve system miniaturisation and mobility.

Navy clears IBM

IBM did not violate any federal procurement regulations in its dealings with the US Navy, according to a report issued by Navy investigators.

Last fall, it was disclosed that Navy officials had visited an IBM training centre where they were entertained with golf and tennis. Other Navy officials had asked IBM to help out in writing a solicitation for computer equipment.

The Navy's report confirmed those and other incidents and said that those contacts with IBM were "unfortunate' and had been ill-advised. But the report also emphasised that those contacts did not constitute any criminal violations on the part of IBM.

Industry veteran to head Sematech

Sematech has announced its selection of a new chief executive to replace the late Robert Noyce. But counter to all speculation, the choice is someone few people have ever heard of. His name is William Spencer, 60, is an industry veteran who is currently group vice president and senior technical officer for Xerox. The little known Spencer will head up the most elaborate corporate venture in US semiconductor history, one that could literally determine the fate of much of that industry.

More immediately, Spencer faces the formidable task of lobbying Washington to continue its US$100 million-a-year support for Sematech. There has been a series of indications in recent months that support for Sematech is eroding, both in the White House and Congress.

Spencer comes to Sematech with reasonably strong credentials, although they pale in comparison to those of his predecessor. He was hired by Xerox in 1981 to head up IC research department at PARC (Palo Alto Research Center). In 1983, he was promoted to vice president of corporate research and development, which made him responsible for all of the company's research activities worldwide. Prior to Xerox, Spencer held upper technical management positions at Bell Labs and the Sandia National Laboratory.

While Spencer's technical credentials may be impeccable, he has never held a job in which political connections played a major role. Some colleagues, however, say he does know his way around Washington DC. "He has many contacts in Washington and in the industry. This is a big loss for Xerox," said Frank Squires, who currently presides over PARC.

Some industry observers, actually believe that Spencer's relative low profile will only help him. "If he is competent and pushes the right buttons, it may work to his advantage that he doesn't have a visible background," said Michael Borrus of the Berkeley Roundtable on International Business.

According to sources close to Sematech, Spencer was the unanimous first choice of the entire Sematech board.

Intel may sue computer makers

With Advanced Micro Devices and several other companies ready to launch cloned versions of the popular 80386 microprocessor, Intel has jumped on the legal offensive in trying to protect the "386 numbers as its trademark in computers built around the chip.

Already, Intel has filed a trademark infringement suit against AMD to prevent the company from marketing the chip as the AM386DX. Intel filed the suit after papers describing the product accidently fell into Intel hands.

Now, Intel has begun talking to computer manufacturers about the legal implications if they were to market computers as '386' systems when they are built in fact around such chips made by other vendors.

Reportedly, a number of computer manufacturers who are currently evaluating the AMD chip, are ready to replace Intel-made 386 chips with those from AMD. If they do, Intel has made it clear they will not be able to use the '386' numeric in product designations.

"When you buy a Compaq 386 today, it implies there is an Intel 80386 inside. We want it to stay that way," said Intel chief legal counsel Thomas Dunlap.

Industry observers said the 386 numbers are Intel's last line of defence against head-on competition for the 386-based systems market. If computer makers are prevented from using the 386 numbers in their product name when they use cloned versions of the chip, it would make it much harder for AMD and others to market their chips.

However, Intel faces a difficult legal battle. Its legal position has been severely weakened by its failure to even register the 286 and 386 numbers as trade marks. And Intel, to date, has never objected to the '286' designation of systems, even if they contained 80287 microprocessors made by AMD and others.

National to sell Oregon chip plant

The possibility that a state-of-the-art chip plant could fall into Japanese hands prompted President Reagan in 1987 to block the sale of Fairchild to Fujitsu. Now, the facility may fall into Japanese hands after all.

Ironically, the main who is presiding over the sale of the Puyallup, Washington plant is Charlie Sporck, who led the drive to block the Fairchild-Fujitsu merger. Sporck and his struggling National Semiconductor operation which acquired the plant as part of the Fairchild acquisition, are desperate to contain cost and prevent the flow of red ink from getting further out of control.

National says it will permanently close the plant if no buyer can be found by next May. Japan's Matsushita Electric is one of several companies that has expressed interest in the 5-building, 375,000 square feet complex. Matsushita officials have inspected the plant and are expected for another visit soon.

The decision to close or sell the plant is the result of National's move to get out of the highly competitive SRAM memory chip business. The Puyallup plant was built by Fairchild in 1982 to produce just such chips. The facility was considered one of the crown jewels in the assortment of Fairchild assets that National acquired for $120 million. ■

SHORTWAVE LISTENING

by Arthur Cushen, MBE

New radio technology makes finding stations easy

There are many of us who struggled with the old calibrated dial, tuning knob and pointer. But today the new listener can find shortwave stations either on a keypad or on a digital frequency display.

Those of us who grew up with receivers in the 1930s and '40s are well aware of the primitive frequency information on radio dials, and recall that one had to have considerable knowledge of stations in operation to find one's way around the dial.

In 1980 Sony released to the world its ICF 2001 receiver. It had a keypad and digital frequency display, memories and was a forerunner of today's communications and portable receivers. This model set the standard for the last decade, and since then almost all manufacturers have presented their new models with this type of information.

The only difficulty for the listener is they now have to learn the time and frequency on which the station is operating. If propagation conditions are satisfactory the broadcast should be heard. Gone is the guesswork of not knowing the frequency and for the visually impaired listener the keypad gives accuracy in tuning. With the inclusion of a voice chip, now available for many receivers, the frequency can also be heard.

I do not propose to look at the merits of the many receivers on the market, there are several experts in this field who have taken various models off the shelf and given an extensive analysis of its performance.

A book such as *Radio Receivers — Chance or Choice* is an excellent example of this; it gives test results for over 70 receivers, with a very unbiased approach.

When purchasing a receiver the new listener should decide in which fields he wants to listen. Interests can be in medium or shortwave, international broadcasters, or reception of utility stations or in listening to ultra high frequency stations.

To start listening a general coverage receiver is essential. This means that the receiver range is from 520 to 26000kHz, which embraces mediumwave and all the shortwave bands. The set should have the capabilitiy of single-side band (SSB) reception, and its greatest asset would have to be its *signal to noise* ratio.

If the new listener is interested in the reception of these bands he or she can move from the moderately priced portable into the field of more sophisticated communications receivers, which have a wide field of extra features.

Aerials

Portable receivers generally have a built-in telescopic aerial which gives ample signal pickup for the stronger stations on shortwave, while on mediumwave a loop aerial is ideal. When deciding on a more elaborate external aerial, space may be limited. Some mediumwave aerials are 500-1000 metres long, and are used by radio listeners in remote locations, but for the city dweller such a long wire or 'Beveridge' aerial is not possible, and you have to compromise. Sometimes interested neighbours will allow you to run an aerial across their properties to a pole further down the street.

When contemplating this type of aerial you have to decide to what part of the world you wish to tune. This is not always possible due to the direction available from your home, but generally such an

AROUND THE WORLD

ALASKA: KNLS Anchor Point schedule, which is effective until March, lists broadcasts in English 0800-0900 on 7365kHz; 1500-1600, 1800-1900 on 7355kHz; and 2000-2100 on 11700kHz.

BELGIUM: BRT Brussels, which has reverted to Standard Time, has an English programme to Australia 0730-0800 on 6035, 11695 and 13675kHz.

ECUADOR: HCJB Quito's popular *DX Party Line,* heard on Saturday 0750 and repeated at 1020UTC on 9745 and 11925kHz, now has a new compere — Richard McVicar, who has taken over from John Beck. Listeners to the Session will have also heard Clayton Howard, who was compere for 22 years and returned to Ecuador recently to take part in the programme.

GUAM: KSDA operated by Adventist World Radio is now operating in English 0000-0100 on 15610kHz; 0200-0300 (Saturday/Sunday) 13720kHz; 1000-1100 on 13720kHz; 1600-1700 on 11980kHz; and 2300-0000 15610kHz.

ISRAEL: Irael Broadcasting Authority has retimed its overseas transmissions in English and now operating: 0500-0515 on 9435, 11605, 11655, 15640, 17575kHz; 1100-1130 on 11585, 15650, 17575, 17590, 21790kHz; and 2000-2030 on 11605, 12077, 15640, 17630kHz. English is also carried 000-0030, 0100-0125, 0200-0225, on 9435, 11605, 12077kHz; 1800-1815 on 11585, 11655kHz; and 2230-2300 on 9435, 11605, 11655, 12077, 17575kHz.

SWITZERLAND: Red Cross Broadcasting Service, operated by the International Committee of the Red Cross, Geneva, uses the facilities of Swiss Radio International for test transmissions to Australia at 0740-0757.

The broadcasts are scheduled Monday December 31, January 28, February 25 and Thursday, January 3 and 31, February 28 and are carried on 9560, 13685, 17670, 21695kHz.

USSR: A contract has been signed with the United States organisation Transworld Communications to provide popular music programmes to be carried on Radio Moscow World Service. The initial broadcasts have been heard on Saturday 0300-0400 with reception on 11775kHz. Using the slogan *Mercedes Weekend,* the programme has been made up of requests from listeners throughout the world, and according to an announcement the programmes are produced in the Studios of Moscow; but the jingles and other backbround material is provided by a United States recording company. Plans have been announced to increase the programming to three hours a day and include commercial announcements.

aerial gives a great variety of incoming signals.

On shortwave there is a multitude of specialised aerials available: dipole, multiband trapped dipole, V-beam and many more. Many of these aerials are available in kitset form and are all ready to put up into the air. After this it is a matter of experimentation with different aerials to find the type which matches your receiver and gives the best overall results.

An excellent publication covering modern receivers both portable and communication types is the *Receiver Shopping List*, a 56-page booklet which is issued free by Radio Nederland, PO Box 222, Hilversum, Holland JG 1200. This publication covers the main points on the many receivers listed and also the prices in various countries of the world. The *World Radio-TV Handbook* also gives details of various types of build-it yourself aerials.

A Grundig 650 communication receiver is typical of a modern radio with keypad tuning, memories and a digital readout showing the time and frequency.

HCJB tests on SSB

Test transmissions are being carried out by HCJB in Quito, Ecuador, using single-sideband transmissions.

Four frequencies are being used: 15155, 17790, 21460 and 25950kHz. The testing is being done on an antenna directed to Europe and the South Pacific. The three lower frequencies use a Rhombic and the higher frequency a folded dipole.

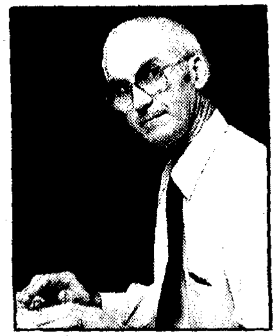
The transmitters were purchased from the Swiss PTT at a low cost, and had been used from about 1970 to communicate with aircraft in flight. But since the introduction of satellite, four of the seven SSB transmitters have been sold to HCJB. The power of each transmitter is 30kW and signals are beamed to the South Pacific from 0000-1500UTC, with best reception at 0050 when the English programme Studio 9 is heard.

The station is interested in reception reports of these transmissions, which will be carrying the normal HCJB programming and reports should be sent to: HCJB, PO Box 691, Quito, Ecuador. ■

This column is contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand, who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT), which is 10 hours behind Australian Eastern Standard Time.

FORUM

Conducted by Jim Rowe



Can you modulate the amplitude of a carrier without making sidebands?

I sense that at least some of our readers are starting to lose interest in the subject of fancy audio cables, and are perhaps also close to that stage with the topic of ELCB's and electrical safety. So this month we're tackling a new subject for a change — or more strictly, revisiting a hardy old perennial.

A long time ago, in the dim distant 1950's, when I was a lad in my final year of high school, I decided to study electronics engineering — so I would be able to understand how all that fascinating and complex equipment worked. Why, with a bit of luck I might even be able to design things myself!

Well, here I am over 30 years later with years of study and a fair bit of experience under my metaphorical belt, and sometimes I think that dream of understanding electronics is still just as far away as ever. As fast as I've tried to learn the technology, it has galloped onwards and upwards — with just as much of it forever out of my grasp, it seems. In fact as time goes on, the number of areas in electronics I seem to be able to keep up with seem be getting fewer and fewer...

I guess many people in electronics have had the same experience. It probably isn't limited to electronics, either; I suspect people in many other areas of engineering have the same difficulty keeping up, along with scientists and medicos.

One of the things I *have* learned, though, in these last 30 years or so is that quite often it's the absolute BASICS of electronics that are the most elusive, in terms of understanding. And much the same seems to apply to physics, as well. Consider the electron, for example; along with the other sub-atomic particles, it now seems more abstract and harder to understand than ever.

In fact when you get down to the absolute basics, it seems there's very little we *do* understand, in the traditional sense. What really *is* an electric field, for example, or a magnetic field? Why *does* energy propagate outwards from a source, in the form of electromagnetic radiation? Why do carriers diffuse throughout a semiconductor crystal?

Of course we have various equations and mathematical 'laws' which allow us to predict *what* happens in situations like an electron moving in an electric or magnetic field, but when it's all boiled down we still don't seem to know *why*. So our understanding is really still quite limited, in many ways.

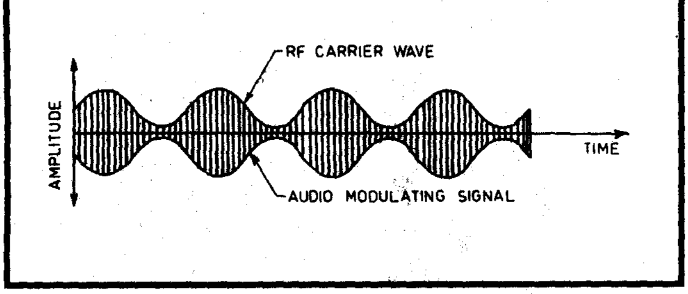
But enough of this philosophising. What actually prompted me to ponder along these lines, as you might guess, was the arrival of a letter from a reader — Mr Peter Fox, of Mudgee in NSW. And the subject raised in Peter's letter is that of *amplitude modulation* or AM, a pretty basic technique that has been used in radio transmission for at least 70 years.

You'd think AM would be well understood by now, wouldn't you? Maybe so, but Peter Fox admits that he doesn't understand it, and I'm sure he's not alone. In fact I'll bet an awful lot of our other readers don't really understand it, either — that's why it seems a good idea to discuss it here, this month.

Let's start the ball rolling by quoting from Peter's letter, which expresses his problem quite clearly:

My purpose in writing is to open another hole in that can of worms, the question of sidebands in radio transmission.The standard explanation of (AM) *radio transmission shows a carrier wave being acted upon by an audio signal, so that the carrier's amplitude varies, to follow the audio signal — hence the name 'amplitude modulation'. Fig.1 shows the usual representation.*

It has been pointed out to me that the process is really not like that at all. What really happens is that the carrier amplitude varies little, if at all, and plays no part in the conveying of the audio information. Two copies of the audio signal are contained in the upper and lower sidebands, the result of heterodyning the audio frequencies with the carrier frequency. The carrier and one sideband are quite redundant, and are actually a



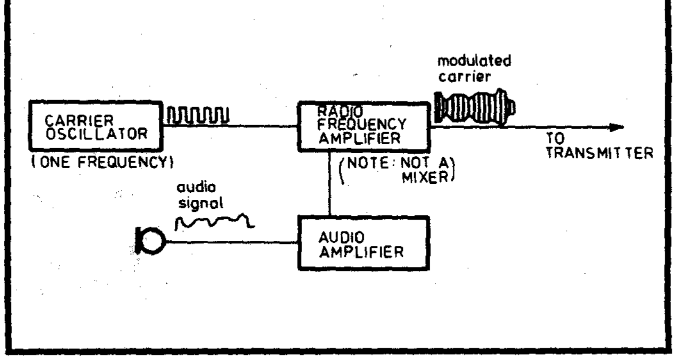
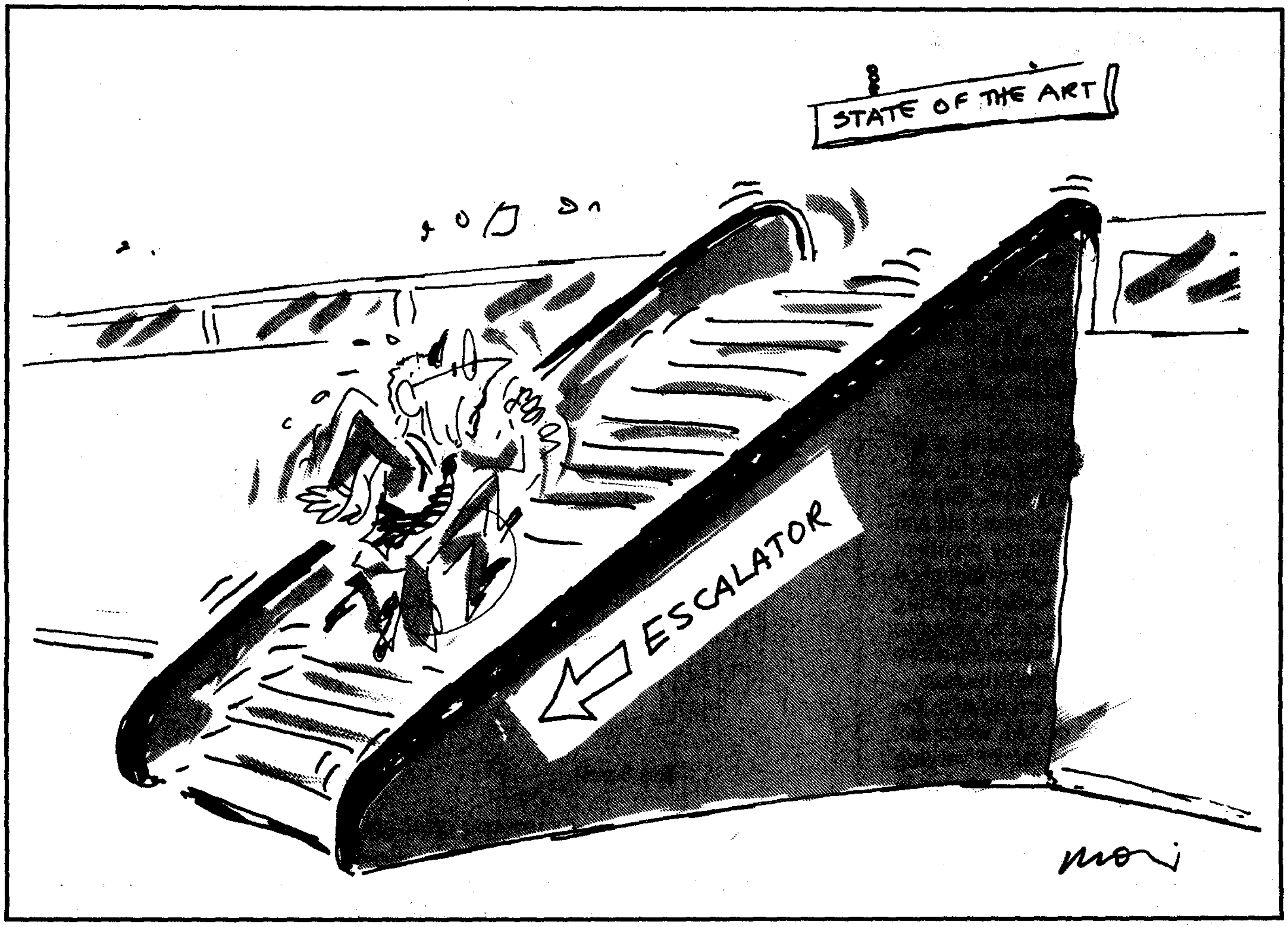


Fig.1 (above): An AM signal, as conventionally drawn. Fig.2 (right): Peter Fox's suggested 'no sideband' transmitter.



waste of energy — which is why 'single sideband, suppressed carrier' transmission is so effective in achieving long range. The available energy is concentrated where it is most needed.

Well, that's what I've been told. My question is, could a circuit be designed that works according to the first theory? A circuit that forces the carrier wave to vary in amplitude as required, and which suppresses any sidebands that may be generated, because they are not needed. The sort of thing I have in mind is shown in Fig.2.

Consider the following example. A CW transmitter generates a single frequency, the carrier. This is gated on and off by the Morse key. If the key were operated to send a rapid series of dots, the transmitted signal would be a series of pulses of carrier wave. In other words, the carrier would be 100% modulated by a square wave, at a frequency of several hertz, as shown in Fig.3.

Now, imagine replacing the Morse key with a circuit which can switch the carrier on and off at any rate we wish. We could then modulate the carrier with square waves of higher frequencies — 50Hz, 100Hz, 1kHz or whatever. If this process generated any sidebands, they could be filtered out before transmission, as they would not be needed. The carrier wave itself would contain the information.

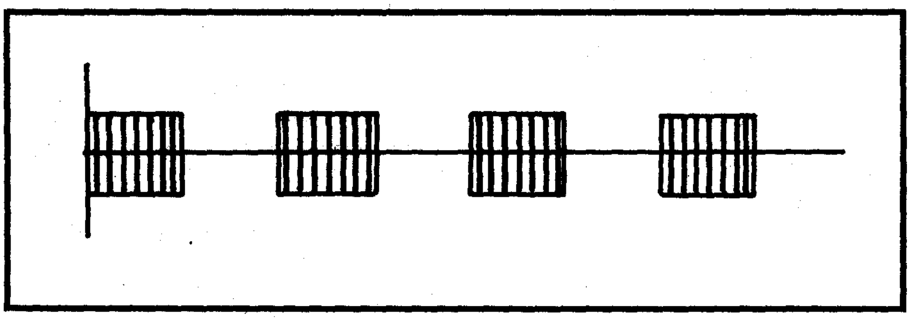


Fig.3: A CW signal consists of pulses of carrier — effectively 100% modulation by a square wave. Reader Peter Fox asks: Isn't this still just one frequency?

This does not apply only to square waves. The carrier could be altered by any type of signal we wish to impose upon it, to any modulation depth. And the only radio frequency involved is the frequency of the carrier wave. Any others produced by heterodyning could be suppressed. The carrier would convey our signal by its varying amplitude, without the need for sidebands. In short, we would have the situation described in Fig.1.

Is this all a lot of rubbish? Have I missed something crucial? Alas, I fear I shall be shot down in flames, by you or one of my knowledgeable fellow readers.

But if there is something in what I have suggested, a transmitter like that could be a real boon to a weary amateur, trying to find a suitable gap in a crowded band.

Well now — how many readers can give Mr Fox absolutely confident answers to the points he raises? No cheating by looking it up in a textbook, now; surely you understand such a basic concept as amplitude modulation?

Jokes aside, Mr Fox has of course

raised a subject that has caused much head-scratching over the last 70-odd years, by countless engineering students and would-be radio hams. And I venture to suggest that there's quite a few qualified technicians and radio hams out there who *still* don't understand AM (let alone FM, SSB or phase modulation!).

The fact is that like many other basic concepts, when you get down to it AM is *not* simple and straightforward. It can be surprisingly hard to explain and understand.

Now I'm not claiming to have a full and complete understanding of the subject myself — particularly now, with my electronics degree some 26 years old and fading rapidly (along with my recollection of much of the theory I ploughed through to get it!). But without delving back into the theory books, I'm going to have a go at explaining where I believe Peter Fox has gone a little off the rails.

Firstly, there's nothing wrong with the traditional explanation of AM, which has the amplitude of the RF carrier varying up and down with the audio, as shown in Fig.1. This is in fact exactly what happens, as you can readily verify if you look at the output of an AM transmitter with a 'scope. But by the same token, there's nothing wrong with the other explanation, either — it's also right!

How can this be, you ask? Well, they're actually two different ways of looking at and describing the same phenomenon. When the amplitude of an RF carrier is modulated, as shown in Fig.1, it no longer consists of a signal having a single frequency; in effect, it 'spreads out', with additional *sideband* frequencies appearing on either side of the original carrier and separated from it by the frequency or frequencies of the audio modulating signal.

If the carrier has a frequency of 1MHz, for example, and the audio signal is a sinewave with a frequency of 5kHz, there will be just two sideband frequencies, with frequencies of 995kHz and 1005kHz.

The amplitude of these sideband frequency signals depends upon the degree of modulation, as you'd expect; the higher the modulation, the larger the sideband signals. For 100% modulation they each have a peak amplitude of 50% that of the carrier, corresponding to 25% of the power.

So if you look at a carrier modulated by a sinewave signal using a 'scope, you'll see a waveform like that of Fig.1. But if you look at the same signal with a spectrum analyser (at the same time, if you wish), you'll see something like the sketch of Fig.4(b) — there are now *three* signals, with the carrier in the centre.

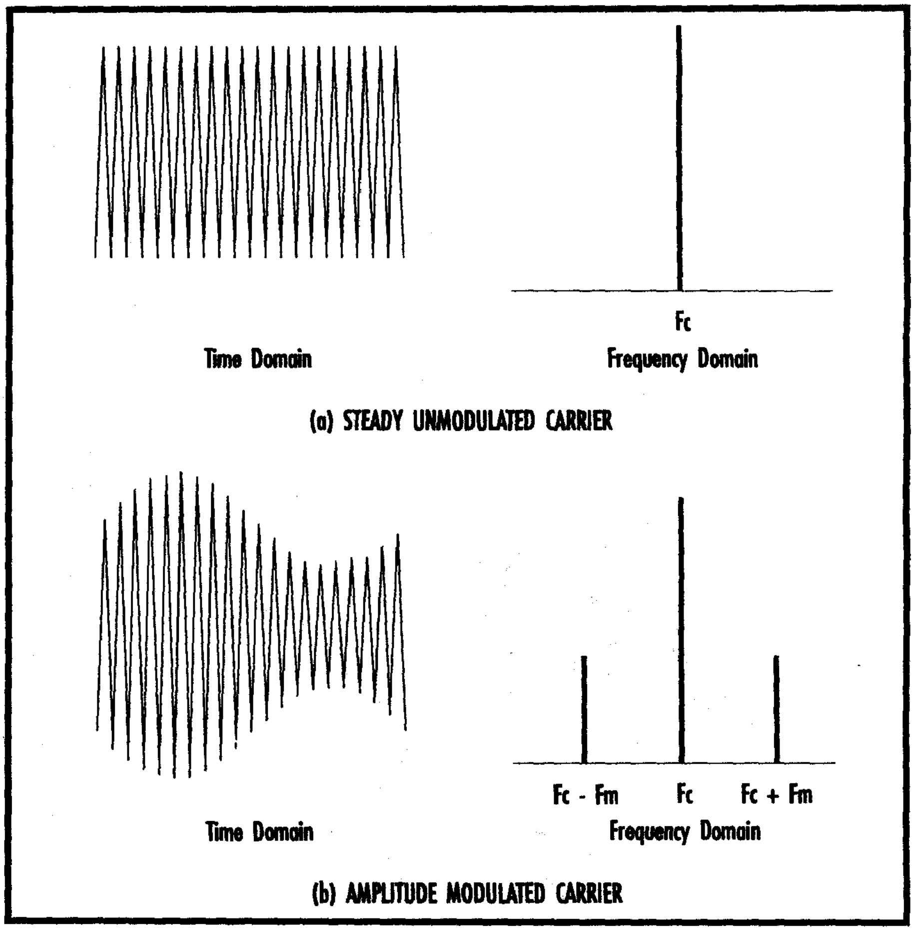


Fig.4: Time domain and frequency domain representations of (a) an unmodulated RF carrier, and (b) an amplitude modulated carrier. Note the latter's sidebands.

The point to grasp is that in both cases, we're still looking at the same signal, but in different ways. The 'scope is showing how the overall modulated signal varies in amplitude, with time, whereas the spectrum analyser shows that now it's actually made up of not just one signal at a single frequency, but three.

It's usual to describe Fig.1 as showing our signal in the *time domain*, while Fig.4 shows it in the *frequency domain*. Fig.4(a) shows the frequency domain view of our unmodulated carrier, for comparison.

At risk of labouring the point, BOTH of these ways of looking at the modulated RF signal are correct. That's because the very act of varying the amplitude of our RF carrier actually *creates* the additional sideband frequency signals or 'modulation components', whether we like it or not. You actually can't achieve one without simultaneously achieving the other, because they're really just the 'opposite sides of the same coin'.

At this stage I almost hear Peter Fox interjecting: Surely if we start with a pure sinewave RF signal, at a single frequency, and simply vary only its amplitude, without any mixing or heterodyning, how can this produce those additional frequencies?

The answer to this is that 'simply varying its amplitude' in a cyclic fashion is inevitably changing its shape, from that of the original pure and steady sinewave. And because of that changing shape, some parts of the sinewave will end up with a higher rate of change than before (corresponding to a higher frequency), while other parts will end up with a lower rate of change (corresponding to a lower frequency). So we end up introducing higher and lower frequency 'components', as a direct result of varying the amplitude.

What this actually means, by the way, is that in theory there's *no real difference* between amplitude modulation and mixing or heterodyning. An amplitude modulator is simply one kind of mixer.

If our modulating signal is a pure sinewave and we don't modulate to more than 100%, it turns out that we create only TWO additional signal components

— one on each side of the carrier, and separated from it in frequency by the frequency of the modulating signal as shown in Fig.4. But if our modulating signal contains many different frequency components, a whole BAND of side frequencies will be created — the *sidebands*. Each frequency component in our modulating signal will produce a corresponding pair of side frequencies, with amplitudes proportional to their original audio amplitude.

Carrier redundant?

Now if you look at the frequency domain picture of such an AM signal, using a spectrum analyser, you'll see that as the audio modulating signal varies in amplitude and frequency, the signals in the sidebands similarly 'dance around' in both amplitude and frequency. But the carrier signal component effectively stays constant, in both frequency and amplitude.

If you looked even closer, you'd see that the sidebands always vary together — mirroring each other in terms of both amplitude and frequency (but not phase).

Does this mean that the carrier and one sideband are really redundant? Yes and no; it depends on how you look at it.

If you want to maintain the waveform shown in Fig.1, you need both the carrier and the two sideband components. They're all needed, if you want keep the 'simple' amplitude-modulated RF carrier. In fact if you filter out or otherwise remove the carrier, you're left with a signal which in the time domain looks like that shown in Fig.5.

You also need the carrier and at least one sideband component if you wish to receive and demodulate the signal using a simple rectifier-type detection system.

It's true, though, that if you simply want to convey the original modulation information from A to B, in the most efficient possible way in terms of both power and bandwidth in the RF spectrum, you really only need the components in one sideband. Since the carrier component doesn't vary in amplitude or frequency, it doesn't in itself carry any of the modulating information — acting more as a frequency reference. And the information in one sideband component is essentially a mirror image of that in the other, so that only one is strictly necessary. In this sense, then, the carrier and the second set of sideband components *can* be considered redundant.

Note, though, that to actually recover the original modulating signal from such a single sideband component, you have to mix it in the receiver with a steady sinewave signal from a beat oscillator — effectively 're-creating' the original carrier, or a substitute for it. That's exactly what is done in the demodulation circuitry of SSB receivers.

Can't be done...

Getting back to Peter Fox's letter, the answer to his first questions is therefore no. You can't design a circuit which only varies the amplitude of the carrier, without producing sidebands, because varying the amplitude *automatically* produces sidebands. And if you try cancelling, suppressing or filtering out the sidebands, you'll find that you no longer have your modulated carrier. In fact if you were successful in removing all traces of the sidebands, you'd be left with an unmodulated carrier again.

The fact is that an RF signal which has only a single frequency component must by definition consist of a pure sinewave of constant amplitude. And also by definition such a signal cannot carry any information, except by its sheer presence. Or looking at it the other way, any method we use to modulate the RF signal so that it can convey information, will automatically cause the generation of sidebands.

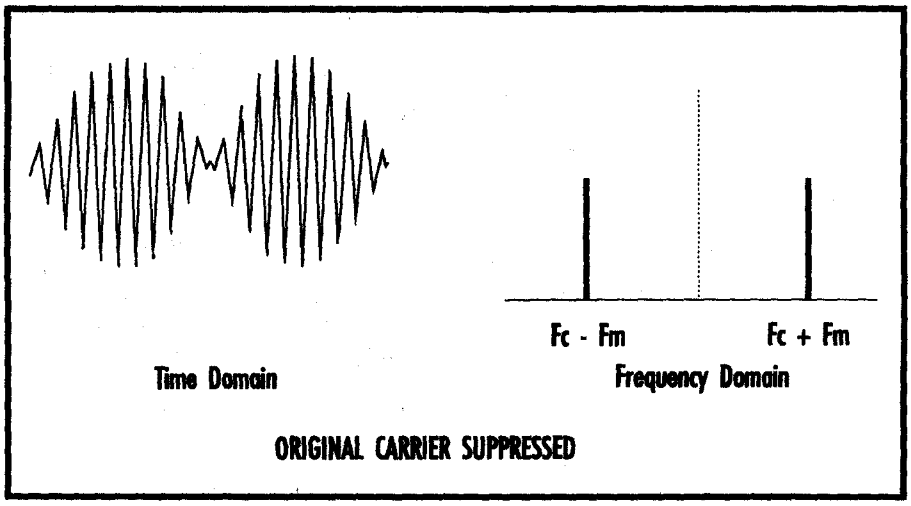


Fig.5: What happens to a normal AM signal if we filter out, or otherwise remove the carrier. You can't demodulate such a signal using a simple diode detector.

What about CW?

At this stage you're probably wondering how this all squares with Peter's example of a keyed CW transmitter. Isn't this a case where a single RF carrier, on just one frequency, is used to convey information by keying it on and off — effectively modulating it to a depth of 100%, with a square or at least rectangular wave?

Sorry folks, but it isn't. The very act of turning our RF carrier on or off generates sidebands, because it generates waveform changes that are far more rapid than those in our original pure and steady sinewave. So every time we key the carrier on or off, we generate 'blips' of sideband information on either side of the carrier information. They're usually called 'key clicks'.

How many sideband components are generated during each key click depends upon how rapidly we attempt to key the carrier on and off. In fact if we could key it on and off *instantaneously*, using an effectively 'perfect' rectangular wave, we would create an INFINITE NUMBER of sideband components, extending right across the spectrum every time we pressed or lifted the key!

Just as well we can't do this, wouldn't you say?

The 'key-click' filter fitted to most CW transmitters is designed expressly to prevent the generation of significant sideband components, and it does this by *slowing down* the on and off transitions. This produces bursts of carrier as shown in Fig.6, with much more rounded ends than those in Peter Fox's suggested pulses of Fig.3.

Note that even *with* such a key click filter, the CW transmission will still contain sideband components. They mightn't extend very far either side of the carrier, but they'll still be there.

Why can't you slow down the keying transitions still further, *until* the sidebands disappear? For the same reason as before, really. The sidebands would only disappear completely when our transitions were infinitely slow — in other words, when we were no longer keying the carrier at all. It would be a steady sinewave, which by definition can convey no messages.

So CW transmission is no exception to the rule. If you want your RF carrier to convey information, you're stuck with sidebands.

Fairly obviously, the filtering used in a key-click filter must be a compromise. If it softens the keying transitions too much, our bursts of carrier will rise and fall too slowly to convey the desired information; on the other hand if it doesn't slow down the transitions *enough*, the keying sidebands will extend out far enough to interfere with other spectrum users.

What about Peter Fox's other idea, of filtering out any sidebands that are produced by the keying?

Sorry to disappoint you, Peter, but this has almost exactly the same effect as slowing down the keying transitions. because CW signals only involved one frequency anyway...

But in reality a CW signal has to obey the laws of nature, just like any other signals with modulation. And in this case, the law concerned says effectively that if you want to use the carrier to convey information, this will inevitably involve the generation of sidebands. It also says that the more information you want to convey, in a given time, the more sidebands you'll generate in doing it.

The fact that a fairly narrow bandwidth can be used for CW transmission and reception — say 500Hz or so — is basically just because CW generally involves a fairly low data transmission rate, compared with voice, data or TV image transmission. But if you speed up the data rate, more bandwidth will be required.

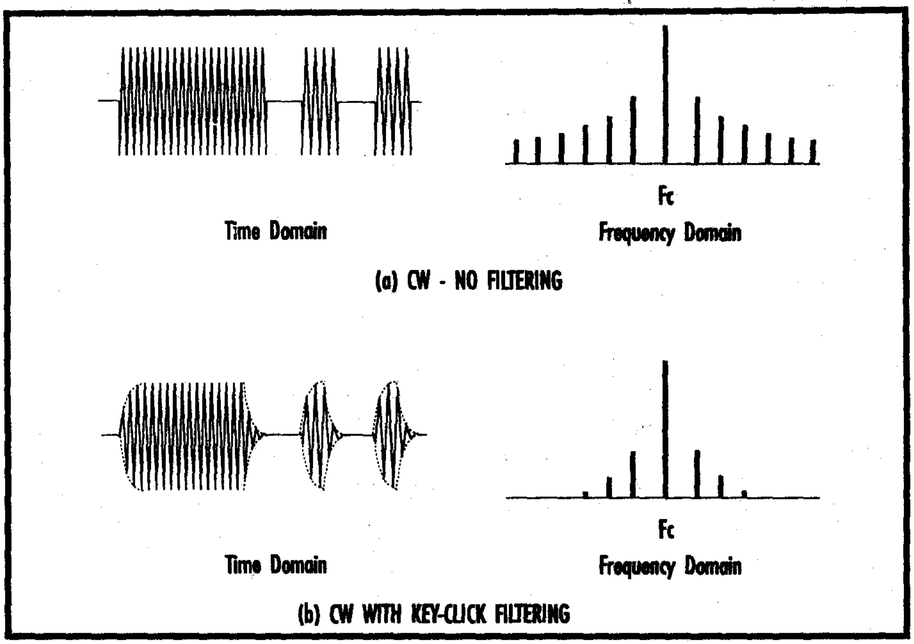


Fig.6: CW signals, both unfiltered (a) and filtered (b), in both domains.

You can certainly filter out the sidebands, but doing so inevitably gets rid of the keying as well. In fact if you could filter out the sidebands completely, you'd be back to a steady carrier.

Incidentally this explanation may surprise some of our older readers, because the traditional view of a CW transmission is that it *does* effectively involve only a single frequency, which is simply keyed on and off. In other words, it has been common to consider a CW signal as occupying 'zero bandwidth'.

Many receivers designed in the past exclusively for CW reception were given extremely narrow IF filters, often using a quartz crystal — on the basis that the narrower the receiver's selectivity curve, the better. You couldn't have the bandwidth too narrow, it was believed,

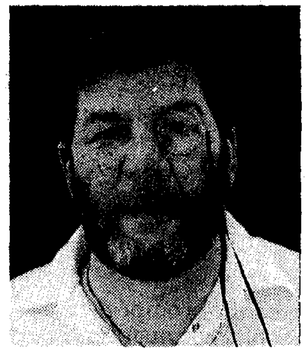
I hope that explanation clarifies the situation, Peter. Hopefully it will have been of interest to other readers, too. Personally, I always find it very interesting to look again at the so-called 'basic principles' — perhaps because when you do, you quite often find out how little we really know!

Perhaps there are similar topics that other readers can send in, for us to examine together. If so, please let me know. I won't always know the answers, but hopefully I'll know where to find them out.

Next month we'll look at another new topic. We'll also look at some further letters that have turned up on the subjects of fancy audio cables and electrical safety, before we put them aside — at least for a while. ■

Moffat's Madhouse...

by TOM MOFFAT



Stopping war the easy way

Here we sit, day after day. Watching the news, listening, wondering — has war broken out yet? By the time you read this, a full scale war may have already started in the Middle East. Maybe it is/was a short, sharp war. Maybe we are all dead, in which case you won't be bothering to read this. But the most likely situation will be just like it is as this is being written: Saddam Hussein and George Bush puffing their chests out, posturing and strutting up and down like a couple of irate peacocks. The tension eases one day, it's on again the next.

Both sides have the ability to wage the most technological war in history. A press of the button: boom! you're dead. The other side retaliates with the press of another button: BOOM! the world's dead. It really curdles the blood to see the many ways that have been devised for killing each other. And even more time and energy has gone into killing the things that kill us... destroying the destroyer.

What's this got to do with electronics? You'd be surprised how much. Just about all of this modern war-making technology is based on techniques you've seen in this magazine all along. In the first instance, video. In September 1990 the hostilities in the Middle East were being thrashed out with rolls of videotape.

Bush started it, sending a taped speech to Iraq and demanding that it be played on television, un-edited, to explain the American position to the Iraqi people. Hussein retaliated with a tape of his own, with the same demands, only his ran something like an hour and a half. It reminds one of that television series *The Hitchiker's Guide to the Galaxy* in which the bad guys, the Vogons, tortured their enemies by reading Vogon poetry at them. The pain was caused by sheer boredom, but at least the technique was relatively harmless. So are Bush and Hussein's videos.

If things really get bad, will Iraqi soldiers fight off American aircraft with anti-aircraft guns shooting shells — bam-bam- bam? Possibly. Or maybe they have access to the latest destroyer — a laser beam. You may remember projects in *EA* in the past: Build Your Own Laser. Just think what happens if you scale that up.

In Albuquerque, New Mexico, in the USA, one of the biggest industries is defence research, carried out at facilities much like the one at Salisbury in South Australia. It is reported that at one of these facilities, Kirtland Air Force Base, scientists managed to shoot a target aircraft clean out of the air by zapping it with a laser beam from the ground.

I have seen photographs of this test. The target looks more like a large model of the type hobbyists build than a full-sized aircraft. But still, it's a pretty impressive feat, and the photos show the motor and fuselage being severed from the rest of the plane just forward of the wing. Zap!

The lasers amateurs play around with deliver powers in the order of a few milliwatts. The one for zapping airplanes would be somewhat bigger: a gas laser with a continuous power rating of around 15kW. If you incorporate this at the focus of a large telescope and then use the telescope backwards, for sending instead of receiving light, you've got your death ray.

It's interesting to note that a similar device was at one time being developed at the University of Tasmania for lighting 'controlled burn' bushfires from a distance. This truck-mounted gadget was announced publicly with much ballyhoo several years ago, but it seems to have gone back into obscurity for the time being.

Particle-beam weapons

Another war-making nasty is the particle-beam weapon. This is basically the electron gun from a television picture tube, scaled up. In a TV set, the electron beam is focussed magnetically and then accelerated by high voltages to make it impinge on the phosphorescent screen, with enough energy to make it glow. In a particle beam weapon the beam is both focussed and accelerated magnetically — making a person glow.

Whereas a high-powered laser can destroy something by sheer light energy, a particle beam device sends physical chunks of matter, electrons or protons, right into the target material.

The particles have their own little magnetic fields and they can physically tear apart the atoms of the target matter. They lose energy as this goes on, and the energy transfers to the target material as heat. So the target gets hit with a smashing shock wave, which disassembles its atoms and heats it violently at the same time. Boom!

Latest reports suggest that scientists haven't actually shot anything down yet, but serious efforts are being made in that direction via a research program called Project White Horse.

Shooting things down is a much publicized use for these 'death rays', but what about limited use on the battlefield, as in the Middle East. What would happen if you got one of these gadgets like Tas Uni's fire-starter and started blasting foot soldiers with it? The result would be too hideous to even think about.

And if they got the particle beam thing going, what about that as an anti-personnel weapon? You point it at a soldier, jiggle his atoms a bit, heat him up, and he's instantly discombobulated. Does this sound sick, is it offensive to you? Well it *is* sick, my friends, but that's just where we're heading.

This whole business is science fiction come to life. Or death. People should start thinking of ways to put a stop to it. But they won't; this time the world's oil is at stake. Next time, who knows. Yes, science fiction — if we can't stop it, maybe somebody else can.

In 1952 or thereabouts, there was a movie made called *The Day the Earth Stood Still.* The film was full of 'firsts' and it's now considered a true classic. It's finally come out on video, and I suggest somebody sit both Bush and Hussein down in front of their tellies and make them watch it.

This was the time in history of the Cold War, anti-communist witch hunts, Reds under the beds and lots of sabre rattling. I remember as a little tyke in school, being made to hit the floor every morning and practice personal defence against nuclear attack ("Cover your eyes!"). We really did think we were going to get nuked, and the potential was certainly there.

This was the climate, then, when I went to the Saturday afternoon flicks to see *The Day the Earth Stood Still*. Soon after the cinema lights went down, a big flying saucer came in to land in a park in Washington, D.C. Then it just sat there. All the people came to look, and the Army came, and it still just sat there. "What is is? A secret weapon from the Russians?" The soldiers drew their guns, and the people waited, and the flying saucer just sat there.

Some time later, after tension in the park, and the cinema, had built to breaking point, a slit opened in the flying saucer and a ramp slid out and down to the ground. Then from the wide slit emerged this most gigantic and frightening robot, and would you believe, his name was Gort! His body was the prototype for screen robots to come, right up into the 1990's, and that name 'Gort' — how many times has that been used since?

When the people saw Gort stomping out along that ramp, they cowered. The soldiers cowered too, and made threatening gestures with their guns. And in the cinema, 500 young boys dropped their popcorn and lollies and threw their arms around each other.

Gort took note of the soldiers' threatening gestures, and he stopped. Then this visor thing over his eyes began to open, reeeall sloowwww...

There were no eyes, just this kind of lens — pulsating, threatening, deep red. It was a black and white film, but we knew that pulsating eye was red anyway, it just had to be.

Full-grown boys, eight, 10, 12 years old, brave boys, heroic boys, macho boys, warriors of the future, a cinema full of them, all got quivering lips. "What's he going to DO?!'. Some couldn't take it and hit the floor behind the seats. Others were simply too scared to move. What Gort DID, after all that, was shoot this sizzling ray at the soldiers. He didn't hurt the soldiers, but he vaporized their guns. First lesson of the day: Soldiers are probably OK, but their GUNS are bad.

Gort was followed out of the saucer by a man in a silver jump suit, named Klaatu. This guy looked like a man, not an alien, with a very distinguished nature. His first act on planet Earth was to perform the very first "Take me to your leader" routine ever seen on film. But he didn't want just one leader; he wanted ALL the world's leaders, together.

Needless to say, the request was denied, and Klaatu was captured. He was taken to the medical center for study; he escaped, he went on the run, he found the romantic lead girl, and he found a friendly sensible scientist. Klaatu finally got the message across that the rest of the universe was sick of all this silly war-mongering on earth. He wanted a word with the World Leaders.

The scientist finally teed up a meeting, right at the saucer, and interestingly enough, many of the assembled leaders were women. This was in the days when such a thing was unheard of. One of the ladies even looked a bit like the future Indira Ghandhi.

As Klaatu and the girl made their way to the meeting, the cops shot Klaatu. Well, that's it, Gort is going to do his metallic block and everybody's going to die. Especially all the kids in the cinema. But no, in his dying breath, Klaatu gives the girl a message for Gort, in his own tongue, and I remember it to this very day: "Klaatu varada nictu".

When Gort saw what the earthlings had done to his boss, he decided to crush the one responsible, the girl. But as he approached, she saved the world with the words "Gort! Klaatu varada nictu!". Well, that stopped him in his tracks; he collected the dead Klaatu, and the girl, and trundled them into the saucer. After a bit of quick hocus-pocus Klaatu came good again, and he went back out to address the World Leaders after all.

The general thrust of it was "If you don't stop trying to destroy the earth with all your fighting, we'll come down and destroy it for you". Klaatu then waved bye-bye to the girl, hopped back in his saucer, and went.

In the cinema, 500 teary-eyed, white-faced boys picked themselves up and marched out of the place, stunned. We all knew the score now: "If you mess up the world, Gort's gonna come down here and get ya!"

That was perhaps history's first anti-war film. The message hit me hard, I've remembered it all my life. But maybe George Bush and Saddam Hussein were too old for that sort of thing when the film came out. It's good it's out on video now; it's time for a re-run.

Come on, Gort old mate, get back down here. Earth needs you now, more than ever! ■

THE SERVICEMAN

Battling a pair of 'cranky' Ranks

Trying to track down and fix a fault in equipment as complex as a colour TV set sometimes seems to become a battle of wits, with the set fighting you all the way. This is particularly so when the fault is one of those dreaded 'intermittents', appearing and disappearing unpredictably. Here's just such a tale, together with one about a similar set which also caused much head scratching.

I've just finished fighting with a Rank Arena model C1412, an old 14" portable colour TV. The battle raged on and off over four days and although I eventually won, that set went down heroically and I never want to see another like it. again.

It all began when a lady brought it in, with the comment that it continually switched itself off. They could sometimes restart it by banging on the cabinet, but at other times it could only be restarted by switching off and waiting until the set cooled down.

This had been happening intermittently for three years. To begin with, it only failed once a week or less, but the problem had been getting worse and had reached the stage where it failed two or three times every night.

In recent months they had tended not to use the set very much, but now her husband was bedridden with a broken leg so the set had been brought out of semi-retirement. However he could not get up to restart the set when it stopped, so understandably she wanted it FIXED — once and for all.

As is the way with these intermittent troubles, the set played *flawlessly* for all of its first day in my workshop. I didn't doubt the lady's veracity, but the first round definitely went to the Rank!

Things were somewhat better the next day, because the set failed within 15 minutes of start-up. I found that I could reset it almost immediately, after which it ran for an hour or more before tripping off again.

This continued for most of the second day, with the set waiting until I was looking somewhere else before it shut down. It wasn't until the third morning that I actually saw the failure.

I had already formed some idea of what the fault was, but I wanted to see it happen before I got down to battle. Besides, there were a dozen other jobs ahead of this one, and although I sympathised with my customer's husband, I couldn't justify making other folk wait.

So, by the third afternoon, I was ready to attack.

The way the set shut down suggested to me that it was a failure of the drive to the line output transistor. The picture collapsed to a vertical line, whereas switching off the power caused the picture to collapse to a horizontal line.

I've seen this kind of trouble before, when it turned out to be a dry joint on the primary side of the line driver transformer.

(Most dry joints are associated with connections that carry moderate to heavy current, so these problems are rare on the secondary side of the driver tranny. I've only ever found one, and that was associated with a shorted line output transistor.)

The dry-joint theory was reinforced by the owner's comment that they could sometimes restore normal operation by thumping the set. That treatment wouldn't work for me, but at that stage of the job that meant nothing.

With the back off, I was confronted with a typical Rank portable - a main board across the bottom of the cabinet, power supply on the left, vertical scan board mounted vertically on the right with the line output transformer above it on a metal frame.

Removing the cabinet back had exposed about two thirds of the main board and with it the line driver transformer.

Round two to the Rank! There was no sign of a dry joint on the transformer, or anywhere else that I could see.

From this point I could do nothing without the circuit diagram, so I dug it out of the file and spread it on the bench. It showed a fairly conventional line output stage, with nothing that was an obvious cause of the trouble.

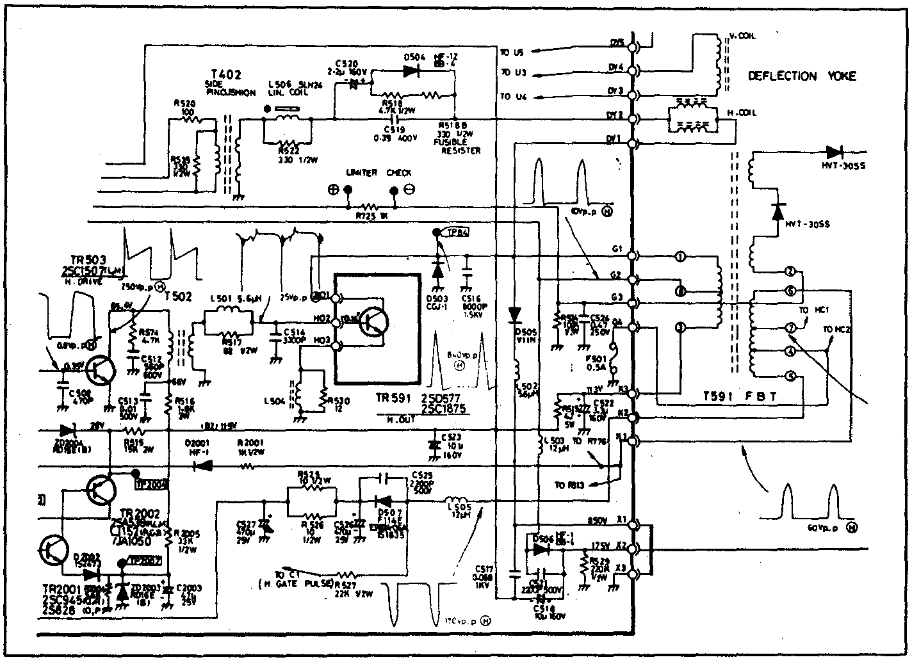
However, closer examination revealed one potential villain — a network around TR2001/TR2002. These were configured as a switch across the line driver Vcc rail, with trigger pulses taken from a tap on the line output transformer.

This arrangement is fairly common on sets of this vintage and is incorporated into the circuit to protect against X-rays, if the EHT goes too high for any reason. In operation, it causes the set to shut down suddenly — just as this one was doing.

Trouble with this network is not common in Ranks, although I have struck difficulty with one model where this circuit has been added on as an afterthought. (It's on a small PCB screwed to the front edge of the main chassis, right under the picture tube!)

Other brands of set, notably Hitachi, have similar protection circuits that have proved unreliable and more trouble than they are worth. The usual treatment is to check the main rail voltage and the EHT, and if all is in order, then removing the protection network will eliminate the problem.

I never like 'remodelling' a set in this



The horizontal output stage of the Rank 1412 schematic. The 'third harmonic tuning' capacitor discussed in this month's first story is C516, just above and to the right of horizontal output transistor TR591.

way, but it's often the lesser of two evils. In this case I was constrained more by time than economics - the man was on his back with no entertainment, and he wanted his telly back ASAP.

I have sometimes found trouble in this type of circuit where one of the transistors develops extraordinary sensitivity. It behaves almost like an SCR, shorting out at the slightest sign of base current.

In this case it seemed a good idea to remove the transistors and test them for leakage and excessive Hfe. I got them unsoldered easily enough, but removing them from the chassis for test was another story altogether.

The two transistors were situated on the left hand side of the main board, hard up against the vertical scan board. The whole assembly was mounted close under the picture tube, with no room to get my hands in to lift the transistors. I couldn't even get a pair of tweezers in to remove them. Round three to the Rank!

I set about removing the chassis from the front of the cabinet, to allow me room to move. I found three screws awkwardly sited at the front edge of the chassis, concealed by the bottom edge of the cabinet front.

Removing these did not release the chassis. I found two more screws above the VHF tuner, but removing these still did not release the chassis. Then, I found yet another screw on the front panel, just under the UHF tuner. Removing this did not release the chassis, either!

Round four to the Rank. I tried twisting the chassis top to bottom and side to side but still it wouldn't move. It seemed as though it was still screwed into the cabinet, yet I couldn't find any more screws to remove.

Finally, I looked more closely and noticed two plastic pegs poking through holes along the front edge of the chassis. These were moulded into the cabinet and seemed to be a kind of locating stud.

My guess was that the pegs were a very tight fit into the holes, so I decided to get brutal. I took a heavy screwdriver and levered the chassis against the edge of the cabinet. There was a resounding CRACK and the screwdriver leapt out of my hand as the chassis came free.

For several moments I wasn't game to look at the set. I could see myself buying a new picture tube, at least.

But it was round five to me! There was no damage to any part of the set. There were a number of plastic shavings around the holes that had held the locating pegs, which confirmed my opinion that the pegs were too tight. The chassis had obviously never been out of the cabinet since the set was new.

Once the chassis was pulled back, away from the picture tube, I was able to get at the two protection transistors and remove them for test. Needless to say it all came to nothing, because the transistors were perfect in every respect.

Still, while they were out I took the opportunity to check other components around them. All of the resistors were spot on, as were most of the capacitors. One electro was probably drying out, because its capacity read low on the meter. It was replaced — with no effect on the set's reliability.

It might have been all the pushing and pulling on the chassis, but at about this time the fault took on a subtle difference. Where it had been failing every 20 minutes or so, it would now run for only 2 to 10 minutes before dropping its bundle.

Whatever the fault was, it was only present for a fraction of a second before the set shut down. I had to devise a way to keep the set running after the fault appeared, in the hope that the reason for the trouble would then be discernable.

I disabled the protection system by removing D2001, the diode that brought the pulses from the line output stage. I was worried that the trouble was something that could cause a catastrophic breakdown without the protection circuit, but it was a chance that I had to take.

Fortunately — if anything about this job could be called fortunate — the set decided at this time that its illness would become permanent. With the protection in place, it would not run for more than a second — not even long enough to produce a picture.

With the protection out, the set came to life and soon produced a picture. When I saw it, I knew immediately what the trouble was.

The picture was small, and very bright. This could only mean excessive EHT, and the usual cause of this was an open circuited 'third harmonic tuning' capacitor.

This long-winded title refers to a high-voltage capacitor across the line output transistor, from collector to ground. The capacitor damps the flyback pulse and reduces the amplitude of the pulse fed to the EHT tripler.

In some sets, loss of this capacitor allows the EHT to go sky-high and can even blow holes in the neck of the picture tube.

In this case, my EHT probe showed me that the voltage had risen to 28kV, some 6kV higher than the value specified in the circuit diagram. It was obvious that this was the reason for the shutdown, but it still remained to confirm the cause, or find something else that would do the same thing.

The first suspect was C516, an 8000pF 1.5kV cap off the line output transistor's collector. This was quite hard to find, being tucked away at the back corner of the main board, behind the metal framework that held the output transformer.

After I had found and unsoldered the capacitor, I had quite a difficult task to remove it. The framework prevented it from being taken out sideways, while the chassis was not quite far enough out of the cabinet to allow me to get at it from the front. It was obvious that the frame would have to come off.

It was held by four self-tapping screws, two on the back edge of the chassis and two at the front right corner. The back screws came out easily enough, but when the others came out the whole assembly went 'Sproinggg!' as the transformer collapsed sideways onto the base of the tube.

Round six to the Rank!

I soon had the capacitor out and examined it carefully. There was no sign of physical damage to the cap, and on the meter it turned up with 8400pF — on the high side of its specified value! Yet it was the only thing that could be causing the trouble, so it had to be replaced.

Unfortunately, the only cap in my collection that came close to the specs was a 6800pF 2kV unit that read 7000pF on the meter. I wondered how close to 8000pF the cap had to be to work properly, but this one was a good starting point, so in it went.

I had a terrible job trying to replace the transformer framework. The whole thing seemed to be twisted and I could not make the screw holes line up. I needed five hands with magnetic fingers to hold everything in place, while I got the first screw in.

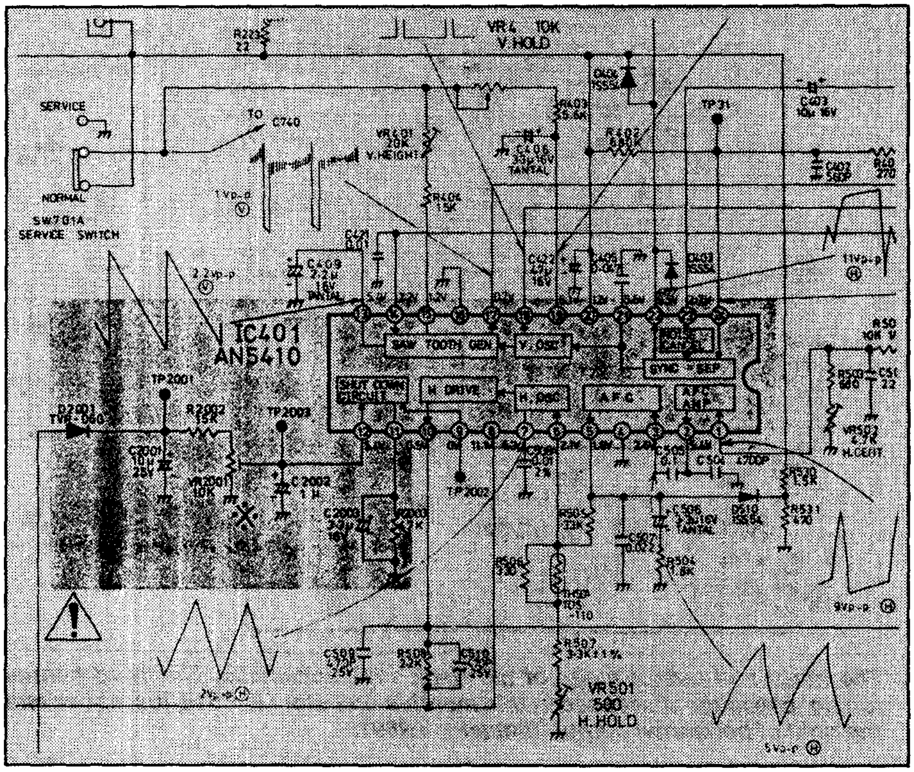
At switch-on, the set started up — and again produced 28kV of EHT. This was quite a setback, because I was convinced that the original capacitor had to be defective, and it looked like a new one was deficient in just the same way.

I was all ready to abandon the job until I could get a proper replacement capacitor when I decided to add to the existing cap by patching a 1000pF unit across its terminals on the copper side of the board. This would restore the value to that shown on the diagram.

With the extra cap in place, the EHT dropped to 25kV. So it was obvious that the circuit parameters had changed a bit over the years and the original value was now not quite enough to keep the EHT under control.

I found an old Philips K9 chassis with a 9500pF cap in this position, so I salvaged it and fitted it to the Rank. It was while I was struggling to replace the transformer framework that I found the reason for my difficulties.

The small vertical scan board was clipped to the underside of the frame and with the screws out, the frame was still held to the main board by the springiness of the vertical board. I was very lucky that my struggles had not broken something. Once I had released the clips the framework went back into place quite easily.



The horizontal oscillator/sync separator/vertical oscillator circuitry of the Rank 1814 portable. Just about everything is done by IC401, as you can see. In trying to fix the lack of horizontal lock, my friend replaced almost all components...

Anyway, it was round seven to me, because the EHT had dropped to the correct 22kV and restoring the protection circuit left the set working quite normally for hours on end.

I still had a battle to refit the chassis over the tight locating pegs, and then to get the holding screws back into position. However, everything was eventually back in place and the job was finished.

This had been a seven-round bout, with the Rank clearly the winner in five of the seven rounds. However, in most of these jobs the battle goes to the one who wins the final round and 'Paid in Full' on the bill shows that I clearly came out on top this time. It was hard work, though!

Sync or swym!

I just haven't been able to get away from Ranks this week, not even at the weekend.

On the Sunday after I had finished the battle related above, I was hard at it weeding in my vegetable garden when a colleague appeared with a sad look on his face and a circuit diagram in his hand. I am never one to miss an opportunity to give up gardening, so I washed my hands and we went to the workshop.

My friend's problem was a Rank C1814, a table model set of slightly later vintage than the C1412. It seems that I had supplied him with a circuit diagram of the set some two weeks earlier, and he had struggled with it ever since.

As he related the story, the set had no sign of horizontal hold, although the vertical hold was OK, as far as he could determine. He had checked all the voltages around the horizontal oscillator IC, (IC401, an AN5410) and found them to be almost spot on.

The various waveforms were the next thing to be looked at, and here he found something quite odd. All the horizontal traces were present at more or less correct levels. However the vertical waveforms were either missing or totally wrong in shape or voltage. This was particularly puzzling because, as far as he could tell, the picture was full height and properly locked. He could also roll the picture up or down, which seemed to imply that the sync separator was working normally.

The block diagram of IC401 shows the sync separator feeding its output direct to the vertical oscillator, inside the chip. The horizontal sync takes a longer, external route to its oscillator, which is also inside the chip. On the face of it, I guess it was reasonable for him to assume that there was a breakdown somewhere in the sync feed to the horizontal oscillator. This led him on a long, detailed and painstaking search for a faulty component in the sync chain.

Needless to say, he didn't find anything or he would not have been asking for my help.

Over a period of about two weeks, he had removed and checked every component in and around the horizontal and vertical circuits. He replaced the IC and several of the electrolytics, but all to no avail. Nothing he could do would restore proper sync.

After spending so much time on the job and getting nowhere, he decided to ask for help and I was the first person he came across after making the decision. He also had to discuss another, quite unrelated matter with me, so that is how he came to be around my way on Sunday afternoon.

Over a glass of afternoon tea, we discussed the problem and I immediately suspected a flaw in his reasoning. He made no mention of the picture 'floating' and this is the most obvious thing about a lack of sync.

When the sync pulses disappear, and assuming that the oscillators are running at about the right speed, then the hold controls can be adjusted to just float the picture, around its normal position. The picture will drift in and out of sync, either horizontal or vertical, but it is clearly under the control of the hold control. In this case, my friend couldn't get any trace of a hold and I suspected a speed problem, rather than a sync one.

When I asked if he had put a frequency counter on the horizontal oscillator, he admitted that he'd been planning to buy a counter for a long time but had never got around to it.

At this point he sheepishly admitted that the offending set just happened to be in the boot of his car, and if I didn't mind, could he check it with my frequency counter?

Well, what are friends for? Anyway, the alternative for me was gardening, so the Rank was soon on the bench with its back removed and the counter's test lead hooked onto the base of the line driver transistor.

A couple of minutes later, when the counter had settled down, the answer was plain for all to see. The horizontal oscillator was running at 16.6 to 17.6kHz, depending on which end of the range the hold control was at. No wonder the sync could not pull in a locked picture.

Now we knew what was wrong, but it still remained to find out why.

As my friend had tested each component, he had checked it off on the circuit diagram. I could see that he had been extremely thorough — almost every item that could conceivably have a bearing on the problem had been tested. With one exception!

The horizontal hold control, VR501, is the last in a chain of resistors from pin 6 of IC401. Immediately above it is a 3.3k resistor, R507. Then above that is a network comprising R506 and TH501, a thermistor.

VR501, R507 and R506 had all been checked, but TH501 had no tick against it. When I asked why, he pointed out the there was no value shown for the component, so any test would not have confirmed whether it was good or bad. Which, I suppose, is a very reasonable answer.

At this point, we decided to consider why TH501 was included in the circuit. We agreed that it was there to adjust the resistance of the 'hold' chain with temperature variations. This would be necessary in any situation where the sync was weak and temperature changes likely to cause the oscillator to drift out of the hold range.

In all probability it would be no problem in strong signal areas, where strong sync pulses would ensure a good hold range. So we decided to remove TH501 and see what happened.

And that was all it needed. Admittedly, the hold was right down one end of the control, but that was easily adjusted by changing the value of R506. We didn't try that on the occasion but left it to him after discussions with his customer.

It may well be that in a temperate climate and in a well ventilated room, there will be no problem and the set can be left without the thermistor. Or, if the owner wants the job finished off properly, my friend can get the correct thermistor and replace it later.

Whatever happens, this job points out the need to carefully consider the symptoms. In this case, the picture could NOT be 'floated', which suggested that the oscillator was not running at the correct speed. So for this reason it was unlikely to be a sync problem. But my colleague had become locked onto the sync theory, and could not see any other possibility.

Which just goes to show that any job that takes more than three or four hours to solve should be passed on to someone else. Or at least put aside for a few weeks, until you can bring a new viewpoint to bear on it. There really is truth in the old saying about woods and trees!

That's enough for this month. We'll see what our contributors have for us next month. ■

Fault of the Month

Lemair KQ-35
(AC/DC Monochrome TV)

SYMPTOM: No go — after trying to operate set from battery supply. Fuse Bx2 is OK and 12V supply is present on either battery or AC. The problem never arises when used only on AC power.

CURE: Resistor 2R8 (4.7 ohm 1/4 watt) goes open circuit. The resistor feeds Vcc to the all-purpose IC and it goes open circuit when the DC supply polarity is reversed. This is the only fault — the fuse does not open and no other components are damaged.

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.

Regulated Power supplies

Most power supplies need some form of regulator to keep the voltage constant and to eliminate ripple. Sounds complicated, but the modern three-terminal regulator chip makes it all very simple. We start in this chapter with the zener diode and end up building a complete variable voltage power supply you can use for your workbench.

by PETER PHILLIPS

Years ago, a variable voltage regulated power supply was a very complex device containing transistors, operational amplifiers and all kinds of components we have not even begun to look at. But thanks to the integrated circuit, we can not only describe such a regulated power supply, but even build one. Not bad, considering this is only chapter 9. While an in-depth discussion on the internals of a regulator IC is useful, it is not essential for using them.

And use them we will. In fact, for those anxious to explore by doing, we are presenting the circuit and constructional details of a simple but highly useful variable voltage regulated power supply. Because a printed circuit board is not required, virtually anyone can build it, although a soldering iron and some workshop tools are required.

But before we start building, first let's look at what a regulated power supply is. This will introduce the *zener* diode, which is the simplest form of regulator. Then a look at three terminal regulators, followed by the project.

A regulator of any sort is something that keeps a particular function constant — such as on a motor, where its speed is kept constant regardless of the load and the supply voltage. A regulator in a power supply needs to keep the output *voltage* constant, or in some cases, to keep the output *current* constant. In most cases it's the output voltage, and virtually all regulated power supplies incorporate a voltage regulator, perhaps with some kind of current limiting to protect against overload.

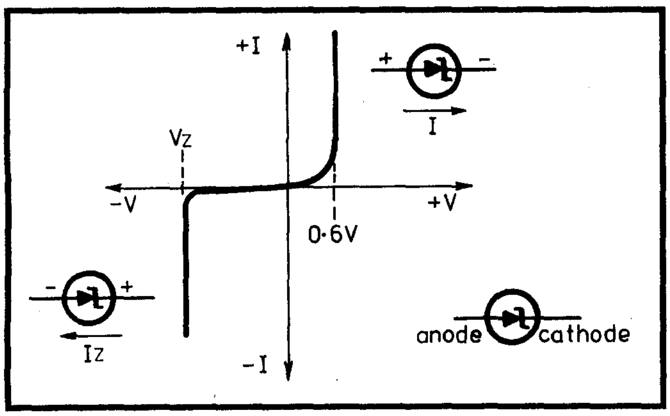
In a power supply, the regulator holds the output voltage constant despite input voltage or output current changes. As well, it should prevent the ripple present on the DC output from the rectifier from appearing at the supply's main output, or at best reduce it considerably.

In the previous chapter, we described a simple power supply that used a filter capacitor to reduce the ripple. However, the ripple was quite significant when the load current increased, and adding more filter capacitance had little effect on reducing it. But just by adding a regulator, the ripple disappears like magic!

How well a regulator maintains the output voltage at a constant value when the input changes is referred to as its *line regulation*. The ideal regulator will show no change at the output for a change at the input, although a practical regulator will usually exhibit a small change, perhaps in the order of 0.5% or so.

Variations of the output voltage when the load current changes is referred to as the *load regulation*. Ideally there should be no change over the operating current range, but a change of a few percent is typical.

The amount of ripple on the output voltage is determined by the *ripple rejection of the regulator and the input ripple voltage. A typical three-terminal regulator can reduce the ripple by a factor of something like 10,000. For example, if the ripple at the input is 1V peak to peak, the ripple on the output voltage will be 0.1mV peak to peak. Try achieving that kind of reduction with a filter!*



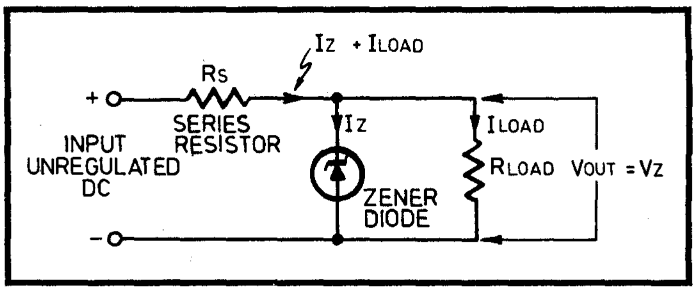
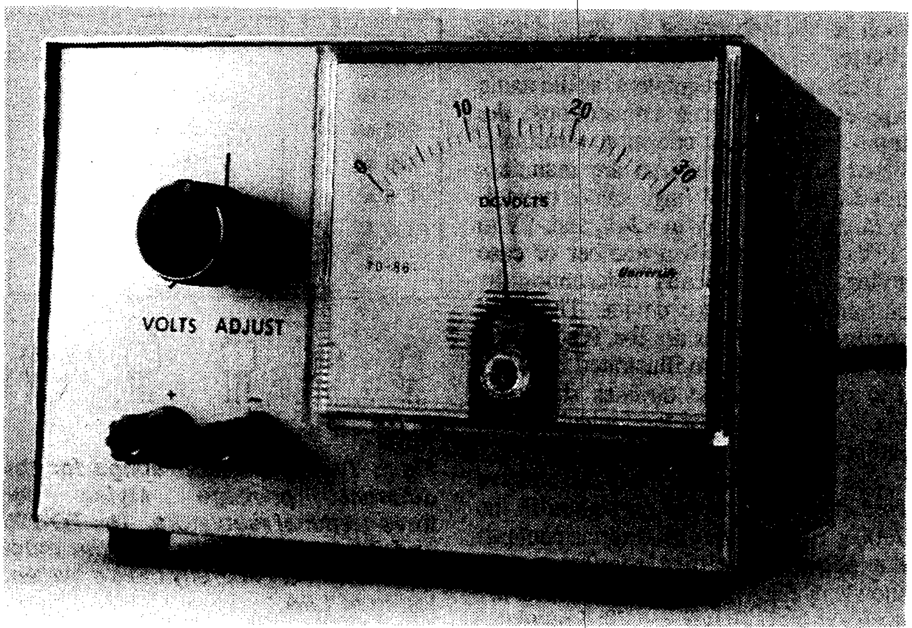


Fig.1 (left): A zener diode conducts both ways as this graph shows. The symbol of the zener diode is shown in (b). Fig.2 (above): A basic zener diode voltage regulator. The zener varies its current to maintain a constant voltage drop.



Our hands-on look at regulators in this chapter also describes how to build this variable voltage regulated power supply. The meter shown here is optional; if it's not used the adjustment pot can be calibrated instead.

The simplest kind of voltage regulator is the zener diode, and these are often used to produce a voltage *reference*.

A zener diode is an unusual type of diode, because unlike normal diodes, it can pass current in both directions. You might wonder how a device that passes current in both directions can be called a diode, when the basic principle of a diode is to conduct current in one direction only.

A normal diode will conduct current when the anode is positive and the cathode negative, and prevent current flowing when these polarities are reversed. But say you increase the voltage across a reverse biased diode to 1000V. Unless the diode is built to withstand this voltage, it will break down and conduct current in the reverse direction. It will also be destroyed into the bargain, but at least we've shown it can conduct current in both directions.

A zener diode operates in the same way, except it won't be destroyed — providing the reverse current doesn't exceed the maximum rated value. The voltage at which it conducts in the reverse direction, that is when the cathode is positive and the anode negative, is known as the *zener* voltage, and zener diodes are available with zener voltages ranging from 2V up to 200V and more.

When the zener diode is forward biased, (anode positive, cathode negative) it behaves as a conventional diode. Fig.1 shows this as a graph, in which conduction occurs at around 0.6V when the zener diode is forward biased, and also at the zener voltage when the device is reverse biased.

The important point to note is that when the diode conducts in the reverse direction, its voltage drop remains very close to constant despite the current it may draw. It's this behaviour that allows us to use a zener diode as a simple voltage regulator.

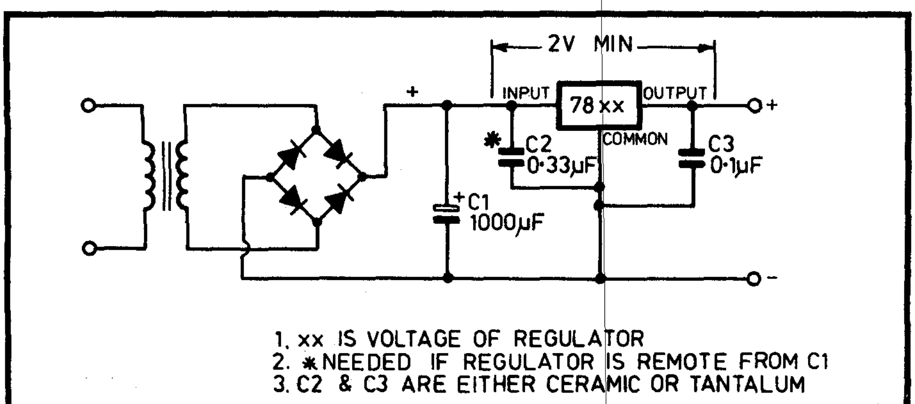


Fig.3: Adding a three terminal regulator to a power supply will improve its performance by virtually eliminating all the ripple, while keeping the output voltage rock steady. The input DC must be at least 2V higher than the output.

The maximum reverse current the zener diode can handle is determined by dividing its power rating by the zener voltage. Thus a 10V/1W zener diode can pass 100mA in the reverse direction without overheating. It can usually pass considerably more in the forward direction, but most zener diode circuits use the device in reverse bias mode.

The zener regulator

A regulator using a zener diode is shown in the circuit of Fig.2. This circuit is extremely simple as it has only two components, the series resistor Rs and the zener diode itself, apart from the load. In practice, determining the value of the series resistor can be quite difficult, particularly if the input voltage and the load current vary.

Operation of the circuit is quite simple, in which the zener diode conducts more or less current as either the input voltage or the load current vary. For example, if the input voltage increases, the zener diode will conduct more current, causing a greater voltage drop across the series resistor. If the load current increases, the zener diode will take less current to keep the voltage across Rs at a value to maintain the output voltage.

The value of Rs therefore needs to be sufficiently high to prevent the zener diode from passing more than its rated current under worse case conditions, but low enough to ensure the zener is always conducting. To calculate the value of Rs, the minimum and maximum values of the input voltage, zener current and load current must be known, and the best value is one that accommodates all these variables. We won't go into how the calculation is done, as it can be quite involved, considering the number of possibilities.

Zener diode regulator circuits are generally used to produce a *reference* voltage, rather than keep the voltage constant across a varying load. A reference voltage is often used as part of a regulator for a power supply, and other factors such as stability and variations with temperature become important.

Variation of the zener voltage with temperature is interesting in that zener diodes below 4.3V have a *negative* temperature coefficient and those above

5V a *positive* temperature coefficient. Those between 4.3V and 5V have a zero temperature coefficient. Temperature coefficient refers to how the zener voltage changes with temperature, and a positive coefficient means the zener voltage rises with an increase in temperature, while a negative coefficient causes the zener voltage to *drop* if the temperature rises.

There is a lot more we can say about the zener diode, and its virtues and limitations as a regulator. The main point to understand is that the zener diode conducts at a specified voltage value when connected in reverse bias, and because of this it finds many applications in electronics.

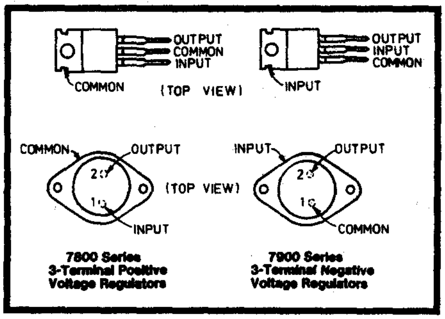


Fig.4: The pin connections for positive and negative three-terminal regulators, in TO-220 and TO-3 cases.

But now we need to move onto the first integrated circuit to be described in this series: the three-terminal voltage regulator.

3-terminal regulators

The three-terminal voltage regulator is one of the great inventions in electronics, as they are simple to use, virtually indestructible, and do away with complex regulating circuits — unless the power requirements are outside their capability. These days, the need for highly regulated voltages is very common and most digital circuits, such as a computer, need supply voltages that are tightly fixed with almost zero ripple. Simple! Use a three-terminal voltage regulator.

Three-terminal regulators not only provide excellent regulating characteristics, but include current limiting and over- temperature protection. Basically, these devices are either of the *fixed* or *variable* type, and made for either positive or negative voltages. The simplest type is the fixed voltage three terminal regulator, and Fig.3 shows how one of these is connected to a DC power supply such as that described in the previous chapter.

Three-terminal regulators, as the name suggests, have three connections: the input, output and common terminals. Fixed voltage regulators are manufactured with output voltage values typically ranging from +5V to +24V, and -5V to -15V. They come in a number of case styles, which basically determines the current rating of the device. The most common case styles are the TO-220 and the TO-3, which are illustrated in Fig.4. The table and case outlines shown in Fig.5 give an idea of the typical current ratings for each type of case.

The most common range of positive voltage three-terminal regulators is the 7800 series, and the 7900 series contains the negative voltage regulators. As shown in Fig.4, the pin connections are different for both types. A 7805 regulator has an output voltage of +5V, the 7905 an output of -5V and as a general rule, the last two figures represent the output voltage. However, always check with a data book to be sure.

Rules of use

There are several considerations in using fixed voltage three terminal regulators. The first is the current rating of the device, and while the case styles give an indication, reference to a data book is recommended. Fortunately, internal circuitry is included to limit the output current to a preset value, and to shut the device down if its operating temperature becomes too high.

Heat consideration is important, and in most situations a heat sink is needed. The power dissipation inside the regulator is determined by the voltage across the device and the current flowing through it. The minimum voltage drop across the regulator to maintain regulation is generally around 2V, although something higher than this is required to prevent the ripple from 'bleeding' through. The heat dissipation will be least if the voltage drop is kept as small as possible, but the likelihood of loosing regulation is increased.

Increasing the voltage differential (difference between the input and the output voltages) will ensure reliable regulation, but raise the operating temperature. The trade-off is therefore one that gives best regulation while keeping the temperature of the device at a reasonable level.

Although not always essential, a capacitor is usually connected between the input and common terminals, and another across the output and the common terminals. These are best placed right next to the regulator and improve

Current	Package
100 mA	TO-92, TO-39
250 mA	TO-39, TO-202
500 mA	TO-39, TO-202
1.5 A	TO-220, TO-3
3.0 A	TO-3
5.0 A	TO-3

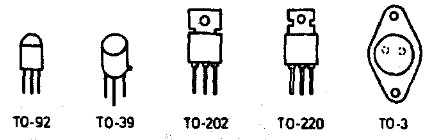


Fig.5: Typical current ratings for the different package styles for three-terminal regulators. The TO-220 and TO-3 case styles are the most common, and generally have a current rating of 1.5A.

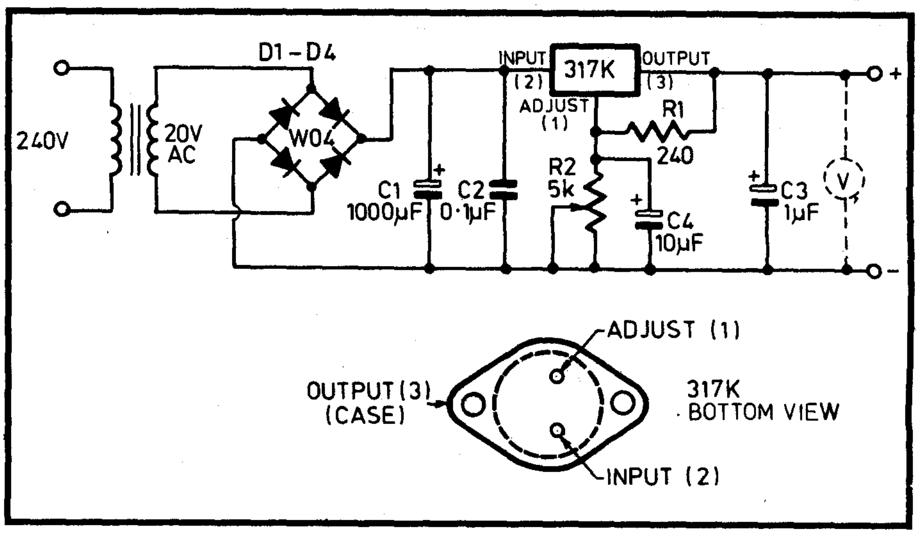


Fig.6: This simple 1A variable voltage regulated power supply produces from 1.2V to 20V and has excellent performance, thanks to the 317K regulator chip.

the regulating characteristics. Typical values are shown in the circuit of Fig.3.

Adjustable regulators

It could be argued that all three-terminal regulators are adjustable, as it is possible to connect them in a way that allows the output voltage to be varied. However, the 317 regulator is designed especially for this purpose and is the IC we are going to use in the promised power supply circuit.

The TO-3 case '317K' regulator can pass currents of up to 1.5A, providing it is mounted on a suitable heatsink. The output voltage range is from 1.2V to 37V, and the usual current limiting and thermal protection of the fixed voltage regulators is also included.

The circuit of the power supply is shown in Fig.6, and for the settings shown, can provide an output voltage adjustable between 1.2V and around 24V. Although the 317 is available in other package styles, the recommended case is the TO-3 type. The pin connections are shown for this case, in which the case itself is the output terminal.

The 317 works by comparing a sample of the output voltage to an internal 1.25V reference. In the circuit of Fig.6, the output is sampled by resistor R1 and variable resistor R2. By changing the value of R2, the amount of feedback is changed, and the output voltage of the 317 is determined using the equation 1.25(1+R1/R2).

It follows from this equation that if R2 is varied, the output voltage changes. If R2 is very high, the output voltage will virtually equal 1.25V, and as R2 is made lower in resistance, the output voltage will rise. If R2 is set to zero, there is no feedback and the output will no longer be regulated. The maximum allowed voltage differential across the 317 is around 40V, and the minimum drop across the device is approximately 3V. Thus, the maximum output voltage is limited to 37V.

The project

The complete circuit of the regulated power supply is shown in Fig.6, which as promised is very simple. It owes its success to the 317 regulator, and remarkable performance characteristics are provided, thanks to this device.

The circuit shown is for a maximum output of around 20V. This value was selected as being suitable for most applications and to limit heat dissipation under worst-case conditions. Even so, if the load current is 1A at an output voltage of 2V, some 20 volts or more will be dropped across the regulator. As power equals V times I, the power dissipation will be 20W. If the input voltage is increased to give a higher output voltage, the worst-case heat dissipation will increase as well. Obviously, the regulator is hottest at low output voltages.

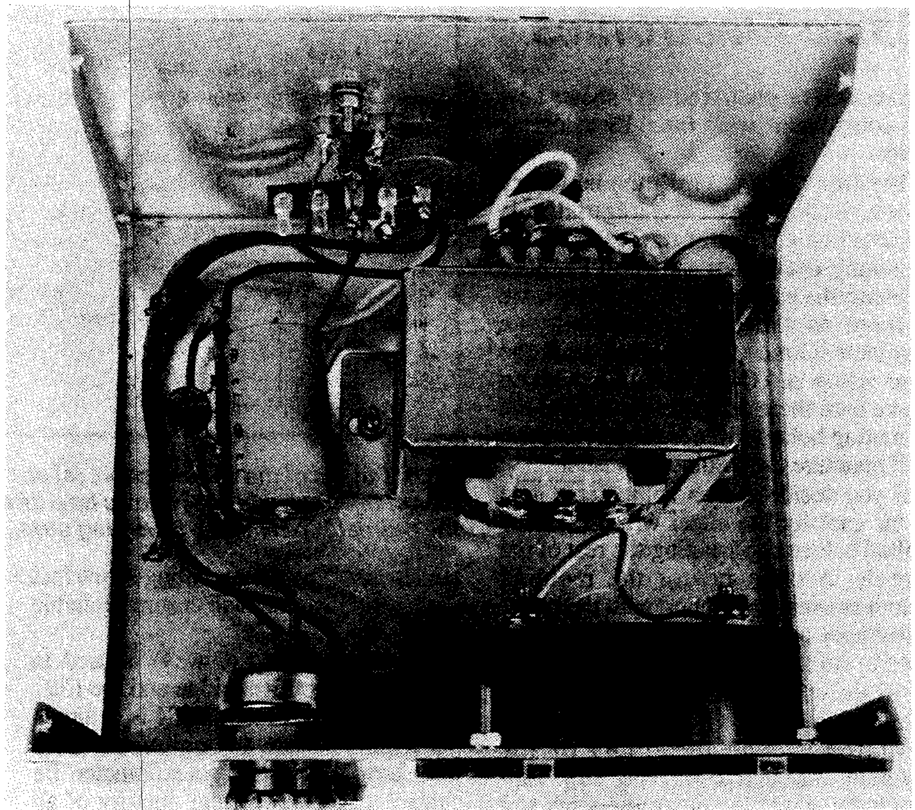


Fig.7:* *The internal construction of the supply. The bridge rectifier and filter capacitor are mounted on a 7-way tag strip and the remaining components on another tag strip held by a regulator mounting screw.

Capacitors C2 and C3 are included to give best stability and noise suppression. C2 is a ceramic capacitor and C3 a tantalum type and these should be mounted close to the regulator. Improved ripple rejection is provided by capacitor C4 across the potentiometer.

The diode bridge is a type WO-4 device, although any diode combination capable of passing 1.5A can be used. The maximum output current of the supply is around 1A, and anything higher than this could cause overheating of the 317 and result in shut down. The main filter capacitor is C1, and its working voltage should be at least 25% higher than the input voltage. This voltage will approximately equal 1.4 times the RMS value of the AC input voltage to the bridge rectifier.

The transformer used is a 30V, 1A type with a 20V tapping. If you wish to avoid the problem of running mains wiring, a 1A plugpack transformer is a recommended option. Most parts suppliers sell a 16V, 1A plugpack for around $17, and using one of these will still provide an output of about 20V DC from the power supply while simplifying construction. I recommend this for those constructors who have never built a project, particularly younger readers.

Although included in the prototype, the panel meter indicating output voltage is not essential. Instead, the output voltage control can be calibrated by measuring the output voltage with a voltmeter. The panel meter can be either a 20V (or 30V) voltmeter, or a meter movement with a series resistor. For a 1mA meter movement, a series resistor of approximately 20k will be required, padded with other resistors either in series or parallel to give the correct calibration.

You could even add an ammeter and an on-off switch if required. However, the simplest unit will comprise a 16V/1A plugpack, the rectifier, capacitors C1 to C4, fixed resistor R1, the potentiometer R2 (with the dial calibrated in volts) and the 317K regulator.

Construction

The prototype was constructed in an aluminium case measuring 152(W) x 132(D) x 103mm(H), although the size of the case is by no means critical. However, use an aluminium case of some sort as it serves as the heatsink for the 317K regulator. The photo of Fig.7 shows how the components were fitted by using tag strips.

The first task is to drill the necessary holes in the case. The regulator is mounted on the rear of the case, and the mounting details are shown in Fig.8(a). Because the case of the IC is at the same voltage as the output terminal, the regulator IC must be insulated from the case using a TO-3 insulating washer. Make sure there are no burrs around the mounting holes for the regulator, as these will puncture the insulating washer.

If you decide to fit a voltmeter, a hole in the case for the meter will need to be drilled before constructing the rest of the circuit. A template for the required cutout is usually supplied with the meter movement and a 'nibbling tool' can be used to cut the hole.

All the components except the bridge rectifier and the filter capacitor are mounted on the terminals of the regulator and a five-way tag strip supported by one of the mounting screws of the 317K as shown in Fig.8(b). The centre tag of this strip is electrically connected to the case of the regulator (output terminal) by the mounting screw and shakeproof washers will ensure a reliable connection.

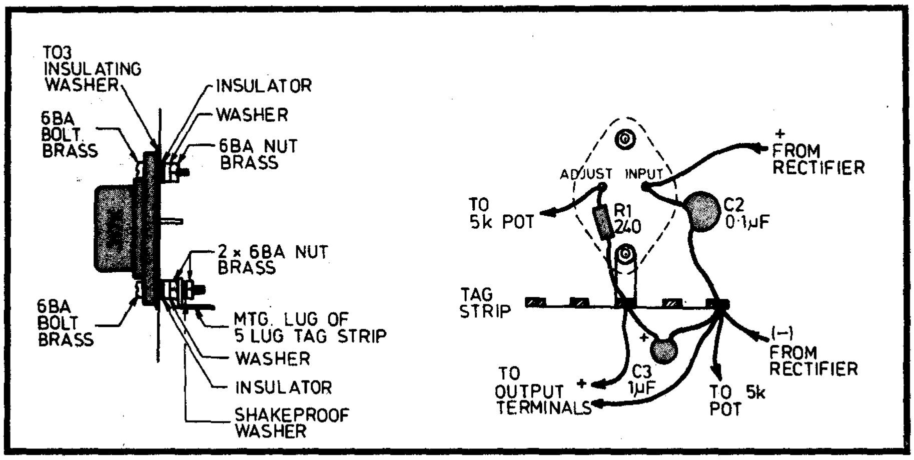


Fig.8: Details of the construction. (a) shows how the regulator chip is fitted to the rear of the case, while (b) shows how its associated components are mounted on the regulator pins and a 5-way tag strip.

Another tag strip (7 way) is used to support the rectifier bridge and the filter capacitor. Also, capacitor C4 is mounted between the centre and right-hand (from rear) terminals of the potentiometer. Be careful to get the correct polarity of all the capacitors (except C2, which isn't polarised). If the polarity is wrong, electrolytic capacitors can explode!

The transformer (if a plugpack is not used) must be earthed, and the mains lead should enter the case through a hole fitted with a grommet. The mains lead should be securely anchored with a cable clamp. *Take special care with the mains wiring, and insulate the connections of the mains to the transformer using plastic tubing.* Mount the transformer so the mains connections are facing the rear of the case, and position the mains lead exit point near the connection point. Connect the earth lead to a lug held by one of the transformer's mounting screws.

The front panel can be dressed up by using press-on lettering sprayed with a suitable lacquer. The output terminals can be anything you have on hand, but two 4mm terminals, spaced 19mm apart is the usual standard. Use a red terminal for the positive output and a black terminal for the negative. The negative terminal should *not* be electrically connected to the case. Finally, fit four rubber feet to prevent the unit scratching the workbench.

And that's it! A great little power supply that will do away with all those batteries. And hopefully you now know a little more about regulated power supplies. In the next chapter we'll start looking at transistors, so perhaps this project can be used to power some of the circuits we'll describe. ■

PARTS LIST

Resistors

R1 240 ohm, 1/4W, 5%
R2 5k linear panel mount pot

Capacitors

C1 1000uF, 63V axial lead electrolytic
C2 0.1uF, 50V disc ceramic
C3 1uF, 35V tantalum
C4 10uF, 63V PCB mount electrolytic

Semiconductors

Diode bridge, WO-4 or equiv
IC1 317K voltage regulator

Miscellaneous

Transformer, either 16V/1A AC plugpack or 20V/1A (type 6672); 7 lug and 5 lug tag strips; 3 core mains flex and plug (if plugpack not used); two x 4mm terminal posts, grommet; TO-3 insulating kit and mounting kit; aluminium case (152 x 132 x 103mm); rubber feet; hookup wire; cable clamp; lug for earth lead; knob for potentiometer. Optional DC panel mount voltmeter or equivalent.

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QUALITY 3mm LEDS

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GREEN	$0.20	$0.15	$0.12
YELLOW	$0.20	$0.15	$0.12

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74LS32	$0.55	$0.50
74LS123	$1.20	$1.10
74LS125	$0.90	$0.80
74LS126	$0.95	$0.90
74LS132	$0.95	$0.90
74LS138	$0.55	$0.50
74LS139	$0.75	$0.70
74LS173	$1.20	$1.10
74LS174	$1.00	$0.90
74LS175	$0.70	$0.60
74LS194	$1.20	$1.10
74LS240	$1.40	$1.30
74LS244	$1.10	$1.00
74LS245	$1.10	$1.00

VOLTAGE REGULATOR BARGAINS

DESCRIPTION	1-9	10+
7805UC	$0.50	$0.45
7812UC	$0.50	$0.45
7815UC	$0.50	$0.45
7905UC	$0.60	$0.55
7912UC	$0.60	$0.55
7915UC	$0.60	$0.55
LM317T	$1.00	$0.90
LM337T	$2.10	$2.00

DIODES

DESCRIPTION	1-9	10+
IN4148	$0.04	$0.03
IN4004	$0.05	$0.04
IN5404	$0.15	$0.12

BRIDGES

DESCRIPTION	1-9	10+
W04	$0.45	$0.40
BR104: 10A 400V	$1.80	$1.50
BR354: 35A 400V	$3.90	$3.00

TRANSISTORS

DESCRIPTION	1-9	10+
BC547	$0.10	$0.08
BC547C	$0.20	$0.15
BC548	$0.10	$0.08
BC548C	$0.20	$0.15
BC549	$0.10	$0.08
BC549C	$0.20	$0.15
BC557	$0.10	$0.08
BC557C	$0.20	$0.15
BC558	$0.10	$0.08
BC558C	$0.20	$0.15
BC559	$0.10	$0.08
BD139	$0.40	$0.35
BD140	$0.40	$0.35
TIP31C	$0.80	$0.75
TIP32C	$0.80	$0.75
2N3055	$1.25	$1.15
2SJ56	$9.50	$8.50
2SK176	$9.50	$8.50

Z80

DESCRIPTION	1-9	10+
Z80ACPU	$3.00	$2.50
Z80BCPU	$4.50	$4.00
Z80CCPU	$6.50	$6.00
Z80AP10	$3.00	$2.50
Z80BP10	$4.50	$4.00

LINEAR

DESCRIPTION	1-9	10 +
TL061	$0.95	$0.90
TL072	$1.10	$1.00
TL084	$1.80	$1.70
1458	$0.50	$0.45
1488	$0.50	$0.45
1489	$0.50	$0.45
LM324	$0.60	$0.55
LM339	$0.60	$0.55
LF353	$0.90	$0.85
LM358	$0.45	$0.40
LM3900	$1.20	$1.10
555	$0.40	$0.38
741	$0.50	$0.45

CMOS

DESCRIPTION	1-9	10+
4001B	$0.25	$0.20
4011B	$0.25	$0.20
4013B	$0.25	$0.20
4016B	$0.40	$0.30
4026B	$0.90	$0.80
4042B	$0.50	$0.45
4044B	$0.80	$0.75
4049B	$0.50	$0.45
4053B	$0.80	$0.75
4060B	$0.70	$0.65
4069B	$0.40	$0.35
4071B	$0.40	$0.35
4081B	$0.40	$0.35
4093B	$0.65	$0.60

74HC

DESCRIPTION	1-9	10+
74HC00	$0.75	$0.65
74HC02	$0.75	$0.65
74HC04	$0.75	$0.65
74HC08	$0.75	$0.65
74HC10	$0.75	$0.65
74HC14	$1.50	$1.40
74HC20	$0.85	$0.80
74HC30	$0.60	$0.50
74HC32	$0.80	$0.75
74HC42	$1.20	$1.10
74HC73	$1.20	$1.15
74HC74	$0.75	$0.65
74HC75	$1.20	$1.10
74HC76	$1.10	$1.05
74HC85	$1.40	$1.30
74HC86	$1.10	$1.00
74HC123	$1.30	$1.15
74HC125	$1.20	$1.10
74HC173	$1.20	$1.10
74HC174	$0.90	$0.80
74HC221	$1.45	$1.35
74HC240	$1.10	$1.00
74HC244	$1.10	$1.00
74HC245	$1.10	$1.00
74HC273	$1.20	$1.10
74HC365	$1.20	$1.10
74HC373	$1.20	$1.10
74HC374	$1.20	$1.00

WIRE WRAP IC SOCKETS

DESCRIPTION	1-9	10+
8 pin	$1.50	$1.40
14 pin	$1.85	$1.75
16 pin	$1.95	$1.80
18 pin	$2.00	$1.90
20 pin	$2.95	$2.75
24 pin	$3.95	$3.50
28 pin	$4.00	$3.60
40 pin	$4.95	$4.50

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Historical feature:

WIRELESS AT SEA - 1

Recent historical research has revealed a great deal of interesting and previously restricted information about the development of early marine radio or 'wireless', between 1896 and 1913. This is of great importance, because it was the British Royal Navy's adoption of Marconi's invention that represented its first practical application, and really launched it into popular use. Here's the first of two articles recounting the story.

by PETER R. JENSEN (VK2AQJ)

When a young and unknown Italian-Irish lad came to England in 1896, carrying a large and precious black tin box, he was soon befriended by more than one influential and well placed Government official. The best known of these persons was Sir William Preece, the Chief Engineer of the Post Office. As is quite well known, Sir William took Marconi under his wing and helped him in a most unbureaucratic manner, in the early development and exploitation of the new field of 'wireless'.

However another major supporter, well disguised by the the protective cloak of a senior Naval position, only really came to light in relatively recent times. This was as a result of the researches of two historians, Pocock and Garratt. During 1963 they were undertaking a research project concerning the well known Naval personality, Admiral Sir Henry Jackson.

While inspecting material that had been made available by the Public Records Office, they discovered a strong and unexpected link between Captain Jackson, as he had been in 1896, and the activities of Marconi in his early years in England.

The reason that this information had been hidden for so long was that, in spite of the absence of an 'Official Secrets Act' prior to 1900, the Naval authorities had evidently considered the wireless experiments to be of sufficient strategic importance to require that they not be exposed to full public scrutiny. So it was that, between 1896 and 1968, the detailed and highly instructive files concerning the involvement of the Royal Navy in the development of the new science of wireless, lay entirely forgotten — but fortunately not lost.

While Sir Henry Jackson has long been revered in England as a far-sighted and important representative of the new breed of Naval Officer that came out of the Naval Defense Act of 1889, his part in the establishment of wireless as a fundamental adjunct to any naval enterprise was very little known.

There was certainly an understanding that he had been involved in wireless experiments at about the time that Marconi came to England. Indeed it appears there was a tradition in the Royal Navy that Jackson had actually invented wireless communication, before Marconi left the Villa Grifone near Bologna.

With access to the Public Records Office files, his part in the success of the new enterprise now became very clear. While they show clearly enough that the Naval tradition is incorrect, and

Captain Henry Jackson pictured in 1897. Later he was to become Admiral Sir Henry Jackson.

Marconi's work was in advance of that of Jackson, nevertheless the part that the future Sea Lord was to play in promoting Marconi's work was of the greatest significance.

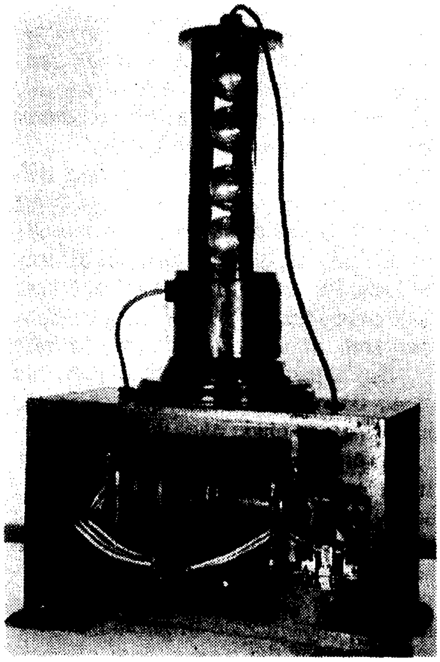
Having analysed the files, the appreciation that Pocock and Garratt make leaves one with a strong impression that, without the support and friendship of Jackson, Marconi's path to success would have been far from smooth.

Indeed a fair reading of some of the correspondence that emanated from Jackson suggests that without his support, both personal and official, there has to be a considerable doubt as to whether Marconi would have managed to have his work develop into the commercial success that it ultimately became.

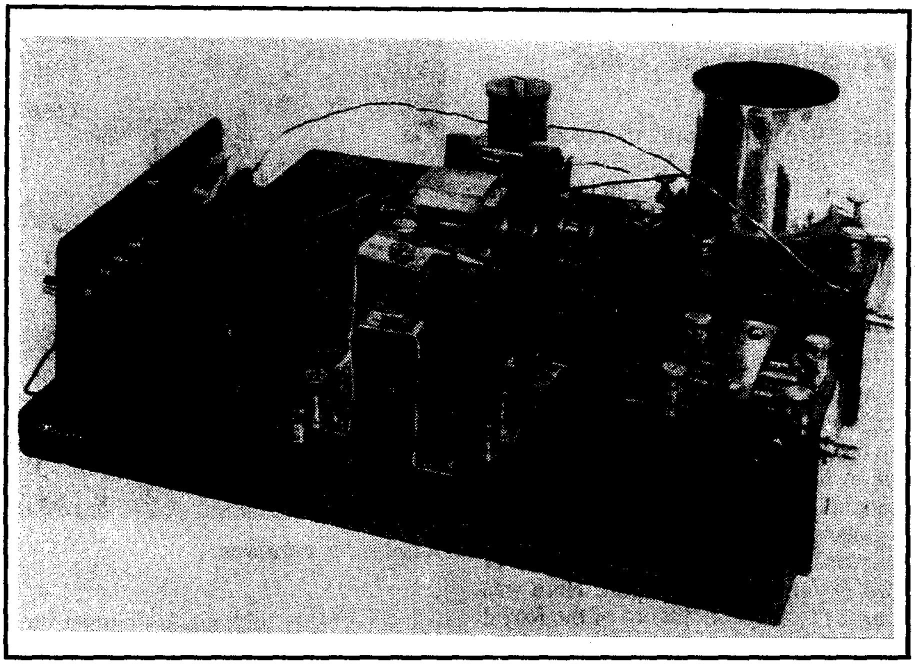
As has been stated in many different publications, the decision that was to bring Marconi to England with his 'communication device' was a direct response to the consummate indifference of the Italian Ministry of Posts and Telegraphs. When presented with a new system of communication, that seemed merely to replicate tried and true cable-based methods, it is perhaps unsurprising that such a lack of interest could have occurred.

However now, many years after and with the benefit of hindsight, it does seem quite extraordinary that such a monumental lack of perception could have been displayed by the Italian officials. Their lack of interest and Marconi's decision to go elsewhere, while being Italy's loss, was soon to be the British Navy's gain.

From historic times the fundamental problem for ships at sea had been isolation, once away from the land. Over the centuries, untold numbers of ships had



Jackson's own wireless transmitter of 1896, with an induction coil in the base and spark gap balls in the tube above.



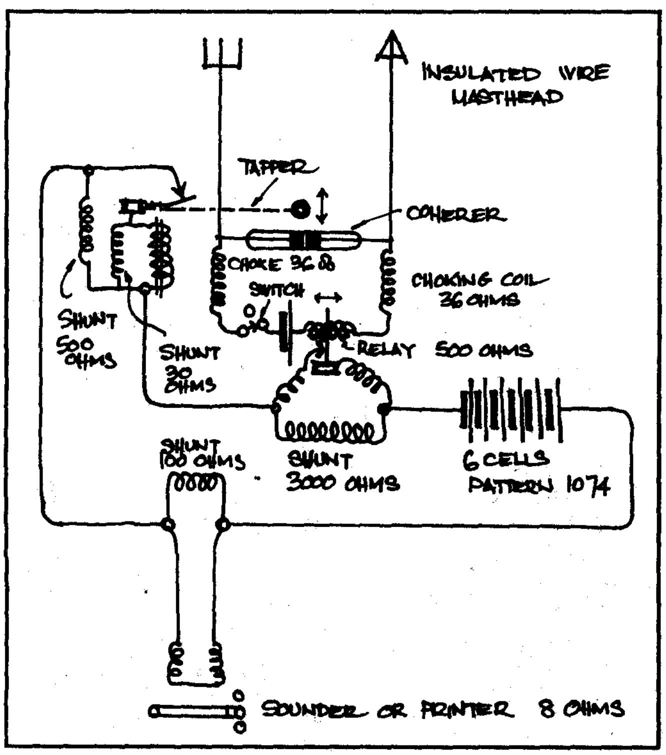
Jackson's receiver of 1896, used with his transmitter at left to achieve communication over a distance of between 25 and 50 metres. A bell trembler was used to reactivate the coherer as in Marconi's apparatus.

gone to the bottom, their plight completely unknown and the cries of their sailors entirely unheard — for lack of a means to communicate with the shore.

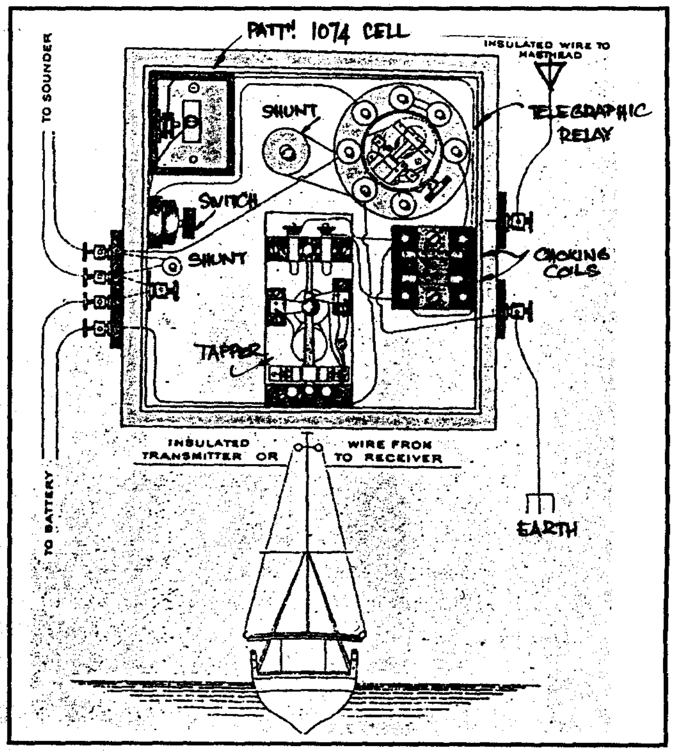
No doubt, sensing that Wireless represented the only effective means of overcoming the problem of isolation of vessels while out of sight of the land, Marconi and his mother went to London. At that time, of course, London was the capital of the most important maritime nation in the world, Britain. There, they probably reasoned, it would be possible to seek the assistance of Mrs Marconi's family and friends to help launch the new system.

One of these relatives, Mr Henry Jameson-Davis, accommodated the newly arrived Marconis at his rooms in Kensington Gardens. Within a very short time he had assisted Marconi to make his initial Patent application in June 1896.

Soon after that, one of Jameson-Davis's friends, a Mr Campbell- Swin-



The schematic for Jackson's 1896 receiver. The coherer connected between aerial and masthead detects the incoming RF, activating the relay, sounder and tapper.



And here is the way it was drawn in 1896 — rather more pictorial in form. Compare it with the photo at the top of the page to identify the various components.

ton, had sent a short letter of introduction to Sir William Preece, Chief Engineer of the Post Office. By August an initial conference had been held with representatives of the Navy, including Captain Henry Jackson and in September of 1896 a series of trials were undertaken on Salisbury Plain, which again has been referred to in many publications.

Captain Jackson had been born in 1855 and by 1881 was receiving instruction on the Naval Torpedo ship *HMS Vernon*. A little later he was to become an Associate of the Society of Telegraphic Engineers, and much later in January 1895 was appointed to the command of *HMS Defiance* at Devonport. Here was located the Torpedo School of the Royal Navy, and here in December of 1895 Jackson was to carry out his first successful experiments in Wireless communication.

What is important in this was that the aim of the experiments was not to demonstrate some new scientific principle, but to try to discover some means of communicating with th: newly developed fast Motor Torpedo boats. These had been brought into service by the Navy during the 1880's and had proved very difficult to control in a battle situation.

By July 1896, one month after Marconi had made his Patent application, Jackson had managed to send Morse signals over a distance of between 25 and 50 metres using apparatus which, in most respects, was technically similar to that of Marconi. This can be readily observed in the accompanying photographs, and it is apparent that the system of reactivat-

A lightship wireless.

ing the coherer with a bell trembler was exactly the same method as used in the Marconi apparatus.

When one month later Jackson was to attend the initial meeting with the young Italian and see the Wireless that he demonstrated, there can be little doubt that he immediately saw the resemblance to his own work. It is also clear from the records that he was generally impressed. Later he wrote to the Commander in Chief at Devonport that, in relation to Wireless, he considered 'The principle of its working has been well established'.

Later again, in September of that same year, Jackson was writing:

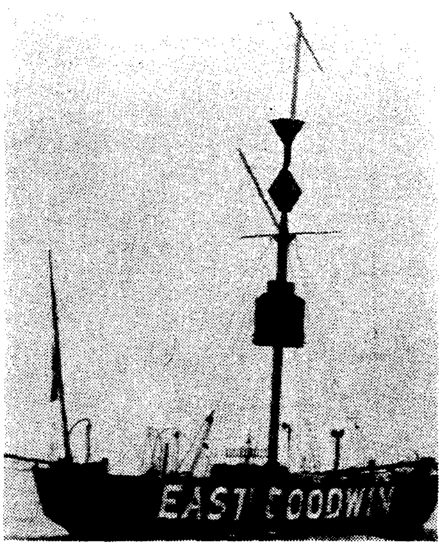
...signals could be as readily and more quickly made by its means, at all times, than by the present system of Morse signalling, and also in a fog, and when the ships are not visible or even aware of the proximity to each other. This would be invaluable for friendly torpedo boats to signal their approach; also signals could if desired be printed by a Morse or other printing telegraph ...for military purposes as an auxiliary signal for fog and transmitting secret intelligence its adoption would be almost invaluable...

Despite the considerable age difference, Jackson by now being 41 years old and Marconi little more than a youth, it is obvious that an immediate affinity developed between them. Within a very short time Jackson was writing to Marconi and, in an initial letter, he said "...your apparatus is worth a trial and would be of use to the service if the signals can be made over three miles..."

Although of little scientific importance, the next step in the chain of events that was to shape the path of Marine Wireless was not much more than a publicity stunt. However because it involved the Royal Family it was of considerable significance in publicising the capabilities of the new system of communication.

During the summer months of 1898, the Prince of Wales was recovering from a minor ailment while on board the Royal Yacht. Queen Victoria was established at Osborne House on the Isle of Wight, and in order that reports of the health of the heir to the throne could be conveyed to the Queen, a wireless link was organized by Marconi. The required equipment was installed on the Royal Yacht and at Ladywood Cottage in the grounds of Osborne House. During August of 1898 some 150 messages of a generally trivial nature passed between the two stations, and news of this successful enterprise did little harm in establishing the name of Marconi as a household word.

Ironically the good that came of this small service to royalty was very nearly destroyed by Marconi's well developed



The East Goodwin Lightship.

Taken after the 1909 Nantucket disaster, this picture shows Marconi (centre) presenting the Republic's wireless operator Jack Binns with a gold watch to reward his initiative in sending a life saving distress call.

streak of Italian democratic independence. One day while going from one part of the grounds of Osborne House to another, Marconi was accosted by a gardener and informed that he had entered a private preserve of the Queen. However despite this he continued on his way. When later the 80 year old Queen demanded to know who it was that she had seen in her private garden, she was told that it was the new 'electrician'. At this, she is reported to have snorted that "They should get another one".

No doubt she was 'not amused' to be told that Mr Marconi was not an electrician that could be replaced. Despite this little *contretemps*, the whole exercise was generally counted a sterling success. A little later the *Electrical Review* was to report:

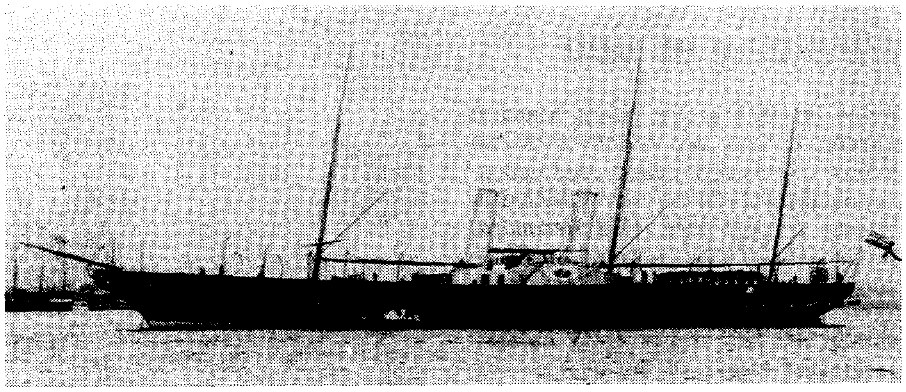
The Prince of Wales and other Royalties gave expression to Mr Marconi of their high appreciation of his system and their astonishment at the perfection to which it had been brought. The Prince presented Mr Marconi with a souvenir in the shape of a handsome scarf pin and wished him every success in this very interesting adventure.

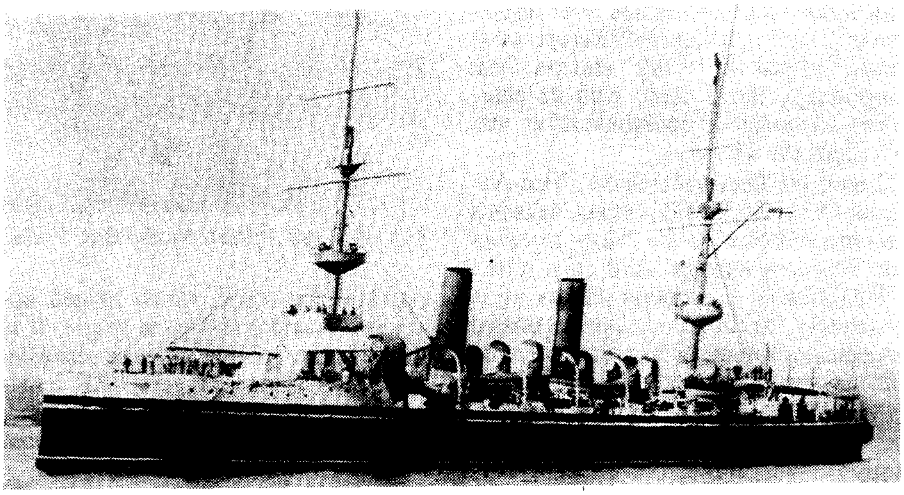
During December of 1898, Marconi was approached by the Trinity House authorities to set up a wireless link to the lightships on the Goodwin Sands — off the extreme east coast of England, near Ramsgate. The shore station was established at the South Foreland lighthouse, near Ramsgate and the other end of the link was set up on the East Goodwin Lightship, approximately 10.4 nautical miles away.

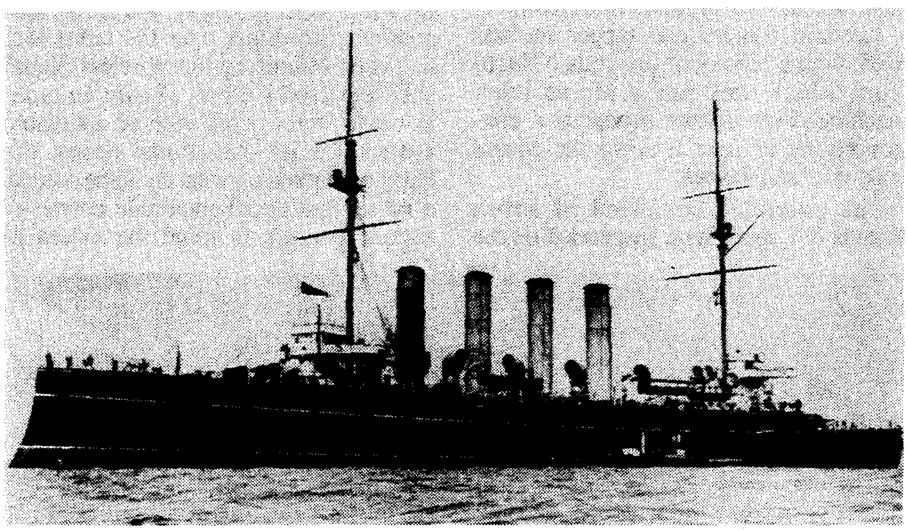
In a very short space of time the Master of the Lightship and his crew had learnt to use the equipment, and messages were being passed with great reliability. This was very fortunate for only a few months later, in April 1899, during a dense fog, the East Goodwin Lighship was rammed by the steamship *R.F. Matthews*. The Master of the Lightship, Captain Clayton, immediately sent a signal to the shore station as follows:

We have just been run into by the steamer R.F. Matthews of London. Steamship is standing by us. Our bows very badly damaged.

With the receipt of this message, the shore station at the South Foreland lighthouse telephoned the Trinity House authorities at Ramsgate, who in turn arranged for the Lifeboats from Deal, Kingsdown and Ramsgate to attend the damaged Lightship. Despite the extent of the damage, the calm sea allowed these Lifeboats to return home without having to render any assistance.







Above: The H.M. Yacht 'Osborne'. Middle: The H.M.S. Juno. Bottom: The H.M.S. Europa.

Later in 1899, for the summer Naval manoeuvres, three of the principal ships were equipped with Wireless apparatus loaned by the newly formed Wireless Telegraph and Signal Co Ltd.

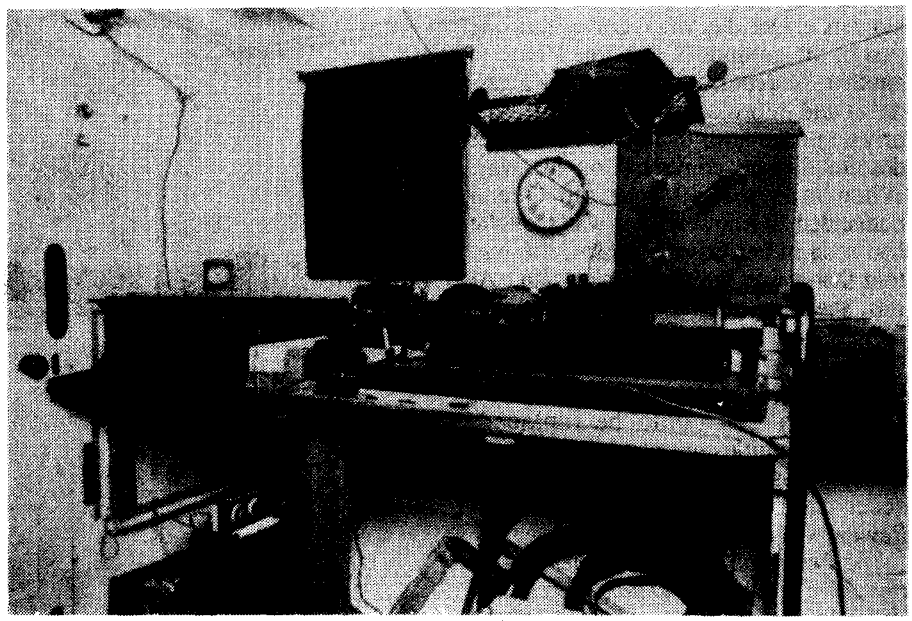
This was despite a failure to agree on an appropriate level of remuneration to be paid to the company by the Navy. Indeed for some considerable time before the Naval manoeuvres of that year, the company had been negotiating unsuccessfully with the Admiralty as to the cost of supply of Marconi apparatus. However, despite Jackson's strong support, the 'sticking point' had proved to be the level of royalty payment demanded by the Company for the use of the system.

In spite of these financial disagreements, and no doubt to bolster the perceived benefits to the Navy, Marconi provided initially two — later extended to three — sets of Wireless communication equipment. These were installed in the flagship of B fleet, *HMS Alexandra*, commanded by Vice- Admiral Sir Compton Domville; the cruiser *HMS Juno*, commanded by Captain Jackson; and later in the fast cruiser *HMS Europa*. During the course of the manoeuvres, communication between the flagship and *HMS Juno* was maintained over distances of 95 miles, using *HMS Europa* as an intermediate or 'relay' station. Not surprisingly the B fleet, with its enormous advantage in communication, was adjudged the winner.

Later, the fleet commander, Vice-Admiral Domville, in supporting Jackson's recommendation to the Navy to adopt the Marconi system, said in a letter, "This system of wireless telegraphy is absolutely invaluable. It can be trusted especially at night or in a fog, when no other system is perfectly reliable".

The equipment used on the Naval vessels consisted of 10" spark induction coils (Rhumkorff coils) together with 1-1/2" diameter brass spark balls set 3/4" apart, for the transmitter. For the receiver a standard coherer and tapper set was used, with a battery of dry cells (Obach) from which was run a Morse inker machine. This in turn produced a continuous paper tape bearing the Morse code dots and dashes.

The antennae consisted of seven strands of copper wire suspended on the masts of the ships, which ranged between 158 and 178 feet in height. It is also of interest that when these sets were operated without 'Jiggers' (RF transformers) in the output of the transmitters, the range dropped from 95 miles to about 7 miles.



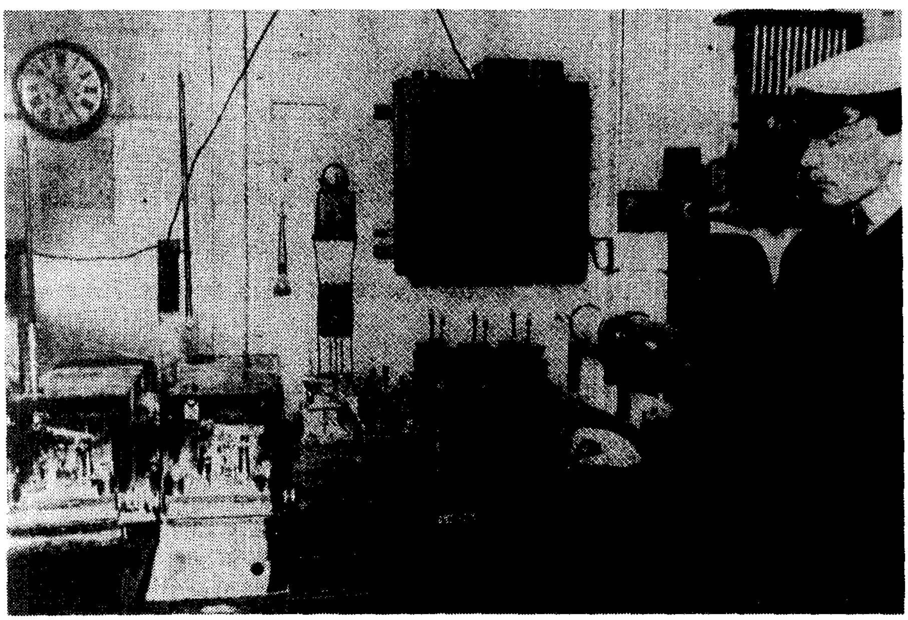
The wireless station on the S.S. Philadelphia.

Notwithstanding the obvious benefit of Wireless to the Navy, the authorities continued to dither over the terms that had been offered by the Wireless Signal and Telegraph Co Ltd. Finally, in order to obtain some semblance of a suitable system for its operational needs, the Navy embarked on what could be seen as a rather less than honourable course of action. Bearing in mind the extent to which Marconi and his company had assisted in equipping the fleet with its apparatus, this seems particularly the case.

Under British law at that time, the Crown was permitted to make use of any Patent where it could be shown to be in the national interest. This of course extended to the newly patented Wireless.

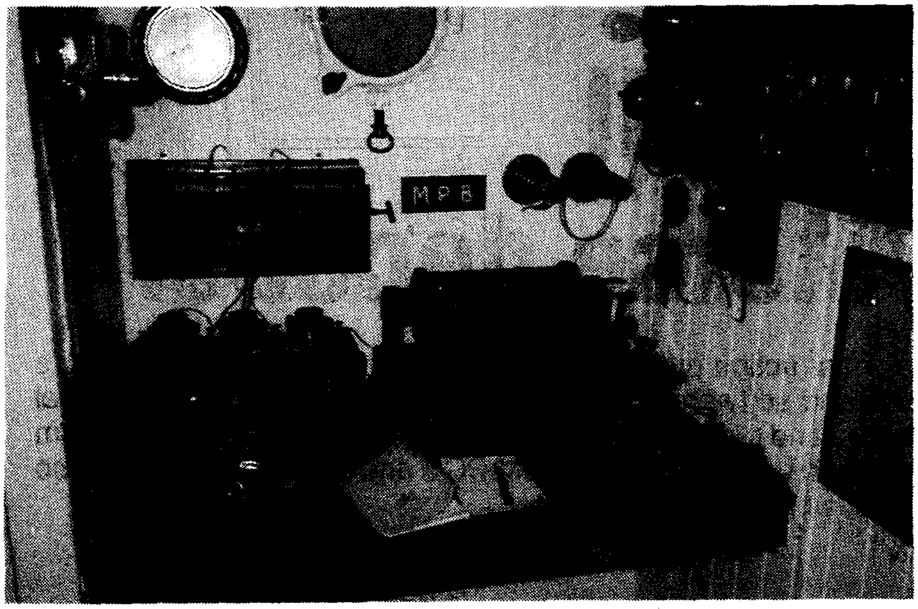
Given this power, the Navy decided that in order to overcome the problem of remuneration to the Marconi company, it should have a number of wireless sets built by its own technicians and contractors. Of course the person best equipped to undertake this exercise was none other than Marconi's friend and supporter, Captain Jackson. It was not very long then, before Jackson was placed in the rather invidious position of having to oversee the construction of wireless sets by naval technicians on *HMS Vernon*, to which he had been appointed in October of 1899. These were based very much on the design that Jackson had developed in the previous year, and no doubt he was aware that they could not compete with the Marconi apparatus in terms of distance of communication. However, despite these reservations, in the end some 19 sets were made up on *HMS Vernon* and distributed around the fleet.

As Jackson no doubt had anticipated, these sets never approached the Marconi apparatus in regard to range and, ultimately, in May of 1900, the Navy finally approved the purchase of some 32 Marconi sets on very much the same basis of charge-plus-royalty as originally proposed by the Company many months earlier.



A typical ship's wireless station in the year 1906.

In coming to this conclusion there is



A replica of a ships wireless station from the period 1912-1914, in London's Science Museum.

little doubt that the Navy was considerably influenced, as previously, by comments made by Captain Jackson. Typical of these was one which he made, in referring to yet another of the Navy's efforts to avoid paying the remuneration which had been proposed by Marconi's company. This involved a legal challenge to the Marconi patents, and in discussing the implications of a successful outcome of the proceedings, Jackson had said:

"Even if the Marconi Company's patents are bad and if they are prepared to supply the Admiralty with instruments on moderate terms, we had better continue to deal with them."

As may now be fairly clear, Jackson's efforts to support the Marconi system were of the greatest importance in having it accepted by the Navy. Given this support it is perhaps not entirely surprising that later again, in July of 1903, the British Admiralty finally signed an agreement which involved the general use of Marconi apparatus in the Royal Naval vessels for a period of 11 years.

The historians Pocock and Garratt conclude their discussion of the involvment of Sir Henry Jackson in the early development of wireless with the comment:

Without Jackson's efforts, radio would not have developed so far as it did by 1900. Though he was not the inventor of radio telegraphy, he was certainly the father of maritime radio.

After this early involvement in the development of Wireless, Jackson continued to take an active interest in radio and electronics. Following a distinguished naval career, in which he reached the rank of Admiral of the Fleet and First Sea Lord, Sir Henry Jackson — as he was then known — was appointed as Chairman of the Radio Research Board of the Department of Scientific and Industrial Research. This body, at a much later date and after Sir Henry's death in 1929, was to have a considerable part in the discovery and development of radar. This of course is another story.

In some respects, the acceptance of the Marconi system by the Navy could be seen as the principal hurdle over which the Company had to jump before the Merchant Navies of the world were prepared to become involved. Certainly from 1900 on, there was a steady progression of marine installations, commencing with the *Kaiser Wilhelm der Grosse* which was owned by the Norddeutcher Lloyd shipping line. This occurred in February of 1900, and can only be seen as a somewhat ironic event in view of the conflagration that was to burst out only 14 years later. The first British merchant naval installation was not to occur until some 15 months later, on the *SS Lake Champlain.*

In the years that followed, up to the start of the First World War in 1914, there was a steady expansion of wireless installations aboard ships. No doubt this was accelerated by more than one disaster in which wireless was to play a conspicuous part.

One such disaster occurred in January 1909 and involved the collision of the White Star liner *Republic* with an Italian ship, the *Florida*, south west of Nantucket. The *Republic* carried wireless apparatus, the power supply to which was damaged in the collision, and an enterprising young Marconi operator named Jack Binns. Using an emergency power supply, Binns used the international distress call 'CQD' to contact the Republic's sister ship the *Baltic* and, later, 1690 passengers from the two damaged ships were transferred.

Later again that day the *Republic* sank, while eventually the *Florida* was able to make port. In all only five people had been killed in the *initial* collision. However it seems probable that, without the availability of wireless, the casualty list would have been very different.

The second disaster is far better known and unfortunately involved a considerable loss of life — 1517 persons — despite the availabiltity of the most up to date form of wireless apparatus. However, in this instance, the basis of the extensive death toll was an insufficiency of life boats and those that were saved were still able to count their safety as resulting from the heroism of the Marconi wireless operator, Jack Phillips.

This disaster, of course, was that of the *Titanic* which, on 14th April 1912, collided with an iceberg on her maiden voyage and sank to the bottom of the Atlantic two miles below. In the history of wireless, this event was to have the most profound repercussions for the development of marine radio, involving the adoption of new standards of vigilance for ships at sea.

This event was also to result in the banishment of amateur radio operators to wavelengths below 200 metres and this, in turn, had a great impact on the ultimate development of long distance communication. The efforts of the amateurs to exploit this new and hitherto unexplored part of the radio frequency spectrum was to lead to the opening up of long distance communications with small power, which the higher frequencies could support.

Having described the development of Marine Wireless up to the sinking of the *Titanic*, it remains to outline the apparatus which was in common use by about 1909, just over 80 years ago. In the second of these articles the arrangement of a typical wireless station of this period will be described together with its replication. Such a station makes use of a number of pieces of equipment previously described in this publication in recent times. However certain other important items require description and these will be referred to as well.

(To be concluded) ■

Hardware/Software Kit Review:

Listening Post II FAX/RTTY/Morse decoder

One of the most popular electronics construction projects in recent years has been Tom Moffat's 'Listening Post' — a simple hardware and software package that allowed a 'Microbee' personal computer to decode radioteletype, Morse and radiofax signals. In response to many requests, Tom has now come up with a new and improved version to run on IBM PC's and compatibles. He's also selling a low cost kit for the new design, which we review here.

by JIM ROWE

When he's not writing articles for *EA* and other magazines, Tom Moffat spends his time either operating his amateur radio gear (VK7TM), using his personal computers or sniffing around the shortwave bands. He's been both a computer enthusiast and an avid shortwave listener for many years, in fact, with a particular interest in 'specialised' areas of radio communications such as Morse, radioteletype (RTTY), radio facsimile (radiofax) and so on.

Way back in the late 70's he developed a you-beaut decoder for RTTY, which was published in the August 1979 issue of *ETI*. Then in 1980 it occurred to him that he could use his 'Dream 6800' computer to operate as a simple RTTY terminal, using a suitable program. This was described in *EA* 's January 1981 issue.

Next he came up with a simpler RTTY decoder using a 4046 phase- locked loop (PLL) chip, and designed to go with a low-cost Microbee computer. This was described in the April 1983 issue of *ETI*.

In the same year's September issue of *ETI* came his first (and possibly the world's first) published design for a weather fax decoder: the 'Picture Plucker'. This used the same 4046 PLL chip, and was again designed to go with the Microbee — but only to drive a printer, as at that stage the 'Bee couldn't display the pictures directly on its screen. The Picture Plucker was very successful, and showed the potential interest in weather fax decoding.

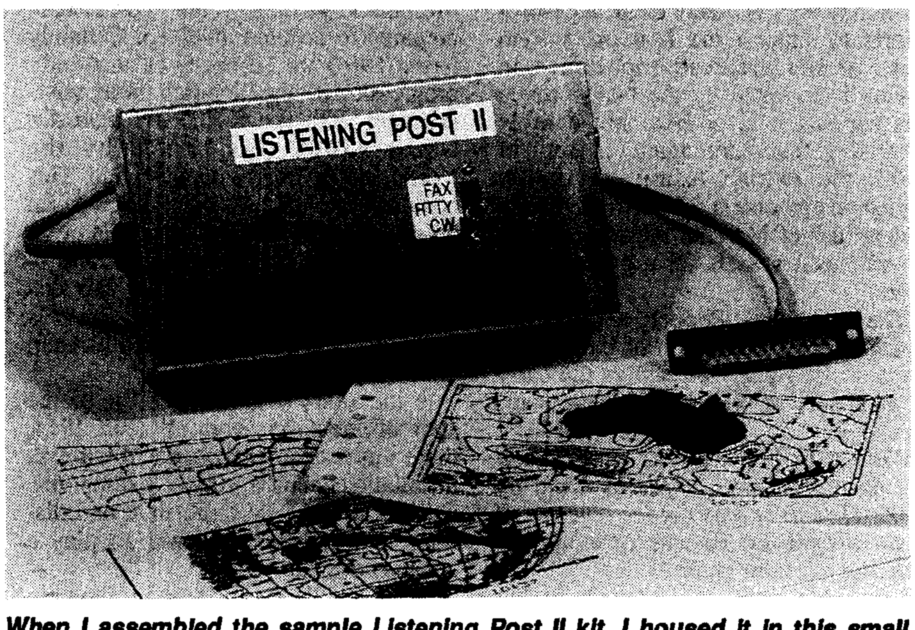
But Tom still wasn't satisfied. He kept experimenting, and finally came up with a much-improved design using an XR-2211 PLL chip instead of the 4046. This was again mated with the Microbee, to provide a setup capable of decoding not just one specialised mode, but three: RTTY, weather fax and Morse. The 'Listening Post' had arrived, and was described in the very first July 1985 issue of *Australian Electronics Monthly* (now defunct).

The performance provided by this original Listening Post was considerably better than that of previous designs, and its fame soon spread. It became extremely popular, with many hundreds of kits sold — making a lot of money for firms selling kits and compatible software. Tom Moffat himself was not among them, sad to say, but at least he had the satisfaction of knowing he'd produced a really successful design.

In fact its success soon spawned 'clone' designs, which have appeared in both local and overseas magazines during the last five years. Generally these have been fairly obvious derivatives from the original Listening Post, contributing little if anything to its performance or operating convenience.

Tom Moffat himself hasn't let the design rest, though. Following the success of the Listening Post itself, he was commissioned to design a commercial weather fax receiver unit for yachts and fishing boats: the 'Navimate'. This used a custom-designed Z-80 computer, and in its final form printed out the fax images on 15" wide paper using an inkjet.

The experience gained while designing the Navimate showed him how the Listening Post itself might be improved, and also how to adapt the design to work with a much more popular and current family of computers: IBM-PCs and their multitudinous clones.



When I assembled the sample Listening Post II kit, I housed it in this small aluminium utility box. As you can see, there are few controls to worry about.

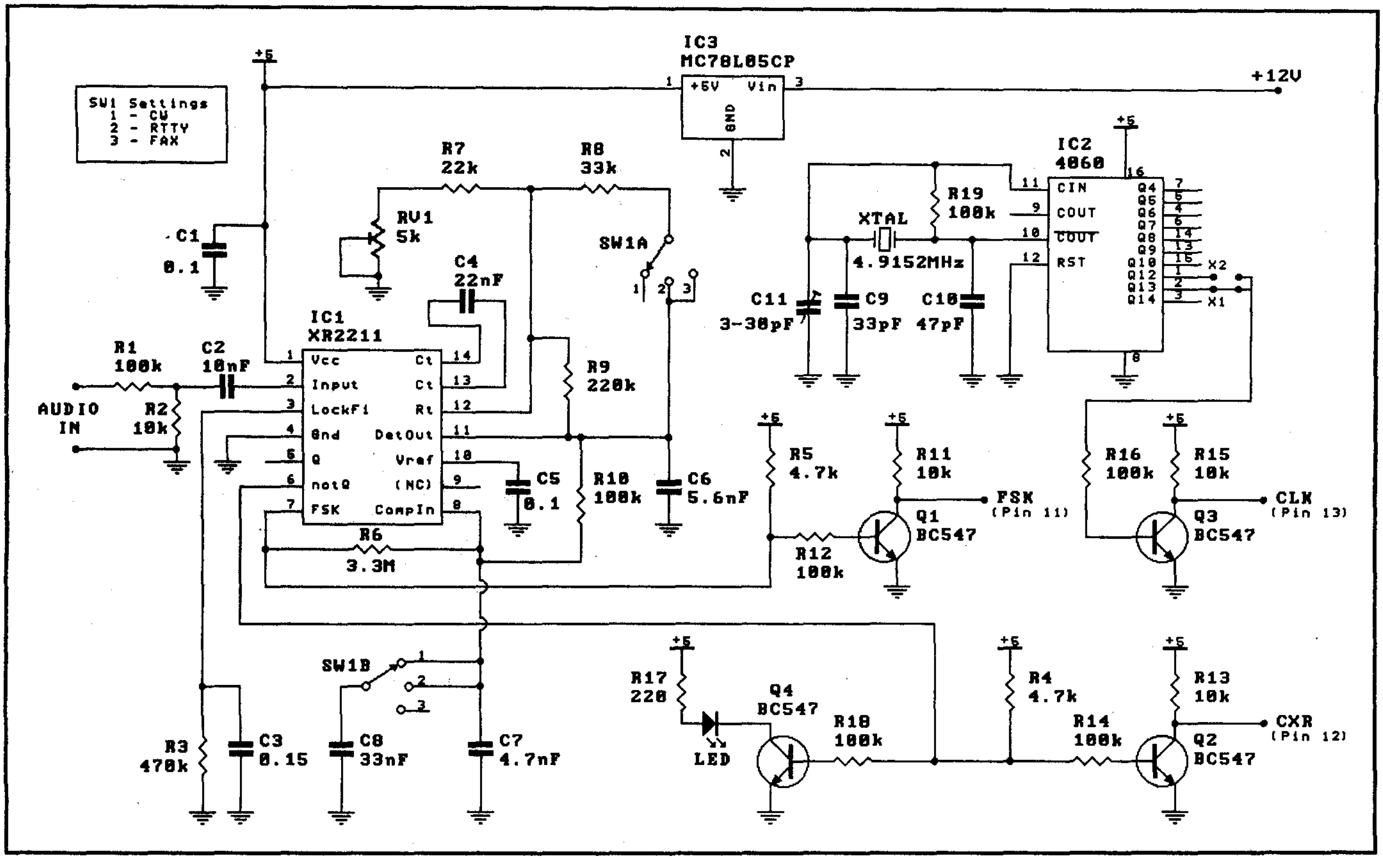


Fig 1: The complete circuit schematic for the hardware 'decoder box' section of the Listening Post II kit.

The end result is his new 'Listening Post II' design, which does everything that the original design did but with significantly better performance than either it or its clones. And it operates with a wide variety of IBM-PCs and compatibles, into the bargain.

Significantly, though, Tom has resisted the temptation to add a lot of 'bells and whistles' that would make the project more costly and more complex to use, without adding significantly to its performance. A firm believer in Occam's Razor, he always opts for the simplest possible approach that does the job properly — so the new Listening Post II has very few more parts than the original, and no additional controls.

His new design is being published in the latest edition of Federal Publishing's *Radio Experimenter's Handbook*, which is due on sale late this month (January 1991). And this time, kits are only be available from Tom Moffat himself, by mail order. In this way Tom will be able to keep better control over the project, and ensure that builders can get continuing support. By selling both hardware and software direct to readers he's also removing 'middle men' and keeping the costs down.

Tom's family firm is called High Tech Tasmania, and all orders are being handled direct from the address given at the end of this article. The complete kit (hardware and IBM-compatible software) costs $59.00, plus $7.00 for packing and postage anywhere in Australia or New Zealand.

Needless to say, because of Tom's regular contributions to *EA*, we soon got to hear of his new and improved Listening Post project. It sounded very interesting, and when he asked if we'd like to review the kit, we jumped at the chance. Hence this story — not strictly a project description, but a kind of review of how the project works, plus a report on what we found when we put a kit together and tried it out...

The LPII kit

The Listening Post II kit includes both hardware and software, and the hardware part comes as what many people call a 'short form' kit. This means that you get all the parts to make up a working PC board, but without a box or case to protect it from physical damage. It also doesn't come with a power supply, being designed to work from a standard 12V DC power supply or 'plug pack'.

Included with the kit is a length of 'rainbow' cable and a DB-25 plug, which can be used to connect the PCB to the printer port of a standard IBM-compatible. However no cable or connector are supplied for the connection between the board's audio input and your communications receiver — this is left to you.

There's not a lot of circuitry on the PC board: three ICs, four transistors, a crystal and a handful of resistors and capacitors. A two-pole three position slider switch connects to the board via a short length of ribbon cable, and is used to switch between fax, RTTY and Morse reception modes. A single LED is provided to assist in tuning up, and this can either be mounted directly on the board, or mounted off-board near the slider switch. The PCB is quite compact, measuring only 85 x 57mm.

The software side of the Listening Post II comes on a single 5.25" floppy disk, and consists of a small suite of machine language (COM) programs. There are separate programs for RTTY and Morse decoding, plus two for fax — one for the more common 120 lines-per-minute transmissions and the other for 60lpm. All four of these programs are able to save received images/messages as files on disk, and there are additional programs which allow the fax image files to be retrieved and either displayed on screen, or printed out. RTTY and Morse files can be displayed on screen using DOS's TYPE command, or printed out using the PRINT command.

In addition there are utility programs to allow setting up the main programs for

Listening Post II

different video displays and printers, plus a number of sample files giving fax images etc., for checking out your system when it's completed.

The circuit

The circuit for the hardware side of the new Listening Post II is shown in Fig.1. Like the original design it's based on an XR-2211 PLL chip (IC1), which is used to lock onto the incoming audio signals from the receiver and generate appropriate digital output signals for processing by the computer.

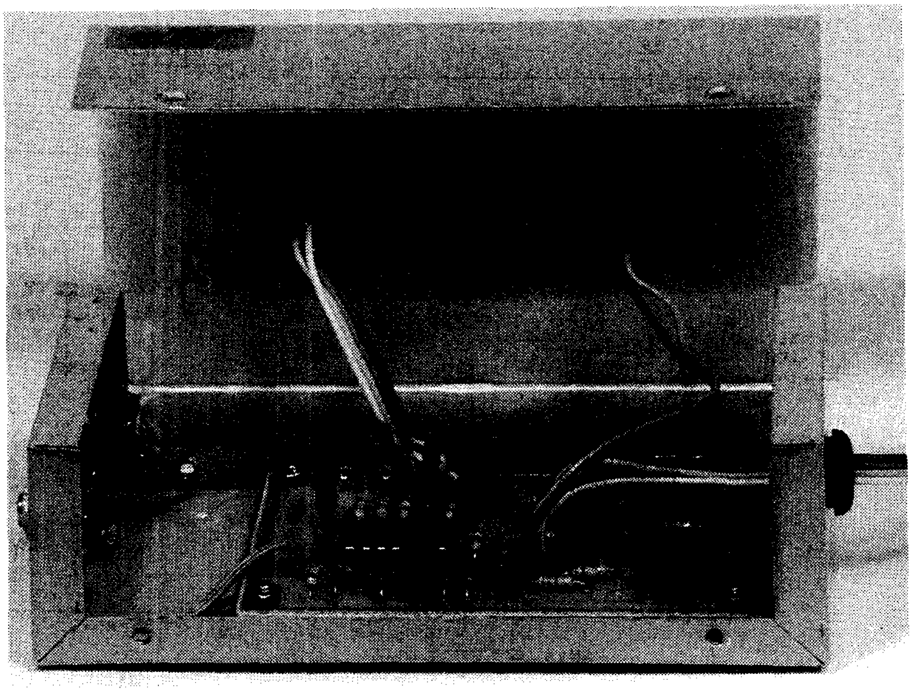
Audio signals from the receiver's 'Recording' output are fed to pin 2 of the chip, via the voltage divider R1/R2 and coupling capacitor C2. Preset pot RV1 is used to adjust the free-running frequency of the 2211's internal VCO, to a point around the middle of your receiver's audio bandpass. The two poles of SW1 are then used to adjust the PLL feedback loop filter constants, to adjust its bandwidth, pull-in range and response speed for optimum decoding of fax, RTTY or Morse as desired.

Since both RTTY and fax are transmitted using FSK (frequency- shift keying), the decoded digital output for these modes appears on pin 7 of IC1. Transistor Q1 is used as a simple inverting buffer stage, to feed this 'FSK' output to the computer.

Of course this decoding will only take place correctly when the PLL's VCO has locked correctly onto the incoming audio signal, and is staying in lock while the signal shifts up and down between the two audio frequencies. To allow you to make sure this is taking place, the base of transistor Q4 is driven from the Q- bar output (pin 6) of IC1, which goes low when the PLL is 'in lock'. The LED in Q4's collector circuit therefore lights whenever the PLL is locked to the signal, and should glow continuously for correct fax and RTTY decoding.

When Morse is being received, the carrier is being keyed on and off rather than shifted in frequency. Hence the audio note fed to the decoder also keys on and off. Inevitably the PLL therefore loses lock in the 'gaps' between the individual dah's and dit's — causing pin 6 to swing high and low, and the LED to flick on and off in time with the keying. In fact it is the signal from pin 6 of IC1 that is used by the Listening Post software for decoding Morse, rather than from pin 7.

The circuitry described so far, consisting of IC1, Q1 and Q4 is basically the same as used in the original Listening Post design. In fact this circuitry formed the complete hardware section of the earlier design. The remaining circuitry and components shown in Fig.1 are those that Tom Moffat has now added, to improve performance.



Inside my version of the Listening Post II decoder. It all went together very easily, and functioned exactly as claimed — after a few initial teething troubles.

Three-terminal regulator IC3 is used to provide a constant +5V supply line for IC1 and the rest of the circuit, to ensure stable and consistent operation. This allows the project to accept virtually any nominal '12V' DC input, without any problems. In fact the 'raw' input can vary anywhere between about 9V and 15V, with no adverse effect on operation.

With the original design, the 'Morse' output was taken directly from pin 6 of IC1, but this output is now also buffered using the stage around transistor Q2, to ensure that PLL performance and decoding are not degraded by cable capacitance or computer port loading.

But perhaps the most important additions are IC2, Q3, the 4.9152MHz crystal and their associated circuitry. These provide a stable timing reference signal for the Listening Post's software, for optimum decoding of fax signals.

With the original Listening Post and virtually all of its clones, the timing reference for fax decoding was carried out using software loops. This meant that the software generally had to be 'tailored' to run at the correct speed on different machines; it also meant that its performance tended to drift with temperature. As a result, the resulting fax pictures could at times be tilted or skewed vertically.

To obviate this problem, Listening Post II has its own crystal- locked oscillator and divider chain using IC2, to produce an accurate and stable timing reference signal. This makes everything completely independant of the computer's clock or timers, and ensures really 'rock steady' fax decoding.

As supplied the kit is set up to derive this reference signal from pin 2 (Q13) of IC2, which gives a frequency of 600Hz for normal-resolution display of weather fax signals. However a link on the board allows selection of an alternative 1200Hz signal from pin 1 (Q12), for a possible higher-resolution display. An optional switch can be fitted to select between the two, if desired.

Trimmer capacitor C11 is used to set the crystal oscillator exactly to frequency. This can be done with a frequency counter, or simply by adjusting it when receiving a fax signal, to get nicely squared-up vertical lines.

As before transistor Q3 is used in a simple buffer stage, to ensure reliable operation regardless of the computer's printer port and connecting cable.

That's basically it, as far as the hardware side is concerned. The rest of the work is done by the software.

The software

The software supplied with Listening Post II is designed to run on standard IBM compatible PCs, with either a CGA video adaptor, one of the higher-resolution adaptors or an LCD display as fitted to 'laptop' models. At present if you have an EGA or VGA adaptor, these are basically used in CGA mode — i.e., you can't take advantage of these cards to get higher resolution for the fax images. You also can't currently run the fax programs on a machine with a 'Hercules' (HGA) monochrome display, due to this adaptor's different scanning rates, etc. However Tom Moffat hopes to have EGA, VGA and HGA versions available in the future, if there is sufficient demand.

As an LCD displays in black on a white background, rather than the white-on-black of a CRT display, there are actually two versions of the fax display software to suit each. A pair of small batch files are provided to simplify this selection, along with another pair of batch files to select versions of the PRINTFAX printing program. At present this will only work with either an Epson-compatible or IBM-compatible dot matrix printer, but again Tom plans to provide versions for other printers if there's enough demand.

The RTTY decoding program can decode both Baudot/Murray and ASCII codes, and at six different speeds: 45.45, 50, 57, 75, 110 and 300 baud. The baud rates and code are selectable using the keyboard's function keys, with others of these keys used to toggle from 'tape' to 'page' mode, force a figures/letters shift or vice-versa, or bail out of the program (with or without saving the received file to disk, to a nominated filename).

The Morse decoding program is even simpler in use, as it automatically locks on to CW signals in the speed range from 10 to 40 words per minute. The only key functional here is the F10 'bail out' key, which again gives you the option of saving the received file to disk if you wish.

Trying it out

When the sample Listening Post II kit arrived, I put the software disk aside while I tackled assembly of the PCB. Although our kit was one of Tom's first batch, and lacked his official assembly instructions, I had a copy of the overlay diagram from his article for *Radio Experimenter's Handbook* to guide me. In any case with a board this simple, the assembly is pretty straightforward.

A quick check showed that the board itself looked quite clean, while the 'bag of bits' turned out to contain everything it was supposed to — always an encouraging sign, with any kit!

Although Tom has apparently designed the board to go in one of the small plastic 'Jiffy' boxes, I was a bit concerned about radiation being picked up by the receiver so elected to build it into a small metal utility box instead, to provide some shielding. As you can see from the pictures, the case I used measures 128 x 71 x 43mm, and carries a 'K&W' label; it came from Jaycar.

Otherwise I used a layout very similar to the one Tom suggests, with the slider switch and tuning LED on the top of the box, the DC power input and audio input connectors on one end, and the cable to the computer's printer port leaving via a grommetted hole in the other end.

It all went together easily, in a couple of hours, without any hitches. And when I set up a working copy of the software to suit my old IBM PC, I was soon able to display Tom's sample fax image files on the IBM's CGA screen, using the SHOW program. I could even print them out on my Epson-compatible dot matrix printer, using the PRINTFAX program.

But of course neither of these functions involve the decoder box. It still remained to make up a suitable cable to hook this up to my trusty Drake SSR-1 communications receiver, and try things out on 'live' off-air signals.

Above: One of the sample weather fax images supplied with the kit software. Those I received weren't quite this clean, but they were quite clear nonetheless.

It was then that the first minor hitch appeared. My old IBM has only one printer port, which was being used for the printer — how was I going to use the same port for the LPII box as well, without a lot of plug swapping?

The answer was to use a switching box, so further testing had to wait a few days until one could be procured. Then everything was fired up, and I spent some hours tracking down suitable weather fax signals. Finally I found a couple — one from Japan (JMH, on 22.770MHz) and the other from Darwin (AXI, on 18.060MHz). In both cases I was able to get quite clear fax images on the screen, after a little fiddling with the tuning, and then print them out after saving to disk.

So far so good. Then I tried receiving some RTTY. It took quite a while to find some good old-fashioned FSK RTTY signals (nowadays a lot of material is sent by fancier modes); but finally I found one — what looked like a news agency, transmitting international news stories in French on 22.070MHz. Its signal was good and strong, with only a small amount of fading, and I got pages and pages of very clean copy.

I had similar success with Morse reception, with less searching for suitable signals as there are more of them around. The only problem here was some sort of glitch with Tom's Morse program, where it would 'hang' at the end of each line. You'd have to bail out with the F10 key, and then re-call the MORSE program from DOS, to continue.

When I raised this problem with Tom, he had apparently just become aware of it — apparently it only shows up with some computers. However as I write he's just contacted me to advise that he has tracked it down, and the software sent out with 'production' kits will have the bug fixed.

Apart from this, though, everything seemed to work quite well with my old IBM. The only other hassle was RF radiation from the overall computer setup — more about this shortly.

Out of interest, I decided to try it out with my newer Epson AX2, an 'AT-compatible' which uses the 80286 processor. And just as well I did, because here I struck a few more snags.

Firstly, it turned out that the printer port on the Epson's EGA video card didn't seem to be compatible with Tom's fax decoding program. Even though the PRINTFAX program would happily use the same port to print out images on the printer, the FAX program wasn't able to tell when the decoder was present.

This didn't seem to be due to any problem with Tom's program, so I looked for a possible slight quirk in the printer port hardware.

The card itself was made by Eizo Corporation in Japan, and is designated the MD-B06. After much head-scratching and a few urgent fax messages to the Technical Support people at Eizo (who were most helpful), the answer emerged.

It turns out that all of the input lines on the MD-B06's printer port are provided with 4.7k pullup resistors, except one: the 'ACK' line, which connects to pin 10 of the DB-25 socket. And the custom chip that handles the printer port interface on this board apparently 'hangs up' if this input line is left floating. You guessed it — by Murphy's Law, the one input that Tom's Listening Post decoder doesn't use is the ACK line.

The addition of a 4.7k pullup resistor on the board fixed this problem, and the fax programs then worked perfectly. But then another problem became apparent: neither the RTTY nor Morse decoding programs seemed to work properly on the AX2, even though they'd worked perfectly on the old IBM. Both of them tended to 'hang', and didn't respond properly to keyboard inputs.

It looked like there might be a compatibility problem between these programs and an 'AT-level' machine, so I tried the setup with two other AT type machines in the office. Sure enough, neither program would work properly with them either.

Needless to say I hastened to inform Tom Moffat of this bug, and we both spent some time (he in Tasmania and I in Sydney) poring over hardware and software references and comparing data on PC/XT and AT machines. Finally we discovered the cause of the problem: Tom's programs use the computer's 'programmable timer channel 2', and this has slightly different addressing in AT machines compared with PC/XT's.

This discovered, and with some hurried access to a couple of AT machines, Tom was soon able to rehash the programs to get around the difficulty. So again, the software sent out with the 'production' Listening Post II kits won't have this problem.

The one remaining hassle, I found, was the one mentioned earlier: radiation from the computer system. This is a common one wherever computers and sensitive radio receivers are used together, of course, and many articles have been written on techniques to get around it.

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   " SIR GEOFFREY AVAIT ETE TROUBLE PAR L'ATTITUDE INTRANSIGEANTE
DE MME TATCER AU SOMMET DE ROME, LE WEEK-END DERNIER, OU ELLE A
REFUSE,  DANS LES TERMES LES PLUS DEFINITIFS,  D'ENVISAGER  L'IN-
STAURATION D'UNE MONNAIE UNIQUE EN EUROPE.

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OUTRANCIERE SEMBLE RENCONTRER PEU D'ECO OUTRE-MANCE.

   --- UN MEMBRE DU PDS,  LE PARTI COMMUNISTE RENOVE ALLEMAND,  A
ETE  ARRETE  HIER  A OSLO,  ALORS QU'IL TENTAIT DE TRANSFERER DES
FONDS D'UNE BANQUE NORVEGIENNE SUR LE COMPTE D'UNE ENTREPRISE SO-
VIETIQUE.
   " CET OMME DE 42 ANS, KARL-HEINZ KAUFMANN,  SECRETAIRE DU PDS
POUR L'ARRONDISSEMENT DE HALLE,  TENTAIT DE VIRER L'EQUIVALENT DE
230 MILLIONS DE FF.
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FQ DE JOR JOR OOR QSX 2 JMHZ K CQ IQ D Q DE JOR JN N R U I QSX 22MH
D K CQ CQ CM DE JOR JOR IMG R QSX 22MHG K IT CQ CQ DE JOR JOR JM R
N TSX 22MHZ K CQ CQ CQ DE JOR JOR JOR USX 22MHZ K CQ CQ CQ DE JOR JOR
JO I QI A 22MHZ K CQ CQ CQ DE JOR JM R JOR U X 22 THZ K CQ CQ CQ DE
JOR JOR JOR T EX 22MHZ K TNQ RQ
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At top is a sample of the kind of RTTY signals I was able to receive — a French language news service, sent at 50 baud. Above is a brief sample of a decoded Morse transmission.

The basic problem is that most personal computer systems tend to produce significant radiation — not necessarily from the computer itself (although many do!), but often from the video monitor, the printer and the interconnecting cables. Harmonics of the many fast digital signals present in these components tend to extend well into the HF spectrum, producing all sorts of annoying 'birdies'.

This tended to happen with all of the machines I tested with the Listening Post II. I soon discovered that it was advisable to turn off the printer, for example, whenever I was trying to tune in and capture any signals from the receiver — only turning it on later, to actually print things out.

I also discovered that there was quite a significant amount of radiation from the ribbon cable connecting the LPII decoder unit to the computer. As this is needed for the system to operate, you obviously can't unplug it; but as soon as I get time, I intend to try fitting some small RF chokes and perhaps bypass capacitors, in all of the leads. Hopefully this will remove much of the higher harmonic content and cut down radiation, without disturbing normal operation.

How one can cut down the radiation from the video monitor I'm not sure, but this is also worth trying. Obviously the more you can cut down on radiation from the computer setup as a whole, the more success you're likely to have with this kind of project.

Summarising, the new Listening Post II design seems an excellent one, and Tom Moffat is to be congratulated. Even more than before, it provides a really low cost way to use an existing personal computer for exploring the fascinating world of weather fax, RTTY and Morse code transmissions.

Tom also seems to have a winner with his kit for the project, too. Now that he's fixed the little bug with the Morse program, and conquered the little differences between PC/XT and AT machines, the project seems to be capable of working well with a wide variety of IBM compatible machines.

Mind you, I'm sure he's going to be swamped with people wanting a version of the fax program to work with 'Hercules' graphics adaptors, and to get better resolution images out of EGA and VGA adaptors. No doubt there'll also be people who want to print fax images out on other printers, too. Some people are never happy, are they?

(That reminds me — I wonder if he'd write a driver to print out the fax images on our office laser?)

Seriously, though, it's a great little design and kit. But don't build it unless you have some time to spare; once you get it going, searching the HF bands for interesting fax, RTTY and Morse signals can be surprisingly addictive...

As noted earlier, the Listening Post II kit is only available by mail order from High Tech Tasmania, whose address is 39 Pillinger Drive, Fern Tree, Tasmania 7054. And the cost is $59.00, plus $7.00 for post and packing anywhere in Australia and New Zealand. ■

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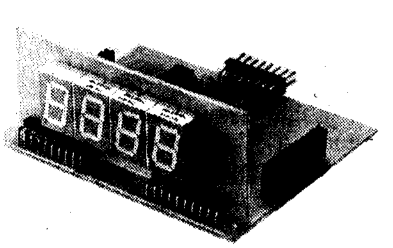

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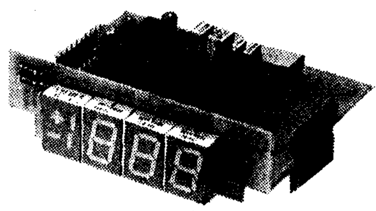

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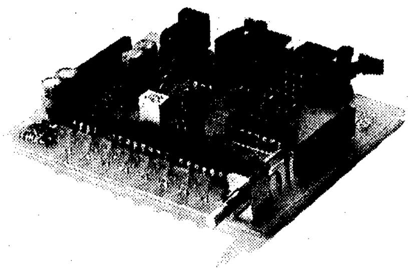

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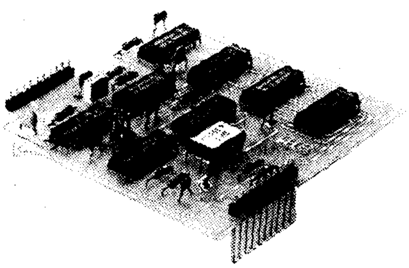

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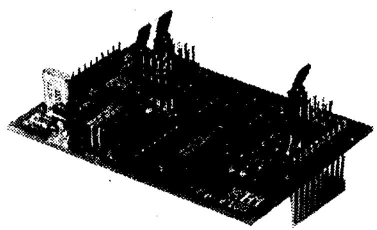

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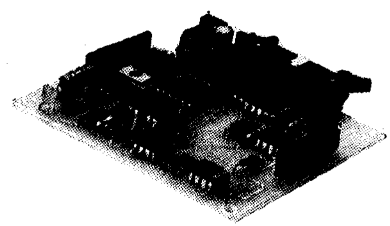

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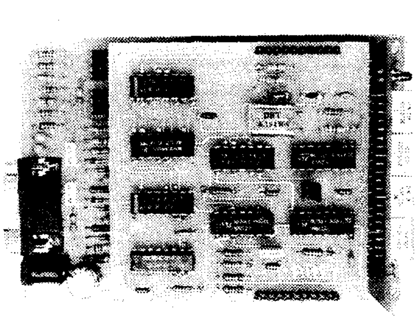

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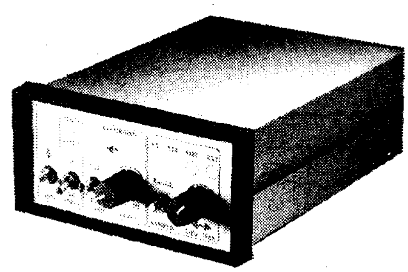

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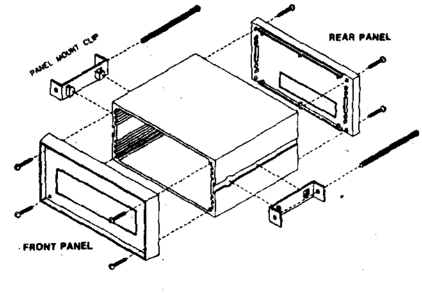

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READER INFO NO. 19

Infra-red proximity detector

I recently had a requirement for a high reliability proximity detection circuit for use in a computer controlled model train set. Although the circuit shown is optimised for this environment and has a range of only 100mm, with some simple modifications it could become a general purpose proximity switch with a usable range of a metre or more.

The design employs an entirely digital detection process and can operate from a wide supply range. The output is compatible with a microprocessor and the entire circuit can be remotely located if necessary. It will work well in all lighting conditions and has a high immunity from stray noise and light from similar nearby detectors.

The detection algorithm works by sampling the reflected signal from a flashing IR LED at twice the flash frequency. When a valid reflection is encountered, the samples will follow the sequence ON, OFF, ON, OFF, etc. After eight consecutively correct samples, proximity is flagged at the output. Individual samples are taken at a 10kHz to 15kHz rate and so detection of an object will take less than 1ms.

IC1a is a square wave oscillator which produces a clock of between 20kHz and 30kHz. It feeds a waveform and timing generator comprising IC2a, IC3a and IC4a. From IC2a, pin 4 produces an LED drive waveform, pin 3 produces a sampling clock at twice the LED drive rate and pin 6 generates the 'eighth sample indicator'.

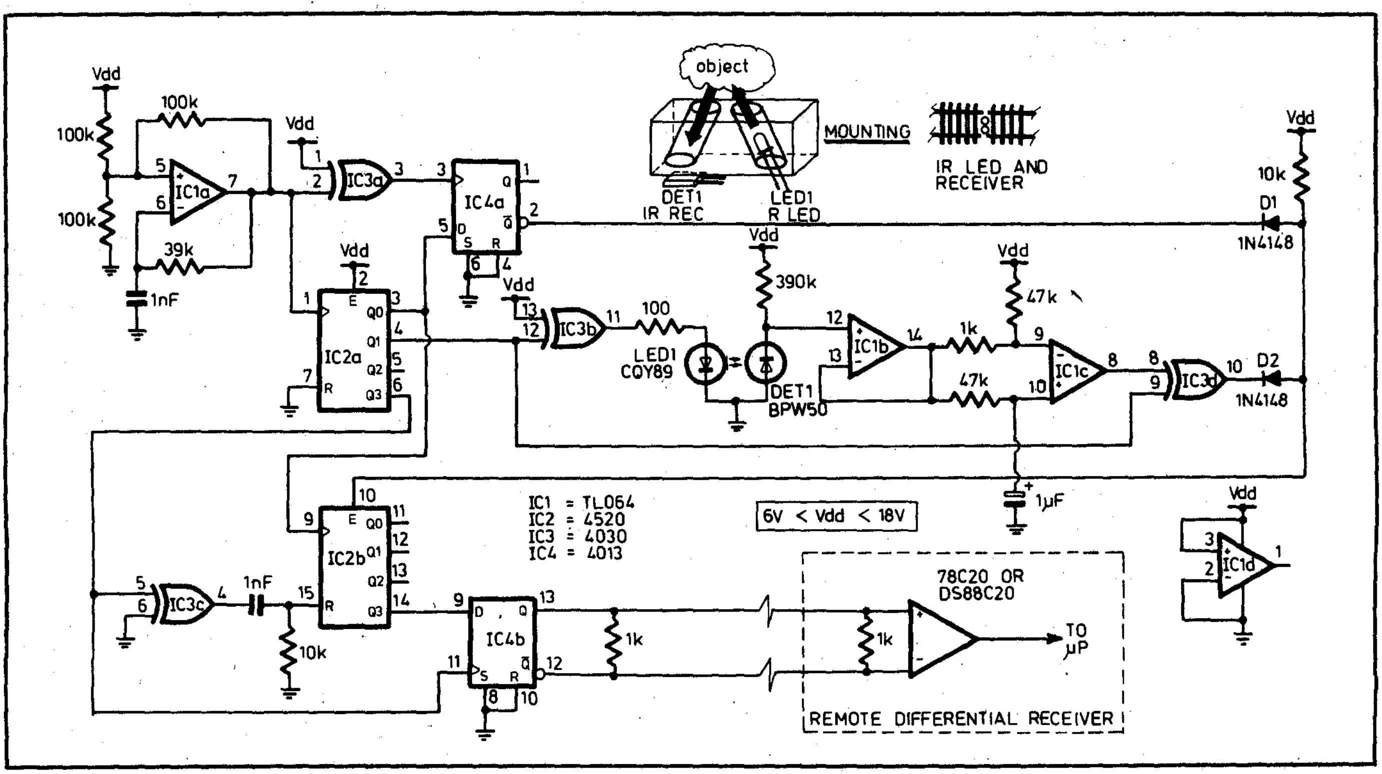
IC4a is driven with a lagging phase and generates a quadrature version of the sampling clock. This is used to delimit the 'detection window' within the LED drive period and it masks out noise which is detected during LED transitions.

IC3b drives the LED and if mounted as shown, has a range of around 100mm or more. For an extended range, this could be enhanced with a transistor buffer (for higher current drive) and multiple drive LEDs wired in series.

Operation of the IR detection and decision making sections is a little more complicated. IC1b acts as a voltage follower for the received reflected signal. IC1c performs the level detection process and the capacitor at its non-inverting input provides an automatic ambience compensation function. The detector will function equally well in direct sunlight, under artificial light or in complete darkness.

IC3d compares the detected level with the instantaneous transmitted level and outputs a '1' when they are identical. When an object is brought into proximity of the detector, the voltage at this point changes from being predominantly '0' to predominantly '1'. It is masked with the detection window by a diode AND gate (D1, D2).

Pin 10 of IC2b will be high if the input is valid during the detection window. The sample clock at pin 9 arrives exactly at the centre of the window and IC2b will therefore advance one count for each valid sample which is received. After every eight samples, there is a rising edge on pin 6 of IC2a. If eight consecutive samples have been clocked into



IC2b, its count will also be eight and pin 14 will be high. In this case, a '1' will be latched into IC4b.

If any of the eight samples were invalid, IC2b will have counted to less than eight and a '0' will be latched into IC4b (indicating that no object is in proximity). IC3c and the 1nF/10k RC combination act as a positive edge detector and reset IC2b to zero. Thus, after every eight samples, the slate is wiped clean and the detection cycle starts again.

Pins 12 or 13 of IC4b can directly drive the interrupt input to a microcontroller, but if the detector is remote from the processor, the complementary outputs from IC4b can be used to advantage. Wired as shown, they will drive a differential line receiver. As differential outputs have much greater immunity to noise than a single voltage level output, they can be operated reliably over a much greater distance or in an electrically noisy environment.

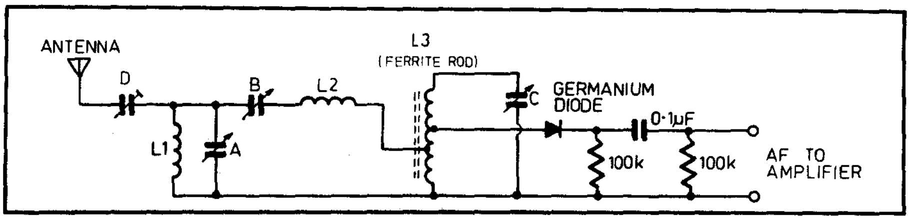
As an electric train set can be a particularly noisy environment, the differential outputs are ideal. The entire circuit can be located at great distance from the microcontroller and be connected with only four wires; two for power and two for the differential detection output.

The optics are best mounted beneath the surface of the layout at the junction of two track segments. Drawings of a suggested mounting strategy are provided.

The sensitivity of the detector can be varied over a small range by manipulating the values of the resistors in series with the IR LED and the IR receiver. The sensitivity obtained by the circuit (as shown) is more than ample to reliably detect a model train. For example, if a loco travelling at the fast rate of 1m/s passed over a detection arrangement as shown, the circuit would identify it before if had travelled another 1mm.

If numerous detectors are placed in close proximity to each other, say at a set of points or in the middle of a tunnel, there is a chance that they will interact. To avoid this, their operating frequencies can be de-matched by increasing the value of the 39k resistor across IC1a to 56k or 100k. It is important that the oscillation frequencies of detectors in proximity be kept as far as possible from even multiples of each other. With careful selection of frequency and IR power, few problems will be experienced.

Stefan Keller, BE (Hons),
Peakhurst, NSW. **$60**



Crystal set AM tuner

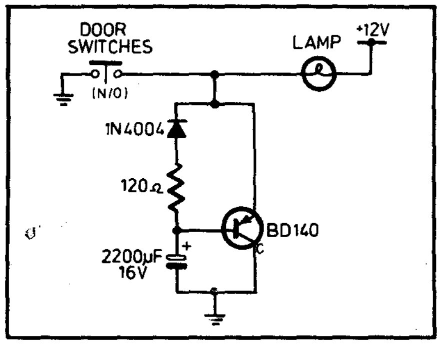
This simple circuit uses on germanium diode plus some old coils from a junk box and can produce excellent AM reception suitable for feeding into a tape recorder or amplifier.

The unit uses an acceptor/rejector circuit comprising two old 'Aegis' antenna coils L1 and L2, tuned by variable capacitors A and B, taken from a scrapped old 'tranny', an old Tandy ferrite rod coil for main calibrated tuning capacitor C. D is merely a small value aerial coupling capacitor.

A 22-metre outside aerial is used without separate earth (earthing is via the amplifier). Careful adjustment of the acceptor and rejector tuning capacitors will ensure adequate selectivity. The whole assembly fits into a metal cabinet measuring 200 x 40 x 60mm.

P.A. Manchee,
Burwood, VIC. **$35**

Courtesy light fader



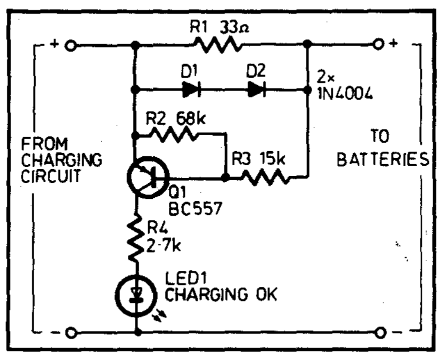
A feature of several late model cars is that when the door is shut the dome light on the ceiling slowly fades, giving enough time to find safety belts etc. The following circuit achieves the same result at low cost, and requires just one connection to the cars' wiring.

When the door is opened, the lamp comes on normally. The door switch also discharges the capacitor through the diode and 120 ohm resistor, acting to dim the lamp. When the capacitor is fully charged the transistor is off and no current flows through the lamp.

With 2200uF, a 10W lamp fades in about 5 seconds. Adjust this value according to the load and desired fade time. The earthing connection is made with a small piece of aluminium bolted to the case of the transistor (collector) and the car body, which also acts as a heatsink.

Olaf Bulenda,
South Yarra, Vic. **$35**

Nicad battery protector



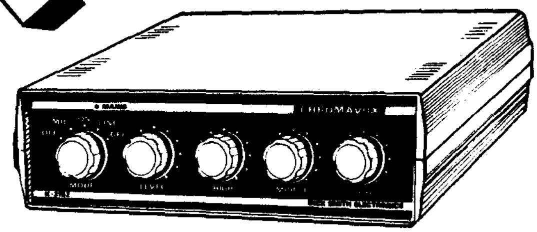
This circuit was designed to protect nicad batteries and their charger from non technical users! The circuit provides a simple 'charging OK' or 'something wrong' indication. It tests shorts, open and bad connections and reversed batteries.

Current to the battery to be charged flows through D1, D2 and R1; when it exceeds 25mA Q1 turns on, lighting LED1 the 'charging OK' LED.This tests open circuits and bad (high resistance) connections. When a short circuit occurs the emitter of Q1 is at the -ve rail and LED1 has no voltage applied therefore cannot light, indicating something is wrong. When the batteries are put in backwards the residual voltage reverse biases LED1, which is off – again indicating a problem.

The circuit works fine for AAA batteries and above, and requires two or more batteries to be charged in series at a time. LED1 must be a high brightness type consuming only a few mA, as this current is subtracted from the battery charging current.

Mr Eades,
Leura, NSW. **$35**

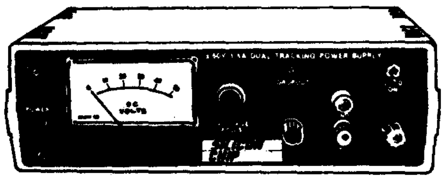
NEW KITS



CHROMAVOX

Automate your light show and let it dance to the music! The Chromavox accepts line input from an amplifier or operates independently, off its built-in microphone. This kit comes complete with a moulded plastic case plus pre-punched silk screened front panel and can handle up to 2400 watts of lighting through 3 channels.

Cat K-3162 **$139**



DUAL TRACKING +/- 50V POWER SUPPLY

This power supply can really deliver the goods with variable output from 0 to 100 volts DC! Ideal for TV servicing.

- Variable current to 1.7A @ 0-87V & 1A @ 100V
- LED indicator for ripple exceeding 5mV p-p
- Short-circuit protected
- Pre-punched & screened front panel
- This kit is supplied complete

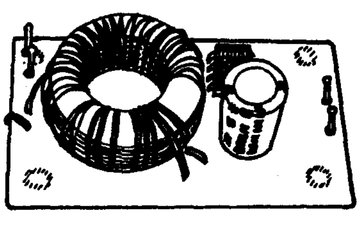
Cat K-3465 **$249**

1.5V to 9VDC CONVERTER

Frustrated at how quickly your 9 volt batteries go flat? Then switch over to more cost efficient 1.5 volt cells with this 1.5 to 9 volt converter. It uses just 3 components and fits on a small PC board. This is a short form kit — PCB and components only.

Cat K-3230

NEW! **$14.95**

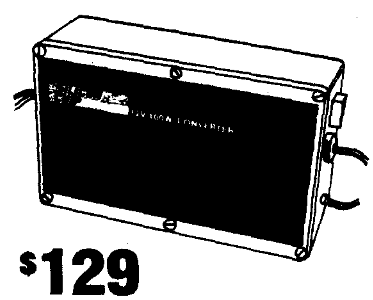


12V 100 WATT DC CONVERTER

Ever wished you had the power of your home stereo in the car? Well now you can! This compact inverter will power equipment up to 100 watts. That makes it ideal for our 50 watt and 100 watt amplifier modules. It has temperature and current overload protection plus low voltage shut down to prevent your car battery going flat. This kit is supplied complete including case.

Cat K-3235

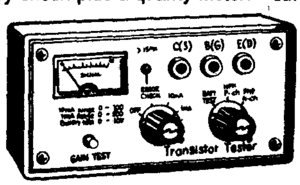
NEW!



$129

TRANSISTOR TESTER

This tester is capable of checking most discrete semiconductor devices, especially bipolars and FETs. It's also an excellent way of becoming familiar with the basic operation of these components. The circuit features an overload indicator and battery check plus a quality meter. Cat K-7220

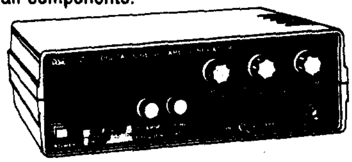


NEW! **$39.95**

DIGITAL SINE/SQUARE WAVE GENERATOR

This new Digital Sine & Square Wave Generator uses high speed CMOS ICs and a digital filter to produce waveforms over a frequency range of 0.1Hz to 500kHz. It also features a 4-digit frequency readout, an output level control, and course/fine frequency adjustment. Supplied with pre-punched front panel, case, and all components.

Cat K-7350

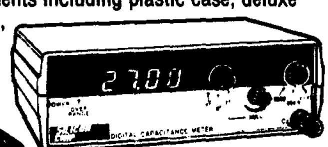


$149

4 DIGIT CAPACITANCE METER

Use it in the workshop, use it in the laboratory. This meter can measure capacitance from 1pf to 9999uf in seven ranges. It is mains powered, which means a big bright LED display, and it has an accuracy of better than +1%. Supplied complete with all — components including plastic case, deluxe pre-punched silk screened front panel, and even alligator clips and BNC plug for test lead.

Cat K-7500



$129

Kits marked with this symbol involve mains power wiring. Take extreme care when working with this equipment.

Degree Of Simplicity — Simple / Intermediate / Detailed

DICK SMITH ELECTRONICS

100 Watt HF Linear Amplifier

A wide band HF amplifier with only 3dB drop-off at 28MHz. Use it with any QRP gear with 3 to 15 watts output. Includes carrier operated Rx/Tx switching and a low-pass filter.

Cat K-6331

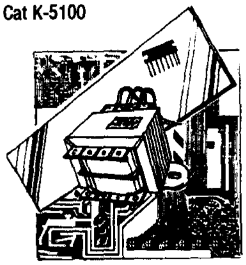
WAS $249 Oct. '90

$199

30W Stereo Amplifier

From the popular Playmaster series, this 30/30W stereo amplifier provides excellent performance, great specs., and low cost. Construction is made easy by mounting all parts, including heatsinks, on one large PCB. Short form kit comes with two TDA1514 ICs, transformer, PCB, and front & rear panels.

Cat K-5100



EA Sept. '88

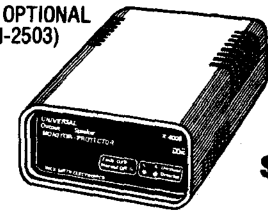
Only $99

BARGAIN KITS

10-150 Watt Speaker Protection Relay

A universal speaker protection device which can be powered from the amplifier's power supply or used as a stand alone device with its own power supply. Features 'De-thumping' delay with power-up and can be preset for clipping and maximum power level detection. Cat K-4008

CASE OPTIONAL (Cat H-2503)



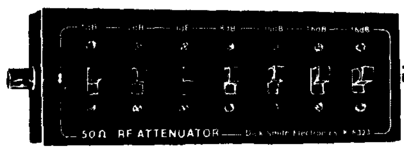
WAS $39.95 Oct. '90

$29.95

RF Attenuator Box

Amateurs know just how valuable a good attenuator is... and how expensive they normally are! Well, here's top value — up to 63dB attenuation in 1dB steps from 50 to 500MHz - and it's heaps less expensive than equivalent commercial units! Rated at ¼ watt, with a 50 ohms input impedance and standard BNC connectors.

Cat K-6323 **AEM April '87**

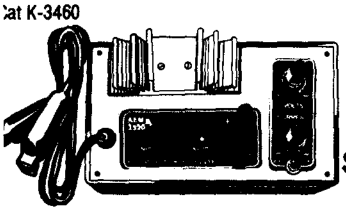


WAS $59.95 Oct. '90 **$49.95**

Battery Power Supply

Variable supply — ideal for beginners. No messing with mains, can be powered from a battery. Includes all components, hardware and case. No metering, no frills, but economical.

Cat K-3460



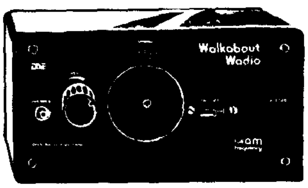
WAS $49.95 Oct. '90

$39.95

Walkabout Wadio

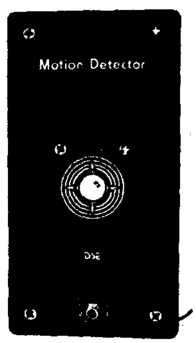
A portable AM radio which can breath live back into that tired AM sound! Using a cunning TRF circuit, the original audio bandwidth transmitted by the station is largely maintained and AM comes alive!

Cat K-2720



WAS $14.95 Oct. '90

$9.95



Optical Motion Detector

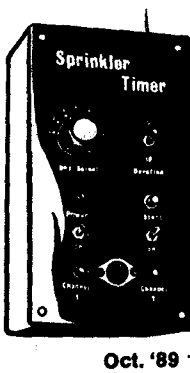
Use it as part of an alarm or as a door minder. Detects movement by changes in light level. Operates in two modes — 'guard' for sensing movement, and 'search' for beam interruption.

Cat K-2721

Only $19.95

Kits marked with this symbol involve mains power wiring. Take extreme care when working with this equipment.

Degree Of Simplicity — Simple — Intermediate — Detailed



2 Channel 7 Day Sprinkler Timer

Design your own garden sprinkler system for a fraction of the cost of commercial devices! With the aid of a standard distributor tap and one or two solenoid valves, this timer will control up to 14 sectors. The kit is mains powered and comes with a case and pre-punched front panel. You will need to supply your own taps and solenoids.

Cat K-3588

Oct. '89 EA

WAS $99 Oct. '90 **$59.95**

MAJOR DICK SMITH ELECTRONICS AUTHORISED STOCKISTS:

N.S.W.: ARMIDALE: New England Electronics 711655 BALLINA: Ballina Electronics 867022 BEGA: OZTECH Electronics 923933 BOWRAL: F.R.H. Electrical 611000 BROKEN HILL: Hobbies & Electronics 884098 COOTAMUNDRA: Cootamundra Music & Lite 422561 COFFS HARBOUR: Coffs Harbour Electronics 525684 DENILIQUIN: Deni Electronics 813672 DUBBO: Chris's Hi Fi 828711 FORSTER: Forster Village Electronics 545006 GLEN INNES: John Sommerlad Electronics 323661 GRAFTON: Repairs and Spares 421911 GRIFFITH: Miatronics 624534 INVERELL: Inverell Electronics 221821 KEMPSEY: P&L Leonard 631134 LEETON: Leeton Audiotronic 532800 LIGHTNING RIDGE: Cycle & Sound 290579 LITHGOW: Douroy Photographics 513173 LISMORE: Decro Electronic Services 214137 MOREE: Moree Electronics 522091 MUDGEE: Headware 723895 NARRABRI: Namoi Computer Service 923274 NELSON BAY: Nelson Bay Elect & Hobbies 813685 NOWRA: Nowra Electronics 210722 ORANGE: Central West Electronics 626491 PARKES: Strad Music Centre 623366 PORT MACQUARIE: Hastings Computer Service 834574 RICHMOND: Silicon Crafts 784101 TAREE: Brads Electronics 526603 WAGGA WAGGA: Phillips Electronics 216558 WELLINGTON: Wellington Service 452325 WINDOR: Silicon Crafts 776722 YASS: Warmington Electrical 261116 YOUNG: Keith Donges Electronics 821279 **VIC:** BAIRNSDALE: LH & LM Crawford 525677 COLAC: Colac Electronics 312847 MILDURA: Pullman Auto Pro 232882 MORWELL: Morwell Electronics 346133 SHEPPARTON: Andrew Guyatt Electronics 219497 SWAN HILL: Nyah District TV Service 329303 TRARALGON: Traralgon Electronics 741699 WARRAGUL: Roylaine 234255 WARRNAMBOOL: Koroit St Elec Services 627417 **QLD:** AYR: Delta Electrix 831566 BOWEN: Bowen Electronics 861656 BUNDABERG: Bob Elkin Electronics 521785 CALOUNDRA: Electro-mart 918533 DYSART: Dysart Videotronixs 582107 INGHAM: Masons Electronics 763188 INNISFAIL: Innisfail Hi-Fi 612014 MACKAY: Stevens Electronics 511723 MARYBOROUGH: Keller Electronics 214559 NAMBOUR: Nambour Electronics Shop 411604 PIALBA: Keller Electronics 283749 STANTHORPE Granite Belt Communications 813333 **TAS:** BURNIE: Electronic City 314760 DEVONPORT: A.I.Electronics 248322 **SA:** MT GAMBIER: Hutchesson's Communication Centre 250400 PORT LINCOLN: Basshams TV & Comp World 822788 WHYALLA: Eyre Electronics 454764 **WA:** ALBANY: Micro Electronics 412077 BUNBURY: Micro Electronics 216222 GERALDTON: Batavia Lighting & Electrical 211278 KALGOORLIE: Today's Electronics 215212 KARRATHA: Daves Oscitronic 854836 MANDRAH: Micro Electronics 5812206 PORT HEDLAND: Ivan Tomek the Elect 732531

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B1072/P1

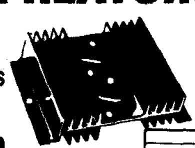
BULK SPECIALS

BUY 10 UP AND SAVE!

ECONOMY POWER HEATSINK

- Flag mounting design with fins top & bottom
- Holds 2 x TO-3, TO-26, or TO-220 ICs
- Size: 74x102x25mm

Cat H-3471



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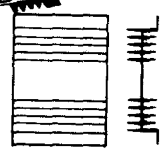
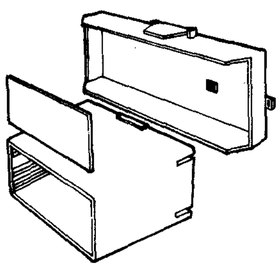


PLASTIC PROJECT CASE

This new Australian designed case has 3 circuit board slots, a snap fit cover, and provision for bar mounting. Its dimensions are 155x100x75mm.

Cat H-2597

$9.95



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PLATED BRASS PCB SPACERS

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Round	4BA hole	6mm	12	H-1831	$4.95
		9mm	10	H-1832	$4.95
		12mm	8	H-1833	$4.95
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Hexagonal	4BA hole	9mm	6	H-1842	$2.95
		12mm	6	H-1843	$2.95
		25mm	4	H-1847	$2.95

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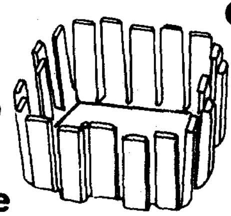
HEATSINK TO-3 TYPE POWERFIN

For the greatest possible heat dissipation in the smallest possible space.
Measures 50x50x26mm. Cat H-3400

$2.95



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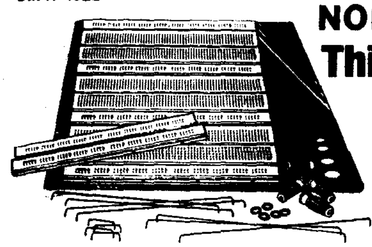
JUMBO BREADBOARD KITS

You'll never have to solder and re-solder experimental circuits again when you have a Wish-Board breadboard kit.

- Colour-coded power rails
- Phosper bronze & Nickel silver contacts
- Aluminium base plate for excellent high frequency performance
- Dovetail joints for interlocking boards
- Includes assorted hook-up wire, terminal posts, and rubber pads

Cat H-4022



NORMALLY $99.95

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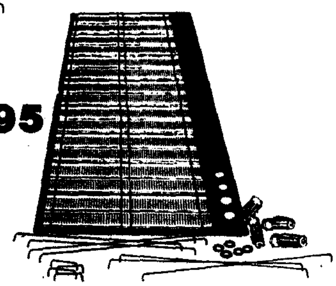
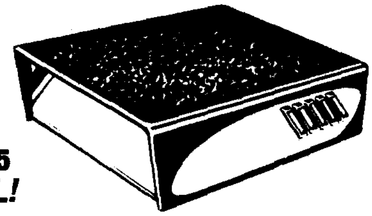


METAL PROJECT CASE

An attractive two-part case with ventilating side slots finished in blue and grey. Dimensions are 160x130x50mm and it's ideal for all your small instruments.

Cat H-2762

$9.95



Reduced from $12.95

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DICK SMITH ELECTRONICS

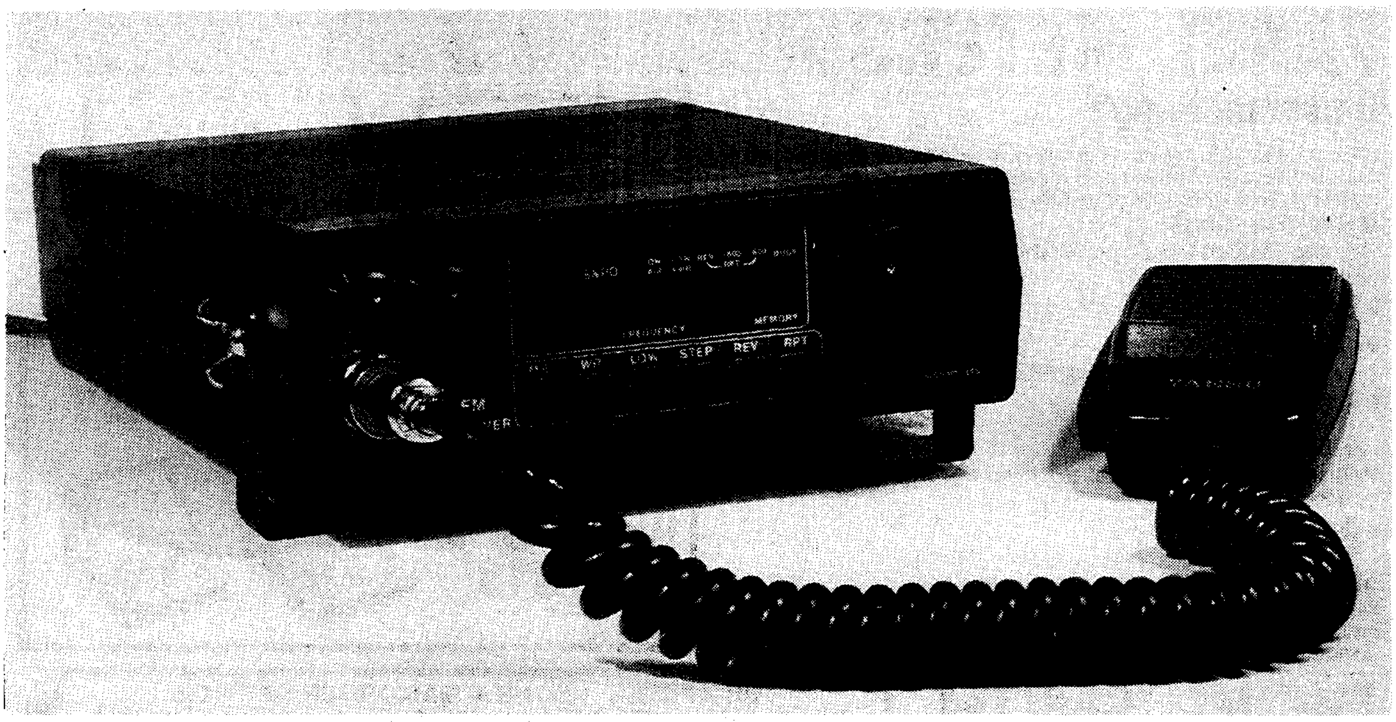
B1072/T1

Construction Project:

A new 2m FM Transceiver - 1

Here's an outstanding new high performance FM transceiver design for either mobile or base station use on the 144-148MHz amateur band. It features full PLL frequency synthesis, 24 memory channels with repeater shifts, selectable output of either 25W or 5W, tuning steps of either 5kHz or 25kHz, protection against excessive SWR and a microcontroller to simplify operation. At the same time, it has also been designed for easy home construction — at a very attractive cost.

by JIM ROWE



This is the first of a short series of articles describing a brand-new multi-channel FM transceiver design for the 2-metre amateur band, intended specifically for home construction.

We cannot tell a lie — the design isn't from our own *EA* lab, but from those busy R&D people at Dick Smith Electronics. Judging from the prototype we've inspected, though, they've gone to a great deal of trouble to ensure that it's both easy to build and an impressive performer. We certainly couldn't have done better ourselves...

Incidentally the last multichannel 2m FM transceiver design described in *EA* also came from DSE. This was the very popular 'Commander' design, published back in the June-July 1984 issues. A great many kits were sold for that design, I gather, and as a result DSE has been spurred to come up with a new and updated design.

I should stress that the new design is by no means just a 'revamp' of the 1984 Commander design, however. It's completely new, and designed to take advantage of the latest components and circuit techniques. This makes it significantly easier to build than the earlier design, while at the same time offering more features and higher performance.

As you can see from the specification panel, it covers the full 144-148MHz band with selectable tuning steps of either 5 or 25kHz. You can also offset the transmitter frequency for repeater operation, by either -600kHz or +600kHz. And 24 of your most common operating frequency channels can be programmed into the memories (with offset), for instant recall.

Transmitter output can be switched between 5W and a husky 25W, while built-in protection circuitry shuts down the PA stage to prevent damage from high antenna SWR. The output is also very clean, with spurious components at lower than -60dB.

Performance of the double-conversion receiver section is also very impressive,

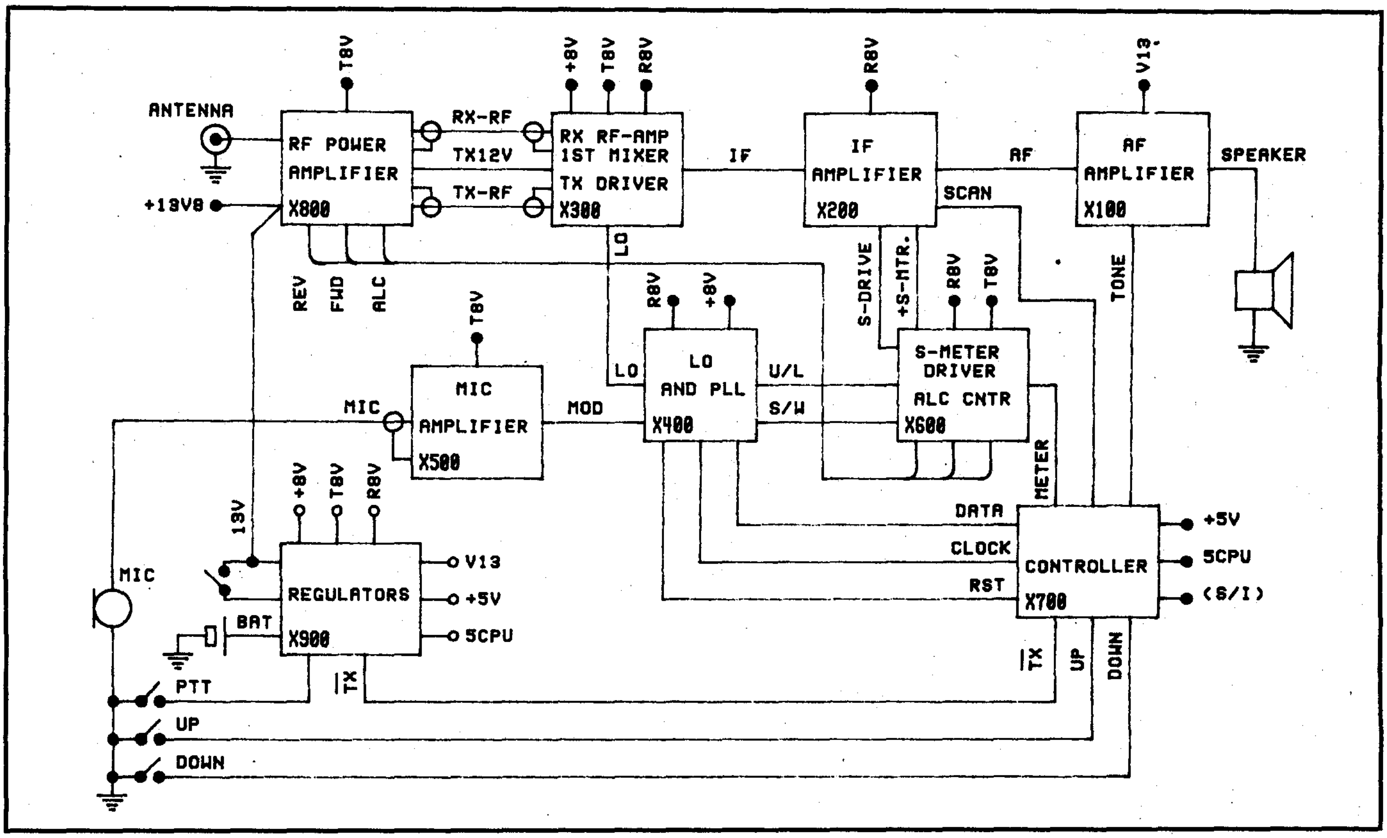


Fig.1: The block diagram for our new 2m FM transceiver. Looks complicated, but we take it section by section...

with a typical sensitivity of 0.15uV for 12dB SINAD, selectivity of 30kHz at the -60dB points and image rejection better than -60dB. You can also make it 'scan' the memory channels, and stop when it finds one active. In short, it's a design that compares extremely well with current commercial transceivers.

Needless to say, kits for the new design will be available in DSE's retail outlets and via its mail-order service. The kit has the catalog number K-6400, and is expected to be available by the time you read this. Its price is projected at $399, which compares very well with equivalent commercial units.

Design summary

In common with most of today's commercial multi-channel tranceivers, the new design features PLL (phase-locked loop) frequency synthesis, under the control of a dedicated single chip microcontroller. The microcontroller's functions include reading the front panel switches and the two-phase rotary encoded channel switch, driving the frequency and memory displays, storing memory channel information and controlling the PLL synthesizer via a three-wire serial bus.

The design employs a single PLL controlled VCO, used for both transmit and receive. In the receive mode the VCO acts as the first local oscillator, and operates 10.7MHz below the received frequency. When transmitting, it operates directly on the transmit frequency, being modulated by the audio signal from the microphone amplifier. The output signal from the VCO is fed to the RF sections of the transceiver, where it is switched to either the 1st mixer, when receiving, or the transmit driver when transmitting.

In the receiver, the narrow-band IF amplifier employs an industry standard amplifier/demodulator IC. The AF amplifier is a simple design using discrete components.

To allow you to get a good understanding of the new transceiver's operation, the remainder of this first article will be devoted to a detailed look at the various sections of the circuit schematic. Then next month we'll start on the construction and assembly, which is organised in easy test-as-you-go stages.

Fig.1 shows the overall system design of the transceiver. Although there's a fair bit in it, understanding how everything works is not difficult as long as you take it in stages. As you can see, it consists of nine main circuit sections — most of which are operational in both receive and transmit modes. These will now be discussed in turn, starting with the power supply and regulators.

Power supply

The transceiver as a whole is designed to operate from a nominal 13.8V DC negative-ground supply, as found in most modern cars or provided by many readily available DC power supplies. It draws about 500mA on receive, and 6A when transmitting in high output (25W) mode.

The internal power supply circuitry (Fig.2) uses the +13.8V input to derive the +5V and +8V supplies needed for many of the circuit sections, via standard 3-terminal IC voltage regulators.

Regulator U901 supplies a +5V rail for the microcontroller only. This supply rail is a crucial one, because if it fails the CPU will lose all data from its internal RAM. When this occurs all frequencies programmed into the memory channels of the transceiver will be lost, and on power-up the transceiver will default to a frequency of 147.000MHz.

To avoid this, the transceiver has connection for an optional 7.2-9V rechargeable backup battery.

This battery is connected to the input of U901 via D902, when no external supply is present. If the external +13.8V is connected to the transceiver, D902 will be reverse biased and the battery will be charged via R901 (the charging current is about 5mA). Series diode D901 prevents the battery from supplying other circuitry if the external +13.8V is not connected and the power switch is closed. Regulator U902 produces a separate +5V rail, for other sections of the controller circuitry.

A supply rail of +8V is produced by regulator U903. This is switched to the receive or transmit circuitry respectively by Q901 and Q902, which are switched in a complementary fashion according to the state of the microphone's press-to-talk (PTT) switch. The 'transmit' rail (T8V) will actually be a little lower than 8V, due to the saturation voltage drop of Q901 (a few hundred millivolts), while the 'receive' rail (R8V) will also be lower because of the saturation voltage and base-emitter voltage drop of Q902.

The PTT line controls the base current of these transistors via D903 and D904, to perform the supply switching, as well as controlling the level on the TX-bar line via D905. The latter is connected to the microcontroller, to switch it between transmit and receive modes.

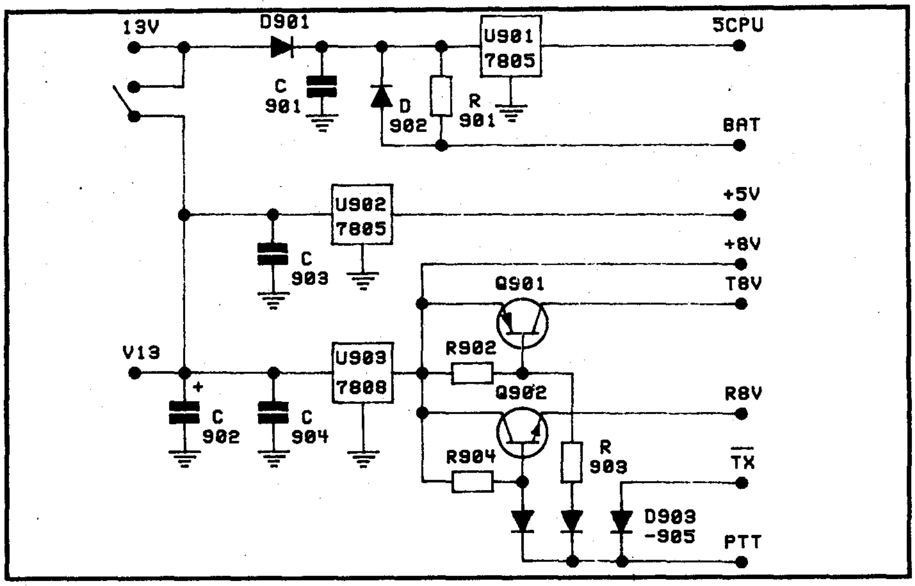


Fig.2: The power supply regulators and transmit-receive power switching.

Controller/display

Now let us look at the transceiver's 'brains' — the controller/display section, which includes the CPU and display boards and covers the controller itself, the control input sensing and the circuitry for displaying frequency, signal level and functions. This is all shown in the schematic of Fig.3.

The microcontroller employed (U701) is an 8-bit 6805 type, with 2 kilobytes of internal EPROM and 128 bytes of RAM. The CPU is preprogrammed to drive the 7 segment displays, scan the front panel switches, memorize frequently used channels and control the PLL frequency synthesizer.

A multiplexing system is used to drive the numeric displays, via seven of the CPU output pins (20-26). The segment data for the displays (in BCD format) appears on pins 23-26, while the digit-select address is fed out via pins 20-22 in 3-bit binary code. The segment data is decoded by U703, a 4511 7-segment decoder, to drive the display common segment lines via current limiting resistors R717-723. Similarly the digit address is decoded by U702, a 4028 1-of-10 decoder (used here as a 1-of-6) and used to select the 7-segment displays in turn via digit driver transistors Q702-707.

This same basic multiplexing system is used to allow the CPU to control the six status LEDs D711-716, which are used to indicate repeater offset, on-air, low power mode and so on. This is done by an eighth control output, produced by the CPU on pin 27 and used to select the LEDs via Q701. The status LEDs are thus treated as if they are an 'additional segment' of the main 7- segment displays — an elegant and efficient solution.

As if that isn't enough, though, the multiplexing system is also used for sensing of the six input pushbutton switches (SW701- 706). These are used to control functions such as memory channel writing and recall, low/high power switching, tuning step selection, repeater offset and so on.

As you can see from Fig.3, the switches are connected to the decoded digit-select outputs from U702, so that one side of each switch is taken in turn to logic 'high' level during the display multiplexing cycle. The other sides of all the switches are connected together and

TRANSCEIVER SPECIFICATIONS

GENERAL

Frequency range:	144-148MHz
Channel steps:	5 or 25kHz
Repeater shift:	+/-600kHz
Memory channels:	24 frequencies, with repeater shifts
Mode of emission:	FM
Supply voltage:	13.8V DC, negative earth
Supply current:	0.5A (receive) 6A (transmit)
Antenna impedance:	unbalanced 50 ohms
Frequency accuracy:	+/-20ppm
Operating temperature range:	0-50°C

RECEIVER

Type:	Double conversion superhet
Intermediate frequencies:	10.7MHz and 455kHz
Sensitivity:	better than 0.25uV for 12dB SINAD (0.15uV typical)
Selectivity:	12kHz (-6dB) 30kHz (-60dB)
Image rejection:	better than 60dB
Audio output:	1W/8ohms for 5% THD

TRANSMITTER

RF power output:	25W/5W
Spurious emissions:	60dB below carrier
Microphone:	low impedance dynamic
Modulation method:	FM-variable reactance
Deviation:	+/-5kHz
Duty cycle:	100% for ambient temperature up to 20°C

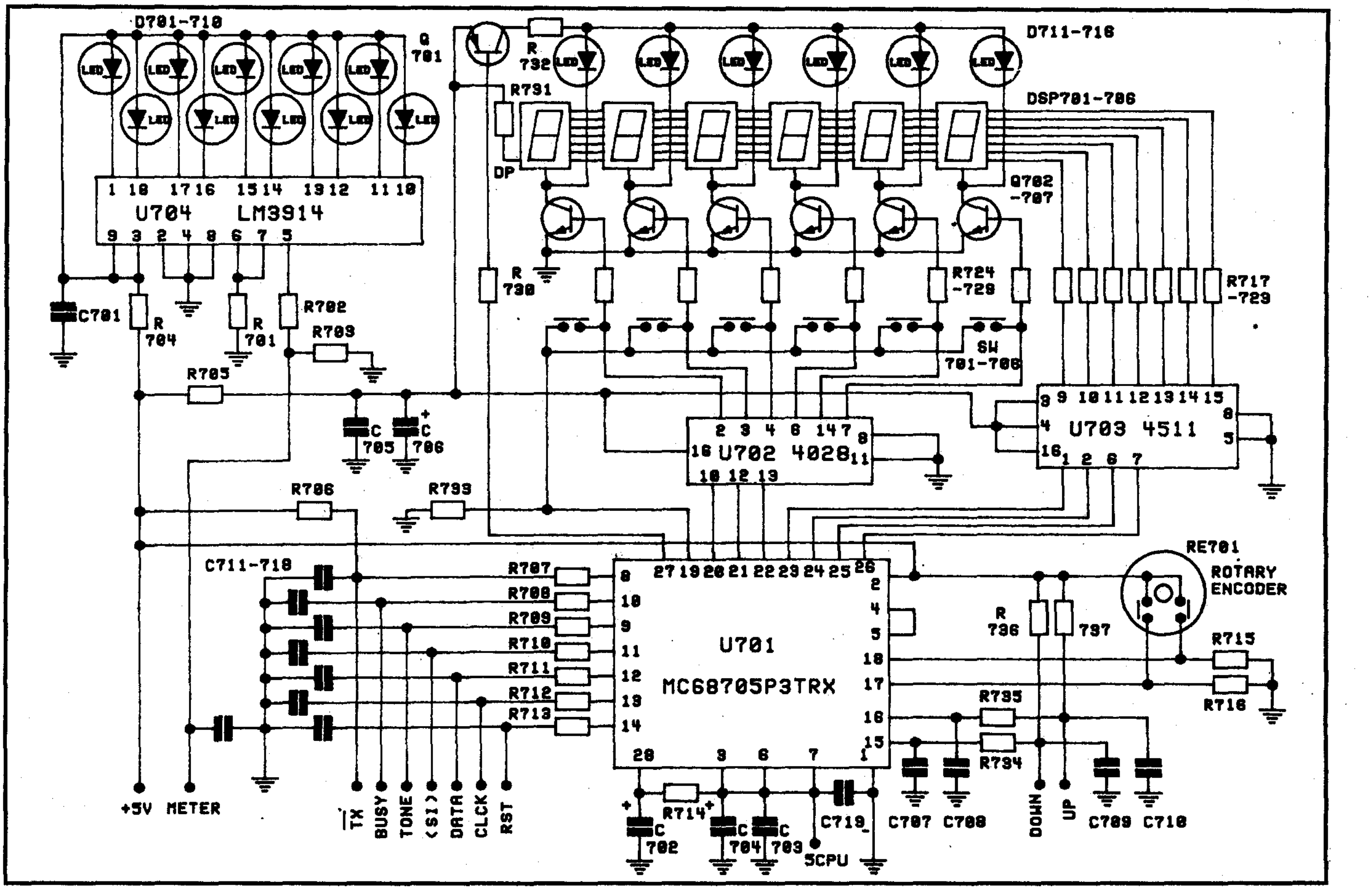


Fig.3: The circuitry for the microcontroller, front panel controls and displays.

taken to pin 19 of the CPU, which is thus able to 'scan' the switches at the same time as it's updating the displays.

The state of the rotary encoded channel switch (RE701) is sampled separately by the CPU via pins 17 and 18. Similarly if a microphone having UP and DOWN buttons is used with the transceiver, the state of these buttons is read by the CPU on pins 16 and 15. Pin 10 is also a dedicated sensing input, used to allow the CPU to monitor the state of the receiver section's squelch gate (so that it knows when to 'stop' during scanning).

If the CPU detects a change on any of the control inputs, the internal ROM firmware jumps to subroutines which perform the required functions — such as sending new serial data to the PLL, changing the display data and so on.

A separate bar-graph LED display is used for the signal strength and power output 'meter' (S&PO meter). Here the 10 LEDs (D701- 710) are driven by U704, an LM3914 linear LED driver IC. This has been used rather than a logarithmic type, because a quasi- logarithmic response is provided by the receiver circuitry.

In AM and SSB receivers, received signal strength has a direct effect on the signal/noise ratio. But in FM receivers, S/N ratio is more a function of the demodulator performance — some good FM receivers can produce the same audio quality at input signals as low as 1uV, as they can with input signals in the millivolt range. Assuming that 'S0' on the meter corresponds to 1uV, and each S-point corresponds to a 6dB increase, there may thus be little difference between 'S0' and 'S9+40dB'.

Many FM tranceivers of Japanese origin typically require only 10- 100uV for a full scale S-meter reading, and our design provides similar performance — albeit with greater resolution than much of the current commercial equipment.

The VCO and PLL

The schematic for the voltage-controlled oscillator (VCO) and PLL section of the transceiver is shown in Fig.4. The VCO uses a well-tried circuit employing a FET (Q401) in the common-gate configuration. The oscillator's frequency is determined by the parallel combination of L401 and all of the capacitance connected to the drain of the FET.

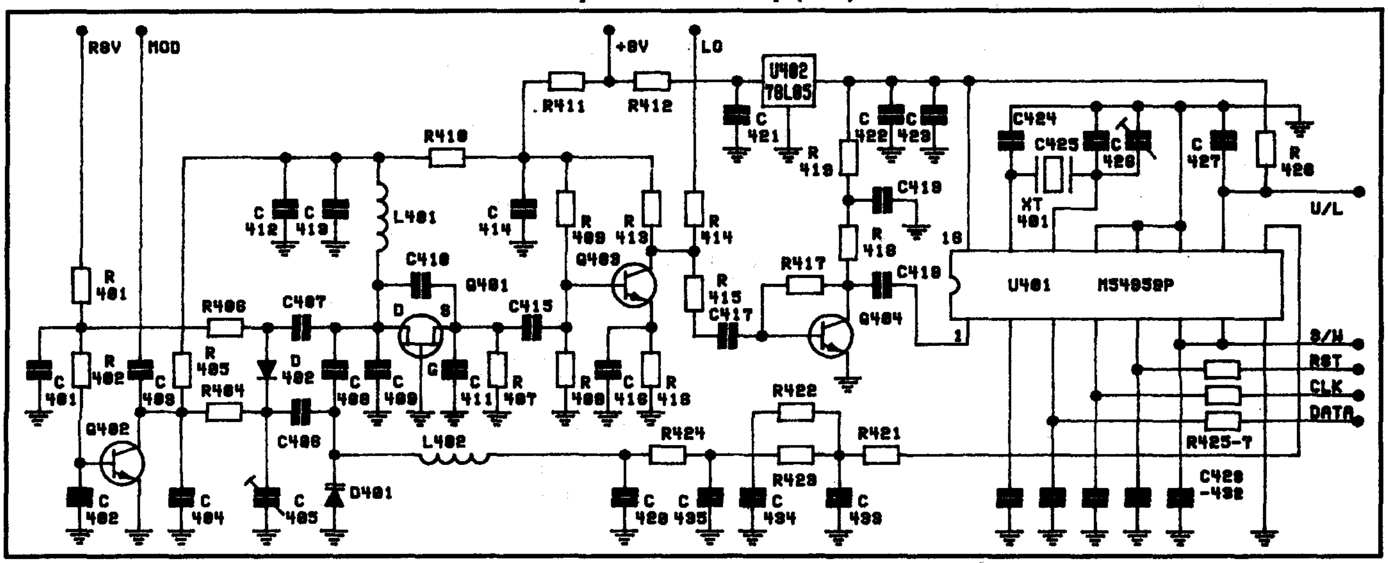
In receive mode, the VCO frequency is shifted down 10.7MHz by causing diode D402 to conduct, which adds capacitor C407 to the resonant circuit. This is done by turning on transistor Q402 via the R8V line, pulling current through D402 via R406 and R404. The diode then represents a very low RF impedance, connecting C407 and C405 in parallel with L401 and the existing drain circuit capacitance, shifting the frequency down.

In transmit mode, the R8V line is switched off and Q402 therfore turns off. As a result the cathode of D402 is pulled up to about +6V via R404 and R405. As the R8V line is now at 0V, the anode of D402 is also pulled down via R406, so D402 is now reverse biased. This effectively changes it from a low-value resistor into a high impedance — a capacitor of a few picofarads (the capacitance of its reverse-bias depletion layer)..

Because the value of this depletion layer capacitance varies with the applied reverse voltage, D402 is also used to achieve the VCO's frequency modulation. The audio modulation signal (MOD) is fed in via C403 and R404, and hence varies the 6V reverse bias voltage across the diode, to vary its capacitance and hence the VCO frequency.

The best modulating performance has

Fig.4: The circuitry for the voltage controlled local oscillator (LO) and its associated phase-locked loop (PLL) controller.



been found with the use of an MC301 diode for D402. This diode has a capacitance of about 2pF at 6 volts reverse voltage, and with carefully chosen additional capacitance, very linear deviation has been achieved for both negative and positive modulation.

The signal from the VCO is amplified and buffered by Q403. From the collector of this transistor the signal is divided between the PLL amplifier (Q404) and the LO output for the RF circuit sections, fed out via R414.

The PLL employs a Mitsubishi M54959 chip (U401), which is a PLL 'building block' capable of operation up to around 500MHz. The IC contains an ECL two-modulus prescaler, a 17-bit programmable divider, a crystal reference oscillator (using crystal XT-401), a 14-bit reference divider, a phase detector, an out-of-lock detector, a shift register for serial control and a 2-bit output port. The phase detector output (pin 9) is tri-state.

If the divided VCO input and reference frequencies are in phase at the inputs of the phase detector, the detector's output remains in the high impedance state. However if the phase of the divided VCO frequency is *behind* the phase of the reference frequency, the output falls to the 'low' state.

Conversely if the VCO phase moves *ahead* of the reference, the output switches to the 'high' state.

The error pulses generated by the phase detector are filtered by the PLL loop filter (C433-435, C420 and R421-424), and fed back to varicap diode D401, to act as a DC tuning voltage and hence correct the frequency of the VCO — locking it to frequency.

Of course when the PLL frequency is changed by the CPU, in response to a command from the front-panel controls, the loop will temporarily become unlocked until the VCO reaches the new frequency. During this 'out of lock' condition the PLL chip delivers an 'unlocked' logic output (U/L) on pin 10, which is used for disabling transmission (so that the transceiver cannot produce spurious transmissions).

As noted above, the PLL chip has a 2-bit output port controlled by serial data from the CPU. The port's output appears on pins 6 and 7, which are of the open-collector type. In this case they are connected in parallel and used to control the transceiver's power output level on transmit, via the 'S/W' line.

Pins 3, 4 and 5 of the PLL chip are the control inputs, used to receive serial command data from the CPU. Referring back to Fig.3, this command data comes directly from pins 14, 13 and 12 of U701.

Microphone amp

The microphone preamp and transmit audio filter circuitry is shown in Fig.5. The signal from the microphone is firstly boosted by the two- transistor amplifier formed by Q501 and Q502. The resulting signal is then applied to a simple diode limiter (D501-502), to prevent over-deviation.

The limiter is followed by a second order low-pass filter stage using Q503, which limits the audio bandwidth to the voice frequency range and reduces distortion components introduced by the limiter stage.

The signal from the filter stage is bandwidth and amplitude limited, and hence ready for application to the FM modulator. Preset pot R512 is used to adjust the peak deviation. Both the mic preamp and the filter stage are operated from the T8V supply rail, so that they function only in transmit mode.

RF section

Fig.6 shows the schematic of the main RF section of the transceiver, which includes the transmit RF driver stages together with the receiver's RF amplifier and first mixer.

The RF signal from the VCO section (LO) is amplified by Q303 and Q304, in standard comon-emitter tuned amplifier stages. The RF switching diodes (D303-304) then switch the output from Q304

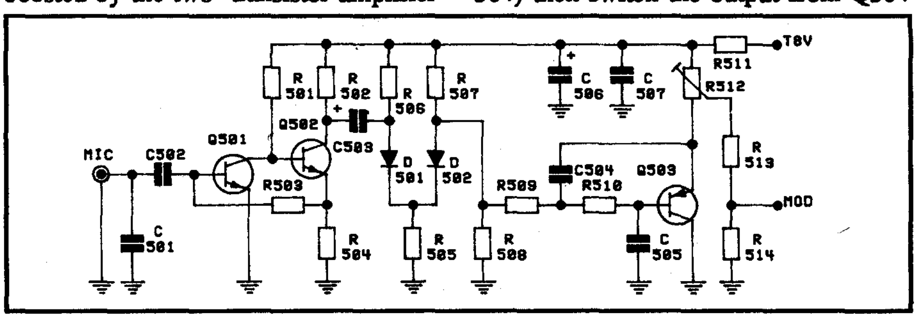


Fig.5: The mike preamplifier, limiter and audio filter stages.

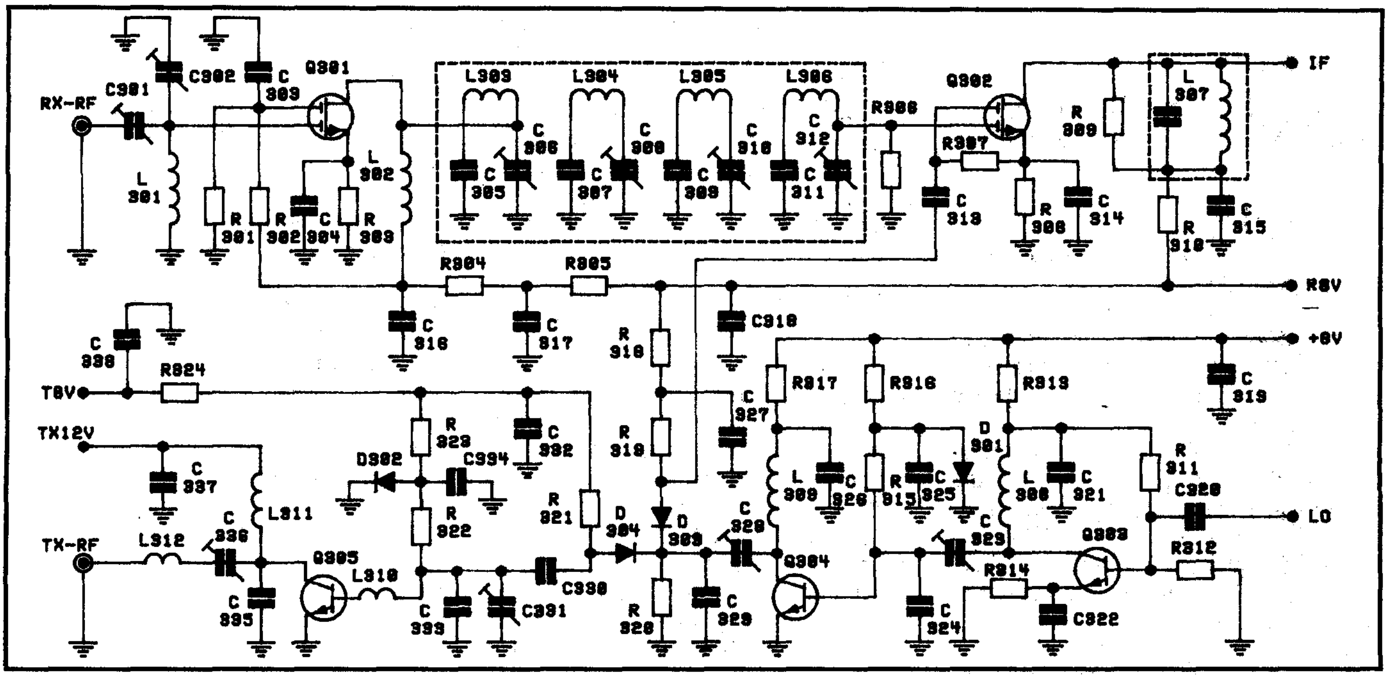


Fig.6: The receive RF amplifier and first mixer stages, together with the VCO amplifier stages and transmit driver stage.

between the transmit driver amplifier (Q305) and 1st mixer (Q302), for transmit and receive modes respectively.

D304 is turned on for transmit b the T8V rail, via R324 and R321, while D303 is turned on for receive by the R8V rail — via R318 and R319. R320 provides the earth return for the diode cathodes.

For reception, the RX-RF signal from the antenna (via the PA board) is amplified by RF stage Q301 and filtered by the bandpass filter L303-306.

The RF stage does not have a lot of input filtering, because every dB of filter insertion loss will increase the noise figure of the receiver by the same amount. By having most of the filtering *after* the input amplifier the filter losses effectively only reduce the gain of the amplifier, resulting in a much smaller degradation of the receiver noise figure.

After filtering, the received signal is injected into a dual gate MOSFET mixer (Q302), where it is mixed with the Local oscillator signal to produce the first IF signal on 10.7MHz.

L307 provides the first stage of IF filtering, ahead of that provided in the IF amplifier section.

IF amp/demodulator

The circuitry of the IF amplifier/demodulator section is shown in Fig.7. As you can see it employs a standard Motorola MC3357 narrowband FM IF chip.

The sensitivity of this IC is about 5uV for 3dB of limiting. The 10.7MHz output from the first mixer and the first IF filter is not always this high, so the signal is amplified by transistor Q201 before being applied to the IC.

Inside the IC, the 10.7MHz signal undergoes moderate gain and is then mixed with the on-chip 10.245MHz crystal oscillator to produce the second IF signal on 455kHz. This signal is filtered by ceramic filter CF201, and then fed through the chip's high- gain 455kHz limiting amplifier.

The output of the limiting amplifier is connected to the inbuilt quadrature FM demodulator. The recovered AF signal is then filtered by an RC low-pass filter (R216/C208) and fed to the AF amplifier.

Absence of input signal is indicated by the presence of wide band AF noise at the demodulator's output (pin 9).

The high frequency part of this noise (above normal speech frequencies) is selected by a high-pass filter (pins 10 and 11), rectified and used for the receiver's squelch and scan control.

The squelch circuit controls the mute switch (pin 14), which effectively shorts the output side of coupling capacitor C207 during no-signal conditions, preventing noise from being fed to the

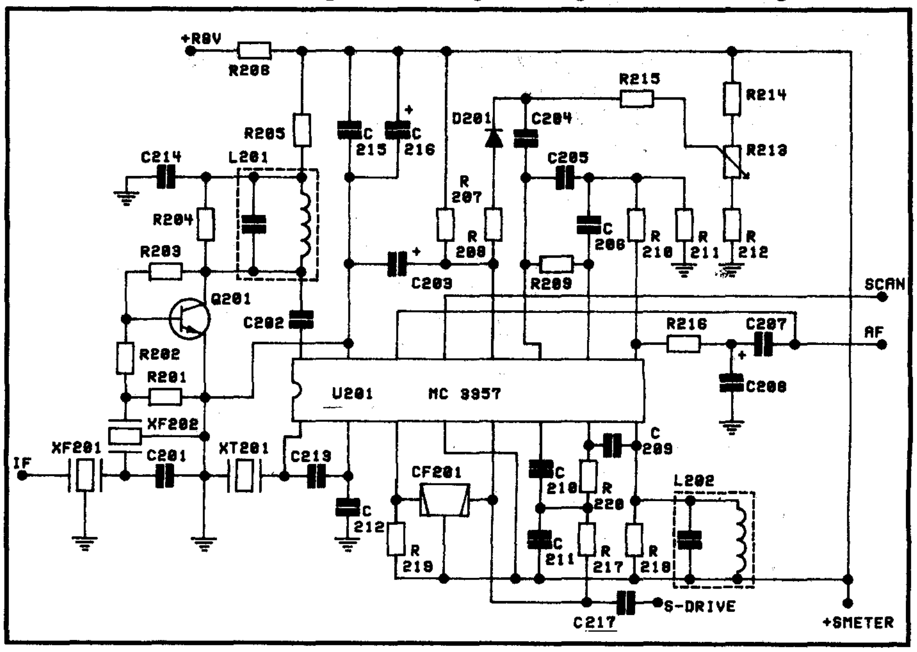


Fig.7: The receive IF amplifier and demodulator section, based on an MC3357.

AF amplifier. Pot R213 is the squelch control, used to adjust the muting threshold.

AF amplifier

Now let's look at the audio output section of the receiver circuit, whose schematic is shown in Fig.8. The design of this section is actually very similar to that used in previous DSE transceiver kits, but with slight changes to improve performance.

Transistor Q105 is a 'capacitance multiplier', filtering out noise on the supply rail. The base voltage of this transistor is filtered via R113, C108 and C107 and as the emitter voltage closely follows the base voltage (but about 0.7 volts lower), any noise on the incoming +V13 rail is significantly reduced.

Output transistors Q103 and Q104 are used in a fairly standard class-B configuration, providing the current gain necessary to drive a low impedance loudspeaker.

Voltage gain is provided by Q101 and Q102. Negative voltage feedback is applied to the emitter of Q101 via R106, ensuring DC stability and low distortion.

Because the amplifier operates from a single supply rail, its output at the junction of R110 and R111 sits at half the supply voltage under quiescent conditions. This DC component is blocked by coupling capacitor C106. Driver load and bias resistor R112 is connected to the speaker side of C106 to provide 'bootstrapping', boosting its effective value for AC and hence achieving greater voltage gain for driver stage Q102. This also removes the output stage bias if the speaker becomes disconnected, preventing possible damage.

Audio signals from the receiver section are coupled to the base of Q101 after passing through the volume control. The beep tone signal from the CPU (used to provide confirmation of control button commands) is fed directly to the emitter of Q101 via C103 and R108, instead of to its base. This provides a constant beep volume, independent of the volume pot's setting.

PA circuit

The transmit RF power amplifier or 'PA' (Fig.9) is implemented using a hybrid power module (U801). These devices are now in common use in commercial equipment. In this project the hybrid device offers two significant advantages, the first being that the constructor is relieved of the burden of having to wind additional coils and construct a power amplifier from individual components. The second benefit is that using a module releases valuable PCB 'real estate', allowing a cleaner layout and again making the overall project easier to construct.

The power amplifier module used, a Mitsubishi M57737, is a two stage 144-148MHz FM amplifier module with 50-ohm input and output impedances and requiring a 100mW input signal for 25 watts output. The first stage of this amplifier as well as the RF driver transistor Q305 (Fig.6) is fed from the 'TX12V' supply rail controlled by the ALC circuitry as will shortly be described. The second stage of the PA modules amplifier is connected directly to the +13.8V supply. The output of the power amplifier is connected to the RX-TX diode switch (D806, D802-3) circuitry, which is followed by a seven pole low-pass filter.

In transmit mode, the switching diodes (D806, D802-803) all represent a low RF impedance. This is because they are forward biased by DC current from the T8V line, passing through resistor R802 and RF choke L801. As a result the lower end of inductor L802 is connected to ground by D802-803, shorting the receiver input to ground and hence protecting it from damage by the high level transmitter output signal.

Of course inductor L802 is therefore effectively connected in parallel with C809 during transmit operation. However the low- pass filter circuitry is designed to cope with this effect.

In receive mode, the T8V line is at 0V and accordingly diodes D806, D802 and D803 are all biased off, presenting a high resistance in parallel with a low capacitance. The output of the PA module is therefore isolated from the low-pass filter by D806, while the received RF from the antenna is able to pass through the low-pass filter and L802, to the receiver's RF amplifier Q301 (Fig.6). The depletion layer capacitance of D802-803 is effectively in parallel with C808, forming a further low-pass filter stage in combination with L802. In receive mode the input filter therefore becomes a 9-pole low-pass filter.

The directional coupler included in the low-pass filter stage is used to detect the power reflected back to the PA stage when there is a high SWR in the antenna circuit. It produces an output voltage which is in proportion to the phase difference between the voltage and the current in the transmit signal path. If the load is purely resistive and properly matched to the output and feeder cable impedance (i.e., 50 ohms), there will be little or no phase shift. However if there is a high SWR and hence a large phase shift, diode D805 will generate a DC output voltage (REV) which is used by the ALC circuit to shut down the PA and driver stages, to prevent damage. This is described shortly.

Capacitive divider C816-C817 and diode D804 are used to produce a DC voltage (FWD) proportional to the RF output level. This is also fed back to the ALC circuitry via R803, being used to maintain the transmitter output at the desired 'high' (25W) or 'low' (5W) levels.

Diode D801 protects all of the transceiver circuitry against the application of a reversed power supply. If the supply is reversed, D801 will conduct and blow the supply line fuse. Sometimes the diode itself may also be damaged, but this is a small price to pay for protecting the much more expensive circuitry in rest of the unit. Incidentally, a shunt diode is used here in preference to a series diode because the voltage drop across a series diode can significantly

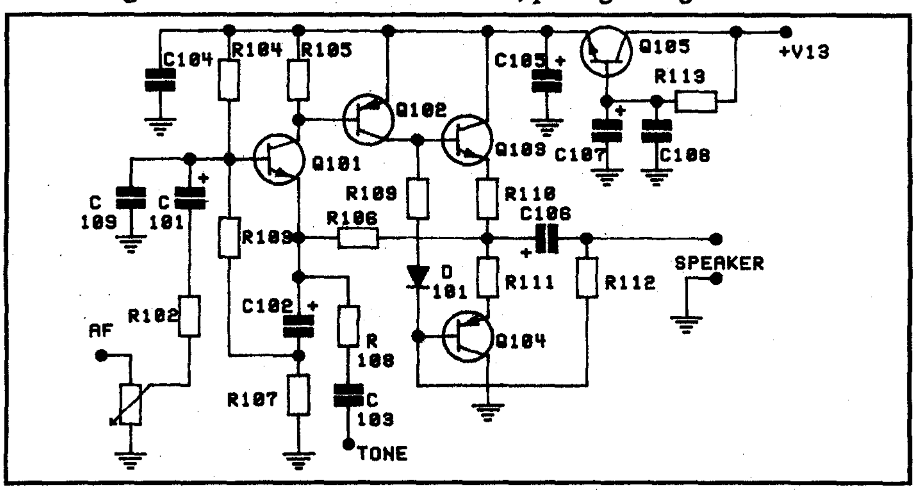


Fig.8: The receive audio amplifier. Note the 'capacitance multiplier' filter stage.

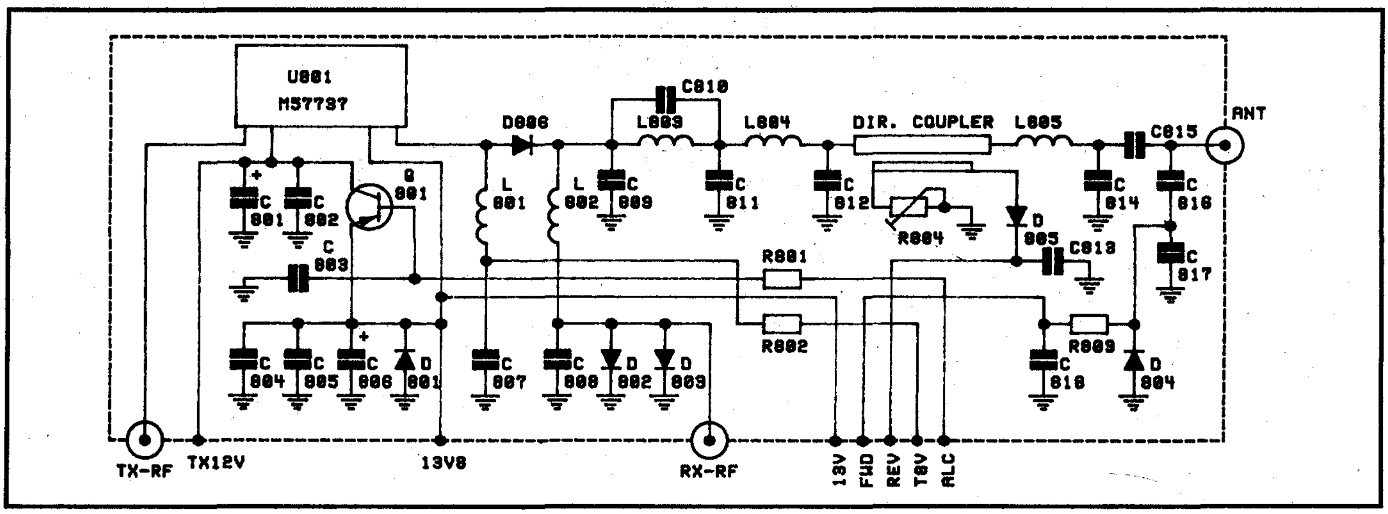


Fig.9: The RF power amplifier board circuit, based on an integrated PA module. Note the built-in directional coupler, used to detect reflected power and shut down the transmitter in the event of high antenna SWR.

reduce the maximum power output of the transmitter.

S-meter and ALC

As shown in Fig.7, the IF signal used to drive the S-meter circuit (S-DRIVE) is taken from pin 5 of IF amplifier U201, just after ceramic filter CF201 and before the main limiting amplifier. This signal is fed to the S-meter driver stage (Fig.10), where it is amplified by Q601 and Q602. Trimpot R604 controls the gain of this amplifier. The amplified signal is then rectified by diodes D601-602 and the resultant DC voltage used to feed the LED driver IC (U704, Fig.3), on receive. Preset pot R606 is used to adjust meter calibration.

The ALC (automatic level control) circuit controls the RF output power of the transmitter, by adjusting the supply voltage (TX12V) fed to the PA module U801 and driver stage Q305. The actual ALC circuitry can be divided to the following parts: a differential amplifier/comparator (Q603-604), a shutdown circuit (Q605) and the DC supply control circuit (Q606 and Q801, on the PA amplifier board).

The differential amplifier (Q603-604) compares the voltage on the base of Q603, set by preset pots R613 (25W output) and/or R612 (5W), with the voltage at the base of Q604 — which is a function of transmitted power (FWD signal). Any difference between these voltages produces a current through Q604's collector resistor R609, and a forward bias at the base of Q606. The base current of Q606 in turn controls the current in Q801 on the PA board, and ultimately, the DC supply to the PA module and driver stage. Hence we have a feedback system which acts to maintain the RF output level at either the 25W or 5W level, as set by pots R613 and R612. The latter becomes effective when the S/W line is pulled low, by pins 6 and 7 of U401 (Fig.4).

Transistor Q605 is used to short out the base-emitter circuit of Q606, removing all supply voltage from the PA module and driver stage, and hence shutting down the transmitter output altogether. This is done in receive mode, by turning on Q605 from the R8V line via D604 and R614, and also in transmit mode for various error conditions. For example D603 turns on Q605 and shuts down the transmitter when the PLL is out of lock, signified by a logic high on the U/L line from U401 pin 10 (Fig.4). Similarly if the antenna conditions are such that there is a high SWR and significant power is reflected back to the PA, this is detected by the directional coupler on the PA board and a corresponding DC voltage fed back via the 'REV' line, from where it is fed in by D605 to again turn on Q605 and disable the transmitter.

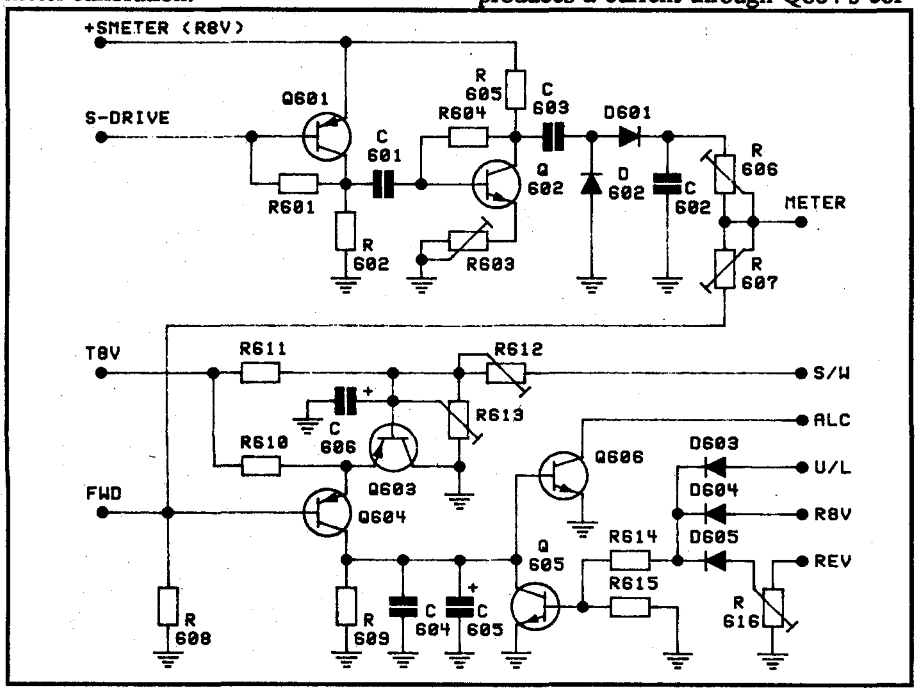


Fig.10: The circuitry used to drive the receiver's S-meter and power meter, together with that used to control the output level of the transmitter.

Next month

Well, that's the end of the circuit description. It wasn't too bad when we took it section by section, now was it?

The construction and testing of the transceiver are also taken in easy stages, so that it's also much easier to build and get going than you might think.

We start the construction next month — I hope you'll join us. ■

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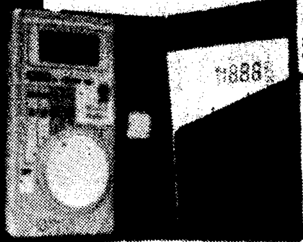

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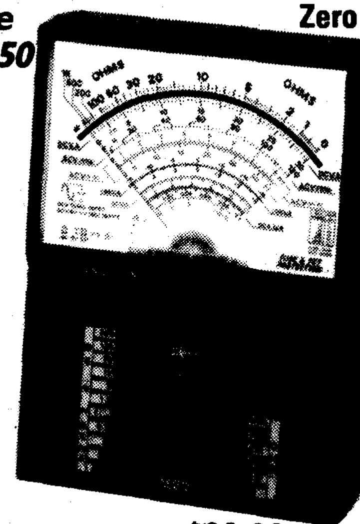

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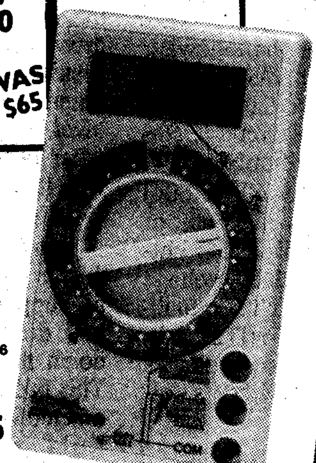

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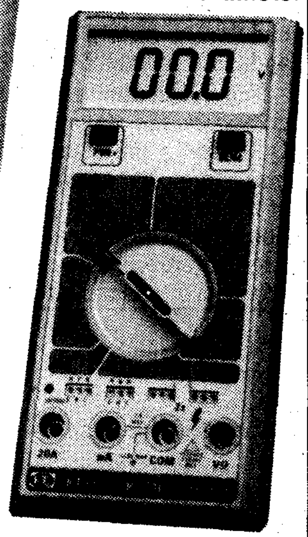

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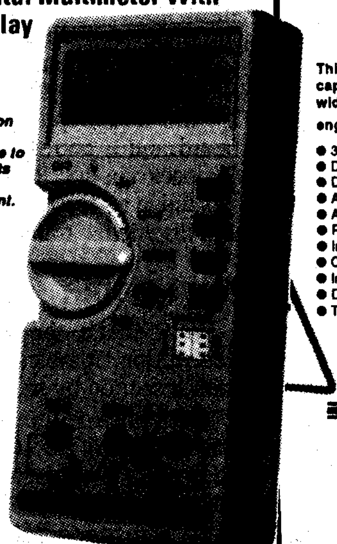

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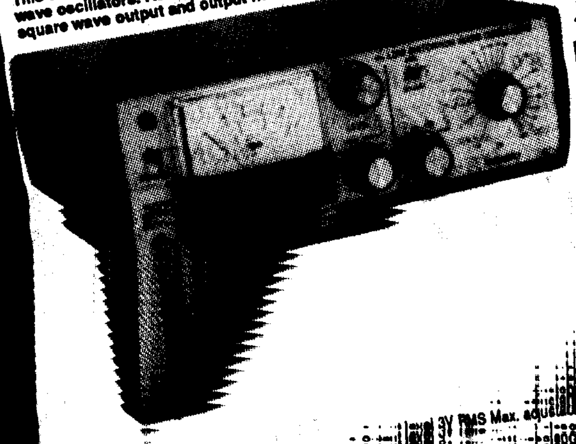

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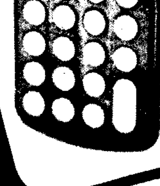

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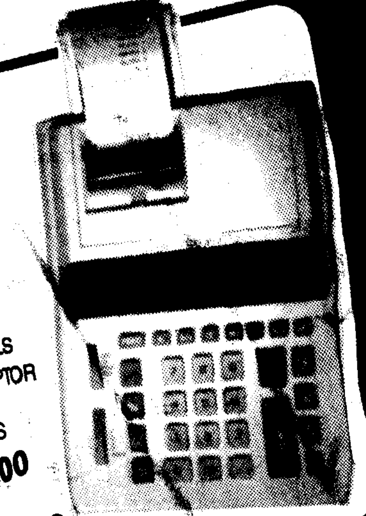

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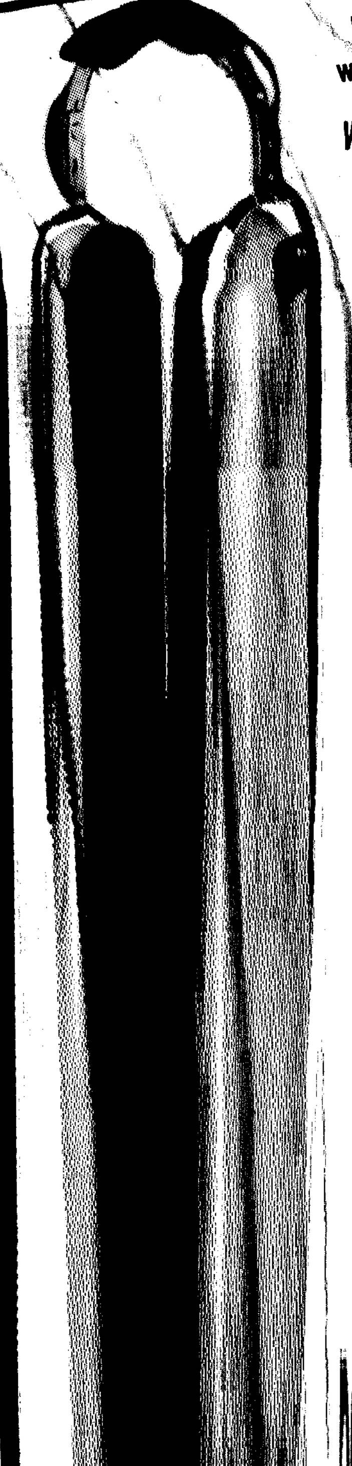

● Easy to operate Simplicity itself - just select the switch to Home, Off or Away as desired. A 45 second exit/entry delay allows you to vacate and/or re-enter your premises and disarm the system.
● No key switches or code buttons to push. Thus the system is ideal for families - even the kids can operate this system.
● Facility for external siren
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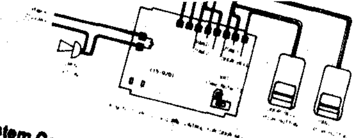

System Contents
● Master Control Unit ● Front Door Bell Switch ● Panic/Emergency Switch ● Three Window/Door Reed Switches ● Mounting Hardware ● 20 Metres Wire ● Instruction Manual

FANTASTIC VALUE Complete System

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(See SC ...)
This refined car ... alarm has about every feature you could possibly want to keep would be thieves away.
FEATURES: ● Internal & External Sirens ● Dash lamp flasher ● Battery back up ● Delayed & Non delayed inputs ● Ignition killer ● Easy to build and install.

K 4370
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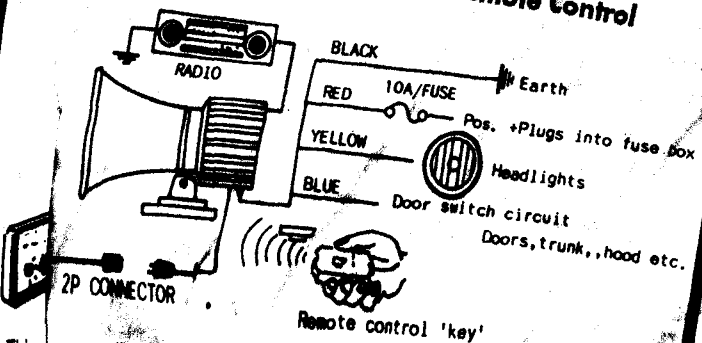
With Wireless Remote Control



This system will be triggered by unauthorised entrance through the car doors, boot, bonnet or removal of the car sound unit. The siren will sound and the headlights flash for 60 seconds.

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Earns its cost hundreds of times over in cleaning connectors, PCB's, switches, jewellery, glasses, watches, drafting pens, etc. Awarded the Good Product Design Award for CETDC in 1987

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(See EA Dec '87)

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Great for powering small appliances eg. lighting, record player, CD etc. Fantastic for camping.
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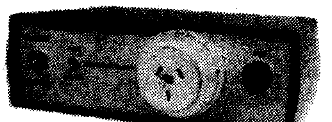

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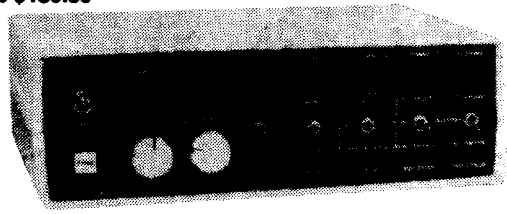

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(See EA June '85)

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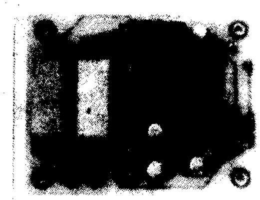

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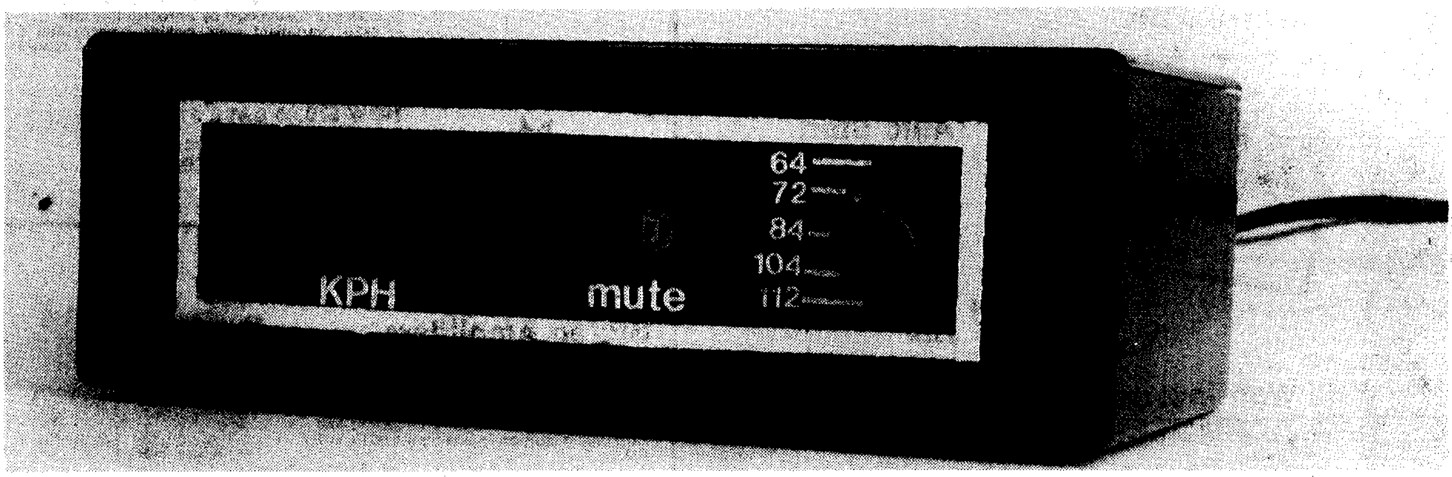
Construction Project:

Digital Speedo

This new fully featured digital speedo, apart from indicating road speed, gives a visual and audible indication of overspeed. Now you can avoid those speed cameras and update to the clarity of a digital display. The sensor used by this project can also be used to operate other automotive projects planned for future publication.

by JEFF MONEGAL



Digital speedos are now fairly common in today's generation of hi-tech cars, due to their obvious advantage of simplicity. No more broken speedo cables, dancing indicator pointers or clogged gearing in the mechanism. The display readout is also clearer and has a greater resolution. So a digital speedo on its own is likely to be attractive to many drivers; but we decided to add a few enhancements to our version.

The main 'extra' we added is an overspeed indicator. Regular readers will remember a previous overspeed alarm published in December 1989, and this unit has since proved very popular with constructors. In our new version, a switch on the front panel can be set to one of five preset values, which represent a 'safe' percentage above typical speed limits. If a preset speed is reached, a buzzer will sound and the display will blink. The preset speeds are 64, 72, 84, 104 and 112kph, chosen to keep circuit complexity to a minimum and to give a reasonable range of speeds which can sound the alarm.

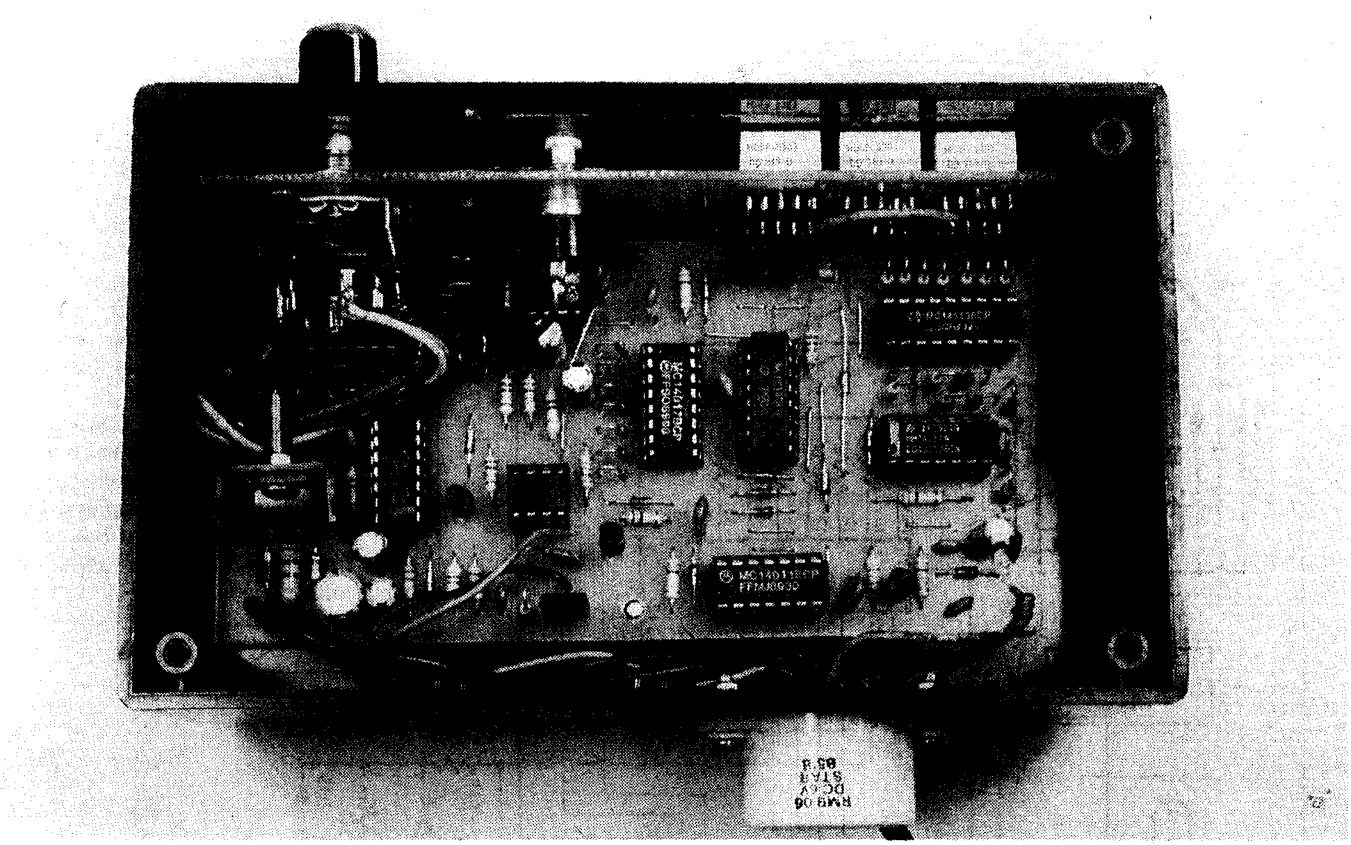
And in these days of increased police surveillance, an overspeed alarm is almost essential – particularly now that various State Governments have announced the introduction of speed cameras. These devices work in conjunction with a slant radar unit and are operated by a police officer. Whether you approve or otherwise of these tactics, speed cameras are a reality and keeping to the speed limit is now the only real way of avoiding hefty fines and a possible loss of your licence.

For those times when you might need to have a burst of speed, perhaps during overtaking, a mute button is included to silence the buzzer for 30 seconds or so. The display will still flash, reminding you of your transgression, and if you keep speeding for more than 30 seconds, the buzzer will resume operation. So used properly, this project will not only give a clearer readout of the vehicle's speed, but continually give a reminder of an overspeed condition.

Another essential feature is dimming the display during night driving. By connecting an input to the vehicle's lighting circuit, the LED readout of the speedo will be dimmed when the lights are turned on. This way the speedo is visible during the day, but is not too bright in the dark.

The speedo is pulsed by a sensor fitted to the tailshaft, which consists of a coil pulsed by two magnets that are held by wire to the tailshaft. This arrangement is now commonly used in conjunction with commercial cruise controls and other automotive enhancements. We intend publishing some more projects that can use this sensor, including a trip meter and a device that turns off the blinkers after a preset distance. This way you can get the maximum benefit from the one sensor, and use technology to make driving that much safer and more pleasant.

The new speedo is contained in a jiffy box, allowing it to be mounted wherever you wish. It can therefore be removed quite easily should you decide to sell the car, and can then be refitted to the new car, (or truck, bus, motor-



This shot shows the unit as assembled inside the case. A small heatsink is fitted to the regulator and all wiring exits via a hole in the back of the case.

home and so on).

To make its description easier to follow, we'll break the circuit into two sections, starting with the speedo itself.

The speedo section

At first sight the circuit diagram may look a bit complex. However it is really nothing more than a frequency counter with a few extras. Like all frequency counters a timebase is required, provided by IC1, which is a 555 timer wired as an astable multivibrator. The various reset, latch and gating signals are generated by the counter of IC2, which is clocked directly by IC1.

Because the outputs of IC2 are internally decoded, only one output is high at a time, depending on the value of the count. Outputs Q0 to Q7 are ORed by diodes D2 to D9, producing a gating signal to the counter section of the circuit that lasts for the first eight clock cycles. This signal is applied to the NAND gate of IC10c, where it gates the pulses generated by the sensor. The sensor output is amplified by the common emitter amplifier of Q4, and the output of IC10c is used to clock both the seven stage binary counter of IC9 and the 3-digit BCD counter, IC3.

At the ninth clock pulse from IC1, output Q8 of IC2 will go high and the gating signal to IC10c will be low, holding its output high. Thus, pulses from the sensor are isolated from both counters, stopping further counting.

Output Q8 of IC2 is differentiated by C5 and R5, inverted by IC6a, then applied to the latch enable input of IC3. Therefore when Q8 goes high, the short duration pulse developed across R5 effectively transfers the contents of the counter to the output latches within IC3.

When output Q9 of IC2 goes high (tenth clock pulse), a reset pulse is produced by the differentiating network of C6 and R6, and both IC3 and IC9 are cleared, ready to start the counting cycle again. The timing is therefore controlled by IC1 and calibration of the unit is set by VR1, which adjusts the clock frequency.

The display section is relatively standard, and consists of IC4, transistors Q1 to Q3 and the associated resistors and capacitors – all forming a multiplexed display system. The output of IC3 (a counter that contains three separate BCD counters) equals the number of pulses received during the counting period, and this value is decoded by the seven segment decoder/driver of IC4. Three other outputs from IC3 are used to switch transistors Q1 to Q3, which in turn activate each of the seven segment displays. As each transistor is turned on the BCD data for that particular display is shown, and numerical values up to 999 can be displayed.

To provide leading zero blanking, the output of IC3 is ORed by diodes D15 to D18. When the output is 0000, the input to inverter IC6f will be a logic 0, due to pulldown resistor R22. This will cause the base of Q1 to be held high, and being a PNP transistor, it will therefore be held off, regardless of the output at pin 15 of IC3. For all other values, Q1 will be driven normally.

This arrangement only blanks the most significant display, and speeds less than 10kph will be displayed with two digits. Thus a speed of 9kph will be shown as 09, but as speeds less than 10kph are unlikely, we decided not to complicate the circuit any further by trying to zero blank the centre display.

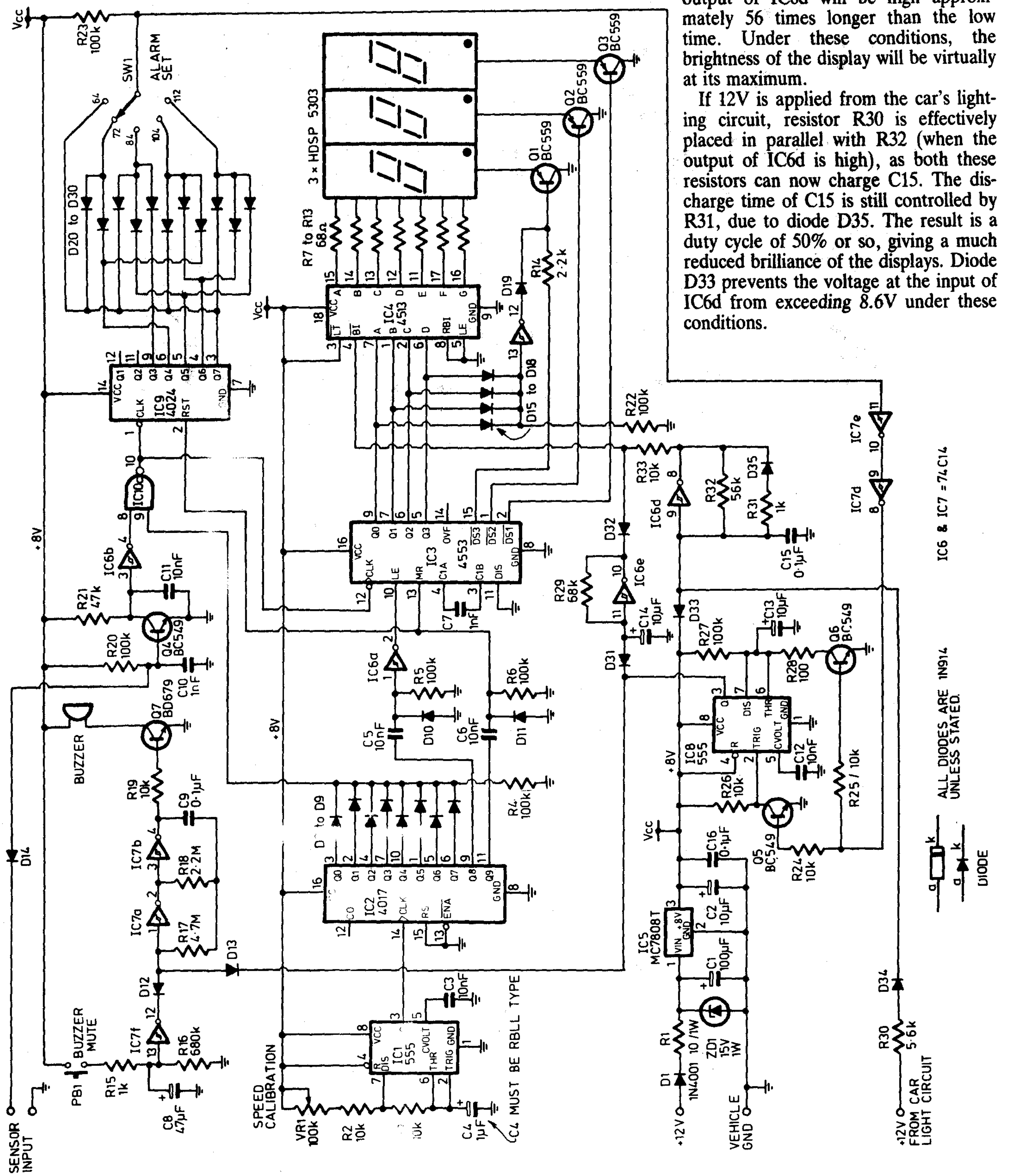
A problem with LED displays is that their brightness needs to be changed from a high brightness during the day to a duller display at night. This is accomplished by duty cycle modulating the displays, via the blanking input at pin 4 of IC4. If this input is connected to a logic 0, all displays are off while a logic 1 turns them on at full brightness.

To achieve the two levels of bright-

Digital Speedo

ness required, a square wave with a variable duty cycle is generated by IC6d. The duty cycle is changed by applying a 12V input from the lighting circuit to R30. When the lights are off, the oscillator produces an output with a duty cycle determined by the ratio of R32 and R31. For the values shown, the output of IC6d will be high approximately 56 times longer than the low time. Under these conditions, the brightness of the display will be virtually at its maximum.

If 12V is applied from the car's lighting circuit, resistor R30 is effectively placed in parallel with R32 (when the output of IC6d is high), as both these resistors can now charge C15. The discharge time of C15 is still controlled by R31, due to diode D35. The result is a duty cycle of 50% or so, giving a much reduced brilliance of the displays. Diode D33 prevents the voltage at the input of IC6d from exceeding 8.6V under these conditions.



The circuit diagram of the speedo has two sections; the speedo and the overspeed alarm section. The speedo section is a digital frequency counter comprising IC1 to 4 and associated components. The overspeed section is based around counter IC9.

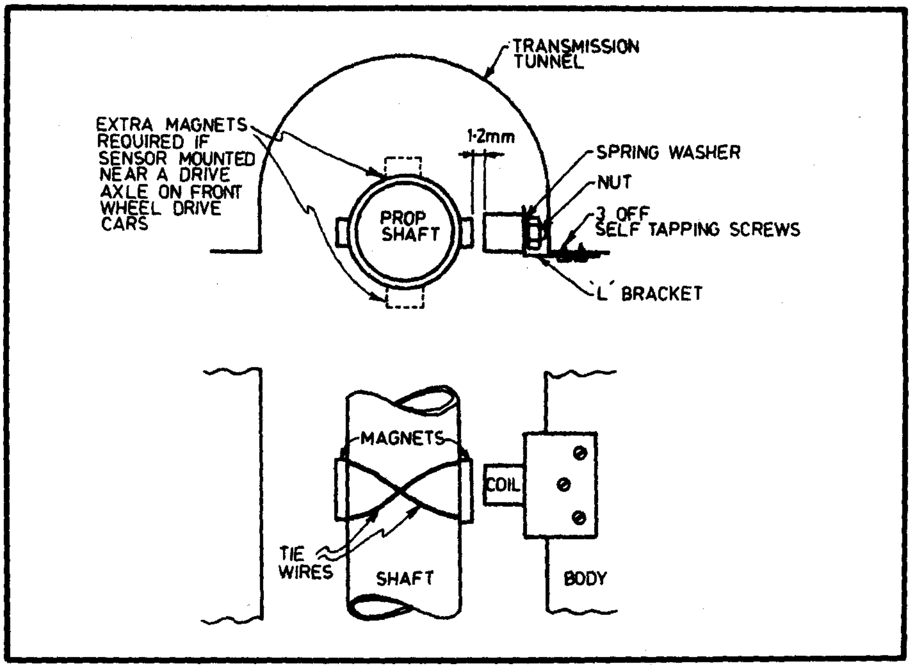


Fig.1: This diagram shows how the sensor is fitted to the car. The magnets are held with double sided tape and strong wire wound over the magnets. Space the coil 1 to 1.5mm from the magnets.

Overspeed section

The overspeed alarm section is based around the seven-stage counter IC9. As already described, the reset pulse for this counter is produced by IC2, and the clock signal is the output of the sensor, as for counter IC3. Because one pulse equals 1kph, (assuming correct calibration) the binary outputs of IC9 represent the speed of the vehicle.

Detecting a particular speed is simply a matter of decoding the outputs of IC9, achieved in this circuit by diodes D20 to D30. These diodes are effectively arranged as four separate AND gates, to give decoding for the speed values shown. Note that a speed of 64kph doesn't require any decoding, as being part of the binary number sequence it is produced by output Q7 going high during the counting process.

For example diodes D20 and D21 AND output Q7 (equals binary 64) and output Q4 (equals binary 8), giving a combined value of 72 (64 plus 8). The same theory applies to the remaining values, which were chosen to represent suitable speeds that shouldn't attract the attention of a speed camera while retaining reasonable circuit simplicity.

The five-position switch SW1 is used to select the speed at which the alarm should sound. When the actual speed is below the alarm setting, the input to inverter IC7e will always be low. For example, if 72kph is selected, and the speed is less than this value, either diode D20 or D21 will be forward biased as outputs Q4 and Q7 will never both be high at the same time. Thus resistor R23 has a path to ground, producing a logic 0 at the input of IC7e.

When the speed exceeds 72kph, a logic 1 will occur at the input of IC7e, producing a high at the output of IC7d which is connected to the retriggerable monostable formed by IC8, Q5 and Q6. Because both these transistors are turned on by the high from IC7d, IC8 will be triggered by the low produced at the collector of Q5, and Q6 will prevent the timing capacitor C13 from charging. The output of IC8 will therefore go high, which will reverse bias diode D13 and allow the buzzer to sound.

A reset pulse from IC2 will eventually clear IC9 to 0000, and a low will now appear at the input of IC7e. Both Q5 and Q6 will turn off, allowing the monostable of IC8 to start timing, as C13 is no longer held to ground by Q6. If the speed still exceeds the limit, another pulse will occur to turn on both transistors, and if the monostable of IC8 has not timed out, its timing cycle will be interrupted by discharging C13. Thus its output will remain high and the buzzer will continue to sound. This will continue until the speed of the vehicle is below the selected alarm speed, and the buzzer will cease sounding when IC8 has eventually timed out.

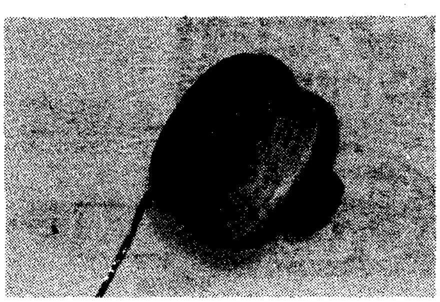
Put simply, if pulses of less than a second apart are being received by the monostable of IC8, its output will remain high and the buzzer will sound. The time between pulses is determined by the values of R27 and C13, and the buzzer will therefore sound for up to a second after the speed of the car falls below the limit.

When the output of IC8 (pin 3) is high, D13 is reverse biased as already described. Under this condition, the oscillator formed by IC7a, IC7b, R17, R18 and C9 starts to operate. This oscillator drives Q7, which in turn drives the buzzer. The frequency of the oscillator is around 1Hz, causing the buzzer to turn on and off – giving pulses of sound rather than a continual buzz.

During those times when exceeding the limit is essential, a push button is provided to give a 30 second mute time. By pressing PB1, capacitor C8 will be rapidly charged via R15, producing a logic high at the input of IC7f. The low at the output of this inverter will forward bias D12, which will prevent the oscillator from running. When C8 discharges through R16, the oscillator will be able to run, providing D13 is still reverse biased. A toggle switch could be used instead of PB1 to disable the alarm section altogether, although this would defeat the purpose of the overspeed alarm.

To cause the display to blink during an overspeed condition, another oscillator formed by IC6e, C14 and R29 is connected to the blanking input of IC4 – isolated from the dimming circuit by D32. When the output of IC8 is high, D31 will be reverse biased and oscillator IC6e will commence running at a rate of around 0.5Hz. The display will therefore flash on and off, even if the mute button has been pressed.

The circuit is powered by an 8V rail, produced by the 8V regulator of IC5. Diode D1 prevents damage to the circuit in the event that the power supply leads are reversed. Resistor R1 limits current to the circuit if a fault occurs, and in conjunction with ZD1 keeps voltage transients below 15V.



The sensor coil consists of 600 turns of 0.2mm diameter enamelled winding wire wound on a bobbin as shown in this photo.

Digital Speedo

Construction

Because a lot of electronics had to be placed on a relatively small PCB, the board is fairly crowded. It is essential to carefully check the PCB before starting construction, as some tracks are quite thin and closely spaced.

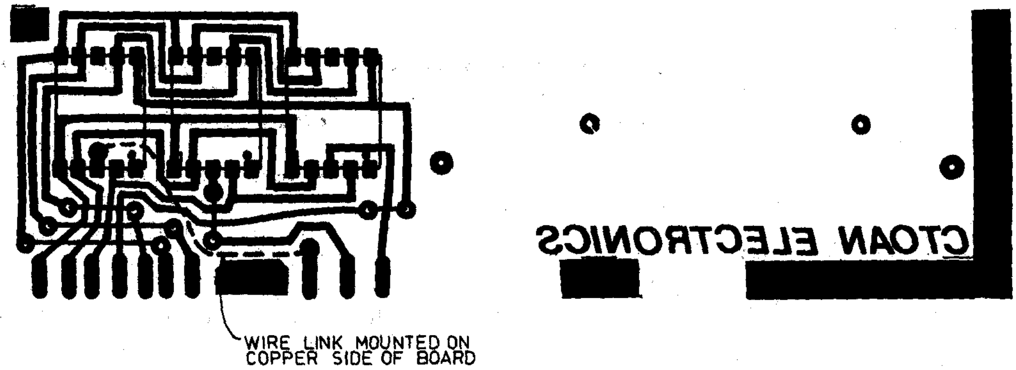
Start by fitting the 14 wire links on the top of the main PCB and the three links to the copper side. The links fitted to the copper side should be insulated and run between the points indicated on the layout diagram.

Fit and solder all resistors and diodes, taking care with the orientation of the diodes. Next the capacitors and transistors can be soldered in. Again be careful with the orientation of the electrolytic capacitors, and note that C4 is a low leakage RBLL type. The 8V regulator and the IC sockets (if used) should now be fitted. A small heatsink should be fitted to the regulator, even though it does not dissipate a great deal of heat. If you decide to solder the ICs directly to the PCB, take the usual precautions against static discharge as all the ICs except IC1 are CMOS.

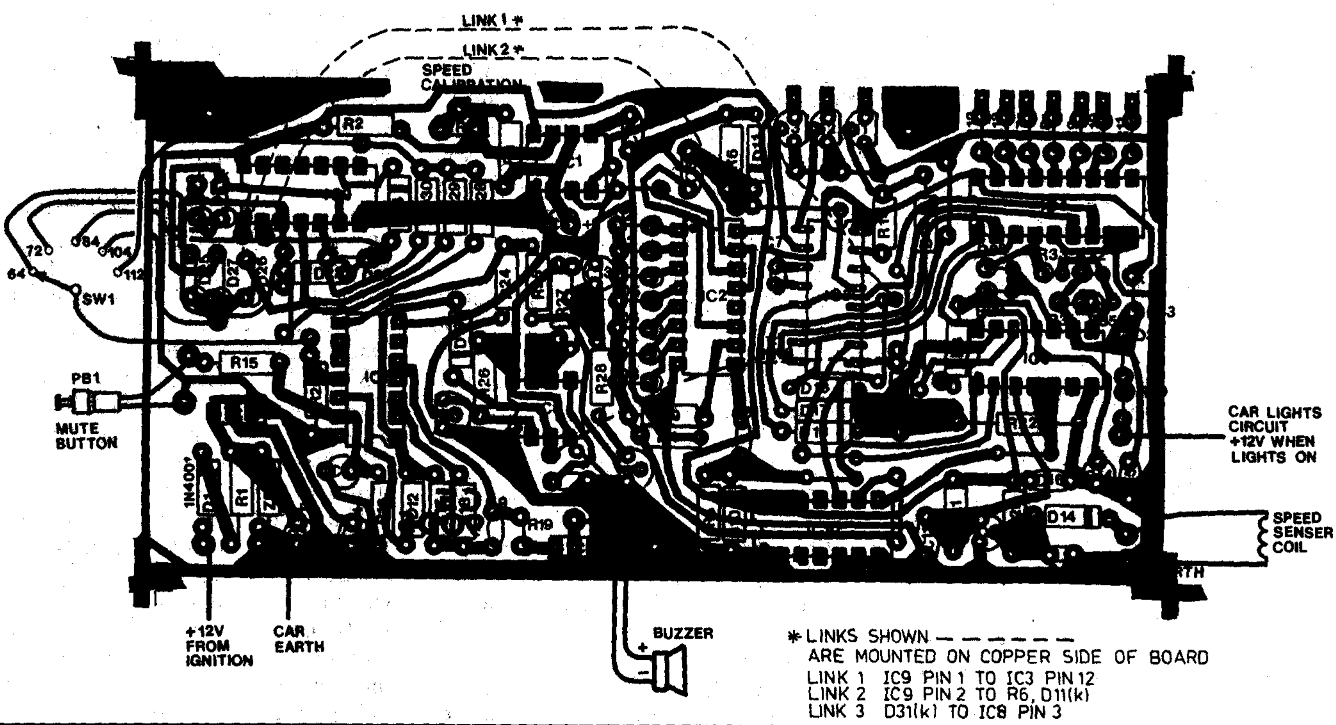
Solder the six wires to the speed alarm selector switch, using the layout diagram and the circuit to identify which switch terminal is used for each wire. We used the most clockwise position of the switch as the lowest speed (64), but this is a matter of choice. The switch wiring should be around 10cm long, and the wires held together with cable ties. The pushbutton and the buzzer can also be connected to the PCB.

Once the main PCB is complete, the display board can be assembled. This board is also used to support the alarm speed selector switch and the pushbutton, and the holes for these should be drilled before assembling the components. There are five wire links fitted on the component side and one insulated link fitted to the copper side of this board.

When the links are completed, mount the three displays. The decimal point for each display should be at the bottom



The layouts for both PCBs are shown here. The links shown dotted are fitted on the copper side of the PCB and should be run with insulated wire. The sensor can be earthed at the car chassis or connected as shown. Note the polarity of the buzzer and that IC7 faces the opposite way to IC2 and 3.



right when viewed from the front.

The connections between the main PCB and the display board are made by aligning the two boards at right angles and then soldering across the pads from each board. A more substantial connection will be obtained if a wire link bent to a right-angle is soldered across each junction. Although not required for circuit operation, improved mechanical strength is provided by soldering the two boards between the extra copper sections at the right-hand end of both boards.

Once assembly is complete, check your construction for any shorts between tracks, missed components and other possible problems before testing it.

Testing

The unit should be tested before installation by connecting it to a 12V DC supply. When power is first applied, the buzzer will sound for one or two pulses and the display should show either 00 or 01. To confirm that everything is operational, connect an audio signal generator (or 50Hz at around 0.1V RMS) to the sensor input lead.

Although the calibration of the unit cannot be done until the unit is installed, the display should respond by indicating a value proportional to the input frequency from the signal generator. The input signal needs to be at least 200mV p-p and can be either a sine or square wave. As a guide, a 50Hz input gave a reading of 38kph on the prototype after it had been calibrated in a car (VR1 set half way).

If you have a signal generator, try the overspeed section by increasing the input frequency to give a reading for each of the preset alarm speeds. By selecting each of the five alarm speeds in turn, confirm that the buzzer operates and the display blinks for inputs equal to or higher than the selected speed. The buzzer should pulse on and off, rather than remain on continually. Also check that the mute button silences the buzzer for at least 30 seconds, but remember that the display will still blink during the mute period.

The reading may vary by one digit when the input frequency is constant, which is usual for any digital frequency counter. The reading may vary a bit more during an overspeed condition, but as the display is blinking anyway, a changing digit is hardly a problem.

Once the circuit has been tested, the sensor can be constructed and the whole unit fitted to the car.

Parts List

Resistors

All 1/4W, 5% unless otherwise stated

R1	10 ohm, 1W
R2,3,19,24,25,26,33	10k
R4,5,6,20,22,23,27	100k
R7-13	68 ohm
R14	2.2k
R15,31	1k
R16	680k
R17	4.7M
R18	2.2M
R21	47k
R28	100 ohm
R29	68k
R30	5.6k
R32	56k
VR1	100k vertical mount miniature trimpot

Capacitors

C1	100uF 25V electrolytic
C2,13,1	410uF 25V electrolytic
C3,4,5,11,12	10nF ceramic
C4	1uF 25V low leakage electrolytic
C7,10	1nF ceramic
C8	47uF 25V electrolytic
C9,15,1	60.1uF ceramic

Semiconductors

D1	1N4001 1A diode
D2-35	1N914 signal diode
ZD1	15V 1W zener diode
Q1-3	BC559 PNP transistor
Q4-6	BC549 NPN transistor
Q7	BD679 transistor
IC1,8	555 timer
IC2	4017 CMOS decade counter
IC3	4553 three digit CMOS counter
IC4	4513 seven seg-decoder/driver
IC5	7808 8V regulator
IC6,7	74C14 hex schmitt trigger inverter
IC9	4024 seven stage CMOS counter
IC10	4011 CMOS NAND
	Displays 3 x HDSP 5303 common cathode 7 segment LED display

Miscellaneous

PCB 64mm x 132mm coded CE 90 DS, display PCB 40mm x 132mm, 12V buzzer, 5 position single pole rotary switch and knob to suit, panel mount normally open pushbutton, heatsink to suit regulator, plastic case 50 x 90 x 150mm, speed sensor coil (see text) and two button magnets, hook up wire, solder, nuts, bolts, red filter.

A kit of parts for this project is available from CTOAN Electronics for $54.95, which includes the PCBs and all components. Add $2.50 for post and packing. Fully built and tested units (including case) can be purchased for $85.95, plus $3.50 P&P.

CTOAN Electronics also offers a full backup and repair service for the kit. Cost for repair is $20, plus $2.50 P&P. Only kits built as described in this article can be accepted for repair.

To order, write or phone:

CTOAN Electronics
PO Box 33
Condell Park, NSW 2200
Phone (02) 7083763

Sensor construction

The sensor is simply a coil of some 600 turns of 0.2mm (32 B&S) enamelled winding wire, using a 3mm (or 1/4") steel bolt as the core. Make a bobbin by fitting two nylon or plastic washers of around 30mm diameter over the bolt, spaced apart by approximately 10mm. Wrap insulating tape over the section of the bolt between the washers before winding the coil. The bolt should be at least 25mm long, as it is also used to attach the coil to a suitable metal bracket fitted under the car.

Drill an exit hole in one washer for the wire, then with the wire passed through this hole, wind the necessary 600 turns. Keep the layers as neat and even as possible, to ensure the full complement of turns will fit in the available space. Cover the complete winding with tape, then terminate the windings with insulated wire leads soldered to the winding wire.

Fit a nut onto the bolt to hold the bobbin together, then pot the coil with a suitable epoxy glue to make it water-

Digital Speedo

proof and to protect it from the ravages of the road. If the coil is connected to *the speedo*, some response should occur if a magnet is quickly passed to and fro over the bolt head.

Assembly & installation

Before the unit is installed in the vehicle, the electronics should be fitted into a case. We used a jiffy box measuring 50 x 90 x 150mm, with the whole assembly attached with three mounting bolts to the bottom of the box.

It is essential to use a red filter over the displays, and a cutout equal to the size of the displays is required in one side of the case. We used a strip of red perspex glued inside the cutout, but any similar red filter *will do*. Holes for the switch shaft and the pushbutton are also required. White press-on lettering can be used to label the front panel, and lacquer should be applied to protect the lettering.

Drill an exit hole for the wires and mount the buzzer on the rear of the case. The buzzer can be fitted inside the case, although this will mute its sound output.

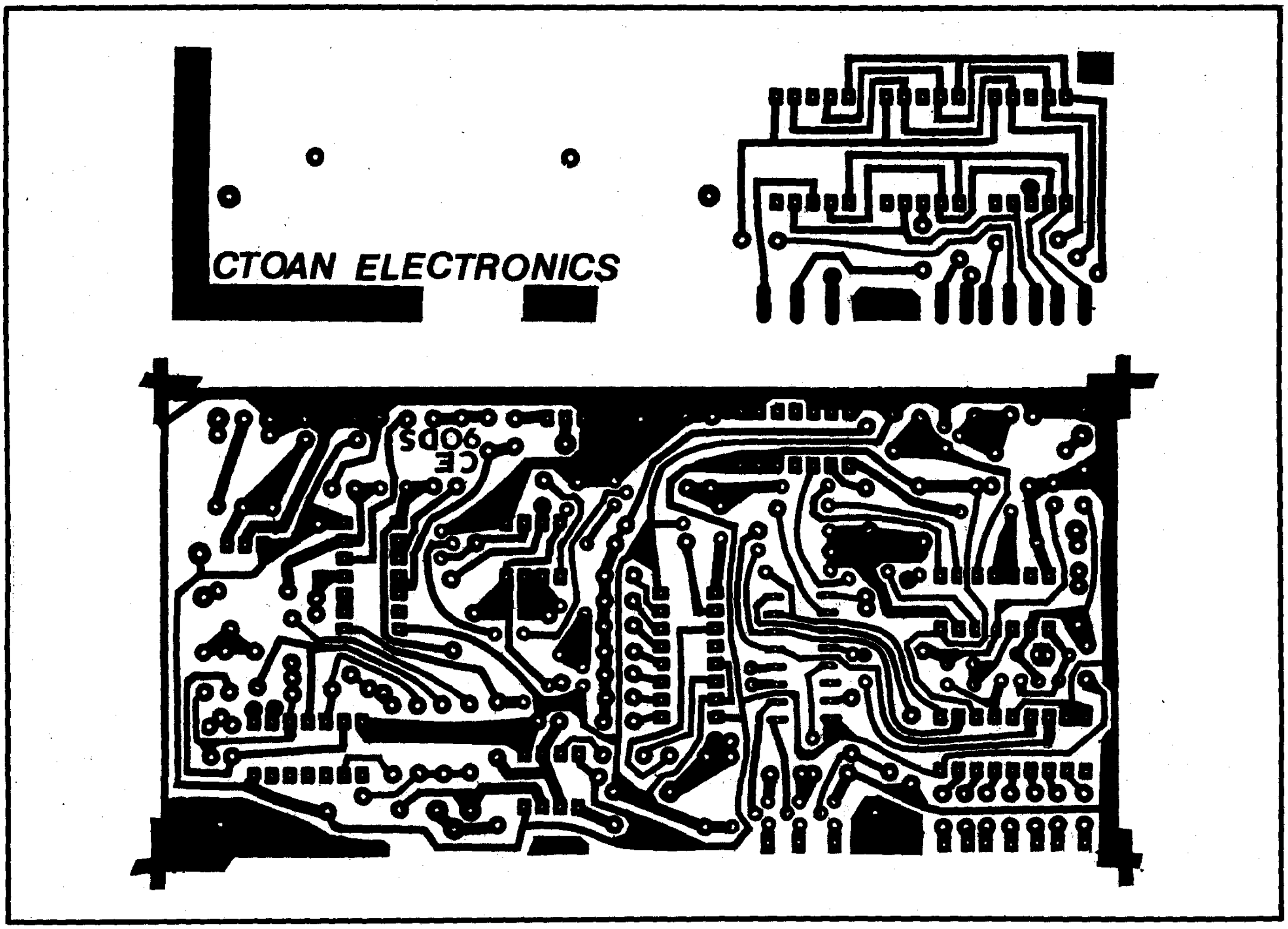
The sensor coil should be secured to a bracket bolted to the underside of the vehicle as shown in Fig.1. Two button magnets (four if the sensor is mounted near a drive axle on front-wheel drive cars) need to be attached to the drive shaft. We used magnets from a reed switch employed in a house alarm, although any type of small magnet will do.

The magnets should be stuck to the drive shaft with double sided tape, then securely held with non-magnetic wire wound over the magnets. To prevent vibration due to imbalance of the shaft, fit the magnets close to the transmission end of the shaft, near the front universal joint and ensure they are directly opposite each other. The sensor should be about 1 to 1.5mm from the top of the magnets.

Position the wires connecting the coil to the speedo so that they are well protected from stones and other debris. One wire from the coil can be connected to the vehicle chassis, requiring the remaining wire to be run inside the car to the speedo. It may be possible to strap it to the existing speedo cable, which will also facilitate passing the wire into the cabin. Alternately, both wires can be run to the speedo, with one earthed on the PCB as shown on the layout diagram.

The other wires required by the speedo are a 12V supply switched by the ignition, and another from either the parking lights or the headlights. The 12V supply should be taken from the fuse block, but make sure it is switched by the ignition switch. Earth the negative supply wire to a suitable point on the chassis to complete the wiring.

All that now remains is to calibrate the unit. As there is only one adjustment, have someone drive the car at a fixed, known speed while you adjust the calibration to give the correct display. Once you are satisfied with the calibration, fit the lid to the case and mount the unit somewhere out of direct sunlight, but so the read-out is clearly visible during driving. Then hopefully the speed cameras will not add you to the police photo album!



The PCB patterns for both boards are reproduced full size.

Solid State Update

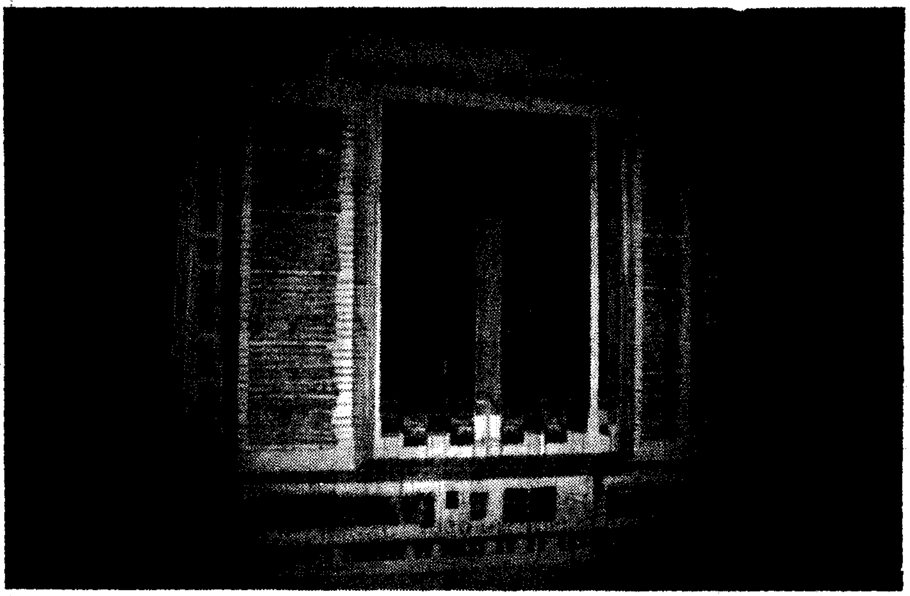
KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Aust-made cache controller from Austek

Austek Microsystems has announced the completion of its Austek A38403 copy-back cache controller.

The controller, designed at Austek's Adelaide facility, enhances the performance of the Intel 80486 processor, boosting Intel's *internal* 8KB cache by a further 512KB. The chip contains 580,000 transistors and supports both write-through and copy-back.

"The A38403 brings out the full power of the Intel 486 by providing strategic cache memory support," said Glen Farrall, staff engineer and architect of the design project. "The cache controller is tuned to match the 486's burst mode read/write capability, allowing it to function in zero wait states."



The chip also offers the capability to configure regions of system memory for copy-back, write-through and non-cacheable data. Central to its performance is a 2048-entry address directory implemented with a 72K bit SRAM with a minimum speed of 8.8 nanoseconds.

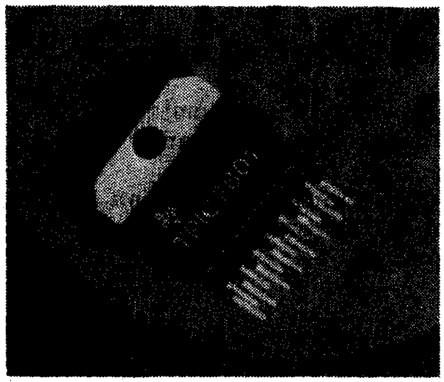
For further information circle 272 on the reader service coupon or contact Austek Microsystems, Technology Park, Adelaide 5095; phone (08) 260 0155.

'Intelligent' power IC

An 'intelligent' power IC with innovative architecture that is claimed to help designers streamline instrumentation systems is available from Texas Instruments. The monolithic peripheral driver has eight one-amp outputs and can be used to reduce component count and required board space as well as increased system reliability.

The TPIC2801 is claimed to be the industry's first intelligent power IC with a serial-input, parallel-output architecture and the first with output-specific fault reporting capabilities. The octal serial peripheral driver also integrates extensive diagnostic, feedback and self-protection features. It can control eight outputs simultaneously, identifying faults, disabling only the affected channels and reporting the status of each output to a microprocessor via a single output.

The highly integrated TPIC2801 has eight low-side switches. It can accept inputs directly from a microprocessor or low-level logic and can directly switch lamps, relays, printheads, small solenoids and other medium-current or high-voltage loads. Inbuilt circuitry per-



forms the active energy snubbing associated with inductive loads, integrating all the self-protection circuitry required and eliminating the need for discrete components.

Each of the eight drivers in the 30-volt device has a 40-millijoule rating and can drive up to a 30-volt 1A load. The presence of a 35V collector-base clamp on each switch eliminates the need for external clamp diodes when switching inductive loads.

For further information circle 277 on the reader service coupon or contact Texas Instruments Australia, 6-10 Talavera Road, North Ryde 2113; phone (02) 887 1122.

Dual current source, mirror

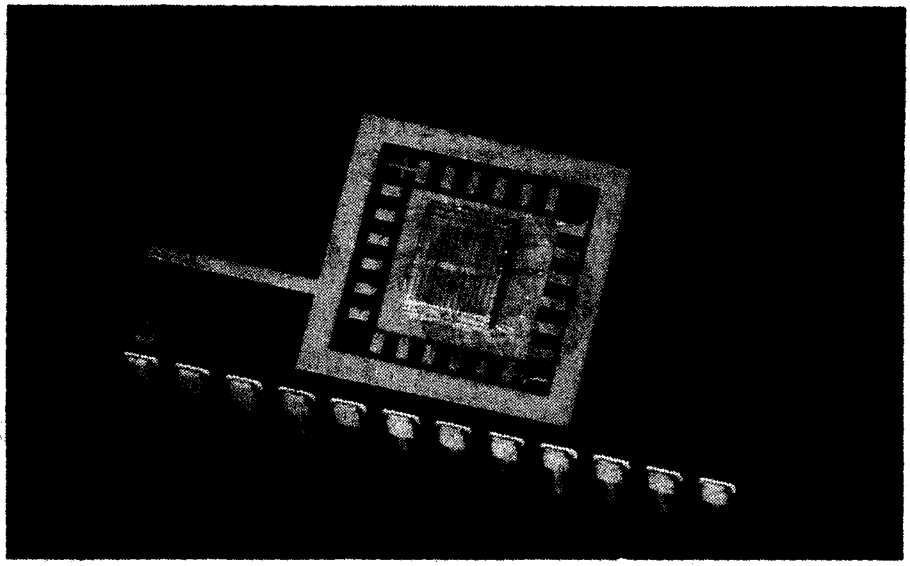
Burr-Brown's REF200 combines three circuit blocks in a simple-to-use 8-pin part. It has two 100-microamp current sources and a current mirror, with each section electrically isolated and completely independent.

Benefits claimed from using the REF200 are less design time and improved performance over other types of current sources. Reduced size and parts count can also give better reliability. The wafers are tested, during manufacture, over temperature range and each die is laser trimmed to ensure low drift operation.

The space savings with the REF200 make it well-suited for use in portable equipment. It is possible to interconnect the sections of the chip without use of external components, to achieve currents up to 400 microamps. By adding an appropriate op-amp, virtually any current can be achieved.

For further information circle 285 on the reader service coupon or contact Kenelec, 48 Henderson Road, Clayton 3168; phone (03) 560 1011.

100MHz monolithic 'flash' A-D converter



Micro Networks has announced the release of the first in a new family of 6- and 8-bit monolithic flash A/D converters: the MN5901.

The MN5901 is an ultra-speed, 8-bit monolithic A/D converter with a guaranteed conversion speed of 100MHz. At higher input frequencies, it provides superior dynamic performance and is claimed to outperform competitive devices such as the AD9002, ADC303 and the CX20116.

The MN5901 offers differential linearity of +/-0.95LSB max, guaranteed over the full operating temperature range, and a high signal-to-noise ratio of 38dB min, also guaranteed over the full operating temperature range. Dynamic linearity (effective bits) is guaranteed to be +/-0.5LSB min over the full operating temperature range.

The MN5901 uses the 'flash' or parallel principle, whereby a field of 255 comparators simultaneously determines the precise analog input. The comparators' outputs are converted to ECL compatible outputs through three encoding stages which are activated by two strobe signals. The MN5901's input is easily driven by a 50-ohm source without the burden of a pre-amplifier or level shifter which is required by most competitive devices.

For further information circle 278 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.

Motorola unveils 'data movement' engine

Motorola's Microprocessor Products Group has announced the 62340, a new 68000-based processor designed to address growing industry demand for a processor that quickly shuttles data in large blocks. In particular, the 68340 was designed to be a central processor for compact disc-interactive products, palmtop or hand-held computers, hard disk and network control data movement, and laser printer input/output.

Compact disc-interactive (CD-I) was a key stimulus for the development of the 68340. CD-I players turn televisions and stereos into interactive entertainment and informative centres. Philips, a driving force behind the commercialisation of CD-I products, has praised the design and development of the 68340.

The 68340 is the newest member of Motorola's 68300 family of integrated processors and microcontrollers. The 68300 family couples a 68000-based processing unit with a variety of intelligent peripherals, memories and glue logic. Motorola's strategy is to customise 68000-based products for specific applications, while retaining the strength of its multibillion dollar software base.

For further information circle 275 on the reader service coupon or contact Motorola Semiconductor Products, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711.

Self-calibrating A-D converter

National Semiconductor has introduced a self-calibrating 12-bit plus-sign analog-to-digital converter, the ADC1251, which is claimed to outperform the industry-standard ADC774 in both speed and accuracy.

The ADC1251 features an innovative self-calibrating function which offers accurate performance over both temperature and time, by adjusting for both linearity and zero errors. Unlike standard non-calibrating ADCs, the ADC1251 automatically corrects all internal errors to guarantee no missing codes over temperature with zero errors of +/-1LSB (least significant bit) and full scale errors of +/-5LSB. The self calibration architecture improves overall system reliability by eliminating parametric drifts due to temperature and time.

A byte-wide interface version of National Semiconductor's ADC1241, the ADC1251 also features a fast conversion time of 8us. The high speed and byte wide interface of the ADC1251 allows for a standard 8-bit bus incorporation in its architecture.

For further information circle 287 on the reader services coupon or contact National Semiconductor Australia, Building 16, Business Park Drive, Monash Business Park, Nottinghill 3168; phone (03) 558 9999

NS second source for OP-07

National Semiconductor Corporation is offering a direct second source to the industry-standard OP-07 operational amplifier. The OP-07 has very low input offset voltage (25uV max) and low voltage drift. The device also features wide input and supply voltage ranges and high open-loop gain.

The low offset voltage and high open-loop gain make the OP-07 particularly useful in high-gain applications such as thermocouple amplifiers, precision reference buffers and analog computing.

THE JANUARY HOBBYIST SALE

THE OK SOLDERING STATION

The all new OK Industries soldering station has set a new standard in cost effective soldering stations for the hobbyist, manufacturer. It features a dial up temperature between 315° - 427°C (600° - 800°F). No more constant tip changing to select a different temperature.

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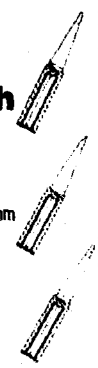
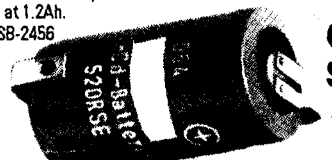


Sub C NiCad

NEW

Sub C NiCads are commonly used in battery packs to power RC racing cars and cordless power tools. Up till now, *if a battery pack failed* - you would need to purchase a new pack from the manufacturer of the product. These battery packs are very expensive.
The most common voltage used is 7.2 volts which is made up with 6 x Sub C NiCads. So, instead of being forced to pay $70 - $100 for a replacement battery pack, you can now fix it yourself and save a fortune.
The Sub C's are suplied with solder tab s and are rated at 1.2Ah.

Cat. SB-2456



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We offered a smaller version in May 1990 and they went incredibly quick.
This supply is in a case, has a quality 250V 4A rocker switch mounted on a metal bracket, IEC input socket and lots of power supply compenents.
Typical outputs wil be +5V around 2A, +12V and -12V low current, and 12V around 2A. Made in Japan.
The problem is that they are 110V powered not 240V. You can use then for parts at this bargain price.
Size 300(L) x 65(H) x 90(D)mm

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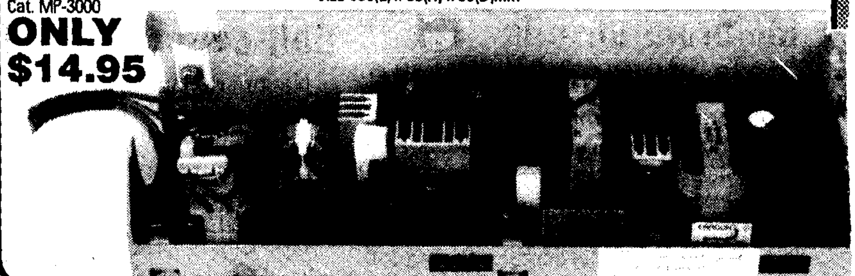

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AA size	450mAh	**$2.50 ea**	Cat. SB-2452	**Save $1**
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FM CAR WIRELESS TELEPHONE

Ideal for communication between 2 (or more) vehicles travelling together. Save a fortune over buying CB radios and aerials.
The unit simply plugs into your cigarette lighter (for power) and transmits your voice on FM. Your friends on the other car will hear you on their car radio and visa versa, you can receive their conversation on your car radio. Full set up procedures are supplied with each unit, its easy to tune in to your own car radio and then swap the unit with your friend.
We have tested these and found they work very well, we had clear reception over 0.5 km apart. The frequency is adjustable 88 - 108 MHz. Each vehicle will need one unit. Power output is 48.0 dBμV.
Unit resembles a car phone!!

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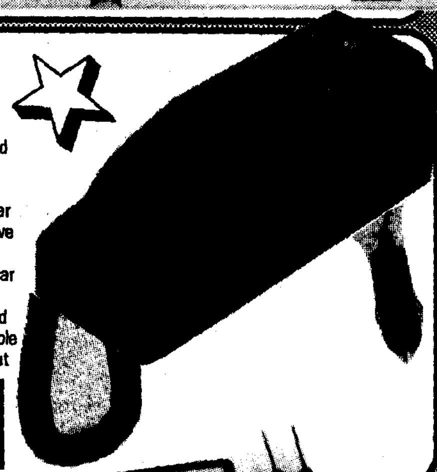

10mm FLASHING LED

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The cheapest way to make your vehicle look like you have a burglar alarm. The pack includes a 120mCd 10mm diameter red LED, and a black bezel. The 120mCd LED is as bright as a normal red bezel.
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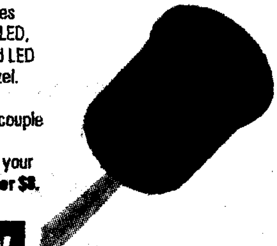

Transistor and Continuity Tester

At last! A pre-built, quality transistor tester. Incorporates a continuity tester with an LED and buzzer. Transistor tester checks both NPN and PNP and also advises if circuit or short circuited. Supplied with multimeter type lead and users 2 x AAA batteries. Size 53(W) x 85(L) x 19(D)mm.

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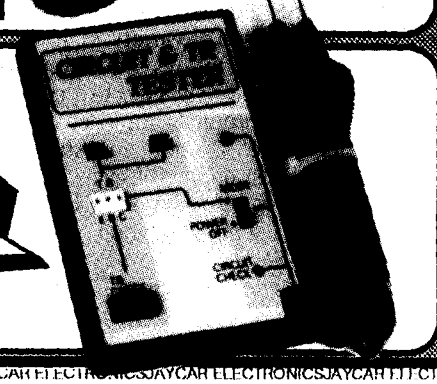

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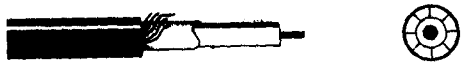
Yes, that's correct. High quality Benelec brand 0.65mm conductor, airspace PE dielectric, foil shield, 5mm OD sheath, brown in colour air space, 75Ω coax. Save a fortune over normal prices. 70¢ mt for quantities less than 100mt roll.

Cat. WB-2002 **$35 - 100 mt roll**

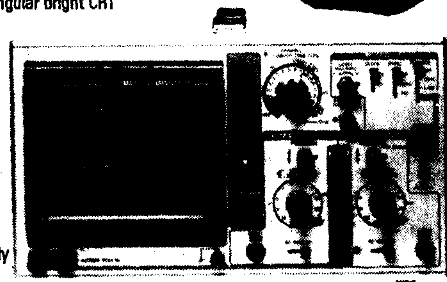


Hung Chang 20 MHz Dual Trace Oscilloscope

SAVE $50

- Wide bandwidth and high sensitivity
- Internal graticule rectangular bright CRT
- Built-in component tester
- Front panel trace rotator
- TV video sync filter
- Z axis (intensity modulation)
- High sensitivity X-Y mode
- Very low power consumption
- Regulated power supply circuit

Cat QC 1900



Catalogue Price $799
Now only $749

Probes to suit QC1902 $39.50 each

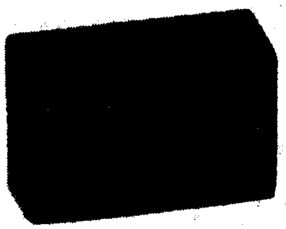
PCB RELAY SENSATION

We have purchased a large quantity of DPDT 12V, 3A, high quality Japanese made Omron PC mount relays. These are Telecom approved, plastic sealed with bifurcated crossbar contacts. They conform to International 2.54mm terminal pitch and have a life expectancy of 100,000,000 operations. You would expect to pay around $10 each for these.

Specifications
Voltage DC - 12V
Current - 24mA
Resistance - 500Ω
Contact rating - 3A
Cat. SY-4055

SAVE UP TO 80%

NEW



Buy up now and save a fortune

1 - 9	**$2.95 ea**
10 - 99	**$2.50 ea**
100+	**$2 ea**

DIGITAL MULTIMETER

- Frequency counter
- Capacitance meter
- Logic probe 20MHz
- Diode Tester
- 10 Amp
- 34 Range
- One hand operation

Cat. QM-1400

Normally $99.95

SAVE $20

Sale price $79.95

TRAVEL ALARM CLOCK WITH CALCULATOR

A must for travellers.
Incorporates an alarm with snooze setting and back light at the touch of a button for night reading. Alarm buzzer is a loud 65-70db.
Calculator is an 8 digit type with memory, square root and percentage keys, auto power off and 1000 hour battery life. The case folds up to a small size 75x65x19mm which makes it very easy to carry.
A perfect gift idea.
Cat QM 7218

ONLY $19.95

Frequency Counter DMM

- Capacitance Meter • Transistor Tester • 20 Amp Current • Metex brand

See catalogue for full specs.
Cat. QM-1555

Catalogue price $149.50

SAVE $20

SALE $129.50

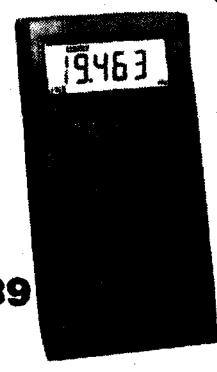
METEX

4.5 Digit DMM
- Frequency
- Transistor Tester
- Capacitance Meter
- Data Hold
- 20 Amp Current

Cat QM 1560

Catalogue price $209
Sale price$189

SAVE $20



CALENDAR/CLOCK

Replace those old desk type calendars. This brand new Electronic Calendar/Clock shows • Time (either 12 or 24 hour format) • Month • Day • Date and Year. Large easy to read display with a back light for night viewing and 3 year battery life. Ideal for desks, cars, kitchens etc.
Cat. QM 7215

Only $19.95

Brisbane OPEN TO 4pm SAT

TURN YOUR SURPLUS STOCK INTO CASH!!

Jaycar will purchase your surplus stocks of components and equipment.
Call Mark Harris or Bruce Routley
(02) 747-2022

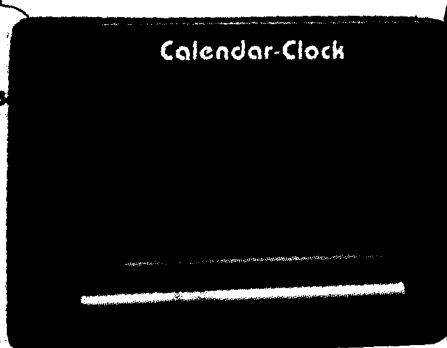
Semiconductor Bargains

2114 350nS 1k x 4 Cat. ZZ-8414
Was $4.95 Now $1 ea 10+ .75

4116 200nS 16k x 1 Cat. ZZ-8418
Was $2.95 Now 50¢

6116 2k x 8 RAM Cat. ZZ-8430
Was $12.95 Now $3.95

6264 RAM Cat. ZZ-8440
Was $15.00 Now $3.95



Maggylamp *Back Again*

ONLY $299

The Maggylamp is a widely adjusted magnifier with a 12.7cm dia. bi-convex lens 4.00 dioptres focal length of 25.4cm, it is essentially a microscope with lighting. Maggylamp has flexible arms for easy positioning. Handsome, sturdy construction assures a lifetime of service.

Multiband Radio - 9 band

Listen to the world

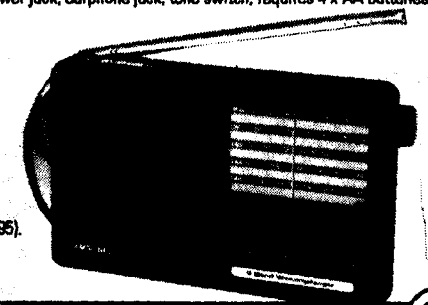
We have rejected every multiband radio sample we have seen, until this one, and this one is a beauty. It features 9 bands. LED tuning indicator, 3" speaker, 6V DC external power jack, earphone jack, tone switch, requires 4 x AA batteries.

Bands:
FM 88 - 108 MHz
AM 530 - 1600kHz
LW 150 - 280 KHz
SW1 49M 5.85 - 6.20MHz
SW2 41M 7.10 - 7.50MHz
SW3 31M 9.45 - 9.90MHz
SW4 25M 11.50 - 11.95MHz
SW5 19M 15.10 - 15.55MHz
SW6 16M 17.45 - 18.00MHz

To operate off 240V use our adaptor (Cat. MP-3008 - $15.95).
Cat. AR-2200

ONLY $59.95

NEW

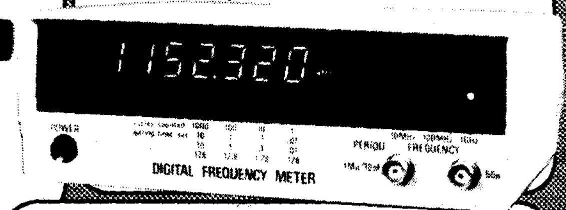


1GHz DIGITAL FREQUENCY METER KIT

Refer Silicon Chip Nov/Dec 90. See catalogue for full details
Cat. KC-5013

Normally $299
ONLY $249

SAVE $50



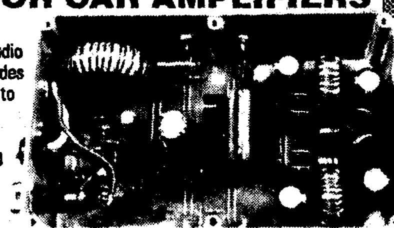
NEW KIT FOR DECEMBER
DC - DC CONVERTER FOR CAR AMPLIFIERS

Refer Silicon Chip Dec. 90

This DC-DC converter will allow you to use a hi-fi power audio amplifier in your car to provide good quality sound. It provides split rails (±35 to ±50V adjustable) which can be adjusted to suit your amplifier module.

Kit includes PCB, panel, diecast box, core, bobbin, toroids, Polyswitches and all specified parts. Absolutely everything supplied you will need to finish your project.

Cat. KC-5086 **$149.50**

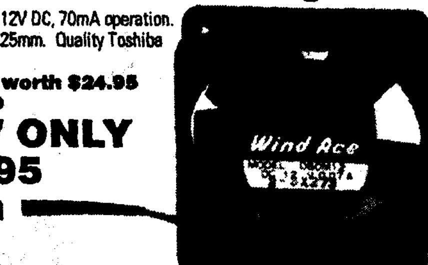


60mm 12 Volt Fan Bargain

DC brushless, 12V DC, 70mA operation. Size 60 x 60 x 25mm. Quality Toshiba brand.

Normally worth $24.95
SAVE $10
NOW ONLY $14.95 each

Cat. YX-2505



Headset/MicrophoneSet

High quality headphone/microphone set. Supplied with a pair of 32ohm quality dynamic headphones and noise cancelling electret microphone. Insert is mounted on a flexible boom with windscreen. Supplied with separate stereo 3.5mm plug for headphones and 3.5mm mono plug for insert (mic insert requires 3 - 5V power for operation). Easily worth $50. Limited quantity available for $29.95, reduced by a further $10 this month only.

Cat. AA-2022

ONLY $19.95

SAVE $10

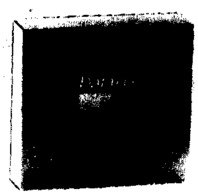
VERBATIM DISKS PRICES SLASHED!!!

CHEAPEST IN AUSTRALIA?

	NOW	WAS	
3.5" DSDD	**$28.95**	$46.95	Cat. XC-4721
3.5" DSHD	**$57.50**	$99.00	Cat. XC-4722
5.25" DSDD	**$21.95**	$26.00	Cat. XC-4726
5.25" DSHD	**$29.95**	$41.00	Cat. XC-4727

Prices for boxes of 10

SAVE $$$$



Minstrel 2 Way Crossovers

Ref: Silicon Chip Feb '89

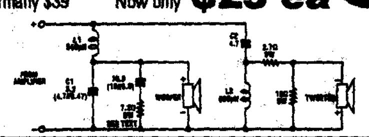
We have a quantity of crossovers left over from our Minstrel 2 way kits. Power handling: 60 W RMS. X over freq.: 3 Khz

See schematic diagram

Cat. CX-2610

Normally $39 Now only **$25 ea**

SAVE $14



PULSE Count PIR Bargain

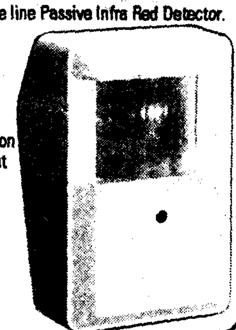
Save an amazing $40 on our top of the line Passive Infra Red Detector.

Features:

- Dual element pyroelectric sensor
- Pulse count triggering circuitry
- Fresnel lens array large coverage
- 24 dual element detection sensor for long, mid and short range protection
- Surface or corner mounting without extra accessories

See catalogue for full details.
Cat. LA-5019

Normally $139
SAVE $40
NOW $99

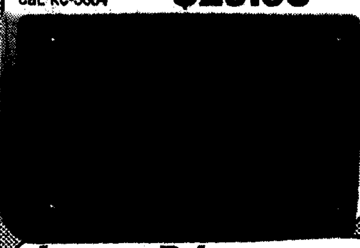


REMOTE CONTROL EXTENDER KIT FOR VCR'S

Ref Silicon Chip Sept 90

Remote control your VCR from another room. Complete kit.

Cat. KC-5084 **$29.95**



New Lower Prices on 'ACT' Computer Diskettes

All supplied with a LIFETIME GUARANTEE, envelopes, index labels and write protect tabs.

		SAVE	
5.25" DSDD 48TPI	**$6.20**	30¢	Cat. XC-4730
5.25" DSHD 96TPI	**$13.95**	$2	Cat. XC-3732
3.5" MF2DD 135TPI	**$12.95**	$4	Cat. XC-4736
3.5" Hi Density 1.4MB	**$29.95**	$5	Cat. XC-4738

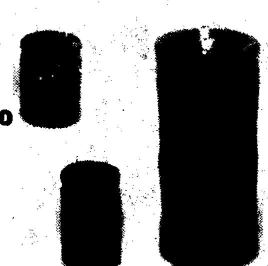
CAPACITOR MADNESS

Stock Up Now

1) 3300µF 63V RB
Cat price $3.95
NOW $2.50 10+ $2
Cat. RU-6730

2) 3300µF 80V RP
Cat price $4.95
NOW $2.95 10+ $2.50
Cat. RU-6731

3) 15,000µF 40V Philips can
Worth $18
NOW $8.95 10+ $8
Cat. RU-6714



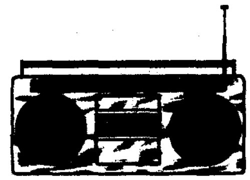
Lower Price on Reed/Magnet Sets

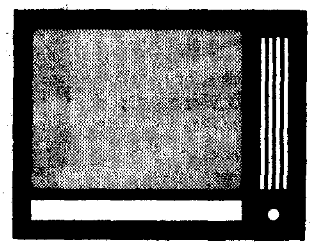
N/O and N/C contacts. A must for doors and windows in home alarms.

Cat. LA-5070

Catalogue price $6.50
NOW $4.75
10+ $4.25

RADIO and TV





Broadcasting Services around Australia

Compiled with the co-operation of the Department of Transport and Communications

ABC TV

New South Wales

Location	Call	Pol	Sound Mode	ERP (W)
Armidale	ABN/5A	H	Mono	50
Ashford	ABUN/5A	V	Mono	15
Batemans Bay/ Moruya	ABWN/9	H	Mono	1k
Bathurst	ABCN/6	V	Mono	200
Bega/Cooma	ABSN8	V	Mono	100k
Bonalbo	ABRN/3	V	Mono	5
Bourke/Brewarrina	ABN/4	H	Mono	1k
Broken Hill	ABLN2	V	Mono	2500
Cen/Western Slopes	ABQN5	V	Mono	100k
Central Tablelands	ABCN1	V	Mono	100k
Cobar	ABN/2	V	Mono	60
Coffs Harbour	ABDN/60	H	Mono	150
Collarenebri	ABN/29	H	Mono	250
Cooma	ABSN/0	H	Mono	35
Deniliquin	ABGN/9	V	Mono	1k
Eden	ABSN/1	H	Mono	50
Glen Innes	ABUN/0	H	Mono	25
Gloucester	ABTN/6	H	Mono	200
Goodooga	ABN/8	H	Mono	10
Gosford	ABN/46	H	Mono	200
Goulburn	ABC/0	V	Mono	50
Grafton/Kempsey	ABDN2	H	Mono	100k
Hay	ABGN/10	H	Mono	2500
Illawarra	ABWN5A	H	Mono	100k
Inverell	ABUN/2	H	Mono	25
Ivanhoe	ABN/6	H	Mono	100
Jerilderie	ABGN/11	H	Mono	7k

Location	Call	Pol	Sound Mode	ERP (W)
Jindabyne	ABSN/60	H	Mono	200
Kandos	ABCN/0	V	Mono	15
Kings Cross	ABN/46	H	Mono	1k
Kyogle	ABRN/3	V	Mono	5
Laurieton	ABTN/44	V	Mono	500
Lightning Ridge	ABN/10	H	Mono	125
Lithgow	ABCN/47	H	Mono	100
Lithgow	ABCN/5	V	Mono	5
Manning River	ABTN1	V	Mono	100k
Menindee	ABLN/9	V	Mono	100
Merriwa	ABHN/8	V	Mono	50
Mudgee	ABQN/11	V	Mono	10
Mungindi	ABUN/10	H	Mono	50
Murrumbidgee Irrigation Area	ABGN7	H	Mono	100k
Murrurundi	ABN/6	H	Mono	50
Narooma	ABWN/0	H	Mono	500
Newcastle/ Hunter River	ABHN5A	H	Mono	100k
Nyngan	ABN/3	V	Mono	10
Portland/ Wallerawang	ABCN/0	H	Mono	100
Quirindi	ABN/5A	H	Mono	500
Richmond/Tweed	ABRN6	H	Mono	100k
SW Slopes/ E Riverina	ABMN0	H	Mono	100k
Scone	ABHN/8	H	Mono	1500
Sydney	ABN2	H	Mono	100k
Tamworth	ABN/2	H	Mono	1k
Tenterfield	ABRN/29	H	Mono	200
Tottenham	ABN/10	H	Mono	100
Tumbarumba	ABMN66	V	Mono	8
Upper Namoi	ABUN7	H	Mono	100k

Location	Call	Pol	Sound Mode	ERP (W)
Wagga Wagga	ABN/8	H	Mono	25
Walcha	ABN/6	H	Mono	100
Walgett	ABN/11	H	Mono	100
Wilcannia	ABN/8	H	Mono	100
Wollongong	ABWN/50	H	Mono	2500
Young	ABMN/11	H	Mono	50

Queensland

Location	Call	Pol	Sound Mode	ERP (W)
Airlie Beach	ABMQ/49	H	Mono	300
Alpha	ABAQ8	H	Mono	13
Aramac	ABQ/11	H	Mono	100
Augathella	ABAAQ11	H	Mono	13
Babinda	ABNQ/1	V	Mono	300
Bamaga	ABQ/69	H	Mono	50
Barcaldine	ABBQ10	H	Mono	13
Bedourie	ABQ/7	H	Mono	10
Birdsville	ABQ/8	H	Mono	100
Blackall	ABBLQ9	H	Mono	100
Blackwater	ABQ/8	H	Mono	500
Bollon	ABQ/69	V	Mono	10
Boulia	ABQ/8	H	Mono	100
Bowen	ABTQ/5A	H	Mono	5k
Brisbane	ABQ2	H	Mono	100k
Burdekin Falls	ABQ/69	V	Mono	10
Cairns	ABNQ9	H	Mono	100k
Cairns North	ABNQ/4	H	Mono	2k
Camooweal	ABQ/8	H	Mono	300
Capella	ABQ/5A	H	Mono	100
Cardstone	ABNQ/52	H	Mono	20
Charleville	ABCEQ9	H	Mono	130
Charters Towers	ABQ/44	H	Mono	50
Clermont	ABCTQ10	H	Mono	50

Location	Call	Pol	Sound Mode	ERP (W)
Cloncurry	ABCLQ7	H	Mono	100
Coen	ABQ/8	H	Mono	30
Collinsville	ABMQ/8	H	Mono	30
Cooktown	ABQ/8	H	Mono	12
Corfield	ABQ/10	H	Mono	100
Croydon	ABQ/8	H	Mono	12
Cunnamulla	ABCAQ10	H	Mono	13
Darling Downs	ABDQ3	H	Mono	100k
Dimbulah	ABNQ/46	H	Mono	800
Dirranbandi	ABDIQ7	V	Mono	10
Dysart	ABMQ/2	V	Mono	250
Edward River	ABQ/69	V	Mono	5
Emerald	ABEQ11	H	Mono	1k
Eulo	ABQ/69	V	Mono	5
Georgetown	ABQ/7	H	Mono	10
Gladstone	ABRQ/5	H	Mono	10
Glenden	ABMQ/29	H	Mono	20
Gold Coast	ABQ/49	H	Mono	50k
Goondiwindi	ABGQ6	H	Mono	250
Gordonvale	ABNQ/0	H	Mono	500
Greenvale	ABQ/8	H	Mono	10
Gununa	ABQ/69	V	Mono	10
Gympie	ABWQ4	V	Mono	3k
Gympie Town	ABQ/58	H	Mono	100
Herberton	ABNQ/4	H	Mono	20
Hope Vale	ABQ/69	V	Mono	5
Hughenden	ABHQ9	H	Mono	100
Injune	ABQ/8	H	Mono	100
Isisford	ABQ/7	H	Mono	100
Jackson Oil Field	ABQ/69	H	Mono	10
Jericho	ABQ/7	H	Mono	250
Julia Creek	ABJQ10	H	Mono	100
Jundah	ABQ/69	V	Mono	10
Karumba	ABQ/6	H	Mono	10
Kowanyama	ABQ/69	V	Mono	10
Laura	ABQ/8	H	Mono	10
Lockhart River	ABQ/69	V	Mono	5
Longreach	ABLQ6	H	Mono	650
Mackay	ABMQ4	H	Mono	100k
Mareeba	ABNQ/1	H	Mono	16
Middlemount	ABMQ/8	V	Mono	25
Miles	ABMSQ9	V	Mono	160
Miriam Vale	ABWQ/11	V	Mono	100
Mission Beach	ABNQ/2	V	Mono	100
Mitchell	ABMLQ6	H	Mono	100
Monto	ABWQ/1	V	Mono	1200
Moranbah	ABMQ/5A	H	Mono	2k
Morven	ABMNQ7	H	Mono	50
Mossman	ABNQ/8	V	Mono	1k
Mt Garnet	ABNQ/2	H	Mono	15
Mt Isa	ABIQ6	H	Mono	1250
Mt Molloy	ABQ/7	H	Mono	150
Muttaburra	ABQ/8	H	Mono	100
Nambour	ABWQ/5A	H	Mono	3k
Nebo	ABMQ/0	H	Mono	100
Normanton	ABQ/8	H	Mono	10
Pentland	ABQ/8	H	Mono	100
Quilpie	ABQ/8	H	Mono	100
Ravenshoe	ABNQ/8	V	Mono	12
Richmond	ABRDQ6	H	Mono	100
Rockhampton	ABRQ3	H	Mono	100k
Roma	ABRAQ7	H	Mono	1k
Shute Harbour	ABMQ/2	H	Mono	160
Southern Downs	ABSQ1	H	Mono	100k
Springsure	ABSEQ9	H	Mono	250
St George	ABSGQ8	H	Mono	65
Stonehenge	ABQ/69	V	Mono	10
Surat	ABQ/11	H	Mono	100
Tambo	ABQ/6	H	Mono	100
Taroom	ABQ/11	H	Mono	100
Texas	ABSQ/11	H	Mono	20
Thargomindah	ABQ/69	V	Mono	20
The Monument	ABQ/69	V	Mono	20
Thursday Island	ABQ/8	H	Mono	10
Tieri	ABQ/69	H	Mono	100
Townsville	ABTQ3	H	Mono	100k
Townsville North	ABTQ/1	H	Mono	10
Tully	ABQ/8	V	Mono	1k
Tully Falls	ABNQ/46	H	Mono	35
Wandoan	ABQ/5A	H	Mono	100
Weipa	ABQ/7	H	Mono	300
Wide Bay	ABWQ6	V	Mono	150k
Windorah	ABQ/69	V	Mono	10
Winton	ABQ/8	H	Mono	1k
Wujal Wujal	ABQ/69	V	Mono	5
Wyandra	ABQ/69	V	Mono	5

Victoria

Location	Call	Pol	Sound Mode	ERP (W)
Alexandra	ABGV/5A	H	Mono	3k
Bairnsdale	ABLV/46	H	Mono	5k
Ballarat	ABRV3	H	Mono	100k
Bendigo	ABEV1	V	Mono	100k
Bonnie Doon	ABGV/58	V	Mono	75
Cann River	ABLV/11	H	Mono	1600
Casterton	ABWV/3	V	Mono	50
Cobden	ABRV/8	H	Mono	500

TV FREQUENCIES

Band I

0	45	-	52MHz
1	56	-	63MHz
2	63	-	70MHz

Band II

3	85	-	92MHz
4	94	-	101MHz
5	101	-	108MHz

Band III

5A	137	-	144MHz
6	174	-	181MHz
7	181	-	188MHz
8	188	-	195MHz
9	195	-	202MHz
10	208	-	215MHz
11	215	-	222MHz

Band IV

28	526	-	533MHz
29	533	-	540MHz
30	540	-	547MHz
31	547	-	554MHz
32	554	-	561MHz
33	561	-	568MHz
34	568	-	575MHz
35	575	-	582MHz

Band V

39	603	-	610MHz
40	610	-	617MHz
41	617	-	624MHz
42	624	-	631MHz
43	631	-	638MHz
44	638	-	645MHz
45	645	-	652MHz
46	652	-	659MHz
47	659	-	666MHz
48	666	-	673MHz
49	673	-	680MHz
50	680	-	687MHz
51	687	-	694MHz
52	694	-	701MHz
53	701	-	708MHz
54	708	-	715MHz
55	715	-	722MHz
56	722	-	729MHz
57	729	-	736MHz
58	736	-	743MHz
59	743	-	750MHz
60	750	-	757MHz
61	757	-	764MHz
62	764	-	771MHz
63	771	-	778MHz
64	778	-	785MHz
65	785	-	792MHz
66	792	-	799MHz
67	799	-	806MHz
68	806	-	813MHz
69	813	-	820MHz

Location	Call	Pol	Sound Mode	ERP (W)
Colac	ABRV/5A	H	Mono	1k
Coleraine	ABWV/2	H	Mono	50
Corryong	ABAV/9	H	Mono	100
Eildon	ABGV/1	H	Mono	5
Ferntree Gully	ABV/56	H	Mono	350
Foster	ABLV/11	H	Mono	250
Goulburn Valley	ABGV3	V	Mono	100k
Latrobe Valley	ABLV4	H	Mono	100k
Mansfield	ABGV/45	H	Mono	1k
Marysville	ABV/46	H	Mono	10
Melbourne	ABV2	H	Mono	100k
Mildura	ABMV4	H	Mono	100k
Murray Valley	ABSV2	V	Mono	100k
Myrtleford	ABGV/2	H	Mono	25
Nhill	ABWV/9	V	Mono	20k
Orbost	ABLV/2	H	Mono	150
Portland	ABWV/4	H	Mono	2k
Selby	ABV/57	H	Mono	500
Tawoonga South	ABAV/45	V	Mono	25
Upper Murray	ABAV1	H	Mono	100k
Upwey	ABV/39	V	Mono	160
Warburton	ABV/46	H	Mono	150
Warrnambool	ABWV/2	V	Mono	2k
Western Victoria	ABWV5A	H	Mono	66k

South Australia

Location	Call	Pol	Sound Mode	ERP (W)
Adelaide	ABS2	H	Mono	100k
Adelaide Foothills	ABS/46	H	Mono	2k
Andamooka	ABS/8	H	Mono	30
Bordertown	ABS/2	V	Mono	500
Ceduna/ Smokey Bay	ABS/9	H	Mono	1k
Coffin Bay	ABS/45	V	Mono	10
Coober Pedy	ABS/8	H	Mono	10
Cowell	ABNS/6	V	Mono	2k
Elliston	ABS/69	H	Mono	100
Hawker	ABNS/48	H	Mono	200
Leigh Creek	ABS/7	H	Mono	50
Leigh Creek Sth	ABS/9	H	Mono	20
Maree	ABS/8	H	Mono	30
Port Lincoln	ABNS/3	H	Mono	1k
Quorn	ABNS/47	H	Mono	1800
Renmark/Loxton	ABRS3	V	Mono	150k
South East	ABGS1	H	Mono	100k
Spencer Gulf Nth	ABNS1	V	Mono	100k
Streaky Bay	ABS/10	V	Mono	1k
Wirrulla	ABS/8	H	Mono	1k
Woomera	ABWS7	H	Mono	10
Wudinna	ABS/30	H	Mono	10k

West Australia

Location	Call	Pol	Sound Mode	ERP (W)
Albany	ABAW/7	V	Mono	50
Argyle	ABW/69	H	Mono	150
Bayulu	ABW/45	V	Mono	12
Broome	ABW/8	H	Mono	1k
Bunbury	ABSW5	H	Mono	100k
Carnarvon	ABCNW7	H	Mono	100
Central Agricultural	ABCW5A	H	Mono	100k
Cervantes	ABW/46	V	Mono	5
Cockatoo Island	ABW/9	H	Mono	4
Condingup/ Howick	ABEW/6	H	Mono	200
Cue	ABW/10	H	Mono	20
Dalwallinu	ABW/46	H	Mono	10k
Dampier	ABDW10	H	Mono	20
Denham	ABW/8	H	Mono	100
Derby	ABW/8	H	Mono	100
Eneabba	ABW/46	H	Mono	40
Esperance	ABEW10	H	Mono	1k
Exmouth	ABW/8	H	Mono	75
Fitzroy Crossing	ABW/58	V	Mono	50
Geraldton	ABGW6	H	Mono	10k
Goldsworthy	ABW/2	V	Mono	50
Halls Creek	ABW/8	H	Mono	20
Jurien	ABW/55	H	Mono	2k
Kalbarri	ABW/9	H	Mono	12
Kalgoorlie	ABKW6	H	Mono	8k
Kambalda	ABKW/5	H	Mono	10
Karratha	ABKAW7	H	Mono	25
Katanning	ABW/7	V	Mono	400
Kojonup	ABW/69	H	Mono	50
Koolan Island	ABW/6	H	Mono	50
Koolyanobbing	ABSBW/11	H	Mono	10
Kunurra	ABW/9	H	Mono	60
Lagrange	ABW/67	H	Mono	50
Lake Grace	ABW/33	V	Mono	20
Laverton	ABW/10	H	Mono	100
Leeman	ABW/5A	H	Mono	60
Leinster	ABW/10	H	Mono	10
Leonora	ABW/8	H	Mono	400
Marble Bar	ABW/8	H	Mono	20
Meekatharra	ABW/8	H	Mono	10
Menzies	ABW/10	H	Mono	10
Merredin	ABW/8	H	Mono	35
Moora	ABW/60	H	Mono	60k
Morawa	ABCMW8	H	Mono	1k
Mt Magnet	ABW/8	H	Mono	15
Mullewa	ABGW/9	H	Mono	40
Narrogin	ABW/57	H	Mono	5k
Newman	ABW/7	H	Mono	50
Norseman	ABNW7	H	Mono	40
Northampton	ABGW/8	H	Mono	10
Nullagine	ABW/50	V	Mono	4
Onslow	ABW/8	H	Mono	30
Pannawonica	ABW/11	H	Mono	30
Paraburdoo	ABW/6	H	Mono	200
Perth	ABW2	H	Mono	100k
Port Hedland	ABPHW7	H	Mono	750
Ravensthorpe	ABW/11	H	Mono	20
Roebourne	ABRBW9	H	Mono	1k
Salmon Gums	ABW/8	H	Mono	300
Shay Gap	ABW/2	H	Mono	50
Sth Agricultural	ABAW2	V	Mono	100k
Southern Cross	ABSBW9	H	Mono	1k
Tom Price	ABW/10	H	Mono	125
Teutonic Bore	ABW/9	H	Mono	20
Wagin	ABW/8	H	Mono	60k
Warburton	ABW/69	V	Mono	4
Wiluna	ABW/69	V	Mono	5
Wongan Hills	ABW/6	V	Mono	300
Wyndham	ABW/10	H	Mono	100
Yalgoo	ABW/10	H	Mono	10

Northern Territory

Location	Call	Pol	Sound Mode	ERP (W)
Adelaide River	ABD/11	H	Mono	20
Alice Springs	ABAD7	H	Mono	250
Bathurst Island	ABD/11	H	Mono	150
Borroloola	ABD/6	H	Mono	200
Daly River	ABD/10	H	Mono	125
Darwin	ABD6	H	Mono	30k
Galiwinku	ABD/8	H	Mono	30
Groote Eylandt	ABD/7	H	Mono	100
Jabiru	ABD/8	H	Mono	10
Katherine	ABKD7	H	Mono	700
Mataranka	ABD/8	H	Mono	30
Newcastle Waters	ABD/8	H	Mono	100
Ngukurr	ABD/69	V	Mono	10
Nhulunbuy	ABD/11	H	Mono	150
Numbulwar	ABD/69	V	Mono	10
Pine Creek	ABD/10	H	Mono	10
Port Keats	ABD/69	V	Mono	10
Pularumpi	ABD/69	V	Mono	10
Santa Teresa	ABAD/68	H	Mono	5
Tennant Creek	ABTD9	H	Mono	1k
Warrego Mine	ABTD/10	H	Mono	100
Yulara	ABD/67	V	Mono	17

Tasmania

Location	Call	Pol	Sound Mode	ERP (W)
Bicheno	ABT/4	H	Mono	500
Burnie	ABNT/4	V	Mono	500
Crotty Camp	ABT/66	H	Mono	500
East Devonport	ABNT/48	H	Mono	800
Hobart	ABT2	H	Mono	100k
King Island	ABKT11	H	Mono	2k
Launceston	ABNT/1	H	Mono	30
Lileah	ABNT/8	V	Mono	2k
Maydena	ABT/58	H	Mono	10
Nth/Eastern Tasmania	ABNT3	H	Mono	300k
Penguin	ABNT/60	H	Mono	100
Queenstown	ABT/4	H	Mono	100
Rosebery	ABT/1	H	Mono	50
Savage River	ABNT/4	H	Mono	100
Smithton	ABNT/4	V	Mono	100
St Helens	ABNT/0	H	Mono	30
St Marys	ABNT/1	V	Mono	100
Strahan	ABT/10	H	Mono	10
Strathgordon	ABT/5	H	Mono	50
Ulverstone	ABNT/59	H	Mono	100
Waratah	ABNT/2	H	Mono	800
Wynyard	ABNT/1	V	Mono	1k

Aust Capital Territory

Location	Call	Pol	Sound Mode	ERP (W)
Canberra	ABC3	V	Mono	100k
Tuggeranong	ABC/9	V	Mono	100
Tuggeranong	ABC/60	H	Mono	400

COMMERCIAL TV

New South Wales

Location	Call	Pol	Sound Mode	ERP (W)
Armidale	NEN10	H	Dual	50
Ashford	NEN10	V	Dual	15
Batemans Bay/ Moruya	WIN11	H	Dual	1k
Bathurst	CBN11	V	Mono	200
Bega	WIN6	H	Dual	1k
Bombala	CTC2	V	Mono	2k
Bonalbo	RTN5	V	Mono	5
Broken Hill	BKN7	V	Mono	7500
Central/ Western Slopes	CWN6	V	Dual	200k
Central Tablelands	CBN8	V	Mono	100k
Cobar	CWN10	V	Dual	50
Coffs Harbour	NRN63	H	Mono	150
Condobolin	CBN68	V	Mono	40
Cooma	CTC10	V	Mono	50k
Deniliquin	GMV10	V	Dual	1k
Dungog	NBN69	H	Mono	50
Eden	WIN3	H	Dual	50
Glen Innes	NEN3	H	Dual	10
Gloucester	NEN11	H	Dual	200
Gosford	ATN49	H	Dual	200
Gosford	NBN40	H	Dual	200
Gosford	TCN52	H	Dual	200
Gosford	TEN55	H	Dual	200
Goulburn	CTC10	V	Mono	100
Grafton/Kempsey	NRN11	H	Mono	200k
Hay	MTN5A	H	Mono	1400
Illawarra	WIN4	H	Dual	200k
Illawarra	WIN59	H	Dual	600k
Inverell	NEN10	H	Dual	25
Jerilderie	GMV8	H	Dual	150
Jindabyne	CTC66	H	Mono	200
Kandos	CBN10	V	Mono	20
Khancoban	AMV7	H	Mono	20
Kings Cross	ATN49	H	Dual	1k
Kings Cross	TCN52	H	Dual	1k
Kings Cross	TEN55	H	Dual	1k
Kyogle	RTN5	V	Mono	5
Laurieton	NEN47	V	Mono	500
Lightning Ridge	NEN69	H	Mono	8
Lithgow	CBN50	H	Mono	100
Lithgow	CBN6	V	Mono	30
Manning River	NEN8	V	Dual	200k
Merriwa	NBN10	V	Mono	50
Mudgee	CWN9	V	Dual	10
Murrumbidgee Irrigation Area	MTN9	H	Mono	100k
Murrurundi	NBN1	H	Mono	50
Murwillumbah	RTN5	H	Mono	25
Narooma	WIN3	H	Dual	500
Newcastle/ Hunter River	NBN3	H	Mono	100k
Nyngan	CWN66	H	Dual	100
Portland/ Wallerawang	CBN4	H	Mono	100
Quirindi	NEN11	H	Dual	500
Richmond/Tweed	RTN8	H	Mono	100k
SW Slopes/ E Riverina	RVN2	H	Mono	100k
Scone	NBN10	H	Mono	1500
Stanwell Park	WIN39	H	Dual	20
Sydney	ATN7	H	Dual	100k
Sydney	TEN10	H	Dual	100k
Sydney	TCN9	H	Dual	100k
Tamworth	NEN0	H	Dual	1k
Tumbarumba	RVN69	V	Mono	8
Upper Namoi	NEN9	H	Dual	200k
Wagga Wagga	RVN11	H	Mono	25
Walcha	NEN1	H	Dual	100
Wollongong	WIN3	H	Dual	5k
Young	RVN6	H	Mono	50

Queensland

Location	Call	Pol	Sound Mode	ERP (W)
Airlie Beach	MVQ46	H	Mono	300
Alpha	RTQ51	V	Mono	20
Babinda	FNQ6	V	Mono	300
Barcaldine	QQQ62	V	Mono	13
Blackall	QQQ69	V	Mono	5
Blackwater	RTQ10	H	Mono	500
Bowen	TNQ1	H	Mono	5k
Boyne Island	RTQ69	H	Mono	50
Brisbane	BTQ7	H	Dual	100k
Brisbane	QTQ9	H	Dual	100k
Brisbane	TVQ0	H	Dual	100k
Cairns	FNQ10	H	Mono	100k
Cairns North	FNQ5A	*	Mono	2k
Capella	RTQ9	H	Mono	100
Cardstone	FNQ55	H	Mono	20
Charleville	QQQ68	V	Mono	5
Clermont	MVQ8	H	Mono	30
Cloncurry	QQQ69	V	Mono	5
Collinsville	MVQ11	H	Mono	20
Cracow	RTQ5	H	Mono	1
Cunnamulla	QQQ67	V	Mono	5
Currumbin	BTQ39	V	Mono	2k
Currumbin	QTQ45	V	Mono	2k
Currumbin	RTN42	V	Mono	2k
Currumbin	TVQ30	V	Mono	2k
Darling Downs	DDQ10	H	Mono	200k
Dysart	MVQ6	V	Mono	610
Emerald	RTQ6	H	Mono	1k
Gladstone	RTQ10	H	Mono	10
Glenden	MVQ32	H	Mono	20
Gold Coast	BTQ52	H	Dual	50k
Gold Coast	QTQ58	H	Dual	50k
Gold Coast	RTN55	H	Mono	50k
Gold Coast	TVQ46	H	Dual	50k
Gordonvale	FNQ2	H	Mono	500
Gympie	SEQ1	V	Mono	3k
Herberton	FNQ5A	H	Mono	20
Hughenden	QQQ69	H	Mono	5
Longreach	QQQ67	V	Mono	5
Mackay	MVQ6	H	Dual	180k
Mareeba	FNQ6	H	Mono	16
Middlemount	MVQ10	V	Mono	25
Mission Beach	FNQ5A	V	Mono	100
Mitchell	QQQ65	V	Mono	5
Monto	SEQ5	V	Mono	1200
Moranbah	MVQ11	H	Mono	2k
Mossman	FNQ11	V	Mono	100
Mt Isa	ITQ8	H	Mono	500
Nambour	SEQ10	H	Mono	3k
Nebo	MVQ8	H	Mono	100
Ravenshoe	FNQ11	V	Mono	12
Rockhampton	RTQ7	H	Mono	100k
Roma	QQQ52	V	Mono	50
Shute Harbour	MVQ58	H	Mono	400
Southern Downs	SDQ4	H	Mono	200
Springsure	RTQ10	H	Mono	250
St George	QQQ69	H	Mono	5
Stuart	TNQ68	H	Mono	100
Thursday Island	QQQ68	V	Mono	5
Toowoomba	DDQ5A	H	Mono	900
Townsville	TNQ7	H	Mono	100k
Townsville North	TNQ5A	H	Mono	20
Tully	FNQ11	V	Mono	1k
Tully Falls	FNQ49	H	Mono	35
Weipa	QQQ69	V	Mono	300
Weipa South	QQQ66	V	Mono	5
Wide Bay	SEQ8	V	Mono	150k
Winton	QQQ69	V	Mono	5

Victoria

Location	Call	Pol	Sound Mode	ERP (W)
Alexandra	GMV11	H	Dual	3k
Ballarat	BTV6	H	Dual	100k
Bendigo	BCV8	V	Mono	125k
Bonnie Doon	GMV61	V	Dual	75
Bright	AMV11	H	Mono	10
Corryong	AMV10	H	Mono	100
Eildon	GMV3	H	Dual	50
Ferntree Gully	ATV65	H	Dual	350
Ferntree Gully	GTV62	H	Dual	350
Ferntree Gully	HSV59	H	Dual	350
Foster	GLV6	H	Mono	250
Goulburn Valley	GMV6	V	Dual	110k
Lakes Entrance	GLV11	H	Mono	100
Latrobe Valley	GLV8	H	Mono	100k
Mansfield	GMV48	H	Dual	1k
Marysville	ATV55	H	Dual	10
Marysville	GTV52	H	Dual	10
Marysville	HSV49	H	Dual	10
Melbourne	ATV10	H	Dual	100k
Melbourne	GTV9	H	Dual	100k
Melbourne	HSV7	H	Dual	100k
Mildura	STV8	H	Mono	50k
Mount Martha	ATV55	H	Dual	100
Mount Martha	GTV52	H	Dual	100
Mount Martha	HSV49	H	Dual	100
Myrtleford	AMV9	H	Mono	20
Nhill	BTV7	V	Dual	20k

Location	Call	Pol	Sound Mode	ERP (W)
Orbost	GLV7	*	Mono	200
Portland	BTV-57	H	Dual	3500
Selby	ATV66	H	Dual	500
Selby	GTV63	H	Dual	500
Selby	HSV60	H	Dual	500
Swan Hill	BCV11	V	Mono	20k
Tawonga South	AMV48	V	Mono	25
Upper Murray	AMV4	H	Mono	100k
Upwey	ATV48	V	Dual	160
Upwey	GTV45	V	Dual	160
Upwey	HSV42	V	Dual	160
Warburton	ATV55	H	Dual	150
Warburton	GTV52	H	Dual	150
Warburton	HSV49	H	Dual	150
Warrnambool	BTV9	V	Dual	1300
Western Victoria	BTV10	H	Mono	30k
Yea	GMV62	H	Mono	25

South Australia

Adelaide	ADS10	H	Mono	100k
Adelaide	NWS9	H	Dual	100k
Adelaide	SAS7	H	Mono	100k
Adelaide Foothills	ADS55	H	Mono	2k
Adelaide Foothills	NWS52	H	Dual	2k
Adelaide Foothills	SAS49	H	Mono	2k
Bordertown	SES49	H	Mono	200
Ceduna	IMP7	H	Mono	1k
Coober Pedy	IMP10	H	Mono	10
Cowell	GTS8	V	Mono	2k
Elliston	GTS66	H	Mono	100
Keith	SES33	H	Mono	1730
Leigh Creek Sth	IMP10	H	Mono	20
Port Lincoln	GTS5	H	Mono	1k
Renmark/Loxton	RTS5A	V	Mono	80k
South East	SES8	H	Mono	250k
Spencer Gulf Nth	GTS4	V	Mono	100k
The Gap	SES32	H	Mono	2290
Woomera	IMP9	H	Mono	50

West Australia

Albany	GSW10	V	Mono	50
Argyle	WAW63	H	Mono	100
Baandee	VEW3	H	Mono	500
Bremer Bay	WAW66	V	Mono	10
Broome	WAW11	H	Mono	1k
Bunbury	BTW3	H	Mono	50k
Carnarvon	WAW10	H	Mono	250
Dampier	WAW32	H	Mono	50
Denham	WAW6	H	Mono	10
Derby	WAW11	H	Mono	100
Eneabba	ABW/46	H	Mono	40
Esperance	VEW9	H	Mono	500
Exmouth	WAW11	H	Mono	75
Geraldton	GTW11	H	Mono	100k
Goldsworth	WAW9	V	Mono	250
Hearson Cove	WAW65	V	Mono	4
Hopetoun	WAW68	V	Mono	4
Hyden	WAW32	H	Mono	8
Jerramungup	WAW66	H	Mono	50
Kalgoorlie	VEW8	H	Mono	8k
Kambalda	VEW3	H	Mono	10
Karratha	WAW57	H	Mono	500
Katanning	BTW10	V	Mono	400
Kojonup	BTW66	H	Mono	50
Koolan Island	WAW8	H	Mono	50
Koolyanobbing	VEW6	H	Mono	1
Koorda	WAW55	V	Mono	10
Kulin	WAW34	V	Mono	4
Kunurra	WAW7	H	Mono	100
Lagrange	WAW64	H	Mono	50
Lake Grace	WAW45	V	Mono	20
Marble Bar	WAW6	H	Mono	20
Mawson	BTW11	H	Mono	100k
Merredin	VEW6	H	Mono	15
Mingenew	GTW62	H	Mono	200
Moora	WAW57	H	Mono	20k
Morawa	GTW30	H	Mono	60k
Mt Magnet	WAW6	H	Mono	15
Mt Nameless	WAW9	H	Mono	2500
Mukinbudin	WAW34	H	Mono	10
Mullewa	GTW63	H	Mono	200
Narrogin	BTW60	H	Mono	5k
Newdegate	WAW63	H	Mono	4
Newman	WAW9	H	Mono	50
Norseman	VEW9	H	Mono	40
Northam	BTW59	H	Mono	50
Nullagine	WAW53	V	Mono	4
Pannawonica	WAW8	H	Mono	30
Paraburdoo	WAW11	H	Mono	200
Perth	TVW7	H	Dual	100k
Perth	NEW10	H	Dual	100k
Perth	STW9	H	Dual	100k
Port Hedland	WAW10	H	Mono	300
Roebourne	WAW6	H	Mono	1k
Shay Gap	WAW9	H	Mono	250
Southern Agricultural	GSW9	V	Mono	50
Southern Cross	VEW10	H	Mono	250
Tom Price	WAW7	H	Mono	50
Trayning	WAW66	V	Mono	8
Wagin	BTW6	H	Mono	60k
Westonia	WAW62	V	Mono	20
Wyndham	WAW8	H	Mono	50

Northern Territory

Alice Springs	IMP9	H	Mono	250
Bathurst Island	IMP9	H	Mono	2
Darwin	NTD8	H	Mono	20k
Groote Eylandt	GEMR9	H	Mono	200
Jabiru	JSWR10	H	Mono	100
Katherine	IMP9	H	Mono	700
Nhulunbuy	GOVR8	H	Mono	100
Tennant Creek	IMP7	H	Mono	250

Tasmania

Bicheno	TVT8	H	Dual	500
Burnie	TNT10	V	Dual	500
Crotty Camp	TVT69	H	Dual	500
Derby	TNT11	H	Dual	1.2
East Devonport	TNT51	H	Dual	800
Hobart	TVT6	H	Dual	100k
Launceston	TNT11	H	Dual	30
Lileah	TNT6	V	Dual	2k
Maydena	TVT8	H	Dual	5
Nth/Eastern Tasmania	TNT9	H	Dual	300k
Queenstown	TVT8	H	Dual	300
Rosebery	TVT10	H	Dual	300
Savage River	TNT7	H	Dual	300
Smithton	TNT11	V	Dual	100
St Helens	TNT7	H	Dual	35
St Marys	TNT11	V	Dual	160
Strathgordon	TVT8	H	Dual	20
Taroona	TVT8	H	Dual	300
Waratah	TNT11	H	Dual	1k
Wynyard	TNT5A	V	Dual	1k

Aust.Capital Territory

Canberra	CTC7	V	Mono	100k
Tuggeranong	CTC10	V	Mono	100

SBS TV

New South Wales

Cooma	SBS/58	V	Mono	100
Gosford	SBS/58	H	Mono	200
Goulburn	SBS58	V	Mono	500
Illawarra	SBS53	H	Dual	600k
Kings Cross	SBS/58	H	Mono	1k
Newcastle/ Hunter River	SBS45	H	Mono	300k
Sydney	SBS28	H	Mono	300k
Wollongong	SBS/44	H	Mono	2500

Queensland

Brisbane	SBS28	H	Mono	300k
Gold Coast	SBS/61	H	Mono	50k

Victoria

Ferntree Gully	SBS/68	H	Mono	350
Marysville	SBS/58	H	Dual	10
Melbourne	SBS28	H	Mono	300k
Selby	SBS/69	H	Mono	500
Upwey	SBS/51	V	Mono	160
Warburton	SBS/58	H	Mono	150

South Australia

Adelaide	SBS28	H	Mono	300k
Adelaide Foothills	SBS/43	H	Mono	2k

Location	Call	Pol	Sound Mode	ERP (W)

West Australia

Location	Call	Pol	Sound Mode	ERP (W)
Perth	SBS28	H	Mono	300k

Tasmania

Location	Call	Pol	Sound Mode	ERP (W)
Hobart	SBS28	H	Mono	225k

Aust Capital Territory

Location	Call	Pol	Sound Mode	ERP (W)
Canberra	SBS28	H	Mono	200k
Tuggeranong	SBS/58	H	Mono	750
Tuggeranong	SBS/54	H	Mono	400

ABC AM RADIO

New South Wales

Location	Call	Freq (kHz)	Power Watts
Armidale	2AN	720	50
Bega	2BA	810	10k
Broken Hill	2NB	999	2k
Byrock	2BY	657	10k
Cooma	2CP	1602	50
Corowa	2CO	675	10k
Cumnock	2CR	549	50k
Glen Innes	2GL	819	10k
Goulburn	2GU	1098	200
Grafton	2NR	738	50k
Kempsey	2KP	684	10k
Lithgow	2LG	1395	200
Murwillumbah	2ML	720	400
Muswellbrook	2UH	1044	1k
Newcastle	2EA	1584	150
Newcastle	2NA	1512	10k
Newcastle	2NC	1233	10k
Sydney	2BL	702	50k
Sydney	2FC	576	50k
Tamworth	2NU	648	10k
Taree	2TR	756	2k
Wilcannia	2WA	1584	100
Wollongong	2WN	1431	2k

Queensland

Location	Call	Freq (kHz)	Power Watts
Atherton	4AT	720	4k
Brisbane	4QG	792	10k
Brisbane	4QR	612	50k
Cairns	4QY	801	2k
Charleville	4CH	603	10k
Eidsvold	4QO	855	10k
Emerald	4QD	1548	50k
Gympie	4GM	1566	200
Hughenden	4HU	1485	50
Longreah	4QL	540	10k
Mackay	4QA	756	2k
Mossmann	4MS	639	1k
Mt Isa	4MI	1080	200
Pialba	4QB	855	10k
Rockhampton	4RK	837	10k
Southport	4SO	1593	200
St George	4QW	711	10k
Thursday Island	4TI	1062	2k
Toowoomba	4QS	747	10k
Townsville	4QN	630	50k
Weipa	4WP	1044	500

Victoria

Location	Call	Freq (MHz)	Power Watts
Albury/Wodonga	3AB	990	250
Horsham	3WV	594	50k
Melbourne	3AR	621	50k
Melbourne	3LO	774	50k
Omeo	3MT	720	2k
Sale	3GI	828	10k
Wangaratta	3WA	756	10k
Warrnambool	3WL	1602	250

South Australia

Location	Call	Freq (MHz)	Power Watts
Adelaide	5AN	891	50k
Adelaide	5CL	729	50k
Leigh Creek South	5LC	1602	100
Mt Gambier	5MG	1584	200
Narracoorte	5PA	1161	10k
Port Lincoln	5LN	1485	200
Port Pirie	5CK	639	10k
Renmark	5MV	1593	2k
Streaky Bay	5SY	693	2k
Woomera	5WM	1584	50

West Australia

Location	Call	Freq (MHz)	Power Watts
Albany	6AL	630	400
Bridgetown	6BR	1044	1k
Broome	6BE	675	50
Busselton	6BS	684	4k
Carnarvon	6CA	846	200
Dalwallinu	6DL	531	10k
Derby	6DB	873	2k
Esperance	6ED	837	1k
Exmouth	6XM	1188	2k
Geraldton	6GN	828	2k
Kalgoorlie	6GF	648	2k
Karratha	6KP	702	10k
Kununurra	6KW	756	100
Manjimup	6MJ	738	5k
Mt Newman	6MN	567	100
Northam	6NM	612	200
Pannawonica	6PN	567	100
Paraburdoo	6PU	567	100
Perth	6WF	720	50k
Perth	6WN	810	10k
Port Hedland	6PH	603	2k
Tom Price	6TP	567	100
Wagin	6WA	558	50k
Wyndham	6WH	1017	100

Northern Territory

Location	Call	Freq (MHz)	Power Watts
Alice Springs	8AL	783	2k
Darwin	8DR	657	2k
Jabiru	8JB	747	100
Katherine	8KN	639	2k
Nhulunbuy	8GO	990	500
Tennant Creek	8TC	684	1k

Tasmania

Location	Call	Freq (MHz)	Power Watts
Fingal	7FG	1161	1k
Hobart	7ZL	585	10k
Hobart	7ZR	936	10k
Launceston	7NT	711	10k
Queenstown	7QN	630	400
St Helens	7SH	1584	100

Aust Capital Territory

Location	Call	Freq (MHz)	Power Watts
Canberra	2CN	666	2k
Canberra	2CY	846	10k

PUBLIC AM RADIO

New South Wales

Location	Call	Freq (MHz)	Power Watts
Bourke	2WEB	585	5k

Queensland

Location	Call	Freq (MHz)	Power Watts
Brisbane	4EB	1053	500

South Australia

Location	Call	Freq (MHz)	Power Watts
Adelaide	5UV	531	500

West Australia

Location	Call	Freq (MHz)	Power Watts
Perth	6NR	927	2k

Aust Capital Territory

Location	Call	Freq (MHz)	Power Watts
Canberra	2XX	1008	300

SBS AM RADIO

New South Wales

Location	Call	Freq (MHz)	Power Watts
Sydney	2EA	1386	5k
Wollongong	2EA	1485	150

Victoria

Location	Call	Freq (MHz)	Power Watts
Melbourne	3EA	1224	5k

COMMERCIAL AM RADIO

New South Wales

Location	Call	Freq (kHz)	Power Watts
Albury	2AY	1494	2k
Armidale	2AD	1134	2k
Bathurst	2BS	1503	5k
Bega	2EC	765	3500
Bowral	2ST/T	1215	350
Broken Hill	2BH	567	500
Cobar	2DU/T	972	300
Coffs Harbour	2CS	639	5k
Cooma	2XL	918	2k
Deniliquin	2QN	1521	2k
Dubbo	2DU	1251	2k
Gosford	2GO	801	5k
Goulburn	2GN	1368	2k
Grafton	2GF	1206	5k
Griffith	2RG	963	5k
Gunnedah	2MO	1080	2k
Inverell	2NZ	1188	2k
Katoomba	2KA	783	2k
Kempsey	2MC	531	5k
Lismore	2LM	900	5k
Lithgow	2LT	900	5k
Moree	2VM	1530	2k
Moruya	2EC/T	765	500
Mudgee	2MG	1449	5k
Murwillumbah	2MW	972	5k
Muswellbrook	2NM	981	5k
Narooma	2EC/T	1584	200
Newcastle	2HD	1143	2k
Newcastle	2KO	1413	5k
Newcastle	2NX	1341	5k
Nowra	2ST	999	5k
Orange	2GZ	1089	5k
Parkes	2PK	1404	2k
Penrith	2KA/T	1476	500
Sydney	2CH	1170	5k
Sydney	2GB	873	5k
Sydney	2KY	1017	5k
Sydney	2SM	1269	5k
Sydney	2UE	954	5k
Sydney	2UW	1107	5k
Sydney	2WS	1224	5k
Tamworth	2TM	1287	2k
Taree	2RE	1557	2k
Wagga Wagga	2WG	1152	2k
Wollongong	2OO	1575	5k
Wollongong	2WL	1314	5k
Young	2LF	1350	5k

Queensland

Location	Call	Freq (kHz)	Power Watts
Atherton	4AM	558	5k
Biloela	4CC/T	927	100
Brisbane	4BC	1116	5k
Brisbane	4BH	882	5k
Brisbane	4BK	1296	5k
Brisbane	4IO	1008	5k
Brisbane	4KQ	693	5k
Bundaberg	4BU	1332	5k
Cairns	4CA	846	5k
Charleville	4VL	918	2k
Charters Towers	4GC	828	500
Cloncurry	4LM/T	1458	100
Cunnamulla	4VL/T	1584	200
Dysart	4HI/T	945	1k
Emerald	4HI	1143	5k
Gladstone	4CC	927	5k
Gold Coast	4GG	1197	5k
Gordonvale	4CA/T	954	350
Gympie	4GY	558	5k
Hughenden	4GC/T	765	500
Innisfail	4KZ	531	5k
Julia Creek	4JK	567	10k
Kingaroy	4SB	1071	2k
Longreach	4LG	1098	2k
Mackay	4MK	1026	5k
Maryborough	4MB	1161	2k
Moranbah	4HI/T	1215	250
Mt Isa	4LM	666	2k
Nambour	4SS	828	5k
Oakey	4AK	1242	2k
Rockhampton	4RO	990	5k
Roma	4ZR	1476	2k
Toowoomba	4GR	864	2k
Townsville	4RR	891	5k
Townsville	4TO	774	5k
Tully	4KZ/T	693	500
Warwick	4WK	963	5k

Victoria

Location	Call	Freq (kHz)	Power Watts
Bendigo	3BO	945	2k
Colac	3CS	1134	5k
Geelong	3GL	1341	5k
Hamilton	3HA	981	2k
Horsham	3WM	1089	5k
Maryborough	3CV	1071	5k
Melbourne	3AK	1503	5k
Melbourne	3AW	1278	5k
Melbourne	3CR	855	1k
Melbourne	3KZ	1179	5k
Melbourne	3MP	1377	5k
Melbourne	3TT	1026	5k
Melbourne	3UZ	927	5k
Melbourne	3XY	1422	5k
Mildura	3MA	1467	2k
Sale	3TR	1242	5k
Shepparton	3SR	1260	2k
Swan Hill	3SH	1332	2k
Wangaratta	3NE	1566	5k
Warragul	3UL	531	5k
Warrnambool	3YB	882	2k

South Australia

Location	Call	Freq (kHz)	Power Watts
Adelaide	5AA	1386	5k
Adelaide	5AD	1323	2k
Adelaide	5DN	972	2k
Adelaide	5KA	1197	2k
Mt Gambier	5SE	963	5k
Murray Bridge	5MU	1458	2k
Port Augusta	5AU	1242	2k
Port Lincoln	5CC	765	5k
Port Pirie	5CS	1044	2k
Renmark	5RM	801	2k

West Australia

Location	Call	Freq (kHz)	Power Watts
Albany	6VA	783	2k
Bridgetown	6BY	900	2k
Bunbury	6TZ	963	2k
Carnarvon	6LN	666	1k
Collie	6CI	1134	2k
Esperance	6SE	747	5k
Exmouth	6LN/T	747	1k
Geraldton	6GE	1008	2k
Kalgoorlie	6KG	981	2k
Karratha	6KA	1260	1k
Katanning	6WB	1071	2k
Mandurah	6MM	1116	2k
Merredin	6MD	1098	2k
Mt Tom Price	6KA/T	765	100
Narrogin	6NA	918	2k
Northam	6AM	864	2k
Paraburdoo	6KA/T	765	100
Perth	6GL	1080	2k
Perth	6KY	1206	2k
Perth	6PM	990	2k
Perth	6PR	882	2k
Port Hedland	6NW	1026	2k

Tasmania

Location	Call	Freq (kHz)	Power Watts
Burnie	7BU	558	2k
Devonport	7AD	900	2k
Hobart	7HO	864	2k
Hobart	7HT	1080	5k
Launceston	7EX	1008	5k
Launceston	7LA	1098	5k
Queenstown	7QT	837	500
Scottsdale	7SD	540	5k

Northern Territory

Location	Call	Freq (kHz)	Power Watts
Alice Springs	8HA	900	2k
Darwin	8DN	1242	2k
Katherine	8DN/T	765	500

Aust Capital Territory

Location	Call	Freq (kHz)	Power Watts
Canberra	2CA	1053	5k
Canberra	2CC	1206	5k

Location	Call	Freq (MHz)	Power Watts

ABC FM RADIO

New South Wales

Location	Call	Freq (MHz)	Power Watts
Bega/Cooma	2ABCFM	105.7	100k
Broken Hill	ABCFM	103.7	2500
Central/ Western Slopes	2ABCFM	93.5	50k
Central Tablelands	ABCFM	93.1	10k
Cobar	2ABCRR	106.1	25
Illawarra	2ABCFM	107.9	25k
Ivanhoe	2ABCRN	107.7	25
Ivanhoe	2ABCRR	106.1	25
Manning River	2ABCFM	107.9	50k
Murrumbidgee Irrigation Area	2ABCFM	107.5	50k
Newcastle/ Hunter River	2ABCFM	106.1	25k
Nyngan	2ABCRR	95.1	25
SW Slopes/ E Riverina	2ABCFM	105.7	50k
Sydney	ABCFM	92.9	50k
Sydney	2JJJ	105.7	10k
Tottenham	ABCRR	98.9	25
Wilcannia	2ABCRN	106.1	25

Queensland

Location	Call	Freq (MHz)	Power Watts
Alpha	4ABCRN	107.3	25
Alpha	4ABCRR	105.7	25
Aramac	4ABCRN	107.9	25
Barcaldine	4ABCRN	107.5	25
Bedourie	4ABCRN	107.7	25
Bedourie	4ABCRR	106.1	25
Birdsville	4ABCRN	100.9	25
Birdsville	4ABCRR	100.1	25
Blackall	4ABCRN	107.9	25
Boulia	4ABCRN	107.7	25
Boulia	4ABCRR	106.1	25
Brisbane	4ABCFM	106.1	50k
Cairns	4ABCFM	105.9	50k
Capella	4ABCRN	107.3	25
Charters Towers	4ABCRN	97.7	25
Clermont	4ABCFM	104.5	50
Clermont	4ABCRN	107.7	50
Cloncurry	4ABCRN	103.3	50
Corfield	4ABCRN	107.3	200
Croydon	4ABCRN	107.5	25
Croydon	4ABCRR	105.9	25
Darling Downs	4ABCFM	107.9	50k
Georgetown	4ABCRN	107.7	25
Georgetown	4ABCRR	106.1	25
Gold Coast	4GCR	91.7	n/a
Greenvale	4ABCRN	101.9	25
Greenvale	4ABCRR	105.9	25
Hughenden	4ABCRN	107.5	25
Injune	4ABCRN	105.1	100
Injune	4ABCRR	104.3	100
Isisford	4ABCRN	107.7	25
Jericho	4ABCRN	107.7	200
Julia Creek	4ABCRN	107.5	25
Karumba	4ABCRN	107.7	25
Karumba	4ABCRR	106.1	25
Longreach	4ABCRN	100.7	500
Mt Isa	4ABCFM	101.7	300
Muttaburra	4ABCRN	107.7	25
Normanton	4ABCRN	107.3	25
Normanton	4ABCRR	105.7	25
Pentland	4ABCRN	107.7	25
Pentland	4ABCRR	106.1	25
Quilpie	4ABCRN	100.9	50
Quilpie	4ABCRR	100.1	50
Richmond	4ABCRN	105.3	50
Rockhampton	4ABCFM	93.7	50k
Tambo	4ABCRN	107.5	25
Tambo	4ABCRR	105.9	25
Taroom	4ABCRN	107.7	25
Taroom	4ABCRR	106.1	25
Townsville	4ABCFM	101.5	65k
Wandoan	4ABCRN	107.5	25
Wandoan	4ABCRR	105.9	25
Wide Bay	4ABCFM	92.5	50k

Victoria

Location	Call	Freq (MHz)	Power Watts
Ballarat	3ABCFM	105.5	50k
Bendigo	3ABCFM	106.3	100k
Latrobe Valley	3ABCFM	107.1	100k
Melbourne	3ABCFM	105.9	50k
Mildura	3ABCFM	102.3	100k
Murray Valley	3ABCFM	105.9	50k
Upper Murray	3ABCFM	104.3	50k
Western Victoria	3ABCFM	107.5	70k

South Australia

Location	Call	Freq (MHz)	Power Watts
Adelaide	5ABCFM	92.1	10k
Andamooka	5ABCRN	107.5	25
Andamooka	5ABCRR	105.9	25
Coober Pedy	5ABCRN	107.7	25
Coober Pedy	5ABCRR	106.1	25
Leigh Creek	5ABCRR	106.1	25
Loxton	5ABCFM	105.1	95k
Marree	5ABCRN	107.3	25
Marree	5ABCRR	105.7	25
Mt Gambier	5ABCFM	104.1	150k
Woomera	5ABCRR	105.7	25

West Australia

Location	Call	Freq (MHz)	Power Watts
Argyle	6ABCRN	101.7	50
Argyle	6ABCRR	104.9	40
Broome	6ABCRN	102.9	100
Bunbury	6ABCFM	93.3	60k
Central Agricultural	6ABCFM	98.9	50k
Cue	6ABCRR	100.3	25
Dampier	6ABCRN	88.1	50
Denham	6ABCRN	102.1	50
Derby	6ABCRN	94.9	100
Exmouth	6ABCRN	88.7	25
Fitzroy Crossing	6ABCRN	107.7	50
Fitzroy Crossing	6ABCRR	106.1	50
Geraldton	6ABCFM	95.1	5k
Halls Creek	6ABCRN	103.5	100
Halls Creek	6ABCRR	101.9	100
Kalbarri	6ABCRR	101.7	25
Kalgoorlie	6ABCFM	95.5	1500
Karratha	6ABCRN	101.7	100
Koolan Island	6ABCFM	102.5	50
Koolan Island	6ABCRN	104.1	50
Koolan Island	6ABCRR	105.7	50
Kununurra	6ABCRN	92.1	50
Laverton	6ABCRR	100.3	25
Leonora	6ABCRR	102.3	50
Marble Bar	6ABCRN	97.3	25
Marble Bar	6ABCRR	98.9	50
Meekatharra	6ABCRN	98.3	25
Meekatharra	6ABCRR	99.9	25
Menzies	6ABCRN	94.9	25
Mt Magnet	6ABCRR	99.9	25
Newman	6ABCRN	96.9	50
Onslow	6ABCRN	94.9	25
Pannawonica	6ABCRN	95.1	25
Paraburdoo	6ABCRN	93.7	50
Perth	6ABCFM	97.5	50k
Port Hedland	6ABCRN	95.7	1k
Ravensthorpe	6ABCRN	100.9	25
Ravensthorpe	6ABCRR	100.1	25
Southern Agricultural	6ABCFM	94.5	50k
Tom Price	6ABCRN	98.5	50
Wyndham	6ABCRN	99.3	50
Yalgoo	6ABCRR	100.3	50

Tasmania

Location	Call	Freq (MHz)	Power Watts
Hobart	7ABCFM	93.9	27k
North/Eastern Tasmania	7ABCFM	93.3	120k
Queenstown/ Mt Owen	7QN/T	107.5	30
Queenstown/ Zeehan	7QN/T	104.7	600
Rosebery	7QN/T	106.3	300
Savage River/ Waratah	7QN/T	104.1	200
Strahan	7QN/T	107.9	200

Northern Territory

Location	Call	Freq (MHz)	Power Watts
Borroloola	8ABCRN	105.3	25
Borroloola	8ABCRR	103.7	50
Darwin	8ABCFM	105.7	10k
Galiwinki	8ABCRN	105.1	5
Galiwinki	8ABCRR	103.5	5
Groote Eylandt	8ABCRN	103.9	100
Groote Eylandt	8ABCRR	104.7	100
Nabarlek	8ABCRR	107.0	20
Nhulunbuy	8ABCRN	103.7	50
Yulara	8ABCRR	99.7	200

Aust Capital Territory

Location	Call	Freq (MHz)	Power Watts
Canberra	2ABCFM	101.9	50k

PUBLIC FM RADIO

New South Wales

Location	Call	Freq (MHz)	Power Watts
Albury	2REM	107.9	300
Armidale	2ARM	92.3	100
Bankstown	2BCR	88.7	100
Bathurst	2MCE	92.3	1k
Bellingen	2BBB	107.3	100
Bowral	2WKT	107.1	200
Burwood	2RDJ	88.1	50
Chatswood	2NSB	91.5	80
Coffs Harbour	2CHY	104.1	1k
Dorrigo	2BBB/T	90.5	400
Forster	2GLA	101.5	5k
Goulburn	2GCR	103.3	100
Lismore	2NCR	92.5	3k
Liverpool	2GLF	89.3	50
Manly	2MWM	93.7	100
Manly	2MWM/T	92.1	25
Moruya	2EAR	107.5	800
Narwee	2NBC	90.1	100
Newcastle	2NUR	103.7	3k
Orange	2MCE/T	94.7	500
Ryde	2RRR	88.5	50
Sydney	2CBA	103.2	5k
Sydney	2MBS	102.5	5k
Sydney	2RSR	88.9	40
Sydney	2SER	107.5	4k
Tamworth	2YOU	95.5	20
Taree	2BOB	104.5	1500
Tenterfield	2TEN	107.5	100
Wagga Wagga	2AAA	107.1	200
Waverley	2RES	89.7	100
Windsor	2VTR	89.7	20

Queensland

Location	Call	Freq (MHz)	Power Watts
Brisbane	4MBS	103.3	7500
Brisbane	4ZZZ	102.1	7500
Cairns	4CCR	89.1	3k
Gold Coast	4CRB	89.3	16k
Toowoomba	4DDB	102.7	2k
Townsville	4TTT	103.9	50

Victoria

Location	Call	Freq (MHz)	Power Watts
Ballarat	3BBB	97.5	200
Castlemaine	3CCC	103.9	300
Churchill	3GCR	103.5	50
Leongatha	3MFM	106.1	1k
Melbourne	3MBS	103.5	10k
Melbourne	3PBS	106.7	10k
Melbourne	3RRR	102.7	10k
Melton	3RIM	95.5	200
Mornington	3RPP	94.3	500
Murrayville	3MBR	103.5	500
Portland	3RPC	106.7	2k

South Australia

Location	Call	Freq (MHz)	Power Watts
Adelaide	5EBI	92.9	4k
Adelaide	5MMM	93.7	4k
Bordertown	5TCB	106.1	1k
Mt Gambier	5GTR	105.7	250
Salisbury	5PBA	89.7	250
Whyalla	5YYY	106.9	100
Woomera	5RRR	107.3	30

West Australia

Location	Call	Freq (MHz)	Power Watts
Fremantle	6CCR	100.1	100
Newman	6NEW	92.9	250
Perth	6SON	98.5	10k
Perth	6UVS	92.1	5k
Rockingham	6RKR	101.7	200

Tasmania

Location	Call	Freq (MHz)	Power Watts
Geeveston	7RGY	95.3	10
Hobart	7HFC	103.3	1500
Hobart	7THE	92.1	3k
Launceston	7LTN	103.7	200
Launceston	7WAY	105.3	2k

Northern Territory

Location	Call	Freq (MHz)	Power Watts
Ali-Curung	8KIN/T	103.7	400
Alice Springs	8CCC	102.1	250
Alice Springs	8KIN	100.5	400
Darwin	8TOP	104.1	10k
Hermannsburg	8KIN/T	103.7	225
Santa Teresa	8KIN/T	103.7	20

Aust Capital Territory

Location	Call	Freq (MHz)	Power Watts
Canberra	2SSS	103.9	10k

COMMERCIAL FM RADIO

New South Wales

Location	Call	Freq (MHz)	Power Watts
Jindabyne	2XL/T	96.3	1k
Perisher	2XL/T	98.7	120
Sydney	2DAY	104.1	35k
Sydney	2MMM	104.9	35k
Thredbo	2XL/T	92.1	70
Ulladulla	2ST/T	106.7	500

Queensland

Location	Call	Freq (MHz)	Power Watts
Airlie Beach	4MK/T	91.5	100
Brisbane	4MMM	104.1	6k

Victoria

Location	Call	Freq (MHz)	Power Watts
Melbourne	3EON	105.1	10k
Melbourne	3FOX	101.9	10k

South Australia

Location	Call	Freq (MHz)	Power Watts
Adelaide	5SSA	107.5	5k
Adelaide	5SSA/T	91.1	1k

West Australia

Location	Call	Freq (MHz)	Power Watts
Perth	6NOW	96.1	10k

Northern Territory

Location	Call	Freq (MHz)	Power Watts
Yulara	8HA/T	100.5	200

Tasmania

Location	Call	Freq (MHz)	Power Watts
Rosebery	7QT/T	107.1	300

Aust Capital Territory

Location	Call	Freq (MHz)	Power Watts
Canberra	2KIX	106.3	10k
Canberra	2ROC	104.7	10k

Vintage Radio

by PETER LANKSHEAR

Doctor Robinson's 'Stenode Radiostat'

By 1929, the popularity of radio was already such that in both Europe and the USA, the broadcast band had become very congested. Heterodyne whistles, 'monkey chatter' and general interference were rife. The problem was compounded by the relative lack of selectivity of the majority of domestic receivers, which were typically TRF's with only a few tuned circuits. Dr James Robinson decided to do something about it.

Late in 1929, one of Britain's highly respected radio physicists, Dr James Robinson MBE DSc MIEE FInstP produced a design for a receiver he called the 'Stenode Radiostat', which he claimed would solve the interference problem by receiving AM transmissions without involving sidebands. After a short period of considerable interest, the Stenode (meaning narrow path) was discredited and quietly disappeared, but it did contribute one important development in communications receiver design.

Born in 1884, Dr Robinson had an impressive career. He was appointed lecturer in physics at Durham University 1906-7, Sheffield University, 1910-12 and at East London University, 1912-15.

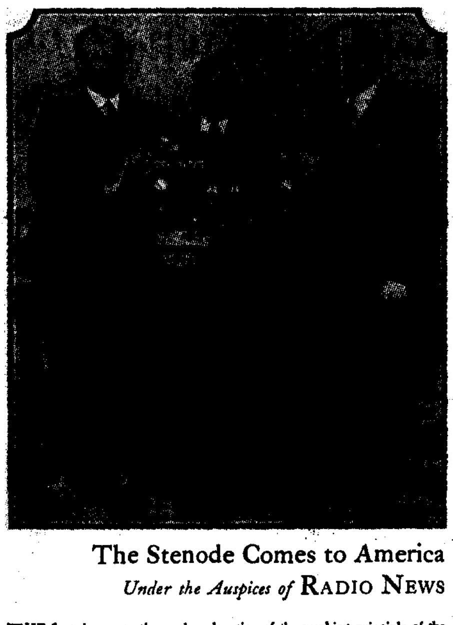
In 1920 he became chief experimental officer at the Instrument Design Establishment, Biggin Hill and then, in 1922 Chief of the Department for Wireless at the Royal Aircraft establishment, Farnborough. He received wide recognition for his invention of the Robinson Direction Finding system, whereby it was possible, by the use of an auxiliary loop, to read a signal when nulling during direction locating. In conventional DF systems the signal disappeared when the null point indicated the exact bearing, an operational inconvenience.

The Stenode

Following an article in the December 1929 edition of Britain's *Wireless World*, a leading American magazine *Radio News* became of aware of Robinson's new receiver theories. If the claims were true, the implications of potential spectrum savings were of enormous significance. *Radio News* therefore commissioned one of Britian's foremost radio writers, W.T. Cocking to investigate the Stenode, and his report was featured in the October 1930 edition.

In his typically lucid style, Cocking covered some basic modulation theory. He explained that with amplitude modulation, a carrier of 1MHz modulated with a note of 1kHz is said to consist of a carrier of constant amplitude with two sideband frequencies, each of constant amplitude, and having frequencies of 1001kHz and 999kHz. Normal receiver design assumes that the presence of these sidebands is needed for proper operation.

There is another way of visualising a modulated carrier, and this is used when visualising the operation of an AM detector. A modulated carrier may be considered as having a constant frequency, the amplitude of which is varying at the modulation frequency.



The Stenode Comes to America

Under the Auspices of RADIO NEWS

THE first demonstration and explanation of the working principle of the Stenode Radiostat, the invention of Dr. James Robinson of England, was given at Washington recently before a distinguished body of the country's leading radio engineers, including those of the Federal Radio Commission, the Army, Navy and private individuals. Above are shown, from left to right: Dr. James Robinson, inventor of the Stenode Radiostat; Arthur H. Lynch, Editor of RADIO NEWS, and Percy Harris, Chief Engineer of the British Radiostat Corporation.

Fig.1: This full page feature photograph appeared in the January 1931 issue of 'Radio News' at the height of the Stenode campaign.

It is obvious that the higher the modulation frequency, the more rapidly is the carrier amplitude varying. Consequently, in order to prevent reduction of high modulation frequencies, it is necessary to design the receiver tuned circuits to allow the current through them to change at least as rapidly as the carrier amplitude is changing. If the circuits do not allow this rapidity of change, the strength of the higher modulation frequencies will be reduced.

The outcome of this is that tuning circuits constants are the same regardless of whichever approach to modulation theory is used. In fact, it can be shown that the two theories are merely alternative ways of looking at the same problem.

With conventional receivers, the bandwidth necessary to respond to AM signals means that transmissions must be separated by 9 or 10 kilohertz to keep mutual interference acceptably low.

Sidebands unnecessary!

Cocking's report described how, at Dr Robinson's British Radiostat Laboratory, he was shown a revolutionary receiver having extremely sharp tuning selectivity. The basic receiver was a state of the art superheterodyne, but with the addition of a quartz crystal filter in the output of the IF amplifier, giving a claimed bandwidth of only 50Hz.

Such extreme selectivity was acknowledged to be unusable with normal AM transmissions as it would, as we have seen, effectively remove all modulation above a few hertz. But this was reported to be compensated for by an audio filter

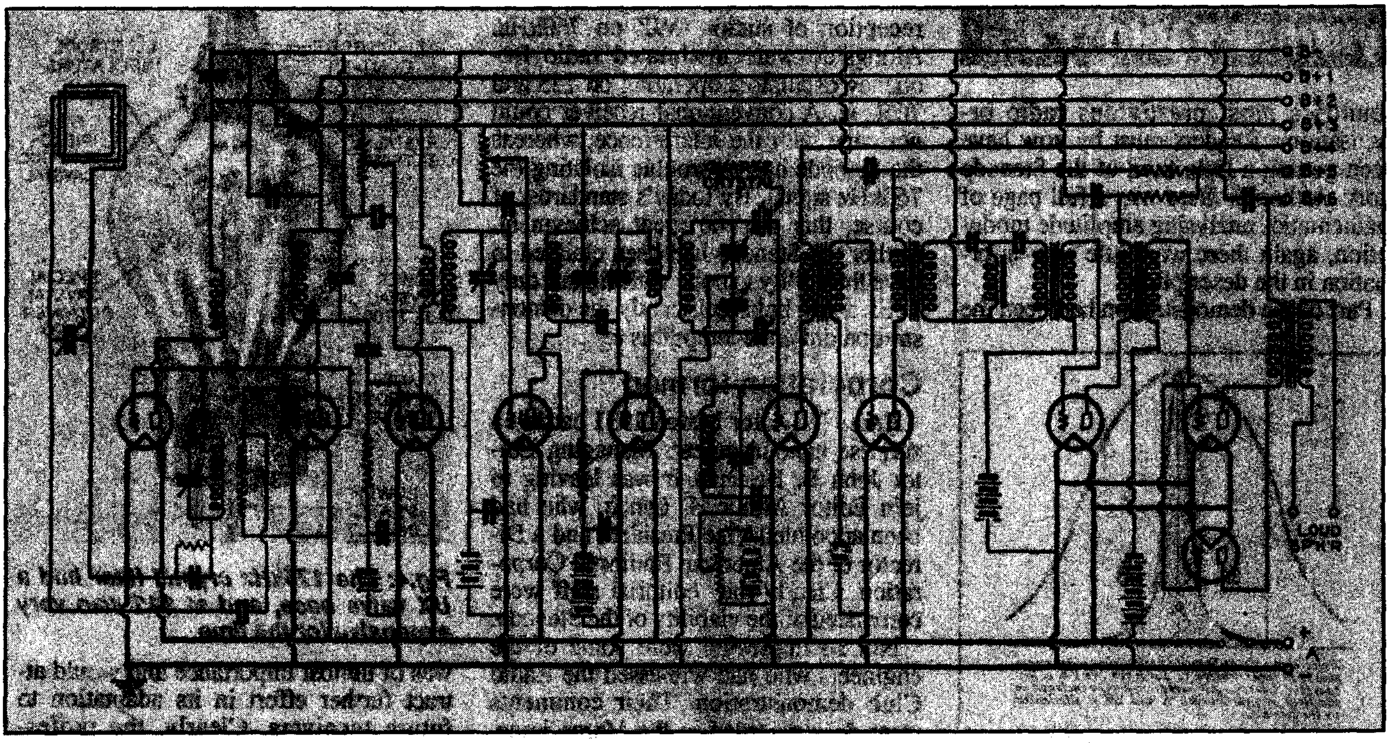


Fig.2: Although clearly simplified, this diagram shows that the prototype Stenode was based on a typical late-1920's superhet. The triode at far left is the local oscillator, whose output is fed to the adjacent tetrode mixer along with the signal from the loop aerial. Then follow three IF stages, with the innovative crystal filter just before the detector.

with a sharply rising audio response. By having an inverse of the IF response, this filter should restore normal fidelity.

Dr Robinson maintained that his 'super selective' receiver would respond only to carrier amplitude variations and that interference from adjacent transmissions would be eliminated. In fact, he claimed that the Stenode system would permit carrier spacings as close as 1kHz. The benefits in a crowded spectrum were obvious.

The Cocking article concluded by reporting that demonstrations had confirmed the prototype receiver was extremely selective, to the extent that tuning was critical, but that more development was required.

Million dollar idea

The editorial staff of *Radio News* were clearly impressed. Although the November 1930 issue had a major event in the release announcement of the landmark RCA model 80 superheterodyne, the editorial, entitled 'A Million Dollar Idea' gave enthusiastic support to the Stenode. Events had moved quickly, and a team from the British Radiostat Company was preparing to travel to America to demonstrate the Stenode.

The leading article was also about the Stenode. This time A. Dinsdale, the editor of the magazine *Science and Invention*, described at considerable length the Stenode theory, but introduced little that had not been covered previously by Cocking. Boundless possibilities for the future development of television were foreseen, but significantly, his assessment did not coincide exactly with the editorial opinion. His concluding paragraph was significant:

There is no hope of the Stenode coming on to the market for broadcasting purposes in the immediate future, however. Radio broadcasting is only one of the many users to which the ether is put; the entire field of radio communication is very much broader, and to begin with, Dr Robinson is concentrating on the adaptation of his receiver for commercial point-to-point services in order to speed up communication. The British Radiostat Corporation does not intend to manufacture or sell apparatus itself, but will license others to do so. Meanwhile, research work is being continued with a view to simplifying the receiver.

Engineering reaction

Radio News for December 1930 confined its Stenode material to comment from several leading American authorities. McMurdo Silver was cautious. In his opinion, Cocking's article did nothing to discredit current sideband theory, and he ascribed the acceptable fidelity of the Stenode to listener tolerance, pointing out that good adjacent channel selectivity could be achieved by conventional circuit design at much lower cost.

Howard Rhodes of Electron Research Laboratories was rightly sceptical of the ability of the audio filter to restore audio fidelity with 60dB of sideband attenuation, while Hammarlund's chief designer D.K. Oram made the valid criticisms that the Stenode was vulnerable to cross modulation and that it was impracticable to revise the frequency allocations of the broadcast frequency band, because they had still to cater for the millions of conventional receivers already in use. National's James Millen looked forward to a demonstration, while L.M. Hull of Radio Frequency Laboratories was critical of the lack of any quantitative data, essential for any real evaluation.

In the January 1931 *Radio News* editorial, Arthur H. Lynch was ecstatic. 'Venit, Vidit, Vicit' were the exultant headlines. Dr Robinson had arrived in America. Demonstrations to industry and government leaders and scientists in Washington and Chicago were reported to be a triumph. Lynch went so far as to state that the Stenode was the most important single communications invention since Morse invented the telegraph!

A feature article provided yet another description of the Stenode receiver, this time by Dr Robinson himself but again with little new information.

The February issue carried the text and a report of Dr Robinson's lecture and demonstration at Columbia University to the Radio Club of America, one of the country's most prestigious radio organisations. Readers must by now have been getting a little tired of the Stenode story. Although there was a full page of mathematics analysing amplitude modulation, again there was little new information in the description.

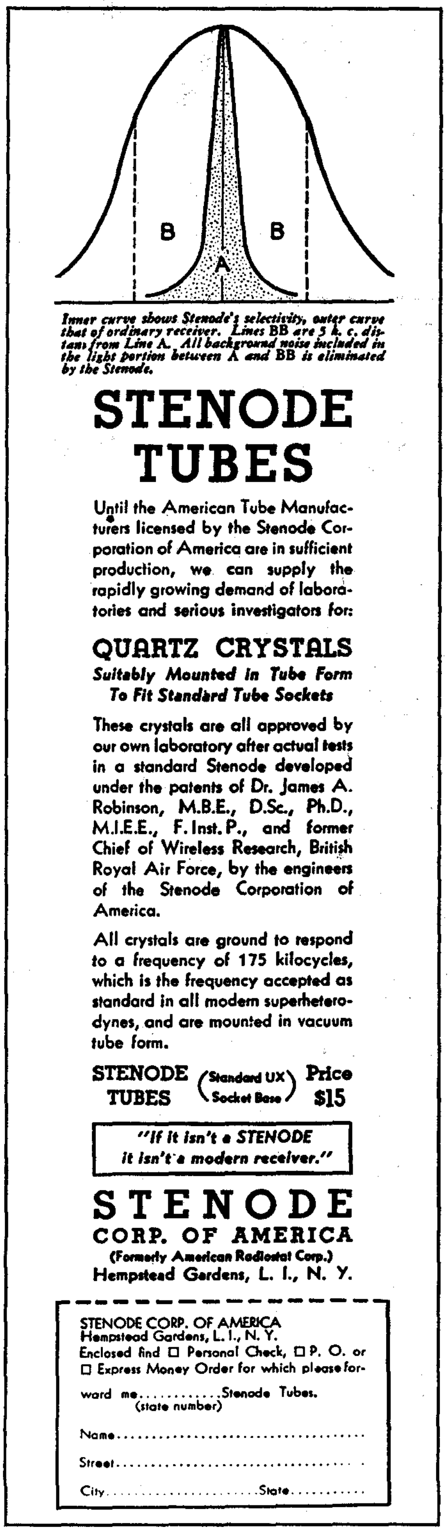
Part of the demonstration had been the reception of station WJZ on 760kHz. Alongside were modulated radio frequency oscillators operating on 755 and 765kHz. A conventional receiver could not cope with the interference, whereas the Stenode had no trouble isolating the 760kHz signal. By today's standards, of course, this was no great achievment. Earlier the Stenode had been claimed to have the ability to cope with signals only 1kHz apart, but significantly the demonstration did not attempt this test.

Corporation formed

Radio News for March 1931 carried a surprise announcement. Managing Editor John B. Brennan Jr was leaving to join Editor Arthur H. Lynch, who had been appointed Vice President and a Director of the American Radiostat Corporation. Clearly the editorial staff were convinced of the viability of the Stenode.

Not so impressed were some of the engineers who had witnessed the Radio Club demonstration. Their comments were duly recorded in the March issue. J.G. Aceves pointed out with suitable mathematical analysis that a simple electrical network could not compensate for the extreme high note attenuation of a crystal filter. He went on to say that he was a trained organist and his ears told him that the reproduction of the Stenode receiver was severely attenuated below 200Hz and above 2kHz.

An interesting and lengthy contribution came from the chairman of the Radio Club debate. L.C.F. Horle regretted his inability to comment at the time of the demonstration, but he confessed that he had difficulty in following Dr Robinson's explanation and that the demonstration did not convince him of the validity of the claims. Prophetically, he considered that the crystal IF filter was of utmost importance and would attract further effort in its adaptation to future receivers. Clearly, the professional engineers were not as wholeheartedly convinced as had been the *Radio News* editorial staff.



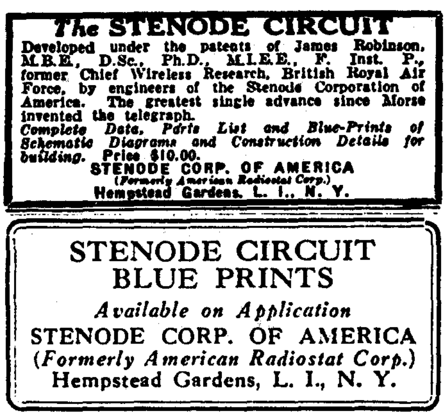


Fig.3 (left): One of Arthur Lynch's initial advertisements in the July 1931 issue of 'Radio News'. Fig.5 above shows samples of the much smaller ads that ran from August to October.

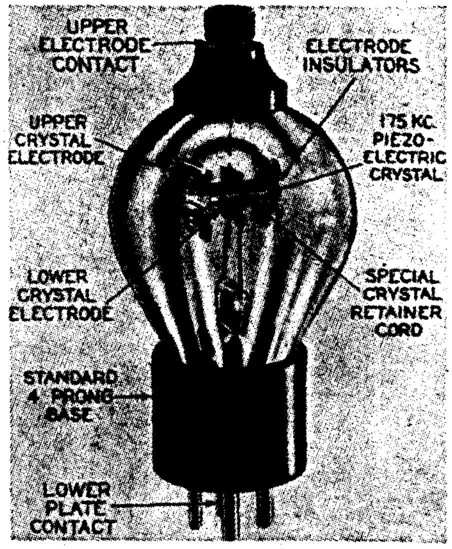


Fig.4: The 175kHz crystal filter had a UX valve base, and at $15 was very expensive for the time.

Amateur version

For the seventh successive month, *Radio News* for April 1931 featured the Stenode. In a short and final article by a member of British Radiostat, Humfrey Andrewes considered the use of the Stenode on the amateur and shortwave bands. He described how in one case reception was possible sandwiched between transmissions only 3kHz apart. Significantly there was no longer any claim to complete elimination of interference - only a considerable reduction. His emphasis was on the value of the crystal filter.

Radio News did not again feature the Stenode. The advertisement in Fig.3 appeared in July's edition. Perhaps Mr Lynch did not control American rights to a million dollar industry after all.

For the next three months, the final *Radio News* advertisements were the modest little notices in Fig.5. Gernsback's *Official Radio Sevice Manual*, published at the end of 1931, has the circuit of the American version and a full page Stenode advertisement offering nine blueprints, data and direction books for only $5. Previous purchasers who had paid $10 were offered a refund! It was pointed out that profits relied solely on royalties paid by licensees. One doubts if in fact there were any, and the Stenode Corporation seems to have disappeared after this.

Recalling his comments made in the

previous December. It is worth noting that, in September 1931, McMurdo Silver produced a design for a very selective superheterodyne receiver, the model 716-683, incorporating two sharply tuned IF stages, but without a crystal filter.

Significantly, this receiver incorporated a tuned audio filter and peaked loudspeaker response to restore tonal balance.

The last references that I can find to the Stenode appeared three years later, in the British *Wireless Magazine*, featuring constructional articles for a pair of receivers called the 'Wireless Magazine Stenode Sets', using selective IF transformers and peaked audio amplifiers, much as McMurdo Silver had done.

Not a total loss

Dr Robinson's efforts were not all wasted. It will be recalled that L.C.F. Horle of the Radio Club had suggested the incorporation of the crystal filter into selective IF systems.

The following year, James Lamb, technical editor of *QST*, pioneered the use of the crystal filter in communications receivers. Practically unchanged from Dr Robinson's design, it has remained a feature of communications receivers ever since. ■

Meyer's HD1 Monitor

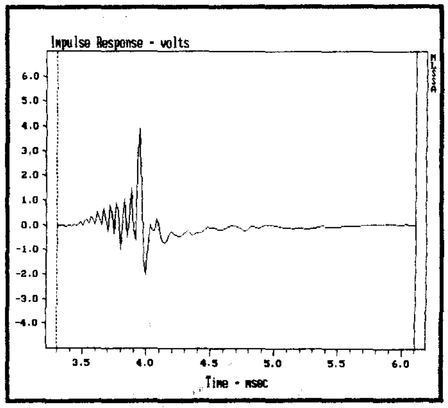
(Continued from page 24)

music, and few are able to cope with the lowest notes in the dynamic register of a large pipe organ like that in the Sydney Town Hall. I was pleasantly surprised by the quality and volume of sound which the HDI's produced and noted that my current monitor speakers could not better them in this regard. I did note however, that with the sustained continuous sinusoidal inputs, the cheeky little red light on the front panel tended to illuminate more frequently with the organ music than with the other music I played.

The last set of discs that I played were the first discs which I purchased from the 'Philips Complete Mozart Edition' (Volume 3, Serenades for Orchestra, Phillips 422 503-2). The music on these particular discs is played by the Academy of St Martin in the Fields, conducted by Sir Neville Marriner. Although I'm a lover of Mozart's music, much of the music is new to me.

The Meyer HD1's, reproduced this music with a delightful delicacy, even at listening levels in excess of 100dB(A). I will have more to say about Mozart's music in future reviews, but suffice it to say that the HD1's provided a superior level of classical reproduction than I would have expected, based solely on my objective laboratory assessments.

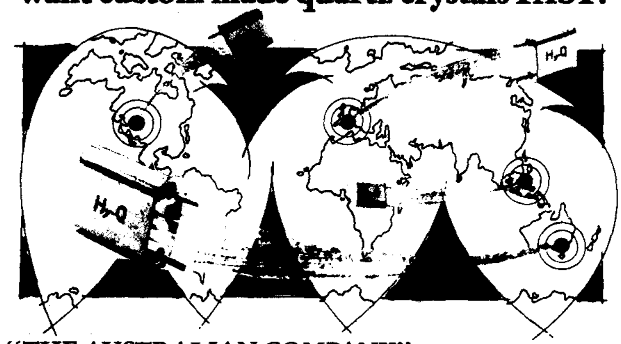
The Meyer HD1's are not everyone's cup of tea. Although visually suited for a



Results of the impulse response test.

sound monitoring suite, or a control room, I believe that they would tend to look out of place in most residential situations. The only exceptions to this would be in a book case, or if they were mounted on a wall with other hardware with which they were visually compatible. In a recording studio, I have no doubt that they would ably perform their task, and potentially would even look better, if the nagging questions in my mind relating to monitoring equalisation distance can be resolved.

The HD1's measure 415 x 305 x 423mm, and each weigh 23.5kg. Recommended price is $5898 per pair, plus tax if applicable. Further information is available from Audio & Recording, 36 Daphne St, Botany 2019; phone (02) 666 9935. ■



NEW BOOKS

Shortwave listening

ARTHUR CUSHEN'S RADIO LISTENERS GUIDE, by Arthur T. Cushen, MBE. Second edition, published by Arthur Cushen Publications, 1990. Soft covers, 298 x 208mm, 116 pages. ISBN 0 473 00948 X. Price in Australia $22 plus $6 for airmail delivery, if applicable.

This is the second edition of Arthur Cushen's *Radio Listeners Guide*. The first was published in 1988, and sold out in a short time. His first book, *The World in My Ears* was published in 1979 and has been sold in over 70 countries.

Arthur is of course a very well-known writer and broadcaster on shortwave listening, as well as serving as a technical monitor in the Pacific for various international broadcasters such as the BBC and CBC. He has presented a monthly report on Radio Nederland since 1966, and has broadcast on many programmes in New Zealand. He began writing a regular column in this magazine back in 1953, transferring to *ETI* in the early 1980's but then returning to *EA* last year. He is National President of the NZ Radio DX League and Secretary-General of the South Pacific Association of Radio Clubs. An impressive set of achievements, for a man who has been classified as blind for many years.

My understanding is that *Radio Listeners Guide* grew from a series of articles entitled 'Starting DX', which Arthur wrote for *ETI* during 1984-85. Response to the articles was so good that he was encouraged to build upon them, expanding on the theme of an introduction to practical shortwave/mediumwave radio listening.

There are seven main sections, headed Shortwave; Mediumwave; Equipment; The Radio Listening Hobby; Programme Listening; The DX Club; and Conferences and Conventions. Each section consists of from two to six parts, and provides a great deal of material not only in the text, but in accompanying data tables and illustrations. There's even an active antenna design contributed by our vintage radio columnist, Peter Lankshear.

In this second edition, some of the material has been rewritten and expanded, with additional pictures. An entirely new 8-page section has also been added in the centre, headed 'Secrets of Wartime Listening'. This gives a comprehensive and very interesting discussion of Arthur's activities monitoring enemy propaganda broadcasts during the Second World War, condensed from his reports to the NZ Security Intelligence Bureau and up until very recently classified. It includes details of crucial battles and broadcasts, transmitter information and the effects of censorship.

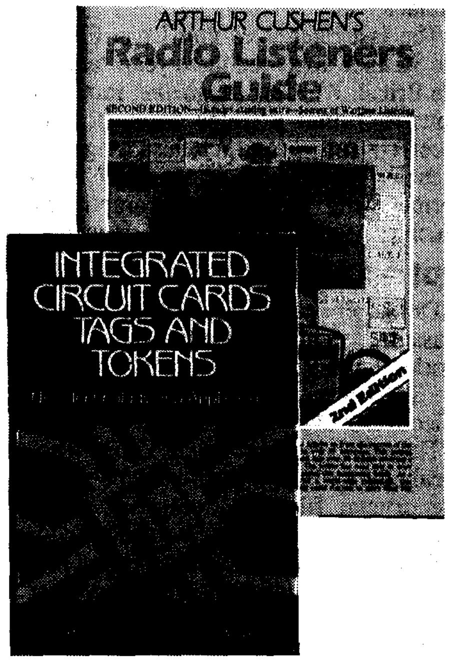
In short, the second edition provides even more information than the first, and should be even more valuable to those starting out in the DX listening hobby. A down-to-earth guide that deserves a place on every shortwave listener's reference bookshelf.

The review copy came direct from Arthur himself, and he can supply copies by mail order from 212 Earn Street, Enwood, Invercargill NZ. However in Australia copies are also available from Technical Book & Magazine Company, of 289-299 Swanston Street, Melbourne 3000. In both cases the price is $22 plus $6 for packing and airmail postage. (J.R.)

'Smart' cards

INTEGRATED CIRCUIT CARDS, TAGS AND TOKENS — New Technology and Applications, edited by Peter Hawkes, Donald Davies and Wyn Price. Published by BSP Professional Books, 1990. Hard covers, 241 x 163mm, 182 pages. ISBN 0-632-01935-2. Recommended retail price $112.

So-called 'smart cards', with either memory chips or full microcomputer chips imbedded within them are now coming into use for vending and payment systems, stock control and security, control of area access by personnel and for identification purposes such as driving licences and passports. This book is essentially an in-depth look at various aspects of this new technology: the hardware and software, typical applications, economic and consumer issues and associated areas such as electronic coins, tags and tokens. The material in the book is



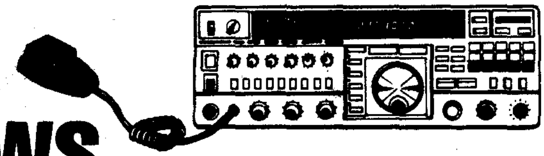
based on a major R&D study of the technology by the UK National Physical Laboratory; all three editors are very experienced in this area.

There are nine chapters in all, the first of which is a general introduction to the technology as a whole. Then follows a review of the development of smart cards in the USA, by a US expert. Following chapters are headed A Contactless Smart Card and its Applications; Low Frequency Radio Tags and their Applications; Electronic Coins; Secure Transactions with an Intelligent Token; Automated Personal Identification Methods for use with Smart Cards; Cryptography and the Smart Card; and finally, Smart Cards — the User's View.

The approach taken is essentially a serious technical one, for the engineer or technician wishing to update their knowledge rather than for the non-technical casual reader. Within this context, the material is presented in clear and concise fashion, and provides a thorough introduction to this emerging new technology.

The review copy came from Blackwell Scientific Publications (Australia), of 54 University Street, Carlton South 3053. However copies should be available from all major book stores. (J.R.) ■

Amateur Radio News



New rules for Ross Hull Contest

John Martin VK3ZJC, chairman of the WIA's Federal Technical Advisory Committee (FTAC) and also manager of the Ross Hull Contest, advises that the rules have been revised for this year's contest, which runs from 0000 UTC on Saturday December 22, 1990 to 2359 UTC on Saturday January 19, 1991. It's hoped that the new rules will help stir up a bit more activity than last year.

John describes the most important change as being the adoption of scoring based on distance and frequency, rather than by totalling locator squares (although the exchange of locators is still being encouraged, to help in distance calculation). Another change has been to introduce separate sections for terrestrial and satellite contacts, allowing both groups to compete in their own areas without being disadvantaged. Anyone can enter for both sections, if they wish.

All bands above 50MHz will be available, with band multipliers to reflect the greater difficulty in making contacts on higher bands. But the multipliers are moderate, and will ensure that the contest cannot be won by a small number of contacts on the more exotic bands. Awards will also be made to the highest scorers on each band. Scores will be based on each entrant's best seven days — not necessarily consecutive.

Note that any licensed amateur can enter this contest — it's not confined to WIA members. Logs should be posted to WIA Ross Hull Contest Manager, PO Box 300, Caulfield South 3162, and must be received by Monday Feb. 18.

Gosford Field Day

This year's Gosford Field Day, run by the NSW Central Coast Amateur Radio Club, will be held on Sunday 17th February at the usual venue: the Gosford Showground. This will be the 34th staging of this annual event, and is expected to attract well over the 1000 people who attended last year.

Technical seminars have been a popular attraction in recent years, and an expanded programme of these has been arranged for this year's event. This is in addition to the traditional features of the field day: displays of the latest amateur gear by equipment distributors and retailers, plus sales of disposals, second-hand and surplus equipment — including a 'flea market'. Other attractions include a display of historical equipment, packet radio and amateur TV displays, and a QSL bureau.

The gates will open at 8am regardless of the weather conditions, as all displays will be under cover. There is plenty of off- street parking available, while a courtesy bus will operate between Gosford railway station and the showground. Food will be available in the Dining room, and also from take-away food bars. Registration for the field day costs $6 for adults and $3 for pensioners. Children are admitted free.

Further information is available from the Field Day Committee, Central Coast Amateur Radio Club Inc., PO Box 252, Gosford 2250 or by ringing (after hours) on (043) 92 2244.

New radio club in Warwick, Qld

The name 'Cunningham Radio Club' has been chosen for a new club formed in Warwick, Queensland, which is intended to serve the region from the range to West of Goondiwindi, and from Toowoomba South to beyond the NSW border. Aims of the new club are to foster community support for amateur radio, encourage people to study towards their licence, and to co-ordinate communications support in times of disaster.

The founding committee consists of Trevor Knight VK4NLX, chairman; John Moulder VK4YX, secretary; Bill Washbourne VK4VJO, treasurer; Bob Harper VK4KNH, publicity officer; Grahame Muirhead VK4WEM, station manager; and WICEN officer John Newley.

The Club's first project is to set up a 2-m repeater, to fill up a gap in the area, and a submission is already being prepared for the WIA and DoTC. Many of the equipment needed has already been acquired. The Club also hopes to conduct NAOCP/AOCP classes at the Southern Downs College of TAFE, commencing in February.

Membership enquiries may be directed to Trevor VK4NLX or John VK4YZ at Audivision, Palmerin Street, Warwick, or phone (076) 61 3131. ■

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GENERAL FEATURES

REVIEWS

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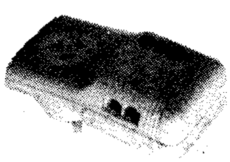
COMPUTER BITS & PIECES

Switchable RS-232 Lead

Easy and quick to change configurations with DIP switches built into both 25-pin "D" plugs. Allows various combinations of TXD and RXD as well as handshaking between pins 2,3,4,5,6,8 & 20 at computer end and pins 2,3,4,5,6,8,11,14,19 & 20 at terminal end.
Five connecting wires including ground, two wires connected straight through, three wires switchable. Gold plated contacts.
Length 2m $39.95



FAX/Modem/ Phone Protector

Protects both telephone line and power sockets from lightning strikes and power surges. Also checks for proper earthing etc. US Modular type plugs and sockets for phone connection plus 3pin power. Incorporates MOV's and Gas Arrestor for maximum protection. Fully approved. $54.95

9 pin to 25 pin Adaptors

9pin male to 25pin female rigid $10.50
9pin female to 25pin male rigid $10.50
9pin female to 25pin male 2m long cable $19.95

Disk Cleaners

3 1/2" or 5 1/4" $6.95

AMIGA Extension Cables

D23 Male/Female, Male/Male, Female/Female. All 2m long $29.95

Data Switch Boxes

Six models to choose from

"D" Type
9 pin 2 way $45.00
25pin 2way $45.00
25pin 3way $65.00
25pin 2way automatic $99.00

Centronics
36pin 2way $45.00
36pin 3way $65.00

Cables

Printer Leads
IBM Parallel type
1.8m $14.95
4.0m $29.95
10m $75.00

Serial type
25 pin "D" type. Male to Female
2m $24.95
5m $45.00
10m $75.00

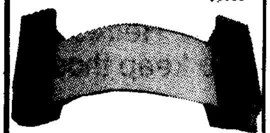
Extension Leads
D25. Male/Female, Male/Male, Female/Female. All 2m long $24.95

Monitor Leads
D9. Male/Female, Male/Male, Female/Female. All 2m long $24.95
5m long $29.95

Keyboard Extensions
1.5m curly cord $9.95

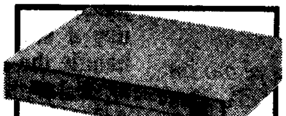
Serial to D9 Converter
D 9Female to D25 Male
2m long $19.95

IEC Power Cord
1.8m $6.95



Flat Ribbon Cables
D25 Male & Female to D25 Male/Female. Yes both sexes each end!
2m long $34.00
Also D25 male to male, female to female or male to female.
All 2m $19.95

SCSI Cables
Centronics 50 way. Male to male, female to female or male to female.
All 1.5m $34.00



Uninterruptible Power Supply

We are stocking the UPS501 which will provide up to 7 minutes battery supply for a 500W load. This gives you ample time to power down your system in the event of a mains failure. Instant switch-over. Battery charger is fully regulated. Extensive alarms and indicators. $820.00
Allow $20 P&P ($680.00 ex tax)

Ethernet Cables Made To Order

51Ω terminator $7.50
"T" pieces
3 females $8.95
2 females, 1 male $7.95

Null Modems

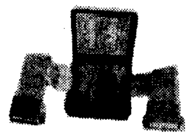
D25 Type Male to Female $12.95
D25 Cable type 2m long $19.95

In-Line Switch Box
Handy for reconfiguring cables.
25pin "D" plug and socket. $14.95

Mini Tester
7 dual colour LEDs monitor TD, RD, RTS, CTS, CD, DSR & DTR.
25pin "D" plug and socket. $24.95

In Line D25 Patch Box
Quick and simple to wire internal pcb pads connected to pins on connectors.
Solder leads provided to make up any configuration. $16.95

In Line D25 Wiring Box
Similar to above but with spring terminals.
Tinned leads supplied $25.95



Breakout Boxes

We have a wide range at prices to suit any budget, including professional ComTest models.
CAS18 Self powered with 25pin "D" connectors. 10 tri-colour LEDs indicate standard activities. 2 spare LEDs for miscellaneous lines. 24 DIP switches for configuration. Patch into any of the 24 active lines $99.95

ComTest - The Ultimate!
If you're a professional user get the data sheets from us. There's a model that's right for you.
COMTEST V25 $315.00
COMTEST 212 $285.00
COMTEST 225 $425.00

Gender Changers

"D" Type
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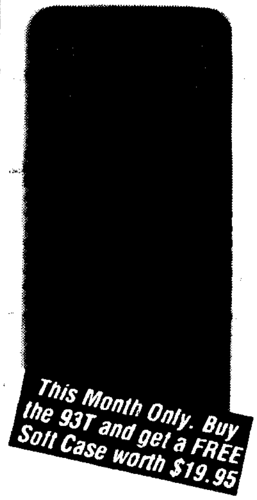

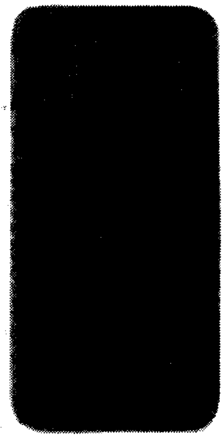

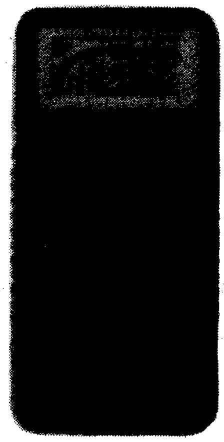

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- 1999 count
- Large 20mm high contrast LCD readout
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- 0.5% dc accuracy

Ranges
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Vac 200mV, 2V, 20V, 200V, 750V
Adc 200μA, 2mA, 20mA, 200mA, 2A, 20A
Aac 200μA, 2mA, 20mA, 200mA, 2A, 20A
Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
Frequency 2kHz, 20kHz, 200kHz
Capacitance 2nF, 20nF, 200nF, 2μF, 20μF
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- 3 1/2 digit plus 41 segment analog bar graph
- Autoranging or manual selection
- 6 functions - Vdc, Vac, Adc, Aac, Ohms, Diode
- Water resistant
- Data hold
- Memory offset

Ranges
Vdc 200mV, 2V, 20V, 200V, 1000V
Vac 200mV, 2V, 20V, 200V, 750V
Adc 200μA, 2mA, 20mA, 200mA, 2A, 20A
Aac 200μA, 2mA, 20mA, 200mA, 2A, 20A
Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
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Model 98
- 3 1/2 digit plus 41 segment analog bar graph
- Autoranging or manual selection
- 8 Functions - Vdc, Vac, Adc, Aac, Ohms, Diode, Frequency, Capacitance
- Data hold
- Memory offset

Ranges
Vdc 200mV, 2V, 20V, 200V, 1000V
Vac 200mV, 2V, 20V, 200V, 750V
Adc 200μA, 2mA, 20mA, 200mA, 2A, 20A
Aac 200μA, 2mA, 20mA, 200mA, 2A, 20A
Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
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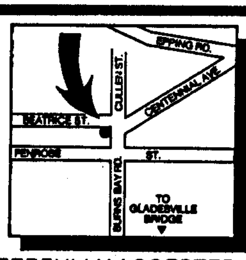

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Information centre

Conducted by Peter Phillips

Clearing up some details

With the start of a new year, it's time to pay attention to a few details. There's a range of letters that seek advice or dispense it — plus a few that take me to task. Refreshed from the annual hols, I wish readers a Happy New Year and as always, ask that you keep those letters coming in.

Letters from readers are one of the attractions of writing this column, as they not only cover a wide range of topics, but often provide humour. For example, I've got a letter that starts *'Regarding September What??: The solution is a simple exercise in maths, don't even need to set up equations.'* What follows is a sequence of attempts, in which the calculator gets blamed for having keys that are too small, complaints about a lost slide rule, a need to wait for the 'tomato juice' to settle and so on. A negative voltage occurred at one attempt, suggesting that the 'anti-electron' is a reality! A lot of fun and great to receive. Thanks, T.B.!

Other letters include concerns on spelling mistakes. It seems flak became flac in the October column, and Wimshurst gained an L, giving Wilmshurst. However as the same reader points out, complement was spelled as compliment in an article about SBS Television on page 28 of the October edition, so I'm not the only one who occasionally can't spell.

For my part, I always run a computer spell checker through my writings, but compliment would pass this test, and Wimshurst is not a word in many computer dictionaries. The annoying thing here however is that I actually looked high and low for the correct spelling, and after finding it, thought I had Wimshurst spelled correctly.

Typos are a part of journalistic life unfortunately. So, try this one: Is it Kirchoff, Kirchhoff or Kirchhof? Answer next month!

Of course most letters are on technical matters, although I welcome those that comment on spelling and so forth as I like to keep mistakes to a minimum and having them pointed out is all part of the process. However, do be understanding dear readers, mistakes will always occur regardless of much proof reading we put our material through.

On the topic of mistakes, here's the first letter about capacitors and their use, edited somewhat to reduce its length...

AC rating for caps

I am writing concerning the photo on page 37 in the August edition of EA. This photo includes two capacitors captioned as being rated for 250V AC. The one on the left is clearly marked with a Y sign in a circle, perhaps suggesting its suitability for use in a three phase system.

However the other alleged AC rated capacitor is simply marked 250V with a symbol (like an equals sign, but with the bottom line shown dotted) that I think refers to DC operation only. I have since ccntacted a manufacturer of these types of capacitors (RIFA in Victoria) who agree with my suggestion. I have not seen this symbol before and I write seeking clarification. Perhaps the capacitor has been incorrectly captioned, or this symbol is really for AC. (B.H., Heathmont Vic).

As the writer of the article containing the photo, this one is clearly my responsibility. I even took the photo, so any mistakes are absolutely mine. In short, the capacitor referred to by B.H. is definitely for DC operation only, and why I confused it for AC operation is something I'm at a loss to explain.

Thinking back, I probably took the 250V rating as meaning 250V AC and ignored the symbol referred to, which I know is for DC. This symbol is quite commonly used, and most DVMs with an 'intelligent' display show this symbol when the meter is set to measure a DC quantity.

In fact I want to set the records straight on this, as using a DC rated capacitor as a mains suppression capacitor is rather dangerous — the stresses imposed on the dielectric are quite different for AC compared to DC. Most AC rated capacitors use a self-healing dielectric and can handle the transients and spikes that are typical with the mains. As well, the 250V AC rating is for an RMS value and the peak value of the mains is around 350V. However using a DC rating of 350V or more is not considered good practice, as the dielectric may not be self-healing.

So thanks B.H., for your letter and observations. I'm glad to have this pointed out and to write an errata to correct this quite obvious mistake. And now to your second letter B.H., which discusses mains suppressors:

MOV data

I recently had occasion to put together a mains filter unit and looked over past EA magazines for a design. The ones that caught my eye were those described in the October 1989 edition.

Trying to procure a module led me to suppliers offering 150 joule rated units, using MOV devices similar to those described in the October article but at prices ranging from $38 to $189. One supplier offered a unit with a V275LA40A MOV rated at 140 joules, which conflicts with your 40J rating for this device. As well, their V275LA20A device is rated at 75 joules, compared to your specification of 20 joules.

Another detail I question is the location of the fuse. I suggest there should be two fuses, one before the first MOV (as shown) and another after the filter *module but before the second MOV. This would protect the second MOV, which seems to be a relatively expensive and difficult to obtain device. This fuse would be particularly useful where the filter module being used is part of an integral construction with a three-pin 'international type' input socket, such as those made by Arista, Belling Lee and other manufacturers. (B.H., Heathmont Vic).*

On the point of 'difficult to obtain' B.H., I have to disagree with you this time. A look through both Jaycar and Dick Smith Electronics catalogs shows that MOVs are neither hard to get nor especially expensive, costing around $3.75 each. And unless they have sold out, Jaycar are still advertising for $9.95 the same module I used in one of the designs. I haven't checked with Oatley Electronics, but I wouldn't mind betting they still have a few mains filters left as well.

But regarding the joule rating of the MOVs specified, I cannot argue. Dick Smith don't give an energy rating for their device, and Jaycar specify their MOV (which is not given a type number) as being rated at 104 joules. I think this may be a misprint anyway, and perhaps should read 140 joules.

The rating I used in the article was suggested by Oatley Electronics, and as I don't have any MOV data, I didn't argue. But to clear it up, B.H., has kindly supplied some data on these devices, which is summarised below.

There are typically four devices available for this application, all commencing with the type number V275LA, followed with a two digit number. They all have a voltage rating of 275V RMS, or a maximum voltage of 369V. The lowest rating is the V274LA10 with an energy dissipation of 45 joules and a peak current handling capacity of 2500A. The type 20 device can handle 75J and a peak current of 4500A, and the 40A and 40B devices are rated at 140J, 6500A. The energy rating is for 10 cycles lasting 1ms, and the current rating is for 8 cycles of 20us duration.

Regarding the extra fuse, the simplest answer here is to leave out the second MOV. This was included only because at the time Oatley Electronics had these devices on special, and an extra MOV was for 'added insurance' rather than better performance. I cannot see any real benefit in having two fuses, as the fuse placed before the complete unit should be rated to protect everything and another fuse seems superfluous. However I suppose one can't have too many fuses, and there is no harm in adding an extra one. Naturally, for units that are built into a mains plug, adding a fuse after the unit is good idea, although it won't protect the filter module.

Thanks for the data on the MOVs, B.H., as these are rather poorly represented and it's good to have the facts. Now to another letter, asking if we would like to take up the challenge and produce a valve guitar amplifier:

Valve guitar amp

This letter has been edited to cut it down a bit, but the writer's intent is hopefully still quite clear...

I have recently been foolish enough to get back to playing the electric guitar, which has led me to a search for a suitable amplifier. It seems rather paradoxical that guitarists still demand valve amplifiers to get the right sound, and my examination of current prices has led me to ask (grovel, crawl, plead) if EA staff might consider a valve guitar amp as a project.

To increase its versatility, perhaps the pre-amp stage could be designed to have inputs for a bass guitar and another for a lead guitar. Also the output stage might have switchable power output ratings of 25W for home practice and 100W for stage use. (A.G., Kings Langley NSW).

This letter continues with further suggestions on how we might best produce this amplifier, but I won't include these as the answer to this request is basically no! Let me hasten to add, though, that we regret having to say it. The reason is simply the difficulty of obtaining suitable output transformers.

To give you some idea, a colleague and I recently decided to make a fortune by designing and marketing a valve hifi amplifier. We had it all worked out, including a see-through case so the bottles were on view; we'd even written our marketing blurb, that included the line 'there's nothing (except a vacuum) to distort the sound!'. Dishonest maybe, but a good line...

However when we started to price a quality output transformer, we had second thoughts. Yes they can be obtained, but only on a special order. The whole thing became extremely difficult and although possible, we decided there must be an easier way to make lots of money. We're still looking, but that's another story.

So, returning to your letter A.G., the problem with such a project is sourcing the components. Also, although there was a time when I and others at the magazine were red hot on valve design, these days we have let this expertise lapse. This probably explains why valve guitar amplifiers are so darn expensive, as the marketplace sets the prices, and rarity is a factor.

I have to agree though, a valve output stage is the main preference for guitarists, as not only are they more rugged, but the overload characteristics give a much better sound than a solid state output. Makes me wish I had bought a few dozen guitar amplifiers some 20 years ago, and put them away for future sale. Ah — *that's* how I could have made my fortune. Oh for a crystal ball!

Active DI box

Continuing with projects for stage sound, here's a letter we *can* help with:

As a third year Electrical Engineering student, I find Information Centre (and especially What??) most interesting.

What I would like to know however, is whether EA has ever developed an active direct injection (DI) box for stage use. As a part-time mixer for a few live bands, I find the greatest problem is the lack of supplied DI's by venues. The cost of buying one is outside my means (I am only a student!) and I thought it may be cheaper to build rather than buy.

The DI box basically converts a line level (high impedance) jack input into a mic level (low impedance) male Cannon output. An active DI gives the signal extra strength to reach the mixing console. (S.D., Stanmore NSW).

Thanks for the compliments, S.D. I'm especially glad to be able help you. An active DI box that should fulfill your needs was described by Rob Evans in the October 1987 edition of EA.

Dot/bar LED drivers

And still on the themes of help and sound, here's a letter from a young (14 years) reader who wants to know why the LM3916 LED driver has a dot mode:

I have been experimenting with an LM3916 dot/bar VU meter driver IC, configuring it to my stereo in different ways. The IC works perfectly in bar mode, but when in dot mode the display appears to be still in bar mode, except the display is duller.

If I connect a signal generator to the circuit, and use a low frequency, the display is clearly a moving dot, but as this IC is designed for use with a music signal, why does it have a dot mode when it doesn't work? Perhaps if the LEDs turn off more quickly the display would be clearer, although this is only a hunch, and it probably wouldn't work anyway.

I have tried placing a capacitor between the input pin and the incoming signal to smooth the input signal, but this didn't work too well. Can you suggest

INFORMATION CENTRE

anything to end the problem I have outlined?

My second query concerns audio spectrum analysers. Can you explain how they work, and whether EA has ever published one as a project. Can you get your colleagues to develop some more audio projects, preferably some that aren't too expensive? I read your column with interest each month. (T.B., Kallaroo WA).

Thanks for your letter, T.B., and also for letting me know you enjoy the column.

Regarding the LM3916 device, this IC is one of a family of three made by National Semiconductor. The others are the LM3914 and the LM3915. Both of these are ICs only, unlike the 3916 which has the LEDs and IC on a small PCB. The 3914 (like the 3916) is configured internally to give a linear readout while the 3915 gives a logarithmic response.

I am a great fan of these devices, and I previously used the LM3914 to great success in a voltmeter currently being reprinted in *Project Electronics 1*.

In this project, I used two LM3914 devices (in dot mode) to show a DC voltage with a resolution of 1%. The fact is T.B., these ICs are useful in many applications other than as a VU meter.

Certainly the dot mode is unsuitable for fast changing signals, which is why National gave them two modes of operation: dot and bar.

The only way to make these ICs operate in dot mode for a music signal would be to convert the signal to DC and filter it so that it slows down to an average, slow changing value.

But as this is hardly useful for indicating signal level, I suggest you leave it in bar mode.

An audio spectrum analyser is relatively complex, and really needs a 'scope or TV display rather than LED displays to be effective.

The principle of operation is to break the signal into 'frequency bands' using filters, and to use a 'scope to display the energy contained in each band.

A good quality analyser might have bands no wider than 100Hz or so, requiring a lot of circuitry to give the large number of bands required to cover the audio spectrum.

A 10-band stereo analyser with LED readout was described back in the February 1980 issue, while a 10-band single channel analyser which used a colour TV for its display was described in the March 1981 issue.

Regarding simple audio projects, I am presenting a simple 5W audio amplifier shortly in the current series Basic Electronics.

The series is running behind time due to insufficient space in the magazine, but I envisage this project will appear around March or May.

Another project you might find interesting is a stereo enhancer I designed some years ago, that has again been reprinted in *Project Electronics - 1*. You should find it on the news stands...

What??

This one has been around for years but is always worth an airing. As shown in Fig.1, three capacitors are connected in series, charged initially as shown.

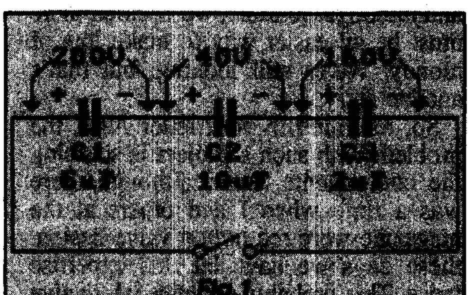


Fig.1

The question is, calculate the voltage that will be present across each capacitor when the switch is closed. Assume no losses in the circuit.

Answer to last month's What??

The answer to last month's What?? question is that the DC ammeter M1 shows zero. As Mr Soong explains, "A transformer cannot 'transform' DC currents or voltages. For instance if a DC voltage is connected to the primary of a transformer, a DC value will be registered for a short time at the secondary, but it will soon decay to zero.

Similarly the half wave rectifier effectively generates a DC current in the secondary of the transformer. This produces a corresponding DC component in the primary, but this soon decays away to zero, leaving only an AC value.

The shape of the primary current waveform is a distorted sinewave, with peaks on one half cycle. I'm not sure of the explanation, but that is what I measured with a 'scope."

By the way, I agree with this explanation, as I confirmed it by experiment. A DC ammeter in the primary will show a brief deflection when the secondary circuit is first connected, but thereafter it shows zero. Thanks for an interesting question, Mr Soong.

NOTES & ERRATA

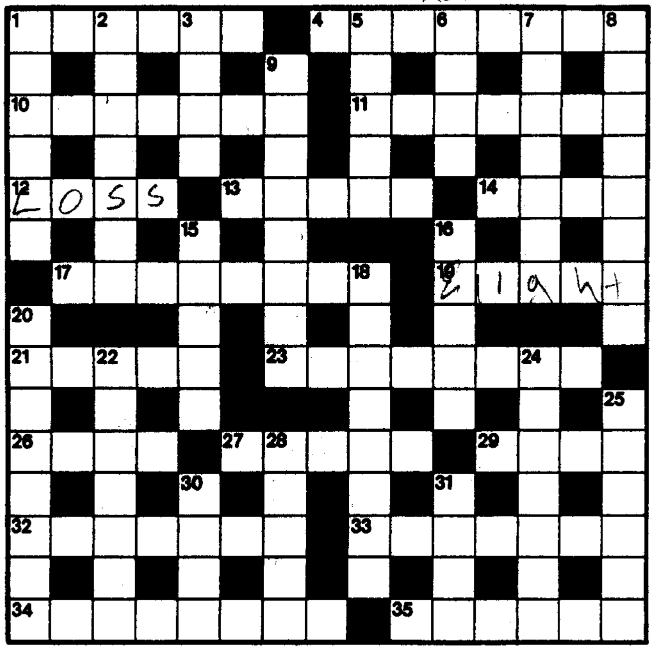
SERVO SYSTEM FOR ROBOTS (Circuit & Design Ideas, October 1990): VR4, the error gain adjustment pot, should have a value of 100k. The 1M/100k divider connected to the output of IC1b should be returned not to 0V, but to the 4.5V supply line. Similarly the 100k resistor connected to the + input (pin 10) of IC1c should return to +4.5V, not 0V. The use of four NiCad cells is also recommended for the output circuit rather than three as shown, to get a full 4V.

PRO SERIES TWO PREAMP. (Oct 1990). A gremlin added three extra lines to the end of the parts list on page 99 — they should be ignored. Also, the 0.5W resistors mentioned in the parts list are not clearly shown on the component overlay (page 97) — they are R43, R44, R45 and R47. Finally, the text did not include the winding details for the phono input chokes (L1 and L101) — these require 5.5 turns of 28 B&S copper wire wound through the centre of the ferrite bead. ■

EA CROSSWORD

Across

1. Electrical faults. (6)
4. Devices for making a circuit. (8)
10. Popular position for electric window controls in a car. (7)
11. Connector. (1,1,1,4)
12. Opposite to gain. (4).

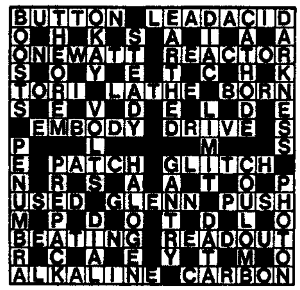


13. Type of terminal. (5)
14. Abrading tool. (4)
17. Element in halogen group. (8)
19. Binary 1000 in base 10. (5)
21. Exhaust fans do this. (5)
23. Steely shade, ---- blue. (7)
26. Principal figures on an electronic scoreboard. (4)
27. Components. (5)
29. Device giving mechanical advantage. (4)
32. Long-established brand of hifi. (7)
33. Superimpose (on circuit, etc.) (7)
34. Said of voltage-lowering transformers. (4-4)
35. Operated a tape deck. (6)

Down

1. Showing tendency to maintain a setting. (6)
2. A form of fluid diffusion. (7)
3. Small harness item for cables. (4)
5. Connected by conductors. (5)
6. Fault in TV picture. (4)
7. Flight path, the ---- pattern. (7)
8. Portions of LCDs. (8)
9. How the intelligent robot progresses to maths functions? (8)
15. List of data. (5)
16. Heinrich ----, helper to Hermann Helmholtz. (5)
18. Charged particle. (8)
20. Translates coded message to plain text. (8)
22. Type of valve. (7)
24. Real gases don't behave this way. (7)
25. Dangerous state of electric flex. (6)
28. Indicator of field direction. (5)
30. Type of magnetic switch. (4)
31. Famous Scottish-born inventor, (1847-1922). (4)

SOLUTION TO DECEMBER



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.

January 1941

Underground Wireless: An underground "wired wireless" system which is to be installed between Sydney and Melbourne will permit up to 400 separate channels for telephonic, telegraphic and teleprinting communications between the two capitals.

This was announced recently by the PMG's Department. The first section of the underground system will be laid immediately between Melbourne and Seymour at a cost of £100,000.

AWA makes Aircraft Instruments: A new Australian industry – the manufacture of aircraft instruments – is being undertaken by Amalgamated Wireless.

The task has hitherto been regarded as beyond the capacity of local enterprises, for the application of the processes involved incorporate the most intricate phases of both engineering and manufacture. This is seen, particularly in the Sperry gyroscopes, to be made by AWA, notably the gyro horizon and the directional gyro.

Precision is vital in the manufacture of Sperry directional gyros and artificial horizons, because an inaccuracy equal to one part in 100,000 parts of an inch in the machining might mean the difference between a good instrument and a poor one. The tiny ball bearings that support the rotor of the gyro are manufactured to the highest standards but even so, are finally inspected under laboratory microscopes so that any slight imperfection may be detected and the part rejected.

January 1966

Window on the Invisible: A new and brighter window on the world of the infinitely small was opened recently by RCA scientists who successfully merged the techniques of television and the electron microscope. The combination of the two techniques, known formally as a Television Image Intensification System for the RCA Electron Microscope, is essentially an ingenious way of extending man's vision to see and study the building blocks of matter.

Television's contribution to the merger was an image intensifier, a device that can make images many times brighter.

A startling effect of combining the two electronic techniques is that images up to two million times as large as the original specimens can be produced. These visible images are ten times as large as the electron microscope alone can show before it runs out of enough brightness for vision.

WWVH on 2500KC: A further frequency has been put into service by the National Bureau of Standards, over the transmitter WWVH at Maui, Hawaii. The station will now transmit its time and frequency services on 2500KC as well as on the present 5000, 10,000 and 15,000KC. The added transmission will be modulated with the same code as the other frequencies. This new service is intended to improve the time services accuracy of WWV broadcasts, and ensure good reception of these services in the Hawaiian Islands area.

1	26	51	76	101	126	151	176	201	226	251	276
2	27	52	77	102	127	152	177	202	227	252	277
3	28	53	78	103	128	153	178	203	228	253	278
4	29	54	79	104	129	154	179	204	229	254	279
5	30	55	80	105	130	155	180	205	230	255	280
6	31	56	81	106	131	156	181	206	231	256	281
7	32	57	82	107	132	157	182	207	232	257	282
8	33	58	83	108	133	158	183	208	233	258	283
9	34	59	84	109	134	159	184	209	234	259	284
10	35	60	85	110	135	160	185	210	235	260	285
11	36	61	86	111	136	161	186	211	236	261	286
12	37	62	87	112	137	162	187	212	237	262	287
13	38	63	88	113	138	163	188	213	238	263	288
14	39	64	89	114	139	164	189	214	239	264	289
15	40	65	90	115	140	165	190	215	240	265	290
16	41	66	91	116	141	166	191	216	241	266	291
17	42	67	92	117	142	167	192	217	242	267	292
18	43	68	93	118	143	168	193	218	243	268	293
19	44	69	94	119	144	169	194	219	244	269	294
20	45	70	95	120	145	170	195	220	245	270	295
21	46	71	96	121	146	171	196	221	246	271	296
22	47	72	97	122	147	172	197	222	247	272	297
23	48	73	98	123	148	173	198	223	248	273	298
24	49	74	99	124	149	174	199	224	249	274	299
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JAN '91

EA with ETI marketplace

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CB RADIOS: $59 to $199, business, amateur, marine, outback, world-wide radios, scanners, power supplies, aerials, walkie talkies, amplifiers, test gear, microphones, HF, VHF, UHF, different gear weekly. We buy, sell, trade-in and repair. Enquire about hobby radio and computer club activities for beginners. Sam Voron, VK2BVS 24 hours, 7 day number, (02) 407 1066

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Relays, silicon controlled rectifiers (SCR's) and bi-directional triodes (TRIAC's) have a wide range of applications in electronics. This book gives tried and practical working circuits which should present the minimum of difficulty for the enthusiast to construct.

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ELECTRONIC SECURITY DEVICES
BP56 $9.50
This book, besides including both simple and more sophisticated burglar alarm circuits using light, infra-red and ultra-sonics, also includes many other types of circuit as well, such as gas and smoke detectors, flood alarms, doorphone and baby alarms, etc.

PRACTICAL ELECTRONIC BUILDING BLOCKS-Book 1
BP117 $8.50

PRACTICAL ELECTRONIC BUILDING BLOCKS-Book 2
BP118 $8.50
These books are designed to aid electronic enthusiasts who like to experiment with circuits and produce their own projects. The circuits for a number of building blocks are included in each book, and component values and type numbers are provided in each case. Where relevant, details of how to change the parameters of each circuit (voltage gain of amplifiers, cut-off frequencies of filters, etc.) are given so that they can be easily modified to suit individual requirements. No difficult mathematics is involved.

HOW TO DESIGN ELECTRONIC PROJECTS
BP127 $9.00
The aim of this book is to help the reader to put together projects from standard building blocks with a minimum of trial and error, but without resorting to any advanced mathematics. Hints on designing circuit blocks to meet your special requirements where no "stock" design is available are also provided.

HOW TO DESIGN AND MAKE YOUR OWN PCBs
BP121 $6.50
Chapter 1 deals with the simple methods of copying printed circuit board designs from magazines and books and covers all aspects of simple PCB construction as comprehensively as possible.
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BP255 $16.00
Totally revised and rewritten to replace the previous edition (BP155), this book contains considerably more information which is now divided into thirteen sections including: Listening to SW Radio, ITU Country Codes, Worldwide SW Stations, European, Middle East & N. African LW Stations, European, Near East & N. African MW Stations, Canadian MW Stations, USA MW Stations, Broadcasts in English, Programmes for DXer's & SW Listener, UK FM Station, Time Differences from GMT, Abbreviations, Wavelength/Frequency Conversion

AERIALS

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The subject of aerials is vast but in this book the author has considered practical aerial designs, including active, loop and ferrite aerials which give good performance and are relatively simple and inexpensive to build.

25 SIMPLE SHORTWAVE BROADCAST BAND AERIALS
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Fortunately good aerials can be erected at low cost, and for a small fractional part of the cost of your receiving equipment.
This book tells the story. A series of 25 aerials of many different types are covered, ranging from a simple dipole through helical designs to the multi-band umbrella.

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The 25 aerials included in this book have been especially designed, built and tested by Mr. Noll to be sure performers and give surprisingly good results considering their limited dimensions.

25 SIMPLE TROPICAL AND MW BAND AERIALS
BP145 $6.00
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AUDIO & HI-FI

DIGITAL AUDIO PROJECTS
BP245 $11.00
Contains practical details of how to construct a number of projects which fall into the "Digital Audio" category. They should be of interest to most audio and electronic music enthusiasts.

AN INTRODUCTION TO LOUDSPEAKERS AND ENCLOSURE DESIGN
BP256 $11.00
All you need to know about the theory and operation of loudspeakers and the various types of boxes they may be fitted into.
Also includes the complete design and constructional details of how to make an inexpensive but high quality enclosure called the "Kapellmeister".

AUDIO PROJECTS
BP90 $8.50
This book covers in detail the construction of a wide range of audio projects. The text has been divided into the following main sections: Pre-amplifiers and Mixers, Power Amplifiers, Tone Controls and Matching, Miscellaneous Projects.
All the projects are fairly simple to build and designed to assist the newcomer to the hobby.

AUDIO (Elements of Electronics-Book 6)
BP111 $13.00
Analysis of the sound wave and an explanation of acoustical quantities prepare the way. These are followed by a study of the mechanism of hearing and examination of the various sounds we hear. A look at room acoustics with a subsequent chapter on microphones and loudspeakers then sets the scene for the main chapter on audio systems, amplifiers, oscillators, disc and magnetic recording and electronic music.

AUDIO AMPLIFIER CONSTRUCTION
BP122 $9.00
The following practical designs are featured and include circuit diagram and description, Veroboard or PCB layout and any necessary constructional or setting-up notes.
Chapter 1 - Preamplifiers: versatile microphone type based on the NE5534; tape type using the LM3802; RIAA pre amp; simple guitar pre amp; ceramic or crystal pick-up type; active tone controls using a LF351; general purpose pre amp.
Chapter 2 - Power amplifiers: simple low power battery type using a 2283 IC; 2 watt using the TBA820; 8 watt using the TDA2030; 16 watt 12 volt P.A. amplifiers; 20 watt using a MOSFET output stage; 100 watt DC coupled amplifier using four MOSFETs in the output stage.

CHOOSING AND USING YOUR HI-FI
BP68 $6.00
Provides the fundamental information necessary to make a satisfactory choice from the extensive range of hi-fi equipment now on the market.
Help is given to the reader in understanding the technical specifications of the equipment he is interested in buying.

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FROM ATOMS TO AMPERES
BP254 $12.00
Explains in crystal clear terms the absolute fundamentals behind the whole of Electricity and Electronics. Really helps you to understand the basis of the subject, perhaps for the first time.

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Written in the same style as the first book (BP53) and with the same objectives in mind, this book is divided into the following fourteen sections: Electricity, Electrostatics, Electromagnetism, Complex numbers, Amplifiers, Signal Generation and Processing, Communication, Statistics, Reliability, Audio, Radio, Transmission Lines, Digital Logic and Power Supplies.

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The aim of this series of books is to provide an inexpensive introduction to modern electronics so that the reader will start on the right road by thoroughly understanding the fundamental principles involved.
BOOK 1: This book contains all the fundamental theory necessary to lead to a full understanding of the simple electronic circuit and its main components.
BOOK 2: This book continues with alternating current theory without which there can be no comprehension of speech, music, radio, television or even the electricity mains.
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ELECTRONIC MUSIC PROJECTS
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Provides the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as fuzz box, waa-waa pedal, sustain unit, reverberation and phaser units, tremelo generator, etc.

MUSICAL APPLICATIONS OF THE ATARI ST's
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The Atari ST's are fast becoming the first choice in computers for the electronic music enthusiast due to their relatively low cost and MIDI interface. The Penfolds show you how to make the most of these machines musically, with simple add-on circuits and program routines.

COMPUTER MUSIC PROJECTS
BP173 $11.00
Shows some of the ways a home computer can be used to good effect in the production of electronic music. Topics covered include sequencing and control via analogue and MIDI interfaces, computers as digital delay lines and sound generators for computer control.

MORE ADVANCED MIDI PROJECTS
BP247 $11.00
Carries on where book BP182 left off by providing constructional details of some more advanced and sophisticated projects such as a mixer, merge unit and harmoniser etc.

ELECTRONIC SYTHESISER CONSTRUCTION
BP185 $11.00
This book will enable a relative beginner to build, with the minimum of difficulty and at reasonably low cost a worthwhile mono-phonic synthesiser, and also learn a great deal about electronic music synthesis in the process.

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BP195 $12.95
As a definitive introduction to the subject this book is presented on two levels. For the absolute beginner with no previous knowledge, the story is told as simply as it can be in the main text.
For the professional engineer, electronics enthusiast, student or others with technical backgrounds, there are numerous appendices backing up the main text with additional technical and scientific details, formulae, calculations and tables etc.

FAULT-FINDING

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
BP110 $8.50
We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome just these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

AUDIO AMPLIFIER FAULT-FINDING CHART
BP120 $4.00
This chart will help the reader to trace most common faults that might occur in audio amplifiers. Across the top of the chart are two "starting" rectangles, vis Low/Distorted Sound Reproduction and No Sound Reproduction; after selecting the most appropriate one of these, the reader simply follows the arrows and carries out the suggested checks until the fault in located and rectified.

GETTING THE MOST FROM YOUR MULTIMETER
BP239 $11.00
It is amazing just what you can check and test with a simple multimeter if you know what you are doing. This book tells the story, covering the basics and relative merits of analogue and digital instruments,component checking and dealing with circuit testing.

MORE ADV. USES OF THE MULTIMETER
BP265 $12.00
A sequel to book BP239 showing the reader some more advanced and unusual applications of that humble test instrument - the simple multimeter.

HOW TO USE OSCILLOSCOPES AND OTHER TEST EQUIPMENT
BP267 $12.00
Just as the title says, this book shows the hobbyist how to effectively use a number of pieces of electronic test equipment including the oscilloscope.

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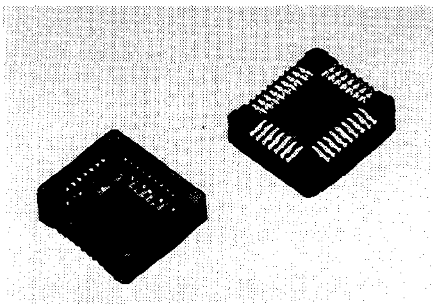


SMT chip carrier/socket

Methode has designed this PLCC socket to take full advantage of surface mount technology. The exclusive visible internal solder tails, along with the use of quality high temperature materials, assures compability with all common reflow processes. The configuration combines the handling and real estate advantages of the J-lead with the processing, inspection and repair advantages of the gull wing.

A centre pad is provided to ensure structural integrity and provide a surface for vacuum pickup or adhesive bonding. The socket uses the same board pattern as the standard JEDEC chip and the exposed tails ensure full cleaning with maximum drainage.

For more information circle 263 on the reader service coupon or contact Adilam Electronics, 145 Parker Street, Templestowe 3106; (03) 846 2511.

Compact quartz oscillators

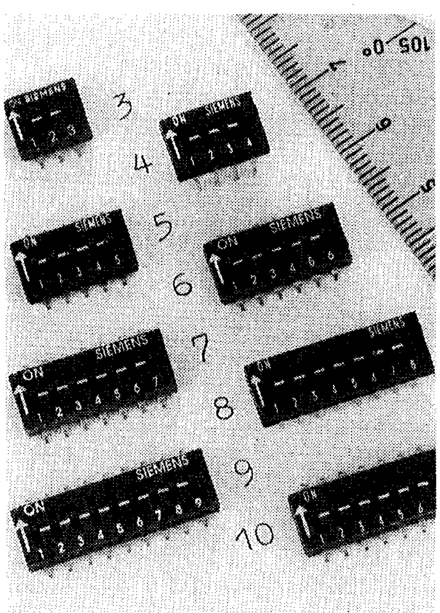
For applications where a compact, low-power, stable frequency source is required, Hy-Q offers a comprehensive range of quartz crystal oscillators with the quartz crystal oscillator packaged in a single can.

In addition to many customised 'specials', four types of oscillator are available: an SPXO (simple packaged crystal oscillator); a TCXO (temperature compensated crystal oscillator); a VCXO (voltage controlled crystal oscillator); and a TCVCXO (temperature compensated VCXO).

A variety of package sizes are available including standard 8 or 14-pin DIL (only 4 pins are fitted). Output stage configurations include sinewave, open collector TTL, TTL compatible, CMOS compatible and HCMOS compatible. Depending on frequency and output stage configuration, voltage ratings of 5V to 12V with current consumption ranging from 1.5 to 15mA are possible.

Where particular requirements can't be met from within the standard product range, Hy-Q's development engineers' can tailor a design to the customer's exact specification. By using sophisticated computer aided design techniques, such customised designs can be produced within weeks of the initial enquiry.

For further information circle 264 on the reader service coupon or contact Hy-Q International, 1 Rosella Street, Frankston 3199; phone (03) 783 9611.

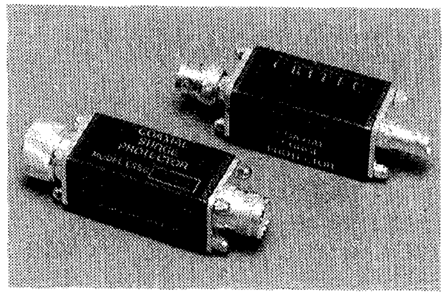


Comprehensive DIL switch range

Siemens' A3000 dual-in-line switch is available in versions comprising between three and 10 individual switches. Whenever user-specific connections have to be switched on or off on a printed circuit board, a device of exactly the required size can now be selected with associated beneficial effect on the packing density.

The switch is available in an SMD version as well as with parallel or spread leads for component insertion assembly. Features include a height of 5mm; a smooth surface for adhesion to a vacuum pipette; and a sealed case for immersion cleaning including ultrasonic.

For further information circle 265 on the reader service coupon or contact Siemens, 383 Pacific Highway, Artarmon 2064; phone (02) 436 8711.



Surge protection for signal lines

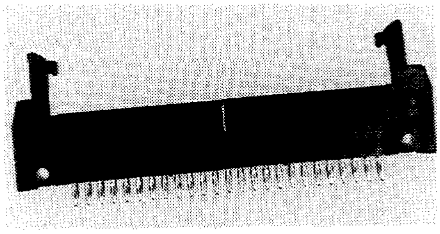
Critec has released two surge protection devices for communications and data signalling. The LSCP is a lightning surge coaxial protector designed to provide protection against lightning, NEMP, induction and other induced electromagnetic disturbances. It is suitable for MF, HF, VHF and UHF frequencies as well as very high speed coaxial LANs.

This device consists of a leadless gas discharge tube contained within a close tolerance machined block, to compensate for component capacitance and maximise frequency response. As a result the LSCP is usable to 2GHz for power levels up to typically 100W. A special high impulse response gas tube is used for NEMP applications. Versions with N, BNC or N bulkhead connectors are available.

The LSSC is a 'Level two' coaxial protection device suitable for MF, HF and coaxial LANs. The LSSC has a usable frequency up to 25MHZ depending upon the application.

The primary protection is provided by a gas discharge tube with secondary protection by high speed transient suppression diodes. The LSSC has superior transient response to the LSCP, but limited maximum usable frequency. Versions with N and BNC type connectors are available. Other connector types such as UHF are available on request.

For further information circle 266 on the reader service coupon or contact Critec, Technopark, Dowsings Point, Glenorchy 7010; phone (002) 73 0066.

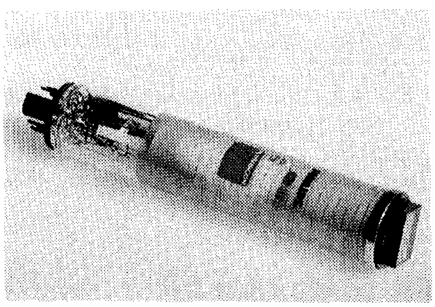


Pressfit headers

Robinson Nugent has released a range of pressfit headers in both standard and low profile configurations, for PCBs with plated-through holes. The headers are designed to eliminate soldering processes and provide a header for applications where space savings are critical. Installation is via an arbor press fitted with appropriate tooling to accommodate the header.

The headers provide foolproof socket polarisation when mated with socket connectors that have a centre polarisation tab. They are available in 10/14/16/20/26/34/40/50 and 60 position product. Standard plating options are gold and ROBEX (palladium nickel), which gives better performance and lower cost than gold.

For further information circle 267 on the reader service coupon or contact DGE Systems, 103 Broadmeadow Road, Broadmeadow 2292; phone (049) 69 1625.

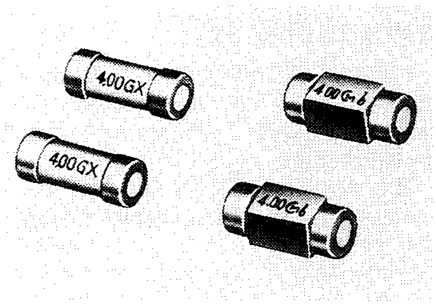


Camera tubes for HDTV

Philips' XQ3550 series of Plumbicons are the result of a three year development effort. They feature a new 'Tetrode' electron gun, with a high beam reserve to keep the spot diameter small and so avoid picture 'blooming' in bright images. The new tubes also exhibit greatly reduced after-images ('lag' and 'sticking') than competing types, which makes the picture quality noticeably higher for moving images.

Primarily aimed at colour HDTV cameras, the XQ3550 series also suit electronic cinematography, and high-resolution industrial applications. The new electron gun, together with a very high resolution lead-oxide photoconductive target, give the tubes excellent sensitivity. Like other Plumbicons, they have unrivalled lifetimes of between 5000 and 6000 hours – about ten times that of some competing types.

For further information circle 268 on the reader service coupon or contact Philips Components, 11 Waltham Street, Artarmon 2064; phone (02) 439 3322.



SMD ceramic resonators

Murata Manufacturing has developed a series of SMD Ceramic Resonator 'Ceralocks'. The CSAC series is suitable for clock generators for microcomputers, various remote control systems and car electronics.

The CSAC is available in two packages – MGC (7mm length x 2.8mm diameter) and MGCM (7mm length x 2.85 x 2.6mm). Both are available in bulk pack, tape and reel (1500 PCS/reel). The CSAC oscillating frequency initial tolerance is +/–0.5% while oscillating frequency temperative stability is +/–0.3% (–20 + 80°C). Mechanical Q is 1500 while resonant resistance is 50 ohms maximum (typical 30 ohms).

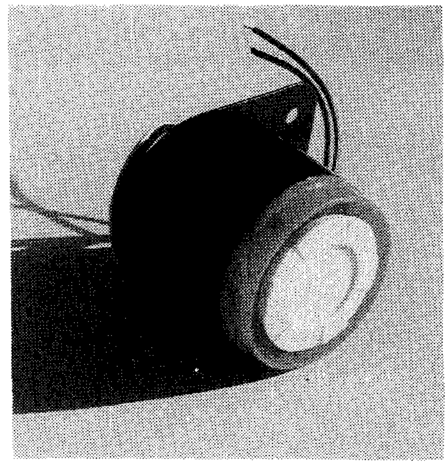
The frequency range is 2.00 to 6.00MHz and standard frequencies are 2.00, 2.45, 3.00, 3.58, 4.00, 4.19, 4.43, 4.91, 5.00 and 6.00MHz.

For further information circle 269 on the reader service coupon or contact IRH Components, 32 Parramatta Road, Lidcombe 2141: phone (02) 748 4066.

Flange mount piezo siren

The Kingstate International KPE 1600 series piezo siren is available with two different mounting flanges. The KPE1600 has a straight flange and the KPE 1600L with a right-angle flange.

The KPE 1600 series has an operating voltage of 6-16V DC, an operating fre-



quency of 1.5-4.0kHz and is extremely piercing at 117dB (min) at 12V DC, at 1 metre. The current drain is 250mA (max) at 12V DC and an operating temperature of –20 to + 60°C.

Termination of the KPE 1600 series is by way of UL1007 22 AWG flex wire. Physical dimensions are diameter 54.5mm and length 56mm.

For further information circle 270 on the reader service coupon or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 748 4066.

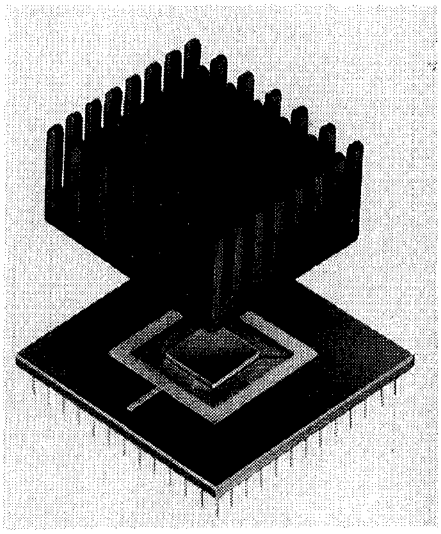
'Soggy foil' AC capacitors

Cornell Dubilier's new type of AC capacitors use an innovative construction with a polypropylene dielectric and metallised electrodes, vacuum deposited on both sides of a paper substrate. The new product is smaller in size, lighter in weight and of significantly improved performance over conventional paper dielectric oil or metallised film types.

The new capacitors are supplied in standard flat oval cases in ratings up to 660V AC, with self-healing properities in the event of dielectric breakdown – due to vaporising of the electrode material around the point of failure. The self-healing operation is accomplished in milliseconds without damage to the dielectric structure, and the capacitors may have many self-healing operations without affecting their operation in most circuits.

Pressure activated circuit interrupters are also built into the capacitors, to give maximum assurance that the cases will not rupture at end of life.

For further information circle 232 on the reader service coupon or contact Crusader Electronic Components, 73-81 Princes Highway, St Peters 2044; phone (02) 516 3855.



Heatsinks for PGA

The new heatsink series ICK-PGA from Fischer Elektronik has been developed in order to dissipate particularly large amounts of heat, especially with pin-grid-array IC's.

The heatsink geometry specially developed for this is a cooling-finger matrix significantly more efficient than customary extruded heatsinks, due to the forced cooling via the air flow that is guided perpendicularly to the projecting cooling-fingers.

Currently heatsinks are available for PGA sizes 11 x 11, 14 x 14, 15 x 15 and 21 x 21.

For further information circle 231 on the reader service coupon or contact Crusader Electronic Components, 73-81 Princes Highway, St Peters 2044; phone (02) 516 3855.

Rotary wafer switches

Lucas EBE (formerly EBE) provides a wide range of rotary wafer switches suitable for most electronic applications. Stepping, plus rotary and linear solenoids are also supplied, which may be used in conjunction with the rotary switches.

The switches are supplied as standard product, or to customer requirement. Types are available with up to 60 pole(s) per wafer, with any number of wafers as required.

Types for PCB mounting (stackable wafer sections) in decimal, BCD, BCD-compatible and hexadecimal are part of the standard range. Binary, binary complimentary, grey, grey complimentary, and hexadecimal are available, with 10 to 32 contact arrangements. Contact material is Ag + gold flash, but special contact material can be used to customer requirement, etc.

For further information circle 233 on the reader service coupon or contact Crusader Electronic Components, 73-81 Princes Highway, St Peters 2044; phone (02) 516 3855.

Supertwist LCD

Handok's HDM 16216H-U10 is the latest addition to its already broad range of Supertwist alphanumeric liquid crystal displays.

The new display is a two line x 16 character LCD with a character height larger than normal: a very viewable 8.09mm, suited for those applications where the normal 4/5mm character height is not sufficient. An advantage of this display is its very wide viewing angle and high contrast, due to the use of Supertwist technology, the option of electroluminescent backlighting adds further versatility.

Driving the display is via the 8-bit parallel interface; power supply is a single +5V rail.

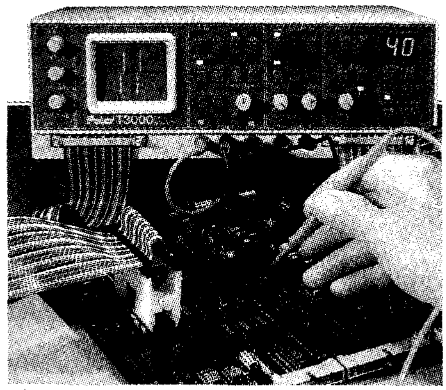
For further information circle 234 on the reader service coupon or contact M.B. & K.J. Davidson, 17 Roberna Street, Moorabbin 3189; phone (03) 555 7277.

Cost effective keyboards

IEE announced the newest addition to its rapidly growing line of cost effective Thriftswitch keyboards, the series 2575. These feature front panel mounting, black ABS bezels and double shot molded keys (white with black legends are standard). Three popular output configurations as standard: single pole/common bus, X-Y matrix and 2 of 7.

Like all Thriftswitch products, the 2575 series provides electrostatic shielding as a standard feature. The conductive rubber contacts are rated 5mA at 12V DC, with a maximum resistance of 200 ohms. The highly reliable key and switch mechanism offers a contact and legend life of over 1,000,000 switch actuations under normal operation.

For further information circle 235 on the reader service coupon or contact M.B. & K.J. Davidson, 17 Roberna Street, Moorabbin 3189; phone (03) 555 7277.



Unpowered PCB faults locator

Polar Instruments of the UK has released the new T3000 digital and analog faults locator, for use on unpowered boards.

The T3000 allows an operator to find faults to component level, by comparing pictures of device characteristics on an inbuilt CRT screen. Devices can be individually probed or, for testing ICs, 2 x 40-pin clips are provided for connection to the suspect devices. The 40-pin scanner automatically displays and compares the signature of each pin.

The T3000 applies a voltage and current limited AC test signal to the device under test and displays the dynamic impedance signature for that component. 'Autoranging' selects the best drive range for optimum display and leaves the operator's hands free to probe the circuit. A choice of test frequencies ensures that a wide range of capacitive/inductive devices can be tested.

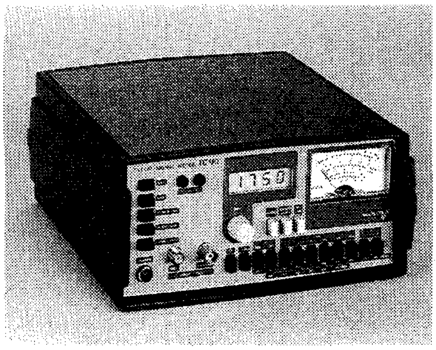
For further information circle 252 on the reader service coupon or contact Emona Instruments, 86 Parramatta Road, Camperdown 2050; phone (02) 519 3933.

FS meter for satellite band

Peter Lacey has released Sadelta's TC90 satellite band field strength meter in Australia.

Designed to measure RF energy levels from 950 to 1750MHz, and 45 to 862MHz, the instrument offers technicians improved features for both traditional aerial work and dish installations. Complete with 4-digit LCD frequency display, the TC90 also has an LNC powering ability, so that users can quickly read dish output in dBm.

The TC90 includes a heavy duty bat-



tery, charger and a rugged in field case, with Sadelta's excellent balance of cost and benefit.

For further information circle 253 on the reader service coupon or contact Peter C. Lacey Services, 74 Fulton Road, Mt Eliza 3930; phone (03) 787 2077.

Dual-slope DMMS count to 3200

Yokogawa Instruments' new 3-1/2 digit 3200 count range of digital multimeters uses a dual-slope integration A-D converter to provide high accuracy and resolution, as well as good noise rejection.

All models features 3200-count full scale with high speed sampling; a 32-segment bargraph LCD display; high speed auto ranging; continuity check and diode test ranges; five DC voltage ranges from 300mV to 1000V; four AC voltage ranges from 3 to 750V; five DC current ranges from 300uA to 10A; five AC current ranges fromm 300uA to 10A; and six resistance ranges from 300 ohms to 30M.

The models 7533-05 and 7534-03 have an additional temperature test function, range hold and data hold, while the model 7534-03 is splash and drop proof.

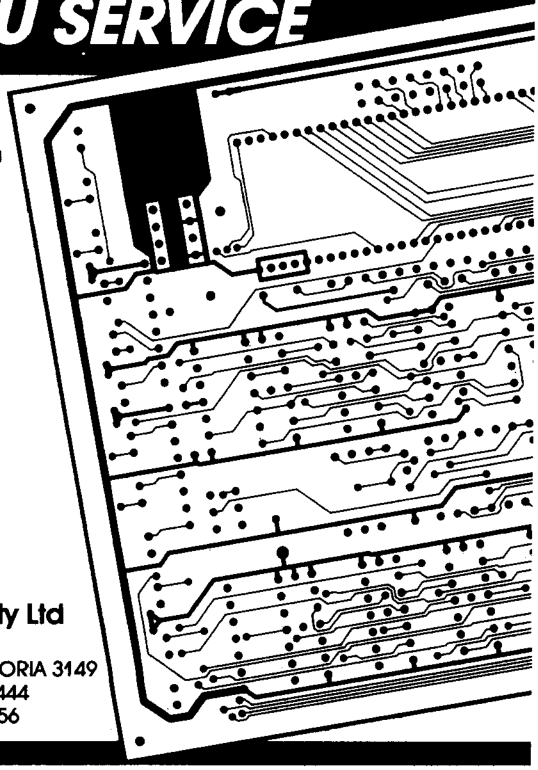
For further information circle 254 on the reader service coupon or contact Nilsen Instruments, PO Box 930, Carlton 3053; phone (03) 347 9166.

Digital scope samples at 1GSa/s

Hewlett-Packard's new HP54510A portable digitixing oscilloscope has two channels, each having a 1-gigasample per second (GSa/s) digitising rate and an 8-bit vertical resolution. HP believes that the 54510A has the fastest sample rate of any portable digital oscilloscope.

Horizontal (timing) accuracy of the HP54510A is specified at 100ps, and the vertical (voltage) accuracy is specified at 1.25% full scale. HP knows of no single-shot oscilloscopes with an equivalent combination of accuracy, bandwidth and resolution.

For further information circle 257 on the reader service coupon or contact Hewlett-Packard Australia by calling (008) 033 821.



Low cost function generator

The TIM model T102C is a new, low-cost, versatile function generator from Elmeasco. With a frequency range of 0.02Hz to 2MHz in seven ranges, the instrument features a digital display which doubles as a frequency counter to measure the frequency of external signals, and a multifunction output with sweep function. It will produce low distortion sine, triangle and square wave outputs and by using the sweep and symmetry controls, a wide variety of further wave shapes is possible.

The T102C also has a variable DC offset control, TTL and variable CMOS plus a VCF input to allow remote programming of frequency FM modulation or external sweep, depending on the type of signal applied to this point.

The unit is housed in a compact case measuring 255(w) x 290(d) x 95(h)mm and is fitted with an adjustable tilt bail/-handle.

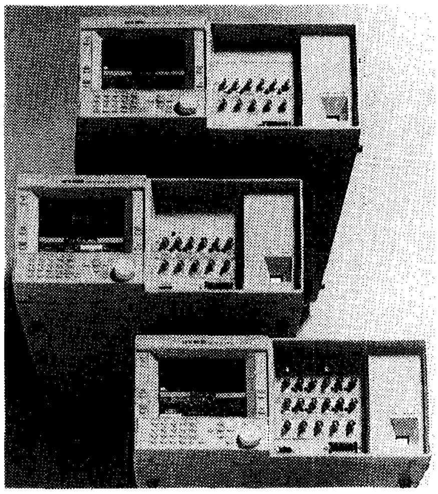
For further information circle 262 on the reader service coupon or contact Elmeasco Instruments on Sydney (02) 736 2888.

600MHz 6-ch pulse generators

The Tektronix HFS9000 series pulse generators are claimed to be the first to offer a repetition rate of up to 600MHz and support from two to six output channels in one instrument. The channels are digitally synthesised from a common clock, resulting in highly accurate independent placement of rising and falling edges.

The generators also feature low RMS jitter, the ability to compensate for external cable skews, and an easy to use graphic human interface. In addition, they offer advanced trigger and pulse output capabilities.

The HFS9010 is designed for characterising ECL, GaAs, and other high-speed devices. Its maximum repetition rate is 600MHz, with a fixed transition time of 200ps. The HFS9020, targeted at the TTL and CMOS markets has a maximum repetition rate of 300HMz, programmable transition times from 1ns, and levels from –2.0 to +5.5V. The HFS9030 combines these two into a single system for mixed signal testing. All three have 10ps edge placement resolution.



For further information circle 258 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066.

Insulation tester

For accurate measurement of high voltage insulation the Megger Instruments BM11/1T provides 5kV testing with measurement of insulation up to 1 teraohm

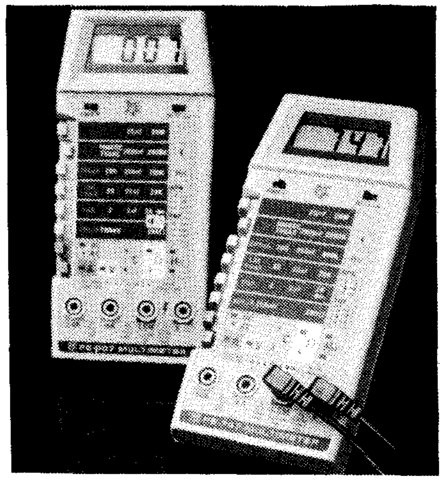
Automatic voltage measurement from 50V to 1000V AC and DC can be made, in order to monitor circuits for dangerous voltages prior to testing and to monitor the discharge of capacitive circuits after testing. The instrument has a large, direct reading analog scale.

The portable BM11/1T, intended for field use, is housed in a strong weatherproof case and is powered by rechargeable cells which give up to 20 hours use. The state of the cells is continuously monitored to avoid false readings due to low batteries.

For further information circle 260 on the reader service coupon or contact Nilsen Instruments, PO Box 930, Carlton 3053: phone (03) 347 9166.

Telecom-approved multimeters

Priority Electronics has released the PE-007 and PE-747 handheld digital multimeters. Both meters have been tested and approved against the reference standards of Telecom Australia, through Telecom State Calibration Laboratory – a registered NATA laboratory. The meters were chosen as 'preferred' under Schedule WS6917 for supply to Telecom Australia – PE-007 (Serial 140/90) and PE-747 (Serial 140/133).



Both PE-007 and PE-747 have 3-1/2 digit LCD display and come with test leads, battery, carry case and comprehensive instruction manual and carry a two year warranty.

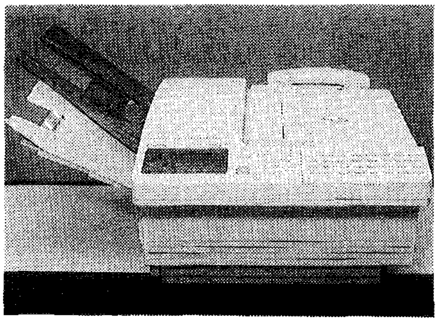
For further information circle 259 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.

HOME & OFFICE

Compact laser fax

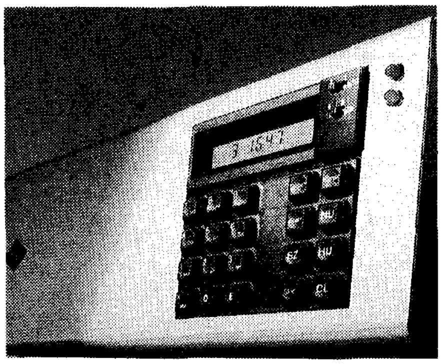
Canon has launched the L770 laser fax, printing on plain paper through a laser printer and embodying advanced features.

The L770 offers 9-second transmission, outstanding image quality through enhanced Ultra High Quality (UHQ) and Error Correction Mode (ECM), and a memory upgrade path allowing



dual access capability, broadcasting, batch transmission and multiple confidential mailbox.

For further information circle 249 on the reader service coupon or contact Canon Australia, 1 Thomas Holt Drive, North Ryde 2113; phone (02) 887 0166.



Intelligent master clocks

Hertz Electronics has released a 'new generation' of intelligent computer master clocks for small to medium size clock systems, displaying uniform time and suitable for commercial and industrial applicatoins.

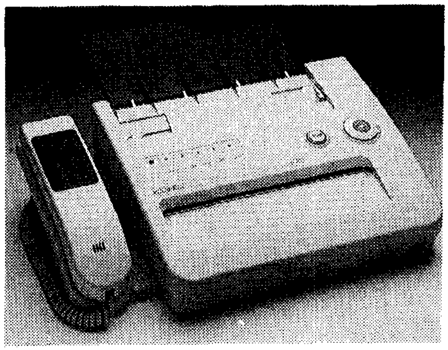
The low cost of the master together with its user friendly programming features, such as daylight saving programmable 12 months in advance, offers an attractive alternative to the inefficient battery clock installation with independent time displays.

Features include fully programmable parameters such as 482 time/date code, sec/min impulse outputs, automatic setting/resetting facility, up to 15 time zone memory, battery back-up and cascading circuits for easy expansion. Options available include RS232/422 ports, EBU/SMPTE modules, IRIG-B time code output and hourly 1KHz time pips.

For further information circle 250 on the reader service coupon or contact Hertz Electronics, 539 Glenmore Road, Edgecliff 2027; phone (02) 363 3029.

Fax for home use

In a bid to accelerate the penetration of the facsimile into the home user segment and bring fax technology within easier reach of small business operators, Voca Communications has positioned its highly featured personal fax machine, the M-900 under the inhibitive $1000



recommended retail price barrier.

Despite its low pricing, the M-900 comes fully equipped with an integral handset, copying function and many of the features otherwise only available on more expensive machines. Ideal for small business, as well as home use, the M-900 simply plugs into an existing telephone extension point and, as all fax functions are controlled by just two keys – start and stop – the unit is extremely simple to use.

Operating at 9600bps, the M-900 uses the fastest speed possible for Group 3 facsimiles and uses a multi-page document feeder to transmit up to five pages consecutively. Users are kept aware of operating status by LEDs which indicate power on, unit on-line, error, start of a call or auto answer mode.

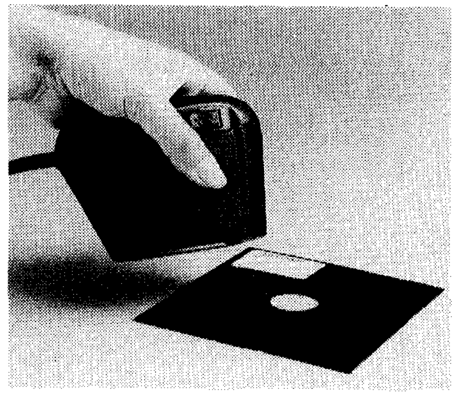
Features include on-hook dialling, 20 number memory including three one-touch number, last number redial and hold. The unit also boasts 'Voice Prompt' and 'Switch-to-Fax' facility.

For further information circle 251 on the reader service coupon on contact Voca Communications, 11-29 Eastern Road, South Melbourne 3205; phone (03) 697 7000.

TOOLS

Hand-held eraser/degausser

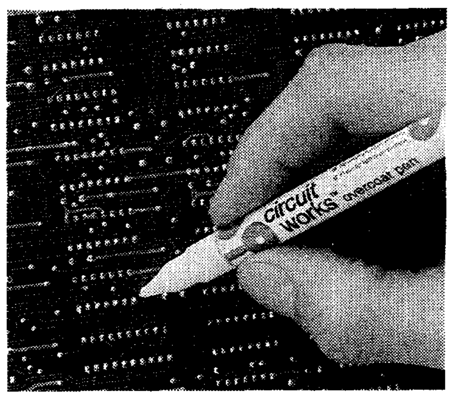
The Weircliffe BTE-2 Eraser/De-Gausser is designed for the general purpose erasure of floppy disks, cassette tapes and security strips. It will effec-



tively erase previously recorded 600 Oersted media to –75dBR, eliminating the potential of an old recording corrupting the new. The convenient hand-held design permits easy operation while an internal sensor provides thermal protection to the unit, by preventing operating temperatures exceeding factory specified limits.

The case is constructed of high impact ABS plastic and is fitted with a power switch and indicator light. The unit measures 12 x 8 x 8.5cm and weighs 0.62kg.

For further information circle 246 on reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975 1211.



Pen protects PCB tracks

The 3300 Circuit Works Overcoat Pen insulates, protects and repairs circuit boards, components and delicate electronics. The pen applies a conformal overcoat to insulate against shorting, arcing and static discharge, while also protecting against moisture, abrasion, chemicals and other environmental hazards.

When used to repair solder mask, the overcoat pen improves the reliability and safety of circuit board modifications and repairs.

NEW PRODUCTS

The 3300 conformal overcoat material is a polymer coating, available in several colours including green and clear. The material matches the durability and colour of normal solder mask, for nearly invisible circuit board repairs. It dries in minutes at room temperature, has excellent adhesion to circuit board materials including laminate and solder masks, and is safe for gold, silver, copper and solder alloys.

Price of the pen is US$9.95 plus US$1 postage.

For further information circle 247 on the reader service coupon or contact Planned Products, 303 Potrero Street, Sutie 53, Santa Cruz, California 95060 USA; phone (408) 459 8088.

Hot plate for reflow

The SA-750 series Hot Plate Reflow system combines precise temperature regulation and variable temperature control to provide tremendous user flexibility, for pre-heat or reflow of SMT boards.

Temperature uniformity of 4°C over the entire surface and RTD sensor feedback for +/-3°C repeatability allow excellent temperature stability for all types of boards and applications. The SA-750's temperature range of 60°C to a maximum 260°C allows dual functions, firstly as a preheater, minimising the effects of thermal stress and secondly as a low-cost method of reflow.

The SA-750 series' compact benchtop design and durable ESD-safe construction make it ideal for small work benches. The hinged hood creates an 'oven-like' reflow environment or can be used as a staging area for cooling. The total available preheat/reflow surface area is 152.5mm x 203mm.

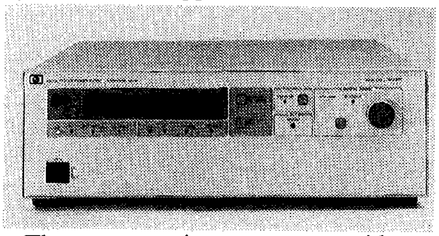
For further information circle 248 on the reader service coupon or contact Electronic Development Sales, 2a/11 Orion Road, Lane Cove 2066; phone (02) 418 6999.

POWER SUPPLIES

500V supply with HP-IB

The new HP6035A is HP's first 500-volt power supply with built-in HP-IB. The HP6035A, as well as the five existing HP6030A series supplies have been enhanced with the addition of Standard Commands for Programmable Instruments (SCPI) and an extendable interface to simplify use.

The HP6035A is suitable for devices that require up to 500 volts of DC power at up to 1 kilowatt. Previously the highest voltage available in a HP system power supply was 200 volts.



The auto-ranging output provides a wide and continuous range of output voltage and current levels at the rated power output. For example, the HP6035A can produce 500 volts at 2 amps, or 200 volts at 5 amps. This allows greater flexibility for applications with varied or changing output needs.

For further information circle 236 on the reader service coupon or contact Hewlett-Packard Australia on (008) 033 821.

300W supplies have quad outputs

Unison has released its UN4300 range of 'quad output' switching 300-watt power supplies, offering a variety of DC voltages including (UN4300-1) 5V at 40A, 12V at 4A (isolated); 12V at 4A (isolated) and 5V at 3A (isolated). Other models offer a selection of 12V, -15V and —24V rails, all isolated and referenced either as positive or negative outputs.

The UN4300 series are Telecom approved and come with overtemperature protection, overload protection, overvoltage protection, remote sense and inhibit control. With typical efficiency of 73% the units come enclosed and can be rack mounted. The AC input and DC output are at separate ends of the unit, offering compliant safety protection.

For further information circle 237 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.

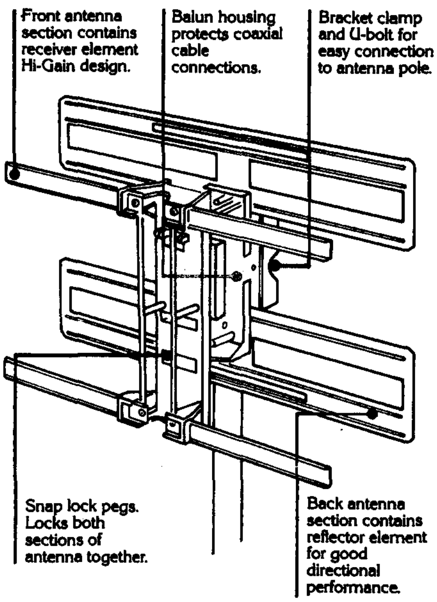
Compact 150W DC-DC converters

Powercub's 150/160 watt Maxi-series modules are rugged, low profile, miniaturised, current mode control switching regulators providing fully isolated, efficient power conversion from a broad DC input range.

Excellent transient response and pulse by pulse current limiting are features of the design. The units are 'parallelable' and load share within 5%. They also include overload and short circuit protection, active overvoltage protection, remote sense and an/off control.

Features include high power density (20W/in^3), low profile, input/output isolation and active overvoltage protection.

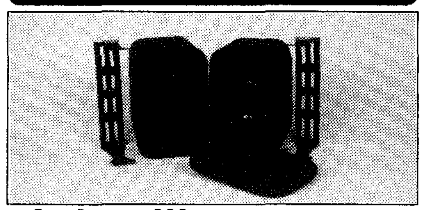
For further information circle 238 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.



Compact new UHF aerial

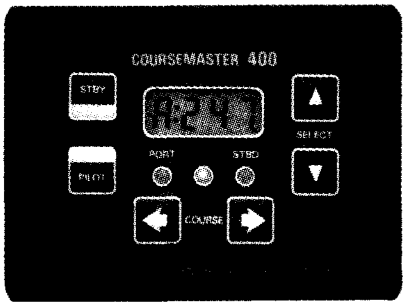
The growing demand for UHF aerials has led HPM Industries to introduce 'Skyscan' – an innovative high gain wideband UHF antenna.

The new UHF unit is only 395 x 285 x 120mm, yet it is credited with better and clearer reception than antennas several times its size. Suitable for use in both country and city installations, it is also easy to install. Its greater wind resistance is said to provide mounting stability, and it can be mounted onto the same mast as a regular VHF antenna.



Skyscan can be used in conjunction with a VHF aerial simply by using a 1215 UHF/VHF diplexer and is available for the competitive trade price of $38.

For further information circle 241 on the reader service coupon or contact HPM Industries, 4 Hill Street, Darlinghurst 2010; phone (02) 361 9999.



Aust-made autopilot

At the recent Sydney International Boat Show Australian company Coursemaster Autopilots released the CM400 marine automatic pilot.

Designed specifically for the rapidly growing market for power boats up to 12 metres which are equipped with hydraulic steering, the CM400 is supplied in standard form with a small hydraulic pump kit as well as a sophisticated computer-based and fluxgate-driven controller.

The controller measures only 125 x 96mm. The CM400 is also easy to install and extremely simple to operate. Most of the time two keys are all you need: press Standby to turn the system on, point the vessel in the direction you want to go and press Pilot. The CM400 will hold that course.

The CM400 comes with standard built-in rudder angle display and push-button course change, as well as a range of options such as mechanical drive, linear drive, remote control and rudder angle indicator.

For further information circle 242 on the reader service coupon or contact Coursemaster Autopilots, 7 Smith Street, Chatswood 2067; phone (02) 417 7097.

Cost-effective DC-DC converters

Manufactured by Power Union, a new range of affordable DC-DC converters has more than 72 models rated from 1/2W to 25W. The converters are available in single, dual and triple out-

puts with voltages 5, 12 and 15V. Input voltages offered are 5, 12, 24 or 48V nominal, with some units having ultra wide inputs.

Four basic sizes are available. Up to 3 watts the converters come in a 24-pin DIP compatible package measuring 31.8 x 20.3 x 10.2mm. Other packages include 25 x 50mm, 50 x 50mm, 76 x 65mm and 114 x 65mm PCB mountable. All are fully encapsulated.

For further information circle 240 on the reader service coupon or contact Amtex Electronics, 13 Avon Road, North Ryde 2113; phone (03) 805 0844.

50W high density switchers

Intended for small, digitally-based systems, the NFS40 series power supplies from Computer Products will deliver 50 watts continuous (forced air), 40 watts (natural convection), or 60 watts for a short period, to actuate a relay or start a hard disk drive. Consisting of eight standard models, the range has a universal input that accepts 85-264V AC or 129-373V DC and provides single or multiple outputs of +5V, +12V, +15V and +24V.

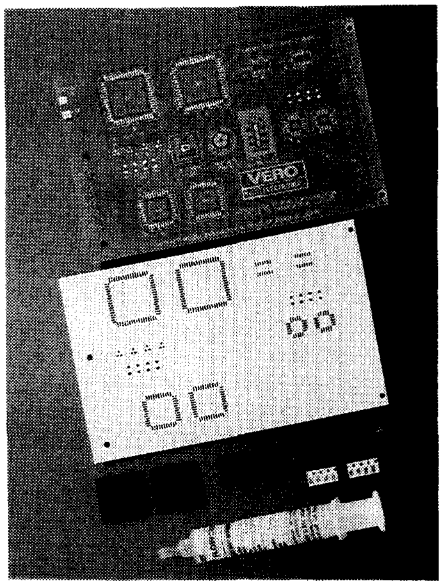
The series is packaged in a low profile, open board configuration of only 127 x 76 x 30.5mm, allowing more compact designs; a power density of 2.8 watts/cubic inch ensures that the design is competitive. With no minimum load requirement, the NFS40 series also has the advantage over similar products that need up to 15 watts minimum load.

For further information circle 239 on the reader service coupon or contact Amtex Electronics, 13 Avon Road, North Ryde 2113; phone (02) 805 0844.

Evaluation kit for SMT

The BICC-VERO 406 series Surface Mount Evaluation Kit is ideal for newcomers to SMT, for training purposes or for quality assurance checks on production facilities employing this technology.

The kit includes a comprehensive range of component parts which provide everything (except the soldering system) needed to start using surface mount devices, and to check that they have been correctly loaded. All components are available separately and may be purchased as replacement parts are required.

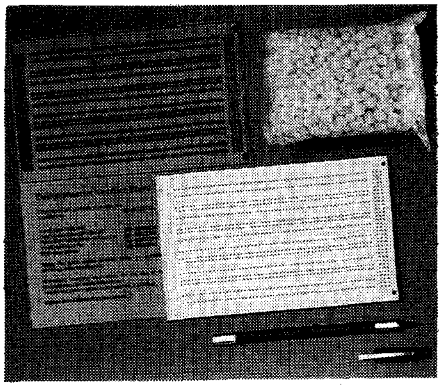


The kit contains a high quality epoxy glass (RF4) plated through-hole board featuring footprints for various surface mount devices, tracked to facilitate the testing of assembled devices, either as individual items or as a complete system. Other SMD items included in the kit include two 68, 44 and 20 IC's and 14-pin DIP IC packages of a special plastic device whose leads are arranged so as to form a 'daisy chain' with board links, to provide quick and easy continuity checking to prove the integrity of each soldered joint.

Also provided are four 1206 SMD resistors with zero resistance, to allow easy continuity checking, four 1206 SMD resistors of 300 ohms which act as dropper resistors for four S023 LED's, which act as indicators to show that the other devices are correctly soldered.

The BICC-VERO surface mount evaluation kit 406-5970AH is available from stock and the price per kit is $115 which includes tax and delivery costs.

For further information circle 243 on the reader service coupon or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 748 4066.



Prototyping boards kit

The Vero Etch Kit 82-302309A enables the user to produce a PCB quickly and easily, meeting the demands of most prototyping requirements.

The accurate location of pads and the drilling of holes are the most time consuming and difficult operations in the preparation of a conventional protyping etch board. With the Vero Etch board both of these processes have been eliminated. The double-sided board consists of rows of pre-drilled holes around which a circuit can be designed.

Around each hole is a gold pad which will remain after etching, eliminating the need for pads to be drawn. There is a thin gold trace running between pads. This enables tracks to be run between pads accurately with the minimum of effort. The layout pattern of gold pads and holes has been designed to give flexibility and high density packaging of 0.3, 0.4, 0.5 and 0.6 DIL packages as well as descrete components.

The kit consists of a double-sided Vero Etch Eurocard board, a Vero Etch pen, a pair of disposable gloves, a pack of ferric chloride crystals (200g), a design layout sheet and instructions. The circuit board, resist pen, gloves and crystals can also be ordered separately.

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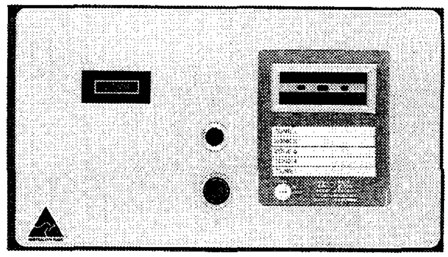

The CM8 recently won a 1990 Australian Design Award for product excellence. To achieve this prestigious award, it had to pass a rigorous 43-point assessment process by the Industrial Design Council of Australia.

Other products can be added to the CM8, including the TE3 client programmable dialler (also an Australian Design Award winner) which uses existing telephone lines (either pulse or tone) and even mobile phones to communicate an alarm condition. New numbers can easily be added or deleted as often as required by the user.

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WORKSTATION

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A DISPLAY FOR YOUR PC'S CLOCK/CALENDAR

Construction Project:

Hardware display for a PC's clock

This simple computer project consists of a plug-in card for an IBM compatible, with a neat looking LED readout that displays the time from the computer's real-time clock. For AT systems, pressing both shift keys also displays the date, giving continual confirmation of the time and date the computer is assigning to files saved to disk. Unlike many computer projects, it's also cheap, easy to build and install.

by MARKO SEVERIN and PETER PHILLIPS

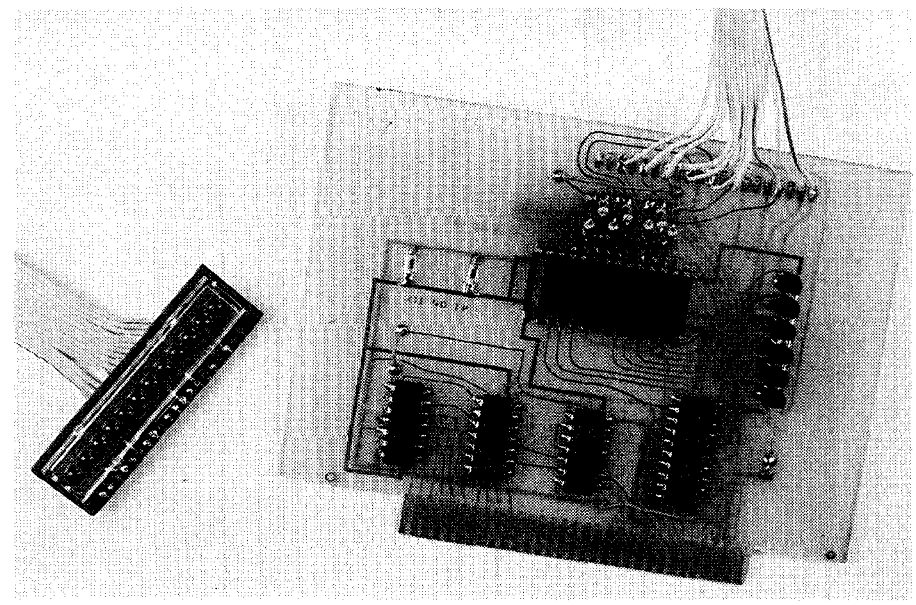
Computers have been described as 'a hole to pour time into', and it's not uncommon for computer users to claim, at 3.00am that they were unaware of the time. A computer monitor tends to mesmerise one's concentration, and unless a clock is right in front of the operator, late nights and missed trains are normal. Time also has another important use in most computers, in that a time stamp is stored with each file saved to disk. What a pity if the time/date being stored is incorrect!

This happened to me recently, when I needed to confirm which version of a file was the most recent — that on the floppy or that on the hard disk. Simple: check the date. Except the file on the floppy had been stored on my home computer, and the other file on a work computer.

The problem was that the date on my home computer was one day slow, and the dates on the two files suggested that the files on the hard disk were the latest versions. Wrong — if only I'd checked the date on my home computer!

But then, how often does one actually check the date, or even the time being generated by the computer? I've yet to see a computer that has a truly accurate internal clock, and daylight saving mucks all this up twice a year anyway. So the more you think about it, having an easily-accessible display of the time and date from the computer is incredibly useful. One might therefore ask: why hasn't someone thought of this before?

This project was developed by Marko Severin, and includes a relatively simple card that plugs into any slot on the mother board of an XT, an AT or in my case a 386SX IBM compatible computer.



Display the internal clock of your DOS based PC with this simple project. It shows the hour, minutes and seconds and for an AT system it can also show the date. Now you can be sure your PC's date and time are correct.

The LED display used on the prototype was purchased from a disposals store, and was originally for a calculator. As the photos show, the display is quite small, yet surprisingly easy to read due to the magnifying effect of the bezel.

The card is basically an output port, driven by a memory resident program that occupies less than 1K of RAM space. As I have already said, Marko Severin is the inventor — I'm merely the presenter of the project. Although my role has also been to test the project, to confirm that it not only works, but that it doesn't interfere with normal computer operation. I've tried it with all sorts of programs, including Windows 3.0, various word processors and other complex applications — all with no problems.

Incidentally, a feature I have found useful with this project is using it to confirm if the computer has hung! This happens occasionally, particularly with Windows applications, and the clock simply stops incrementing when the computer has gone 'off with the pixies'. It saves waiting to see if the program is simply taking a long time to execute a function...In fact, the only problem with this project will be when I have to return the prototype to its inventor. I've now become so used to having a hardware display of the computer clock that I will probably be the first customer for a kit of parts.

Oatley Electronics has decided to offer a full kit for this innovative project, which will include a professional quality, double sided PCB with plated-through holes and tinned tracks. The cost will be less than $60, and includes the software, the display and all the components. When you consider that the cheapest card for an IBM computer costs around this amount, the project is attractively priced and is an enhancement to a computer that I can assure readers is worth twice this amount.

The details

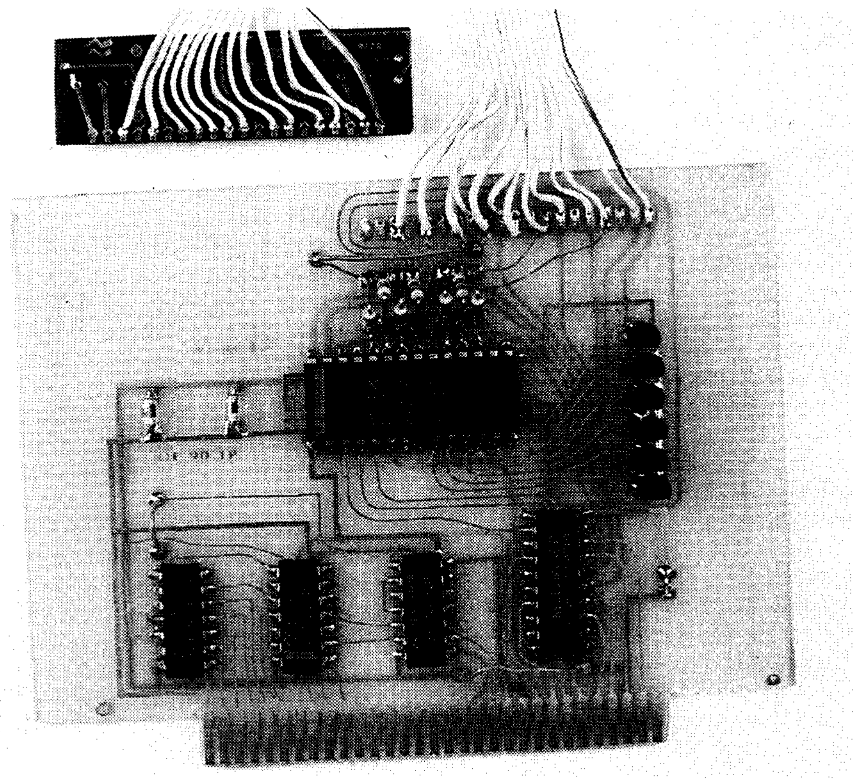
This project, like most computer projects, is a mix of hardware and software. The hardware is actually quite simple, comprising an output port driven by the address and data lines available at each of the expansion slot sockets in the computer. This method was chosen after considering other options, such as using a serial comms port or a parallel printer port.

While the latter methods might initially seem attractive, the additional hardware to drive the display is still required, and unless you have a spare output port, an I/O card is also needed. Also the software is more complex, and therefore occupies more memory space.

The software is written in assembly language, as it uses the least amount of memory. However it is also the most difficult language to understand, and the program took over six months of development time. In fact, the development process required both the hardware and the software to be perfected, and crashing the computer on numerous occasions was all part of the fun.

Because of their differences, two programs needed to be developed — one for an AT only and another that can be used with both an XT and an AT type PC. The AT computer has a built in real-time clock, unlike the XT which uses the operating system to update the time. In other words, an XT has a software clock, while the AT has both. For the AT version of the software, the date can also be displayed by pressing both shift keys simultaneously. This causes the date to appear for five seconds, after which the display reverts to showing the time.

As we'll explain later on, for machines equipped with a hard drive, the software can be made to run automatically at boot-up by including a statement in the AUTOEXEC.BAT file. Although the program is memory resident, its small size ensures it doesn't interfere with normal computer operation. Although



This shot shows the prototype PCB and how the display is connected. Take care when soldering the ribbon cable, as the connection points on both the display and the PCB are closely spaced.

probably an unnecessary precaution, the program will not update the display during a disk operation, just in case it interferes with the data going to or from the disk.

The output card was initially constructed on a wire-wrap board, with all the usual problems this type of construction gives. Once perfected, a PCB design was developed, requiring a double-sided board because of the expansion socket pinouts. However we are not printing the pattern for the PCB, for two reasons.

Firstly, because a commercial quality kit will be available — so most people would not want to go through the difficult exercise of making a double-sided PCB that would lack the essential through hole plating anyway.

The other reason is that the board is useless without the software. Because this project has the potential to become a commercial item, it has been decided to only supply software with the kit. That is, the software will not be sold separately. Software development is a time-intensive activity, and although the cost of the programs will be a very small part of the kit price, by limiting its distribution to constructors only the developer is assured of some return for his efforts. We hope readers understand, and accept that the software and PCB design are both copyrighted.

The hardware

The hardware consists of a small plug-in card, with a separate display unit connected to the card with a length of ribbon cable. The card contains a parallel output port, connected via the expansion socket to the bus systems of the computer. Because there are generally a number of output (and input) ports connected to the computer, each port needs its own unique address so that it can be accessed by the microprocessor. When the correct address (or device code) for that port appears on the address lines, data can be sent to or received from that port. For this project, the address is 31F (hex) or 799 (decimal), chosen as it is one of several set aside for a prototype card. By using this address, no conflicts should occur with other cards plugged into the computer's expansion bus.

The decoding for the correct address is achieved by ICs 1, 2 and 3. When the card is being accessed, the 10-bit code 31F (hex) appears on the lower half of the address bus, lines A0 to A9. These lines connect to the card via the expansion socket on pin numbers A22 to A31 and are decoded by ICs 1a to 1e, IC2b and the eight input NAND gate of IC3. In addition to the address lines, the Address Enable (AEN) line and the Output Write (OW) line need to be part of the decoding process.

PC Clock

The logic level of both these lines goes low whenever a valid I/O port address appears on the address bus and valid data for output to the port appears on the data bus. Thus, when the the conditions are correct, a low appears at the 'latch enable' pin (pin 11) of IC4. This IC is an 8-bit data latch, and the data present when the latch is enabled is stored until the next update of the latch. The data inputs for IC4 are connected to data lines D0 to D7 of the computer bus, via socket pins A2 to A9.

The output of IC4 connects to the data inputs of IC5, a CMOS six digit, 7-segment display decoder/driver IC.

This IC contains all the logic to multiplex the data to drive the six common cathode displays, via driver transistors Q1 to Q6. The data for each digit is sent sequentially to the card once every second, under control of the software.

The display used in the prototype is from a calculator, and is the type that will be supplied in the kit for the project.

This particular display, made by National, is ideal for the purpose as it features small size and a 12-digit readout. Of these, only six are required, and the connection format is arranged to give a blank between each pair of numerals.

The software

As already explained, there are two programs on the disk that will be supplied with the kit, named AT_TIME.COM and SYSTIME.COM. The latter is for an XT or an AT, and uses the DOS time clock rather than the hardware clock present in an AT.

The program AT_TIME.COM is for an AT only, although I have the card installed in a 20MHz 386SX system, with the bus speed set to 12MHz. The card has performed perfectly in this system, driven by the AT_TIME.COM program.

For computers without a hard drive, the software is loaded by typing the name of the program after the computer has been booted. The program will then remain in memory until the computer is turned off.

For systems with a hard drive, the appropriate driver program can be automatically loaded by including the name of the program in the AUTOEXEC.BAT file. When the computer is booted, the program will be read into memory and commence working automatically. While the program can be installed in a subdirectory, it is easiest to copy it to the root directory of the drive.

For example, if the program is installed on C drive in the root directory, the AUTOEXEC.BAT file might read something like this:

```
echo = off
cls
PROMPT $e36m$p$e32m$g
PATH C:\windows;C:\DOS;D:\WS4
break = on
AT_TIME
CD\MENU
gmouse 2
gmenu
MENU
set TEMP=C:\WINDOWS\TEMP
```

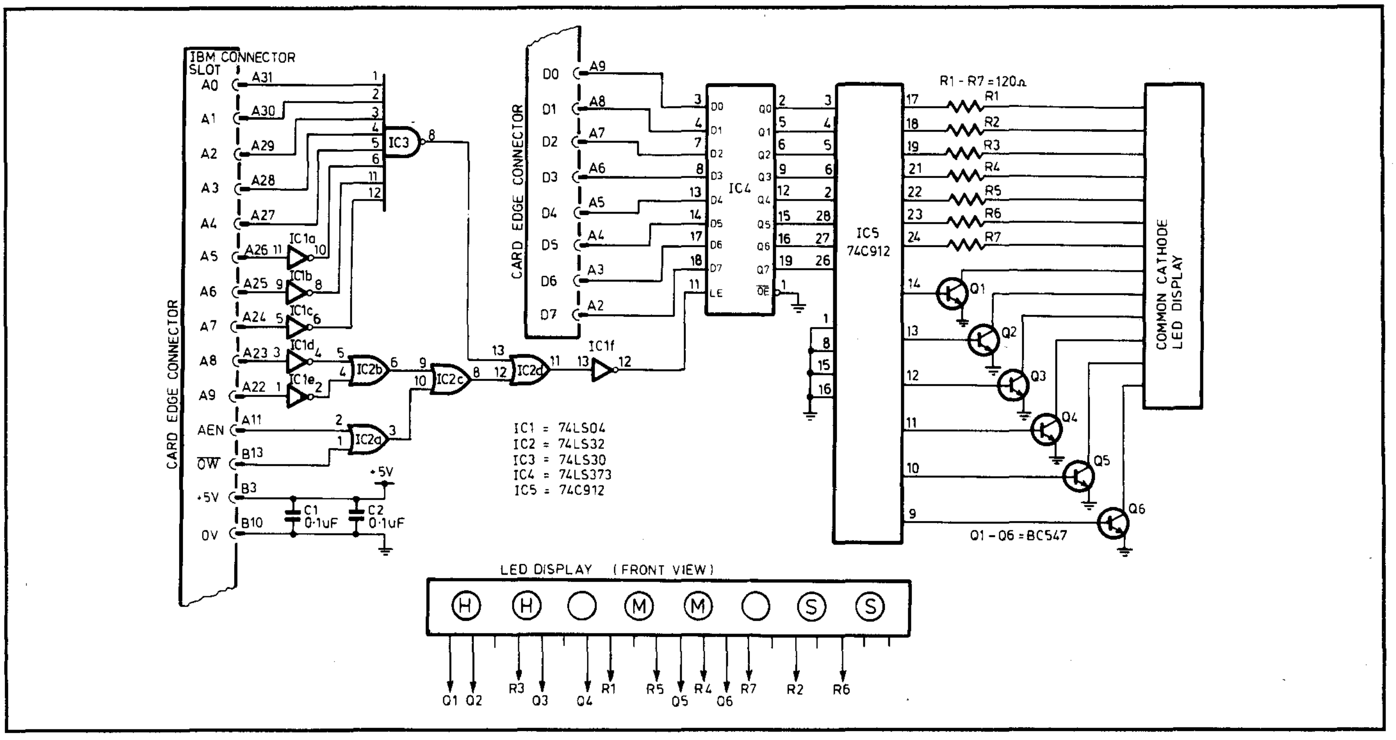
This sequence has the name of the clock card driver program before the directory is changed from the root directory to one containing a menu program and the mouse drivers.

Note that the AUTOEXEC.BAT file should be edited using a text editor or as an ASCII file in a wordprocessor, to prevent control characters being added to the text. Incidentally if the date and time are wrong, they can be corrected using the DOS commands TIME and DATE. To change the time, simply type TIME under the DOS prompt and enter the new time. For an AT the new time will be stored in battery RAM and should be correct at the next bootup. Similarly, typing DATE under the DOS prompt allows the date to be changed, and again the changes will be stored. The alternative is to change the time and date using the setup program.

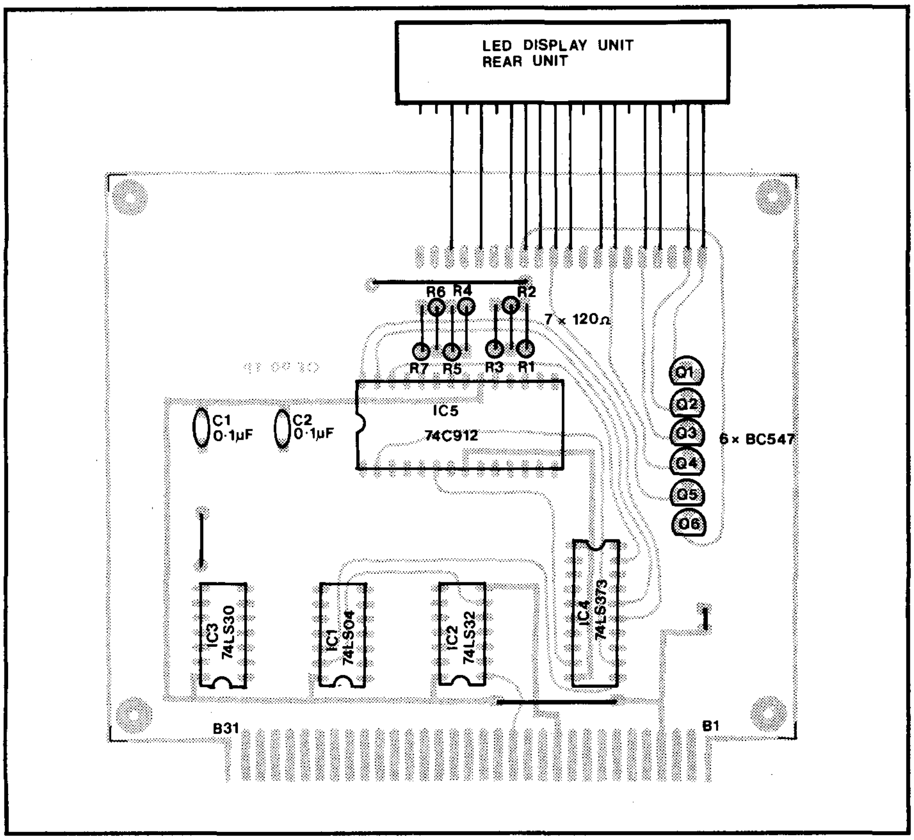
The format of the time display is shown on the circuit diagram, and the date format will usually be DD/MM/YY. However, this can vary depending on the country chosen in the CONFIG.SYS file. For Australia, the line:

country = 061,, C:\DOS\country.sys

will be required in the CONFIG.SYS file. This line assumes that the DOS files



The circuit is essentially a parallel output port driving a six digit, seven segment LED display. The port address is decoded by ICs 1, 2 and 3, the data is latched by IC4 and the display is driven by IC5.



This layout diagram is for the prototype and the track design may be different for the board that will be supplied with the kit. The track pattern shown is the bottom layer and care should be taken that components are mounted on the correct side of the board. Note that IC4 faces the opposite way to the other ICs.

PARTS LIST

Resistors

R1,7 120 ohm 1/4W

Capacitors

C1,2 0.1uF mono or ceramic

Semiconductors

Q1,7 BC547 NPN transistor
IC1 74LS04 hex inverter
IC2 74LS32 quad OR
IC3 74LS30 eight input NOR
IC4 74LS373 eight bit latch
IC5 74C912 six digit display driver

Miscellaneous

Doubled side PCB, coded OE 90 TP; 12-digit miniature common cathode display; 200mm length of 13-way ribbon cable; software as supplied.

Kits of parts for this project are available from:
Oatley Electronics,
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.
Cost of the kit, which includes a professional quality double sided, plated through PCB, all components, the display and the software is $59.90, plus $2.50 P&P. Commercial interest in this project is also invited and enquiries should be directed to the above address.

are installed on C drive, in a subdirectory called DOS.

Assembly, installation

Assembly of the PCB is simply a matter of fitting and soldering the ICs (in sockets or directly), the transistors and resistors. Note that IC4 faces the opposite way to ICs 1, 2 and 3 and that the seven resistors are all mounted vertically. The layout diagram shown is for the prototype, and the board that will be supplied with the kit may have a different track pattern but should use the same component layout. If there are any major changes, a revised layout will be supplied with the kit.

The LED display is connected with a 200mm (or so) length of 13- way ribbon cable. The layout diagram shows the rear of the display and the physical location of the connection points, which are all located along the bottom of the display. As shown, a total of seven connection points are not used, including the first two on the left. Take the usual precautions when soldering and use a fine tipped iron, as some of the solder points are fairly close to each other.

When construction is complete, examine everything carefully to ensure there are no accidental solder bridges. You might also like to read the resistance between terminals B3 and B10 (supply terminals) to check for a possible short circuit.

Once convinced that everything is ready to go, the card can be plugged into the computer. Although this may take a bit of courage, it is unlikely that any damage will occur providing the supply lines on the card are not short circuited. This happened during the development process, causing the offending tracks on the card to be vapourised. However no damage occurred to the computer (whew!).

The card can be plugged into any slot, and the components should face towards the right, as per the standard used in the IBM. Naturally, the power to the computer should be off when the card is inserted into the socket. Also check carefully that the tracks on the card are not shorting adjacent terminals of the socket. The display simply hangs outside the front of the computer, held by the ribbon cable. A piece of insulating material should be glued over the rear of the display to prevent accidental shorts between tracks on the display and the case of the computer.

When the card is installed and you have plucked up the necessary courage, turn on the power. Needless to say, switch off immediately if things go wrong, although we repeat that this is unlikely.

The display will be random at first, as it needs the software to cause it to function. When the computer has fully booted (hopefully with no problems), it remains to run the software as already described.

If all is working well, the computer's time will be displayed with the seconds display updating every second. Pressing both shift keys for the AT version of the software should cause the date to be displayed.

The time display will return after approximately five seconds. The display itself can be dressed up in various ways, although it looks quite presentable as it is. A red filter will enhance its readability, while a small case could be constructed to enclose the display.

Otherwise, that's it, and when you have it all up and running you will see what I mean about the usefulness of this project. ■

Mini project for computers:

RS-232 interface for Decwriters

Although they're officially obsolete and no longer supported by the manufacturer, DEC's 'Decwriter' terminal/printers are still quite suitable for use with personal computers. They're very solid and reliable, and can be picked up very cheaply. Here's a very cheap interface to allow one to be used with any computer having an RS-232 port.

by PETER LAUGHTON, VK2XAN

There must be literally hundreds of old Decwriter printers, floating around, either still in commercial use or in disposal stores, auctions, etc. I recently acquired a couple from work and then tried to work out how to connect it to a Microbee computer.

The first thing about the old Decwriters is that most of them operate at 300 bauds. On the old 'Bee, this is not too hard as it has an RS-232 port that can be configured easily to run at 300 bauds.

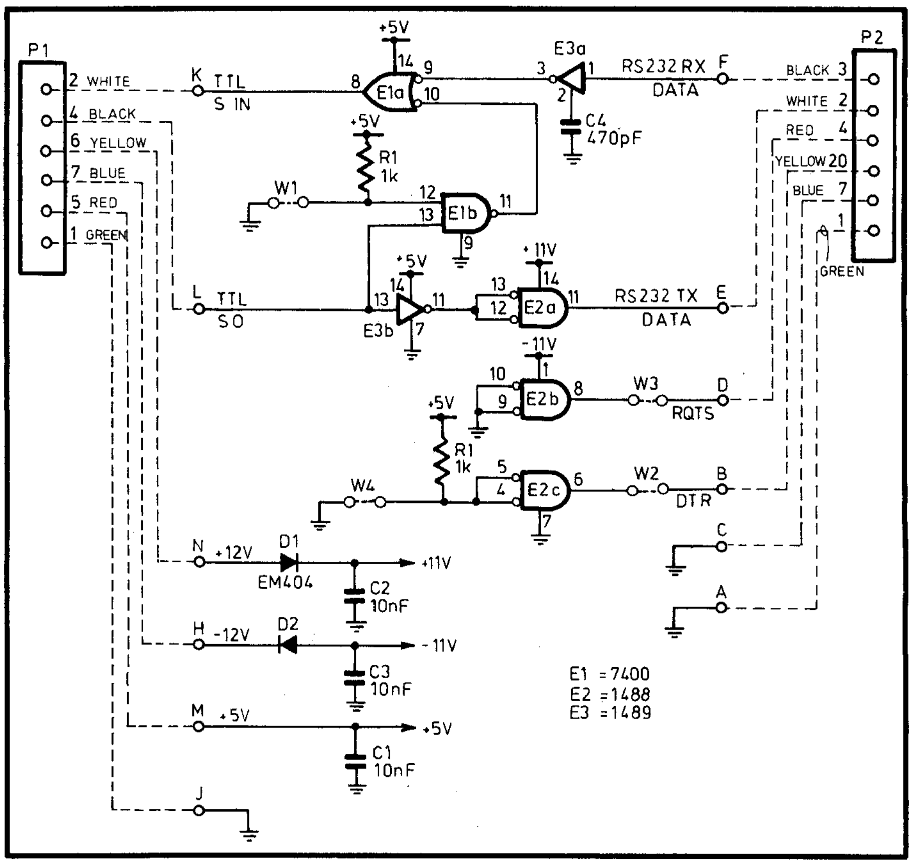
The next thing to be considered is that the input to the Dec's are either four to 20mA current loop, or TTL logic levels.

An interface was described in *EA* some time ago for the four to 20mA option, by Tom Moffat. This interface can be used directly with the four to 20mA input, with the advantage that for the Dec no program to do the conversion from RS-232 to Baudot code is needed. But that interface, unfortunately, needed a 110 volt transformer, which is both inconvenient and expensive to buy.

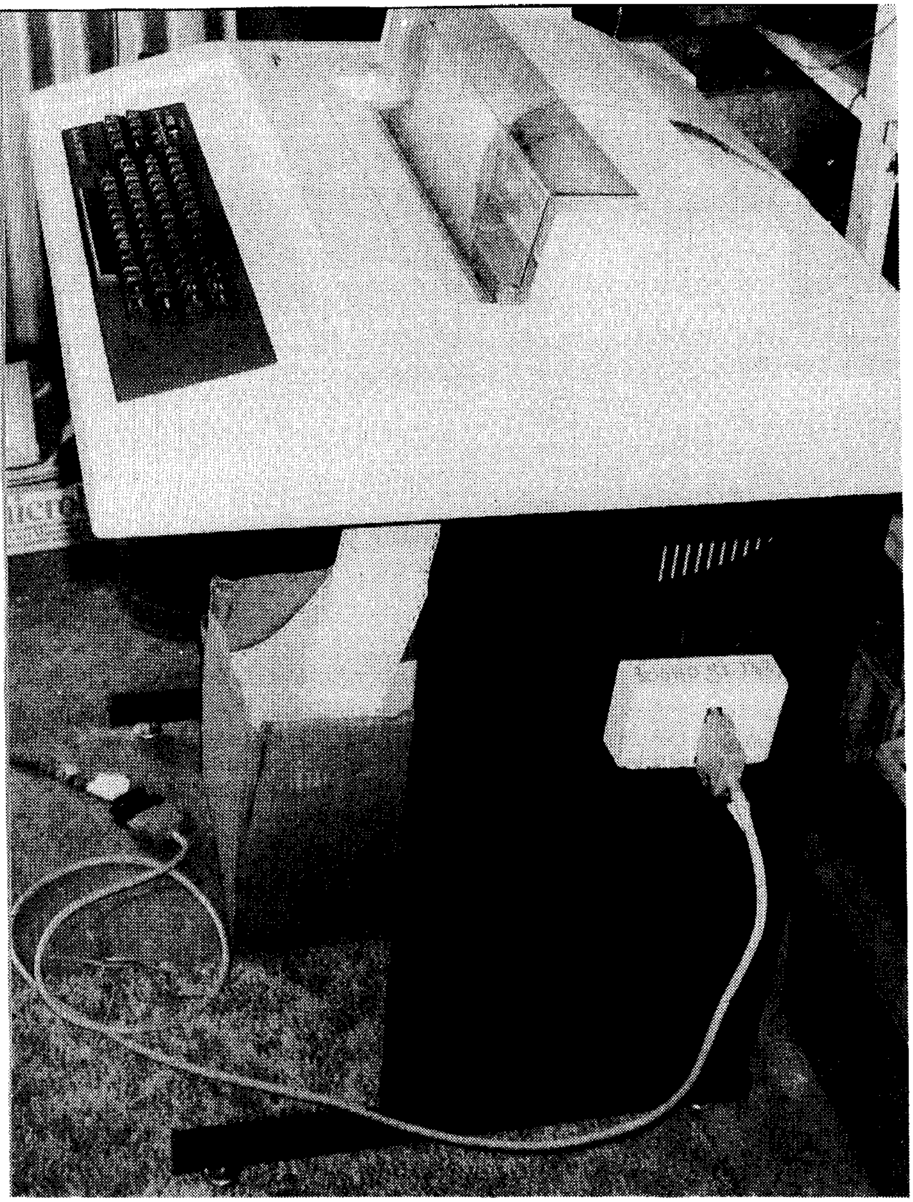
What is needed is an interface that can be powered from within the Decwriter and fits within the cabinet. Some investigation revealed that DEC did have an interface to do the job, but that old Decwriter printers are no longer supported. It was also learnt that Autotrol in America had an interface card to interface a Dec to their CAD computer.

An interface card was obtained and fitted to the Decwriter. It appeared to be a four to 20mA current interface unit, without the 110 volt transformer. Unfortunately, the interface that I obtained, doesn't work: All the numbers have also been ground off the IC's, so the internal works cannot be figured out, or duplicated. It also appears that Autotrol no longer supports the interface and at the time of writing, will not devote resources to finding the circuit information required to set the interface working.

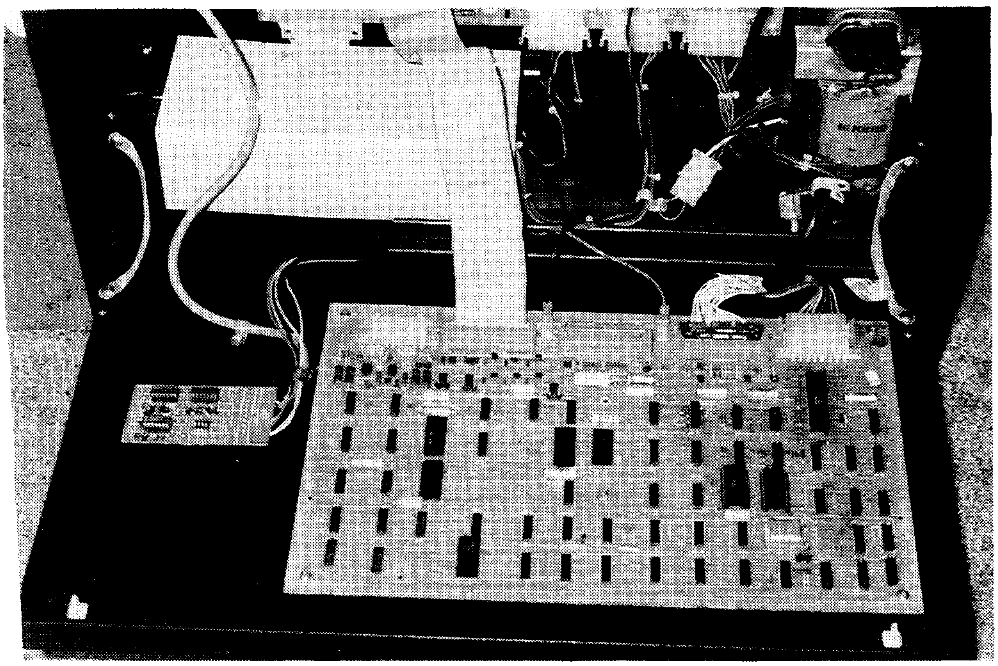
The following project is an interface based on the DEC design that is powered from the logic card on the Decwriter, does the conversion from RS-232



The schematic for the interface, which uses only three low-cost chips.



Above: A general view of the author's modified Decwriter, with its new RS-232 connector mounted on the side. Below is the interior, with the interface board at lower left.



to TTL logic levels, and doesn't need any external program to run.

There is no reason why it would not run up to 19.2k bauds and is transparent with respect to parity etc. This means that it should work for other applications that need conversion from RS-232 to TTL logic level signals.

The interface also supports communications from the printer to the host so that you can control the 'Bee from the keyboard that is on the Decwriter.

(P.S. For those with dead 'Bee keyboards, this is an ideal way to get the old 'Bee going again as all of these old printers seem to have full size QWERTY keyboards as well as a numeric keypad. You need to have the 'in#4' command working; and as the Decwriters don't have a reset key, that needs to work also).

There are some disadvantages with the old Dec's. Obviously, parts can be a problem; but they were built to last and there are many still working with no maintenance, 20 years after they were made. Sheer size is a problem in a computer room, but as they are freestanding, it leaves the computer desk space free, and the paper is meant to fit neatly beneath the printer. They are relatively noisy in operation, though not as bad as the early teletype machines were.

I used a DIP switch for the setup for CTS and RTS data lines, but it could be hardwired as the 'Bee doesn't seem to mind whether these pins are on or off.

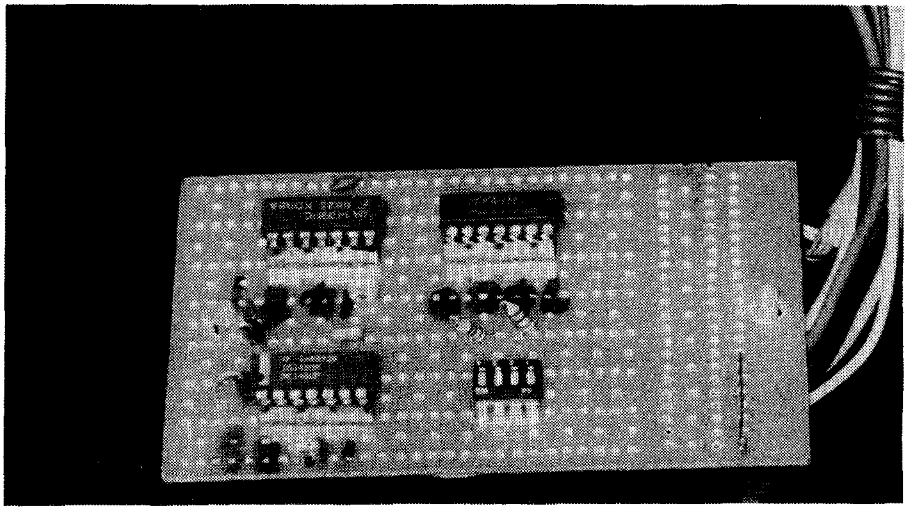
I wired the interface on a piece of perforated circuit board and soldered wire links between the three IC's and the other minor components. It's also a good idea to use IC sockets, as these are relatively inexpensive and convenient. Almost any wiring scheme could be used as the data rates are not high. Those who are clever could, no doubt, make a PCB up. Unfortunately not having access to the original DEC card nor a board layout to copy, I used the perforated IC board from Dick Smith.

All other components are available from any electronics store or from Radio-spares by mail order. Total cost for the project was in the order of $20 and it took about two hours to wire up, with another two hours or so to fit to the Decwriter.

I used a blank power outlet and spacer block mounted on the side of the printer; however there is no reason why you couldn't run a lead directly from the interface to the computer.

NOTE: The interface lead as shown wired in the diagram is wired for 'null modem' operation. If you use the

RS-232 Interface



A close-up of the author's prototype, wired up on a small piece of perforated utility stripboard. The small DIP switch visible at lower centre was added to allow for convenient setting-up of the CTS and RTS control lines — although with the author's $20 Microbee, this turned out to be unnecessary.

socket on the side of the printer, you will need to use a null modem lead to connect to the computer. This is an RS-232 cable with pins 2 and 3 cross connected and pins 1, 4, 5, 7 and 20 connected straight through.

If you are directly connecting to the computer, just connect the RS-232 DB25 connector pins 2 and 3 to the circuit pins 3 and 2. This will make the connection automatically. Don't worry if you get it wrong, the RS-232 standard is pretty easy to work with and no damage will be done. If you still don't know what to do, cotact your local computer club or myself, care of the magazine.

Before powering up, check the voltages at the pins of the IC sockets and confirm that the + and –12V and +5V are available and within specifications. Note that the power supply on the Dec can deliver about 1.5 amps extra at + and –12V, and about 2 amps extra at +5V DC. This can be useful to power other projects.

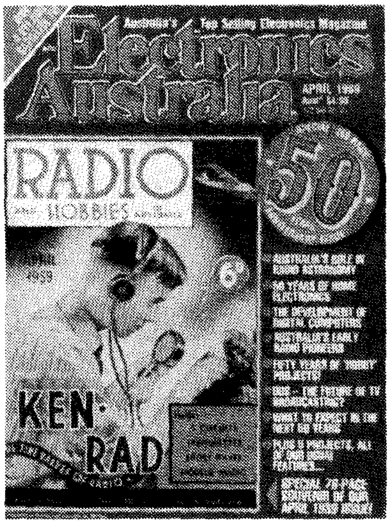
The interface doesn't seem to mind whether the computer has a true RS-232 interface or not. The negative voltage doesn't seem to be needed to operate the unit. This is good news for those with an RS-232 port that doesn't have that voltage.

Finally, this article was typed into a $20 Microbee and printed via the above interface on a $2 Decwriter printer!

PARTS LIST

- 1 7400IC
- 1 1488 IC
- 1 1489 IC
- 1 470pF capacitor
- 4 0.4uF capacitors
- 2 1N4001 diodes
- 1 RS-232 DB25 socket
- 1 RS-232 DB25 null modem lead
- 1 Printed circuit/perforated board
- 1 8-way plug to connect to the Decwriter logic board
- 1 4-way DIP switch operational)
- 3 16-pin IC sockets
- 3 1k ohm resistors

Several lengths of different coloured insulated hockup wire.



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20 MB Harddisk & card	$465.00	Mono & CGA (dual) card	$75.00	Panasonic 9 pins	$350.00	12" x 12" Digitiser	$590.00
42 MB VC HDD & card	$680.00	EGA card	$150.00	Epson 10" 9 pins	$380.00	Mouse with software	$65.00
80 MB VC Harddisk	$1000.00	VGA card (16 bits)	$200.00	Epson 10" 24 pins	$550.00	Keyboard draw	$75.00
100 MB VC Harddisk	$1225.00	Dual mode monitor	$188.00	Star colour	$380.00	Joystick	$30.00
200 MB ESDI Harddisk	$1950.00	EGA monitor	$550.00	Epson 15" 24 pins	$1280.00	Printer stand	$25.00
360 KB Floppy disk drive	$130.00	VGA monitor	$620.00	Printers switch box	$45.00	Diskette Storage Box	$18.00
1.2 MB Floppy disk drive	$150.00	NEC 2A Super VGA	$720.00	Printer cable	$12.00	360 KB DDSD Diskette/10	$10.00
1.4 MB Floppy disk drive	$138.00	NEC 3D Multi-sync	$1080.00	Printer stand	$25.00	1.2 MB DSHD Diskette/10	$22.00
AT HDD/FDD controller	$185.00	NEC 4D 16"	$2180.00	TI Laser	call	1.4 MB DSHD Diskette/10	$35.00
		NEC 5D 20"	$3630.00	HP Laser	call	Co-processor from	$250.00

PC SX

80386 SX
1024 KB RAM
42 MB HDD
LM = 26 MHz

MONO	$2013
EGA	$2450
NEC2A	$2640

PC 386

80386 — 33 MHz
1 MB RAM
80 MB HDD
LM = 59 MHz

MONO	$3712
EGA	$4149
NEC3D	$4729

READER INFO No. 40

PC networking, LANs:

Building tomorrow's 'seamless' networks

In the first stage of integrating personal computers into the office environment, individual self-contained systems were acquired in ad-hoc fashion. The next stage has been to link them into small local-area networks or LANs. But to gain the full benefits of the technology, it's necessary to link LANs with each other and the rest of the communications world...

by STEVE KAUFMAN

Perhaps no company better illustrates the new age of 'enterprise-wide' computing than Microsoft. About 4500 employees use 9000 personal computers at the software giant's 16-building headquarters complex in Redmond, Washington, and it's almost as if everybody is sharing one giant, easy-to-use system.

The technological magic doesn't stop in Redmond, which has strong computer links with many other Microsoft facilities worldwide. "Almost everybody is on line with everybody else," says Neil Evans, the company's director of management information services.

Almost all of the network links at Microsoft were done by Ungermann-Bass of Santa Clara, a Tandem Computers subsidiary and one of two Silicon Valley companies that are well positioned to take advantage of the explosion in enterprise-wide networking. The other is Synoptics Communications of Mountain View, the fastest-growing computer-networking company. In its own way, each company aims to help customers make sense of their computerised Towers of Babel by linking all their computers into one seamless digital network.

"In the last decade, companies have spent a fortune on computers, but they have managed to show only relatively small gains in productivity," says Ralph Ungermann, the president and co-founder of Ungermann-Bass. "They want enterprise-wide computing to change that."

Only a few years ago, companies that began dabbling in local area networks, or LAN, had nothing resembling a grand plan. In 1983, the typical LAN linked four to seven personal computers and allowed them to share a printer or simple software like a word-processing program. The Gartner Group, a Stamford, Connecticut, market research firm, says the US LAN market then totalled about US$250 million.

Mr Ralph Ungermann, president and co-founder of Ungermann-Bass.

Today, typical LANs connect about 15 computers each, and they're evolving from corporate islands to a digital lattice that links LANs with other LANs, LANs with minicomputers and mainframes, and LANs with computers in other buildings. With the help of other equipment, LANs are also linked to other computers worldwide.

Gartner Group estimated that 45% of all personal computers used in business in the United States would be linked into a LAN by the end of 1990, up from 35% in 1989. The figure is expected to rise to 70% by 1994. The worldwide LAN and LAN interconnect market was expected to hit US$6 billion last year and swell to as much as US$9 billion by 1994.

Leading the pack

More recently, LAN and LAN interconnect technology — the linking of LANs to each other and to even broader networks — took another step forward with the development of computerised 'concentrators.' These support and manage much bigger LANs, allow different LANs to 'talk' to each other, and make it much easier to find and fix problems in the network.

Ungermann-Bass, which was founded as the first computer networking company in July 1979 and now has sales of about US$250 million a year, has always adhered to an open, enterprise-wide approach. It links more types of computers than any competitor. Many of its networks are built around telephone wire, but they aren't limited to that.

The company, which has been growing more than 35% a year since it was acquired by Tandem in March 1988 for US$260 million, has focused on building long-term relationships with the computer departments of big corporations. It works with such large clients as Pacific Telesis Group, Procter & Gamble, Shell Oil and the New York Stock Exchange. Three years ago, it helped General Motors link three auto plants in metropolitan Detroit, and now the company is doing similar work for Nissan Motor and Toyota Motor in Japan and Ford Motor in Britain.

"At any point in time, another company probably has a hotter technology than Ungermann-Bass and may be growing more rapidly. But it probably has the

Ungermann-Bass is a subsidiary of Tandem Computers, which is based in these impressive facilities in Cupertino.

Fortune 500 companies," said analyst Michael De Santis.

Meanwhile, Synoptics is skyrocketing on the strength of sales of its telephone wire-based LANs which support Ethernet, the most common networking standard.

Synoptics reported sales of US$177 million in 1989, an increase of 93% over the previous year. Analysts predict sales to double once again this year.

Unlike Ungermann-Bass, Synoptics sells most of its products through independent retailers. Some analysts say this may become a problem as more companies computers are linked into giant networks.

Others are not so worried. "Ungermann-Bass was born and bred in the minicomputer era when direct sales and top-notch customer support was The Bible.

Synoptics, in contrast, is a child of the personal computer/LAN era when indirect volume sales became important," said analyst Mary Modahl. "Now we are seeing the two worlds collide, and the jury is still out as to which approach will win."

Even if Synoptics eventually passes Ungermann-Bass in the United States, it may have a hard time rivalling its older competitor in the international marketplace.

U-B already does 55% of its business outside the US and that percentage of sales is likely to increase even further as the company, with financial support from Tandem is pushing its overseas efforts.

U-B currently dominates the LAN market in Japan and has identified tremendous market opportunities in Europe amid the pending economic unification of most of the major countries in 1992.

New opportunities

And more opportunities are being created with Eastern Europe's adoption of market driven economies. "We can soon start looking at Europe as a market with almost 800 million people. That is more than four times the size of the American market," Ungermann notes.

Meanwhile, his company is hardly giving up the fight in the US market.

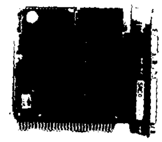
AST Research, a leading maker of IBM-PC-type computers, picked U-B over Synoptics when the company consolidated all of its operations, scattered around Los Angeles, into two large buildings in Irvine.

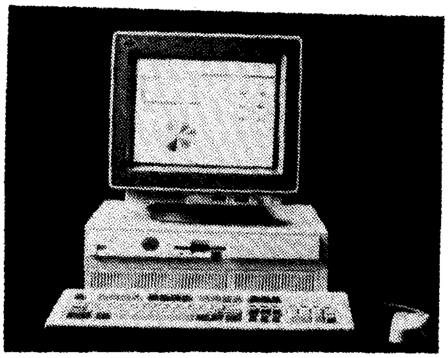
AST said it chose U-B's networking system because if offered more pieces of the overall networking pie, including computer network add-in cards to link different LAN and software to help run the network.

While Synoptics would have been able to offer the same capabilities, those would have to be handled through outside service companies.

"With Ungermann-Bass, we go to just one company for everything. That simplifies things, especially if there are problems later," said Paul Claffrey, who manages the network at AST. ■

Computer News and New Products

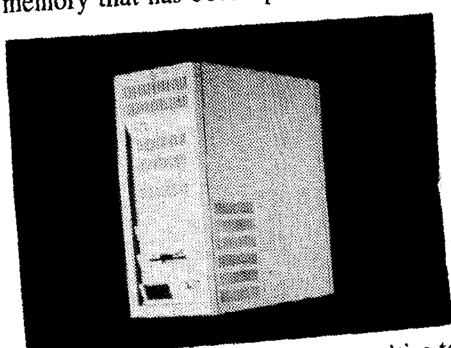




IBM adds 486-based PS/2s

IBM has expanded the high end of its Personal System/2 family with a variety of new systems and options that deliver advanced functions and substantial performance gains over previous PS/2 models.

Designed to unleash the power of the Intel i486 processor, two new PS/2 members – the PS/2 model 95 XP 486 and the PS/2 model 90 XP 486 – combine the industry's fastest microprocessor with Micro Channel architecture, advanced graphics known as Extended Graphics Array (XGA), high-speed memory that has been optimised for the



i486 and significant storage capacities to satisfy customers' most advanced computing needs.

An integrated design combines a new high-performance graphics subsystem, unique processor-complex design for future upgradability, and an advanced file subsystem with the i486 processor to deliver throughput rates that are up to two and a half times faster than the existing top-of-the-line, floor standing PS/2 model 80-A31.

The model 95 and the model 90 are available with either a 25MHz or 33MHz processor, depending on customer requirements. Customers with 25MHz versions of these systems can easily upgrade to 33MHz. In addition, customers can integrate an optional 256KB memory cache option to achieve even faster processing power.

The PS/2 model 95 XP 486 is a local-area network (LAN) file serve with plenty of memory, storage and advanced technologies to handle complex network-server tasks. The floor-standing system can accommodate nearly nine gigabytes (GB) of IBM storage options – 1.6GB is supported internally through inclusion of up to five 320MB fixed disks, while an additional 2.24GB of storage is available through the PS/2 External Storage Enclosure for SCSI devices. Up to four of these enclosures can be attached to the system.

Toshiba develops 2.5" hard disk drive

Toshiba Corporation has developed a 2.5" 'micro' hard disk drive (HDD) for small personal computers. The new drive has a memory capacity of 43 megabytes – the largest capacity among HDDs of this size available in the market.

Mass production of the new micro HDD (MK-1122FC) is scheduled for April 1991.

At 180 grams in weight and 17 millimeters in height, the new drive compares favourably with the average 800g and 41mm of present 3.5", 40MB HDDs. Moreover, the adoption of a small rotary voice-coil-motor and 32KB cache memory reduces the average seek-time (the time taken to retrive written data) to 23 milliseconds.

OrCAD upgrades product line

OrCAD has upgraded its very popular range of design automation software. Among the new enhancements is 'ESP', a new graphically based design environment which greatly improves the operating convenience and speed in performing sequences of design tasks. The five original OrCAD packages are also no longer limited to 640K of memory.

SDT Release IV provides the new ESP framework together with many new enhancements and features – including expansion of the symbol library. This now contains over 20,000 symbols, including IEEE.

VST Release IV takes the schematic from SDT, and provides simulation editing. It now includes a new netlist format, supporting incremental design changes for much faster simulation.

PCB Release IV now also features the new ESP interface, and provides significantly improved speed. It also supports semi- and automatic placement, SMT support, user-defined macros and a much larger library.

PLD Release IV has a new compiler with greater capacity, supporting open architectures. Information transfer between PLD and the other packages is now also much faster.

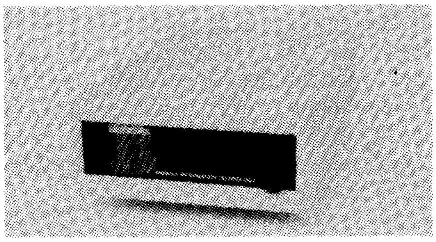
MOD Release IV now includes enhanced debugging, better optimisation and code generation to eliminate redundant gates in PLD simulation.

Pricing for the new packages is SDT $1195, VST $1985, PCB $2995, PLD $995 and MOD $995. Updates to existing OrCAD packages will be available via the one year free update service and the Update Support Extension (USE) scheme, or may be purchased.

For further information circle 180 on the reader service coupon or contact Prometheus Software Developments, 5 Devlin Street, Ryde 2112; phone (02) 809 7255.

Portable tape streamer

The BIT Portable Tape Streamer can be quickly and conveniently plugged into a port at the back of any PC, back-up completed and the streamer



unplugged to be taken to the next computer in the office. It does not require a separate power supply, so it is easy to carry and to connect to your computers as they require back-up. The BIT Tape Streamer actually draws its power from the computer through a specially designed BIT controller card.

The system includes the tape unit, a controller card which fits into any expansion slot in a PC, a 60-megabyte tape cassette, software and manual. The easy-to-use software offers a menu-driven version or command line control in batch file mode. You can be ready to start back-up within 10 minutes of first installation.

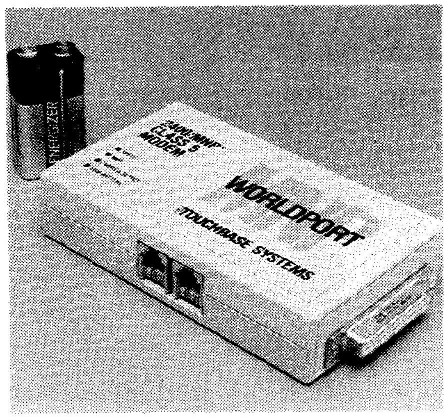
The BIT Portable Tape Streamer achieves file-by-file back-up at up to five megabytes per minute. If your back-up exceeds the tape capacity, the system provides simple prompts to allow you to change cassettes and complete the back-up. All data is verified during the procedure and errors corrected without the user needing to intervene. MS-DOS and PC-DOS 2.0 and higher are supported, as well as Xenix and PC-MOS in image or file-by-file mode.

For further information circle 166 on the reader service coupon or contact Banksia Information Technology, Suite 205, 83 Longueville Road, Lane Cove 2066; phone (02) 418 6033.

Pocket modem compresses data

For people on the move, the Worldport 2400/MNP pocket modem offers MNP-5 data compression, boosting throughput up to 4900bps – error free.

Distributed and supported in Australia by Dataplex, the 2400/MNP is claimed to be the smallest modem available in its category. Operating from batteries or mains, it can be used on any computer with an RS-232 serial port and is compatible with both Bell and CCITT transmission protocols.



Major features include a constant speed interface, AT command set compatibility, auto-dial, auto-answer, auto-rate selector, speaker and LED indicators.

For more information circle 165 on the reader service coupon or contact Dataplex, PO Box 541, Lilydale 3140; phone (03) 735 3333.

Super turbo XT motherboard

Electronic Solutions has released the MBXC2, an 80286-based XT motherboard which comes in at a staggering 10.9 on Norton's SI – that's 31MHz compared to 4.77MHz on your standard XT, or 6.5 times faster.

Upgrading an older machine by fitting an AT motherboard is often not a proposition due to differing cards, etc. The MBXC2 board gets around this problem by using a completely standard XT bus, but with the speed and performance of a 12MHz zero wait state 80286 processor and memory. While disk performance is not up to that of an AT disk controller, neither is the cost of the upgrade. And computing performance is otherwise up to the standard of the latest 'hot' ATs.

All standard XT cards run perfectly. Speed is switchable between standard 4.77MHz and turbo speed. Up to 1MB of RAM can be fitted on-board. For even faster operation, the memory above 640K can be used as 'shadow RAM' for speeding up BIOS operations or as a RAM disk. The board provides software selection of wait-state.

For further information circle 166 on the reader service coupon or contact Electronic Solutions, 5 Waltham Street, Artarmon 2064; phone (02) 906 6666.

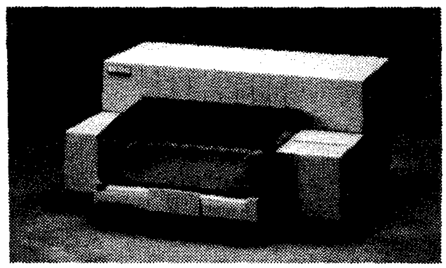
Easytrax upgraded

Protel Technology's very popular low cost PCB design package Easytrax has been upgraded, and is now called Easytrax 2. As before it is intended for the part-time designer, hobbyist or student.

The key improvements added in are:

- Pad-to-pad autorouter (identical to that of the more expensive Autotrax package)
- Metric support – includes use of metric grid and co-ordinates
- Additional printer/plotter options including Postscript drivers
- New hi-resolution video drivers including the 1024 x 768 ATI VGA driver
- Improved Gerber file generation

For more information circle 169 on the reader service coupon or contact Technical Imports Australia, 220 Pacific Highway, Crows Nest 2065; phone (02) 954 0248.



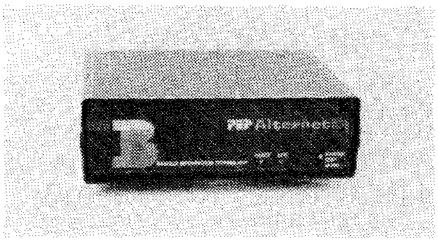
Higher performance HP deskjet

Hewlett-Packard has introduced a higher-performance lower priced HP DeskJet printer – the HP DeskJet 500.

The HP DeskJet 500 improves upon the performance of its predecessors by offering more fonts and better font spacing, water-resistant ink and compatibility with Microsoft's *Windows 3.0*.

Like the HP DeskJet PLUS printer, the HP DeskJet 500 printer produces up to three pages of text or two pages of graphics per minute, in 300dpi resolution. It has four internal typefaces – CG Times, Letter Gothic, and portrait and landscape Courier, each available in medium, bold, italic and bold italic treatments. Type sizes are Courier 6 and 12 point in portrait orientation and 6, 12 and 24 point in landscape. CG Times and Letter Gothic are in 6-point and 12-point sizes.

For further information circle 170 on the reader service coupon or contact Hewlett-Packard Australia on (008) 033 821.



'No slot' networking

Banksia Information Technology has announced an economical alternative to networks, for organisations which need to link their PC systems without the headaches of network costs and management.

PEPalternet is virtually a 'no-slot network' that allows users to share printers, modems, host computers and files without installing specialised add-in boards and administration software. The system operates through the PC's existing serial communications port. A simple twisted pair wire connects up to 16 PCs in a department or office and the software offers pop-up menus which can be called from within an application.

The PEPalternet begins with an eight-user hub and can easily be expanded to 16 users by the addition of a second hub. The shared printers can be connected to any one of the PC's serial or parallel ports or to one of the eight serial ports on the hub.

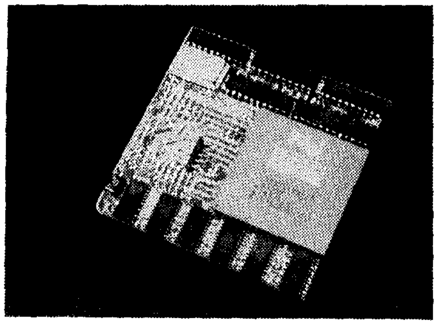
PEPalternet's file transfer capability includes send-to and get-from any PC connected to the hub, distribution to a number of PCs and an electronic mail facility.

For more information circle 167 on the reader service coupon or contact Banksia Information Technology, Suite 205, 83 Longueville Road, Lane Cove 2066; phone (02) 418 6033.

486 upgrade adaptor

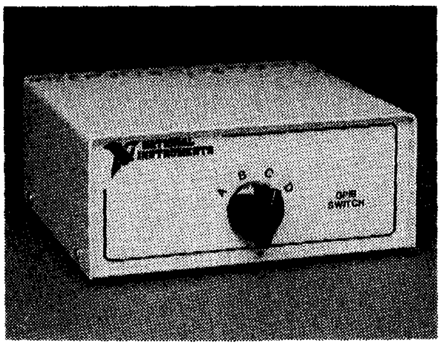
GO!486 is a plug-in daughter board that replaces a 16/20/25MHz 386 and 387 processor to deliver full zero wait-state 486 power in minutes. By using onboard caching, the board achieves zero-wait-state performance while allowing the motherboard to run at its original speed.

Due to the 'computer on a chip' design of the 80486, GO!486 is said to achieve 97% of the performance of a 486 motherboard, for a fraction of the price. It can be installed in minutes. Unlike motherboard swaps or upgrading to a new machine, there is no need to



format the hard disk or transfer data.

For further information circle 175 on the reader service coupon or contact the Australian distributor Computer Connection, 220 Pacific Highway, Crows Nest 2065; phone (02) 957 6719.



GPIB switchbox

National Instruments' new GPIB-switch switches up to four GPIB sources into one common GPIB port. Users of up to four computers can share a single GPIB device – a printer or plotter – with this unit. It can also be used to select peripherals independently.

The economical GPIB-switch box also takes up little room – it measures only 165 x 171 x 57mm.

For more information circle 171 on the reader service coupon or contact Elmeasco Instruments on Sydney (02) 736 2888.

Run-time version of Labview 2

National Instruments has announced its new LabVIEW 2 Run-Time system – a compact, operate-only version of the popular LabVIEW 2 graphical programming software. The run-time system is tailored to end-users and VARS who want only to run ready-to-use programs in application for test stations, process monitoring and control systems and other turn-key data acquisition and instrument control solutions.

The intuitive front panels are easy to learn and use, reducing training costs and operator mistakes. The run-time system requires only two megabytes of RAM as compared to at least four megabytes required by the full-development system.

For further information circle 172 on the reader service coupon or contact Elmeasco Instruments on Sydney (02) 736 2888.

Pocket computer for engineers

A pocket computer boasting over 1100 built-in engineering software programs and functions, double-precision calculations and a large four-line, 40

column liquid crystal display giving exceptional fast rate of execution has been released nationally by Sharp.

The PC-E500 has 32K bytes of RAM as standard expandable to 96K bytes by using an optional plug-in 64KB RAM card, and it has a large 256KB ROM. This has built-in comprehensive software covering maths, science, engineering and statistics.

The PC-E500 has powerful Basic language commands, including 60 maths functions, many options, and management of floppy disks, RAM files and cassette. The key layout is similar to a PC with the numeric keys positioned far right, scientific functions at the top and the QWERTY keyboard and five function keys to the left. The machine comes with a protective slide-on case. Options include a pocket 2.5" floppy disk drive and a thermal printer.

For further information circle 173 on the reader service coupon or contact your nearest Sharp dealer.

'Executive' range of 286/386/486 PCs

A new range of high performance 286-, 386- and 486-based personal computers has been released by Alldata: the Arrow Executive series. All models are fully assembled and tested in Australia, under rigid quality assessment/control conditions.

The two Arrow 286-based AT models operate at 12MHz and 16MHz respectively, and offer 1MB of zero-wait state RAM expandable to 4MB on the mother board. They come in a compact flip-top desk type case, with a 200W power supply, and have 4 x 16-bit and 2 x 8-bity expansion slots.

Next in the range is the Arrow 386SX, which operates at 16MHz 19.6MHz Landmark) and comes with 2MB of 0ws RAM expandable to 8MB, with a power supply and case as for the AT's.

The Arrow 386/25 and 386/33 models operate at 25MHz (41.9MHz Landmark) and 33MHz (59MHz Landmark) respectively, and offer 64KB cache memory plus 4MB of 0ws RAM expandable to 16MB. Even faster is the 486/25, which operates at 25MHz but clocks in at 114MHz on the Landmark test. This model provides caching within the 486 processor, and 4MB of 0ws RAM expandable to 16MB.

All models come with a full 12 month parts and labour warranty (on-site optional).

For further information circle 179 on the reader service coupon or contact Alldata, 27 Rhur Street, Dandenong 3175; phone (03) 794 5799.

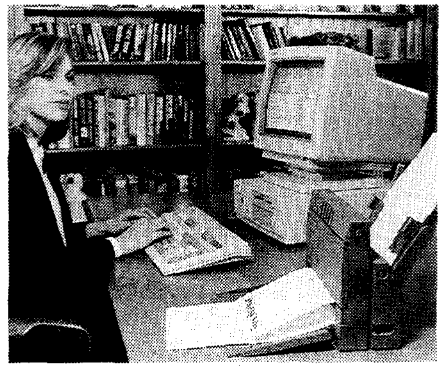
Compact bubble jet printer

Canon Australia has released an inexpensive battery-powered portable printer that fits into a briefcase, weighs only 1.8kg and offers print quality similar to that of a laser printer.

The diminutive newcomer to printing is the 'Little Squirt' BJ-10e, which uses bubble jet printing technology. Canon says that "Little Squirt is to the destop printer what the laptop computer is to the desktop PC."

The BJ-10e gives letter quality performance for home and office, with operating noise level greatly reduced. With the use of LePrint software which is optional, it can also print scalable fonts.

The replaceable bubble jet cartridge



contains both print head and ink, and being a complete unit, minimises risk of leakage under normal transportation handling. The ink has a life expectancy of 700,000 characters – about the size of a hefty novel.

Keyed at the control panel, it will print at 83cps on plain paper, A4, letter, legal, envelope or transparency, in high quality mode at 360 x 360dpi; and in economy mode at 180 x 360dip; in Courier or Prestige Elite.

The BJ-10e has a parallel Centronics type interface, and emulates the IBM Proprinter XL24E; and an input buffer of 37KB, or 3KB with 34KB reserved for font download.

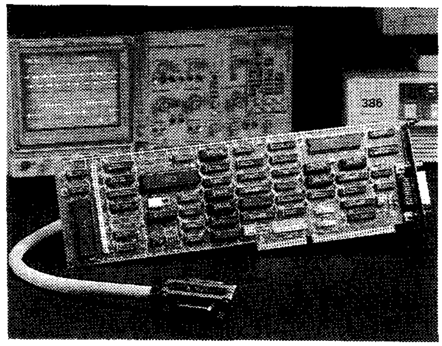
The recommended retail price is $795 (including tax).

1MB/s IEEE488 card for PCs

The new Power488 from IOtech is claimed to be the first IEEE 488.2 compatible board and software to provide high-speed IEEE instrument control plus additional I/O functions most often required by IEEE systems. Features provided on this new product were determined from an extensive survey of PC-based IEEE 488 users, resulting in a new 16-bit AT-bus compatible board that can replace as many as three separate PC boards.

Unlike other recently introduced boards which have simply added 488.2 compatibility, Power488 adds a host of additional I/O functionality which is programmable using the new SCPI command standard (Standard Commands for Programmable Instruments). Key hardware features include:

- 100% compatibility with the new 488.2 revision of the IEEE standard, including the ability to monitor bus handshake lines and to detect changes on the SRQ line.
- Data can be read from IEEE 488 devices at up to 1M byte/s, the highest available data rate supported by the IEEE 488 standard. The board uses the computer's 16-bit address and data bus with DMA capability to achieve the 1M byte/s throughput. Interrupt drive I/O is also supported, with 11 user selectable interrupt lines available.



- 40 lines of digital I/O provide the ability to read and control 40 discrete TTL-level digital signals.
- Five programmable 16-bit timer/-counters support a wide variety of configurations for counting pulses and measuring frequency or time. Pulse/frequency counting can measure up to 7MHz, and timing measurements can resolve down to 140 nanoseconds.

Power488 is supplied with Driver488 software, an enhanced version of IOtech's popular device driver software.

For further information circle 164 on the reader service coupon or contact Scientific Devices Australia, 2 Jacks Road, South Oakleigh 3167; phone (03) 579 3622.

Super VGA colour monitor

The new Philips 6CM3209 'Brilliance' Super VGA colour monitor offers a dedicated solution to today's need for higher-resolution display and clearer presentation of information, and is claimed to make multi-frequency monitors obsolete.

The monitor has a refresh rate of 60Hz – 4Hz higher than the multi-frequency monitors which are the usual solution for operation in Super VGA

mode. This higher refresh rate effectively eliminates image flicker, and gives a sharp, stable display that minimises user fatigue, even after extended operation.

The 6CM3209 is a dual-frequency monitor with a peak frequency of 37.8kHz in Super VGA mode, with a resolution of 800 x 600 pixels, as well as the standard VGA frequency of 31.5kHz (640 x 480) pixels. This dedicated high performance is said to allow both modes to be handled optimally, without the compromises made by multi-frequency monitors.

A fine dot pitch of 0.28mm ensures maximum resolution and legibility, while the non-glare coated Black Matrix screen provides optimum contrast and freedom from glare, as well as brilliant, pure colours.

The monitor and matched card package can handle the other major video standards – EGA, CGA, MDA and Hercules – ensuring full compatibility with users' existing software.

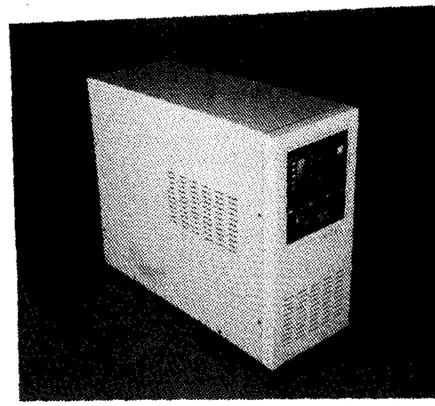
For further information circle 163 on the reader service coupon or contact Philips Components, 11 Waltham Street, Artarmon 2064; phone (02) 439 3322.

Australian-made 1500VA UPS

Critec has just launched its new Dataguard Series 2, the DG1500 UPS, which is 100% Australian designed and manufactured.

The DG1500 is a true no-break UPS, in that its inverter stage is continuously on line – so there is nothing to change over when the mains fail. The rectified mains and the battery are connected together via steering diodes. When the mains voltage drops, the battery diode conducts.

The DG1500 also produces low distortion regulated sinewave power, and can output 1500VA continuously. If the load power factor is 1, its output is 1500W. Because heating is a long term effect, the current limit circuitry is designed to allow substantial overloads before coming into operation. For example, the DG1500 can output



3000W (12.5A) for short periods, typically up to 5 seconds. This is useful for computer disk drive start and capacitor inrush in SMPS. In the extreme the DG1500 can even deliver 6.25A into a short circuit.

For further information circle 162 on the reader service coupon or contact Critect, Technopark, Dowsings Point, Glenorchy 7010; phone (002) 73 0066.