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SEPTEMBER 1991

HOW KODAK'S NEW PHOTO CD SYSTEM WORKS

THOSE COMPACT FLUORO LAMPS: *DO* THEY HAVE PROBLEMS?

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Bargraph		●	●	●	●	●
Zoom Mode[1]		●	●	●	●	●
Zero Mode[2]		●	●	●	●	●
Live Trend Memory[3]		●	●	●	●	●
Logic Function		●	●	●	●	●
Min/Max Recording			●	●	●	●
Store 5 readings			●	●	●	●
Relative Mode			●	●		
RMS Conversion					●	●
Frequency					●	●
dB level					●	●
High Accuracy(0.1%) 4-20mA				●		●
Intrinsic Safety				●		
EEx ib IIC T6						
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September 1991

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Kodak's new hi-res Photo CD system

Although the cost of Kodak's new Photo CD system may slow its penetration of the consumer market, professional graphic arts people are very enthusiastic about the high resolution electronic images it delivers. See our story starting on page 10.

Launceston's new college for air traffic controllers

On a visit to Australia's new college for ATC's in Launceston, Tom Moffat was very impressed with their computer simulation system. He also discovered an interesting new occupation: driving a radar 'blip'. Tom's story begins on page 26...

On the cover

It turned out to be surprisingly hard to capture the light output of our new low cost helium-neon laser (see page 60) on film, so we asked Federal editor Carmel Gatt to augment it with the glow of her smile. The result is pretty impressive, wouldn't you say? (Picture by Peter Beattie)

Video and Audio

Features

Projects and Technical

Professional Electronics

Columns and Comments

Departments

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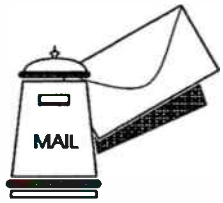
LETTERS TO THE EDITOR



Technical education

Your editorial in the May issue of *EA* really struck a nerve. Being German myself, got my education back home, and at the same time having been here since 1973 (naturalised in 1980), I have a good perception of what should be, and what should not.

You are correct in pointing out the problems as you see them, and you are even more correct questioning the scientific and technical eduction in this country.

But it's not just this area of education which one needs to question; the whole system of education is not geared to make us the clever country.

We have good teachers everywhere, and they are neglected, underpaid and frustrated. There is a distinct lack of equipment in many areas. I have been round young people leaving school, or having finished their apprenticeship and TAFE, not able to assess the basic problems they may be confronted with.

It's not just a question of the system either, the real problem is the attitude fostered in our society with little regard for the country. It's an attitude lacking in values necessary to bring Australia to the foreground of technology.

As long as we have inept politicians without a vision and only looking from one election to the next, as long as we have companies with inadequate management and not able to recognise their most valuable resource, their staff, as long as we have a society burdened with inefficient and overweight public services, as well as some unions still living in the last century, as long as Australia will knock itself and lack self esteem and confidence, we will not be able to turn around and make this country what it should be.

People need to realise that the next five years will most likely determine our future for the next 25 years, a whole generation of the population.

Maybe it's the lack of certain traditions, which have not been allowed to establish themselves, but whatever it is, we must recognise in the first instance our problems, and the extent of them.

Solving the problems is not as hard as it may seem, it only requires determination and hard work. The catch is, we must also be able to look in the mirror and be honest with ourselves. If we can't do that, we've lost it already.

And yes Jim, you are correct, anyone in Germany not having a Uni degree will have some sort of other formal training.

Take myself. HSC, Toolmaker by trade, studied mechanical engineering, accountancy and economics, educated myself in electronics. And guess what, I can't even get a job. Too old at 45, and know too much.

Keep up the good work.

Bernd Kalup,
Landsborough QLD

Radio Australia replies

I have some comments on several points Tom Moffat made in his column 'Moffatt's Madhouse' in the May edition, concerning Radio Australia' role in the Middle East War.

First, was Radio Australia right or wrong to broadcast a program by a woman claiming that the entire Middle East was run by eight ruling families, all propped by up the United States for its own financial benefit?

The answer is yes, we do think it is right, providing the item is clearly introduced as an independent opinion, and that we balance this with comment giving other perspectives on the occupation of Kuwait and the War.

Radio Australia reflects Australia to the world, including all opinions in the country as well as some out of it.

Second, yes Radio Australia has always tried to remain independent of the Australian Government, and has developed a worldwide reputation for impartiality. We are particularly jealous of preserving this impartiality in our news and current affairs programs.

Third, whilst Navy compiled personal messages for the crews on Navy ships in the Gulf, Radio Australia produced and presented the programs. In a sense, this was a continuation of the programs we had run so successfully for civil hostages held by Saddam Hussein, and the Navy, together with special news and current affairs about Australia prior to the outbreak of hostilities.

Finally, Radio Australia does of

course operate, as all other divisions of the ABC, basically on Australian taxpayers' money. It provides for Australia a most effective means of projecting our image to the Asia/Pacific region. Shortwave itself is probably technologically of limited widespread use. It is a 1930's technology that may be around for a while yet, but which will inevitably be supplanted.

We at Radio Australia, are actively exploring other means of communicating our programs abroad, including by satellite, television and on-line services. By the turn of the century, I predict Radio Australia's services will be radically different, but we will still have the central responsibility of being Australia's principle means of projecting our image abroad.

Incidentally, I like best the thought at the end of Tom Moffat's column: it is much more likely that Australians with intellectual curiosity will get a better idea of a wide international variety of any complex international issue if they listen with an open mind to shortwave radio.

Richard Broinowski,
General Manager,
Radio Australia,
Melbourne, VIC.

Plug packs —bah!

In my article 'Power Supply to Replace Plug Packs' (June 1991), I accused *EA* of being guilty of specifying plug packs in projects that had plenty of room for an internal supply. In that same issue there was a perfect example!

In the DI box project, on page 66, the caption even admits that the case appears to be too big. So why not include the power supply, instead of replying on unstable plug packs and flimsy DC panel sockets?

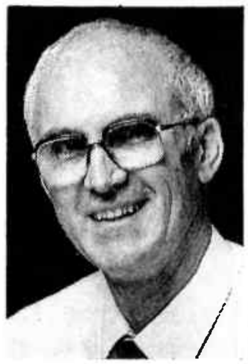
As I wrote in my article, there's a conspiracy to sell more plug packs. Down with 'em, I say.

Jim Lawler,
Geilston Bay, TAS.

Comment: You mightn't like them, Jim, but they do have some advantages. For the DI Box project, using a plug pack minimised the chances of hum injection from stray magnetic or electric fields, from the power transformer or mains wiring — an important consideration for audio circuits working at low signal levels.

A plug pack also makes a safe power supply for beginners' projects, as it keeps dangerous mains voltages well away from the rest of the circuitry. ■

EDITORIAL VIEWPOINT



Correcting a few furphies about those compact fluorescent lamps

I think you might find the subject of this month's Forum column rather interesting and topical. It's about the new compact fluorescent lamps, and whether they save as much power and are as environmentally friendly as is claimed.

What prompted me to tackle the subject was the somewhat garbled stories I've been reading about these lamps, in various magazines and newspapers. Even one of the well-known and respected scientific magazines carried a story containing some obvious technical blunders, showing that the subject really needed some urgent clarification. That's exactly what I've tried to do, after arming myself with as much accurate technical information as possible — both from Philips, the main developer of the new lamps, and from some experiments of my own.

Hopefully this column will clear up at least some of the confusion, and you'll find it helpful in making your own decision about using the new lamps.

Having now looked into them fairly thoroughly, I do believe that on the whole, they're a very significant step forward in terms of saving energy. But they're probably not the 'ultimate' lamp; as you'll read in the column, they share a problem with many other modern electronic appliances — a problem that needs to be solved. They also take a good minute or so to reach full brightness, and like ordinary fluoro's they don't like being switched on and off frequently. So they're not really suitable for applications that involve turning a lamp on for only a short time...

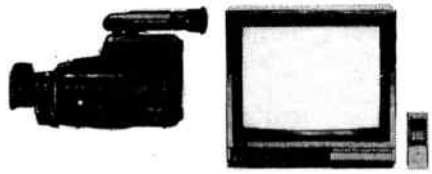
But make no mistake. They *do* save energy as claimed, and by a significant factor of around five times compared with a standard incandescent.

Hopefully after you've read the column, you might be in a position to clarify the true pro's and con's of the new lamps for your friends. There's still a lot of confusion out there, among non-technical people — only the other night, I was relaxing with the family, watching the popular TV programme *Burke's Backyard*. After a short segment introducing the lamps and explaining their energy saving feature, presenter Don Burke virtually demolished their image in viewers' minds by adding a comment along the lines that "But we've just been advised that tests have shown these lamps to use about four times their rated power".

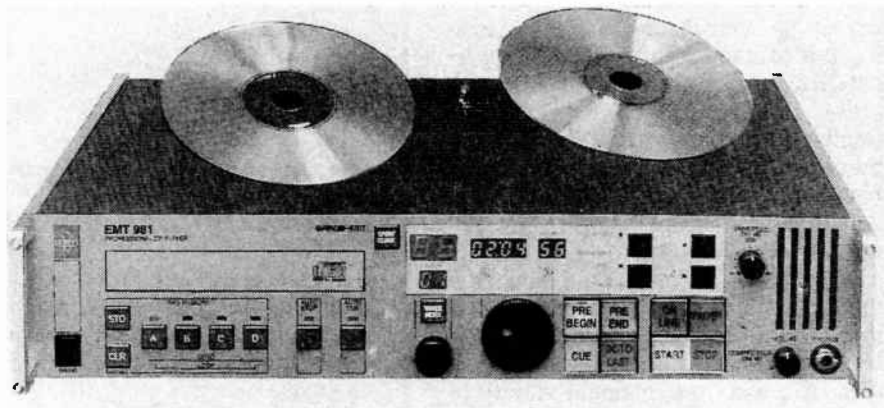
Needless to say yours truly was then heard to proclaim a terse and rather crude expression, likening Don's comment to bovine excreta — much to the surprise of the family! If I hadn't already written this month's Forum, it would certainly have spurred me into writing it...

Jim Rowe

What's New in VIDEO and AUDIO



Professional CD player



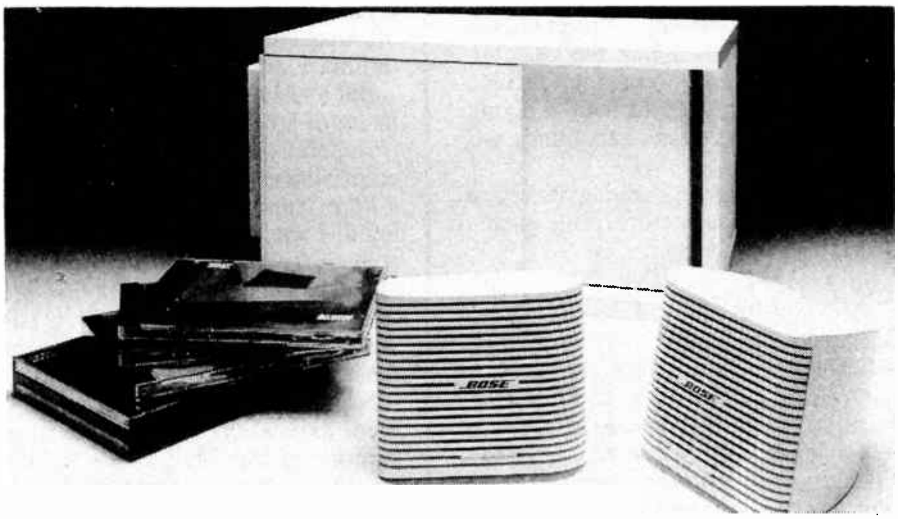
The new Barco EMT 981 Professional CD player is designed for professional broadcast and post production applications, offering flexible control and monitoring facilities which make it suitable for integration into automated programming systems.

The CD player features an ergonomic layout of controls and displays with large illuminated push buttons, rotary controls and large, high contrast displays. Operating functions include: switchable edit/online modes, cue mode for exact cueing with repeated segments, auto cue, auto stop, +/- 10% varispeed, and comprehensive time display modes. A LED display indicates disc or track time, elapsed or remaining time, total time, and time to end of modulation.

The EMT981 provides access to any location on disc by tracks, index or time. Rapid track selection is made possible with a stepped selector dial which permits next/previous track and index selection. The 'take memory' function permits storage of four takes, enabling single step or sequential playback of takes, go to and loop functions. A jog wheel is provided for time positioning, fast forward and cue, while a 'pre-listen' feature enables automatic return to the starting position or to the last seven seconds of a track. Comprehensive remote control facilities are included in the Barco EMT981 to enable remote fader start, connection of dedicated remote control units and external displays, and computer remote control via an RS232 interface. Electronically balanced analog line outputs with 16 bit four times oversampling are provided for left, right and optionally mono signals, adjustable from -10 to +21dBu. An AES digital output is also provided with word clock output and digital sync input. An independent monitoring section with a built-in stereo headphone amplifier is included, together with a monitor loudspeaker with integral, switchable compressor.

For further information, circle 181 on the reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975 1211.

Acoustimass 3 now available in white



Bose Corporation's Acoustimass 3 speaker system is now available in white as well as the original black. Claimed to be the world's smallest three-piece loudspeaker system, it now includes two white speaker enclosures — small enough to fit into the palm of one's hand — and a white bass module the size of a shoebox.

Through the innovative Bose Acoustimass technology, this virtually 'invisible' speaker system produces lifelike and spacious stereo sound with the bass, power handling and dynamic range of a much larger system.

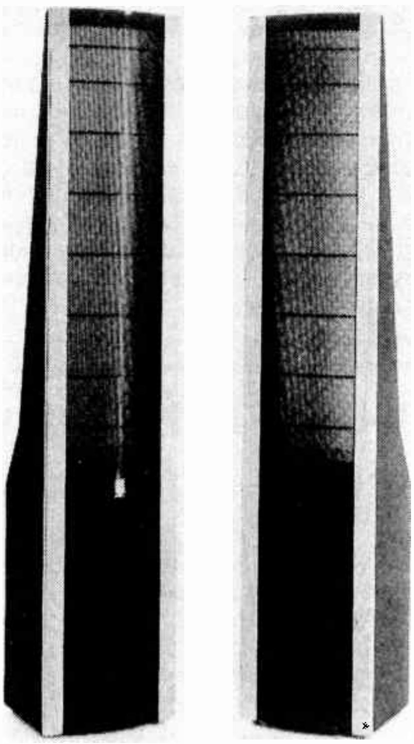
These small enclosures, measuring 110 x 110 x 90mm and weighing 500 grams each, produce the high and mid range frequencies. Operating in a range above 200Hz, each speaker contains a single long-throw 60mm wide-range transducer specially designed by Bose. Each driver is magnetically shielded for audio/visual applications. Measuring 200 x 200 x 360mm and weighing 7kg, the Acoustimass 3 bass module provides the low frequency energy for the system. It can be hidden almost anywhere in a room, including under furniture. Sound waves of an Acoustimass system are launched into the room by two acoustic air masses.

The white Acoustimass 3 system retails for $829.

'Sequel II' speakers from Martin Logan

The Martin Logan Sequel II loudspeaker system is claimed to represent the culmination of a research program that aimed to produce a world class monitor, using leading edge technology.

The Sequel II is a hybrid electrostatic/woofer design that is constructed and trim finished in selected hardwoods. The cabinet is constructed from special high density hardwood powderboard and finished in nextel suede paint. The curvilinear electrostatic panel is claimed to be one of the most durable and reliable electrostatic transducers available today. The electrostatic membrane is only 12.7um in thickness and uses a



proprietary nylon/delrin polymer membrane coated panel which can be driven by amplifiers with outputs of up to 200W continuous. The electrostatic panel extends from 100Hz to beyond 24kHz (+ or -2db) and the woofer section extends to below 28Hz. Sensitivity is claimed to be 89dB/1m, making it well suited for amplifiers from the 80 to 200 watts/channel. Impedance is stated at 8 ohms, with a minimum drop to 2. The Sequel IIs stand 6' x 14" wide and weigh 110lb each. They are covered by a three year optional limited warranty and have a recommended retail price of $8295. For retail enquiries, contact The Audio Connection on (02) 708 4388.

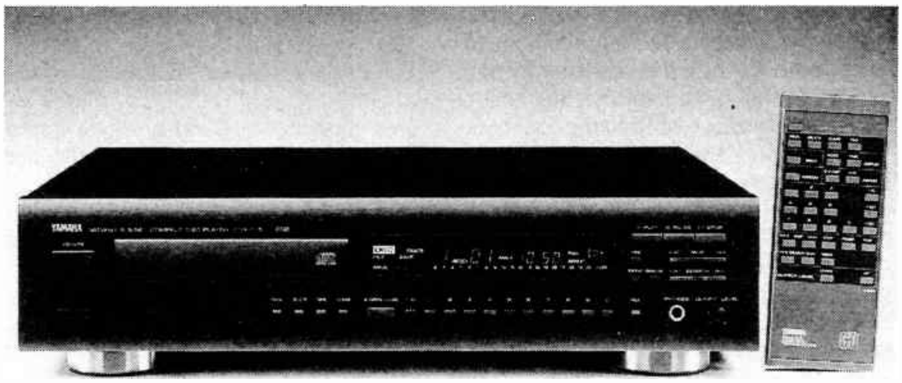
New CD players offer improved sound

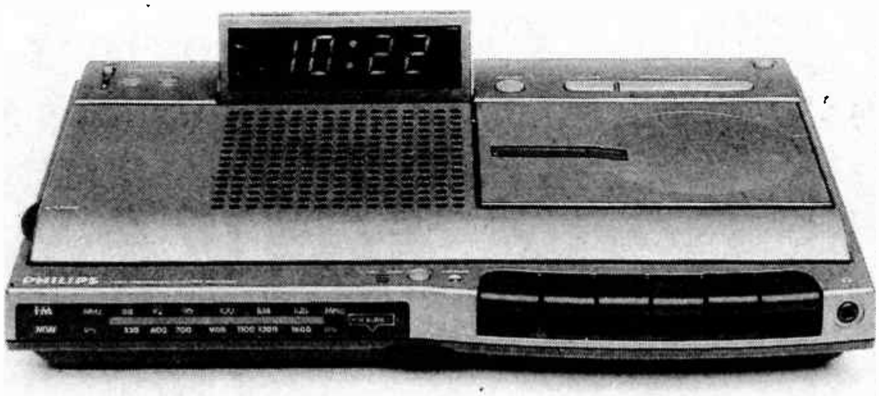
Yamaha has introduced the first three models in a new line of compact disc players which feature 'S-Bit Plus' technology and are claimed to provide more natural music reproduction, better dynamic range and signal-to-noise figures than previous single bit models.

The new models are designated CDX-1050, CDX-750, and CDX-550 and range in price from the flagship $999 to $499. S-Bit Plus is the name Yamaha has given to a group of enhancements to the company's 'S-Bit', single-bit, digital-to-analog conversion. S-bit first appeared on the company's CD players in 1990. The core of S-Bit Plus is a proprietary digital-to-analog converter developed by the company's engineers.

The 'Independent Pulse Density Modulation' DAC is said to produce pulse waveforms more precisely than previously available converters, by independently using two pulses as amplitude rather than attempting to reproduce the double-width pulse. In addition to the improved fidelity achieved by the proprietary new I-PDM DACs, S-Bit Plus also incorporates second order noise shaping and an eight times oversampling 20-bit digital filter.

In addition to S-Bit Plus, Yamaha's flagship player, the CDX-1050, incorporates 'Twin Balanced Processing', which uses two DACs per channel — one normal and one reverse phase.





Clock radio with a difference

Philips has found a way around the not-always-reliable method of leaving reminder notes on the fridge.

The firm's new AJ3800 is an AM/FM clock radio with a difference — it has an inbuilt cassette recorder/player.

You can choose to wake up to your favourite radio program, to a persistent buzzer, to your favourite musicassette, or a recording to remind yourself of the tasks you've set down for this day. Philips has also given the AJ3800 a new fold-away LED time display, which can be angled for a perfect pillow viewing. Naturally, there is a power back-up to keep track of time if the clock is disconnected or electricity fails. The wake-up mode is selected with a sliding switch and you can reset the alarm to catch an extra nine minutes snooze.

The AJ3800 retails at around $99.95 and is just one of the dozen clock radios in the current Philips range. ■

Fairlight ESP shipping digital audio systems

Sydney-based digital audio/video specialist Fairlight ESP has begun shipping its new MFX digital audio production system to dealer worldwide.

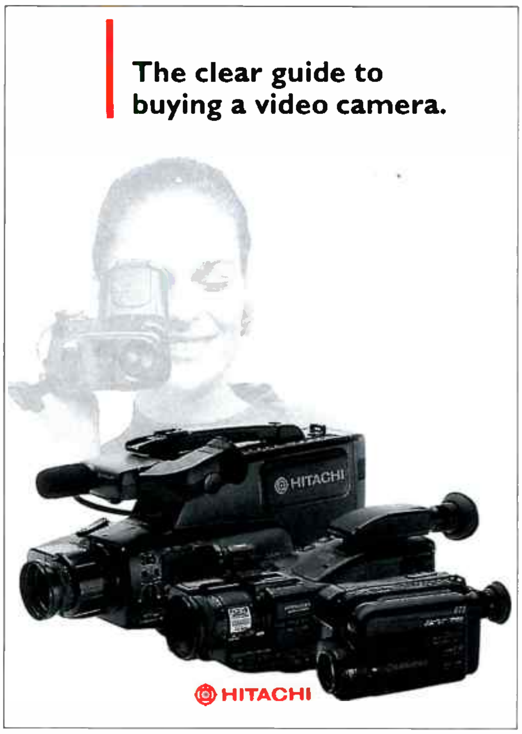
The Fairlight MFX is a digital multitrack disk recording and editing system, designed for audio post production. The system was previewed at NAB, Atlanta 1990, and shown at AES Los Angeles last October and at the NAB at Las Vegas in April.

Fairlight pioneered the digital audio workstation, introducing sound sampling, waveform editing and real-time music sequencing. According to Fairlight's David Hudson, "MFX is the next logical step in the gradual changeover to the all-digital production facility. MFX takes advantage of existing analog facilities, whilst capitalising on areas where digital technology has the undisputed ege — sound design, archiving, editing, and synchronising to picture."

The Fairlight MFX provides 24 tracks of digital recording and editing and features an intuitive user interface with the familiar feel of a multitrack during recording operations. The MFX console uses push buttons and a jogger control for all functions, eliminating the need for 'mouse-and-screen' editing, with a friendly menu system for all commands. A large, easy-to-read colour screen and LCD panel display 24 tracks of audio, as well as system options and status.

Two AES/EBU digital inputs and outputs are provided with the MFX system, together with two 64 times oversampled analog inputs and 24 analog track outputs. MFX offers 16 tracks of simultaneous playback and supports up to six disk drives, each providing 215 minutes of track time at 44.1kHz, for a maximum of 21 hours storage. Back up is provided by an Exabyte 2.2 gigabyte, 8mm drive, storage both audio and edit data. ■

Unclear whether to buy VHS, VHS-C or 8mm? This free book gives you simple direction.



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KODAK'S NEW PHOTO CD SYSTEM

At a photographic exhibition in Sydney earlier this year, Kodak demonstrated a technology that could, on the face of it, change the entire process of traditional photo taking, processing and viewing. But, for Kodak, the 'golden prize' would seem to be not only the family snapshooter's business, but that of the desktop publishing and presentation companies.

by BARRIE SMITH

For the consumer, this is the way that Kodak's new Photo CD system works: You begin by shooting your roll of colour film (negative or transparency), with any 35mm camera.

Then, you amble down to the nearest mini lab for a little developing and processing. While there, a request can be made, not only for the usual album prints, but to have the entire roll transferred to video compact disk — a Photo CD.

The photofinisher, having outlaid $100,000 for his CD work station, will then 'read' the roll of processed negs or slides. The frames of film are 'written' as digitised pictures onto a Photo CD. The customer then collects his Photo CD — and his prints.

Once home, the customer turns on the domestic Photo CD player, inserts the disk and plays the family snapshots on the TV.

Should the customer need to shoot and have processed more rolls of film he goes through the same process, but without the immediate need to acquire additional Photo CD disks. Each disk can store up to 100 full colour 35mm images, and can be 'topped up' with additional ones at any time.

And the cost? Aside from the mini lab's not inconsiderable investment, it's predicted that the first roll of 24 exposures could be imprinted onto a Photo CD for about A$30. For this you get the disk — and enough room for 76 more images. Subsequent additions of more pictures should be around $10 per roll. The Photo CD player itself should cost around $800.

When will we be enjoying all these wonders?

It's expected that Photo CD will be launched in the US around June of 1992. Soon after, depending on retail acceptance and completion of installations, we should see it in Australia.

Obviously for the retail consumer market, the success of the scheme will depend on the willingness of lab operators to spend the hundred grand, and for the consumer to outlay nearly a thousand dollars to relish the pleasure of seeing his home made images on the lounge room TV — pictures he now views simply by opening the family album.

But Kodak can see far past the retail consumer market. The demand for colour business desktop publishing (DTP) systems is exploding: 99% of Fortune 1000 companies have installed DTP systems with colour monitors; in 1990 more than 30% of these purchased colour printers; and colour copiers alone are expected to generate nearly a billion dollars in sales in 1992.

Software applications in DTP are now being joined by sophisticated programs for Desktop Video — not only for preparation of the actual page/screen or document, but for precise manipulation of the colour images contained within them; and the cost of this software and its accompanying high level hardware is falling. Until now the usual method of incorporating colour images into DTP or DTV has been via the *scanner* — even in its most elegant form, an inadequate answer to the task.

Another path has been to install a video frame capture board or 'grabber', and take images from a video source — with the inherent quality limitations of the broadcast line structure.

A digitised colour photograph can call for a file size of 18MB of computer storage — but most computers have hard disks of less than 100Mb; additionally, scanners capable of inputting this file size can cost up to 10 times as much as a typical personal computer.

Another problem in DTP and DTV is the lack of colour consistency across input and output devices. The colours created or selected via the phosphors of a computer monitor are rarely similar to those produced by printing inks or photographic dyes.

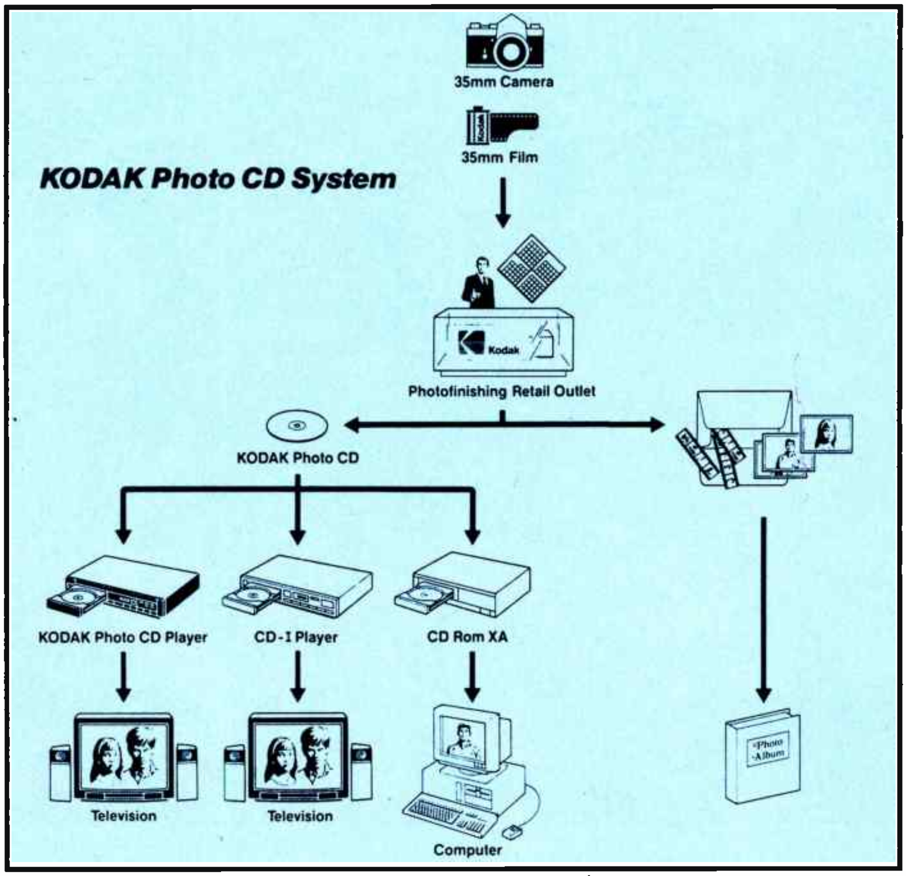
Kodak's strategy

With probably more experience in imaging systems than any other company, Kodak has developed core technologies which span two areas: Photo CD as both an acquisition and storage system. This uses a low cost storage medium — write-once CD disks, compatible with CD-ROM XA drives and CDI players.

Using optical storage overcomes the storage limitations of magnetic media, as well as addressing cost and consistency factors.

Communication and control of colour will be conformed by means of *PhotoYCC*, a device-independent colour interchange specification which organises colour consistency from device to device.

Currently, there is no industry standard for defining colour — put simply, one system (computer, scanner, printer) may not know what another system



With the Photo CD system, customers taking an exposed film into the photo-finisher can receive a CD with electronic images of their shots on it, in addition to the normal transparencies or negatives and prints.

Kodak's Photo CDs

defines as red, or blue or green. PhotoYCC would allow image files, programs, displays, printers, proofing systems and — most importantly — printing presses to retain a consistent colour record. What you saw, would be truly what you would get.

Kodak has been hard at work promoting its own range of PhotoYCC range of scanners, colour printers and other digital devices. By making Photo CD the carrier, programs and devices will benefit from support of PhotoYCC. The standard, incidentally, is being offered to industry as a no-cost, public domain product.

The system

The key components of the Photo CD system are these:

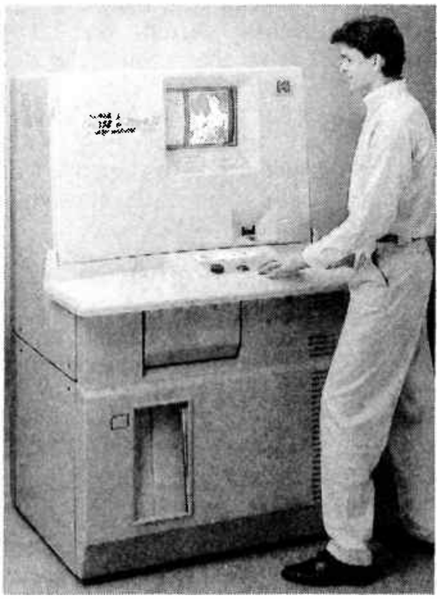
- A photofinishing work station, based on a film scanner, developed and manufactured by Kodak — plus a computer produced by Sun Microsystems, and a Philips Photo CDdiscwriter.
- The scanner reads both 35mm slides and negs — later options may include other film sizes. The scanner has three parallel linear CCD arrays. Reading across a frame, each array captures 2048 pixels at high speed; this yields 18 megabytes of information per frame.
- The scanned information is then passed onto a Sun SPARCstation for compression, and for colour and density corrections: 18MB slims to 6MB, allowing 100 full colour images to be stored on a 600MB Photo CD disk. The 3:1 compression chore takes about 6 seconds.
- (By contrast, current DTP image acquisition devices only capture 0.5MB to 4.5MB per frame.)
- Each disk is packaged like current audio CDs — in a plastic 'jewel case'. The liner of the case, however, shows a thermally produced thumbnail picture index of the disk's contents.
- A new Photo CD player, made by Philips, and able to play not only audio CDs, but also the new photo CDs. The players will be fully compatible with PAL, NTSC and SECAM — and any future HDTV formats.
- Blank, recordable Photo CDs, made by Kodak. Each is capable of holding 100 full colour images.
- New, higher quality thermal printers and paper made by Kodak.

The system has been in development for 18 months, and is only one of many Kodak initiatives to link silver and electronic imaging technologies.

Features include:

- The ability to create disc 'albums' from any 35mm original: colour or monochrome negs and slides.
- Users can obtain high quality prints from the Photo CD itself, using it as an electronic picture file.
- Access to high quality TV images derived from a 35mm camera is possible.
- Photo CDs will be compatible with the soon to be released CDI (Computer Disc Interactive system) developed by Sony and Philips.
- Compatibility with CD ROM XA drives — meaning any PC linked to one can replay a Photo CD, and access the digitised images.
- The consumer can still have his 'happy snap' prints made at the local mini lab, but the system provides him with a route to video and computer imaging technologies.

Here's a sample of the print quality which can be produced from a Photo CD image file, reproduced directly from a thermal print (same size). Resolution is excellent, and few people would recognise that they are viewing an 'electronic' image.



Kodak's 'Create-A-Print' unit allows consumers to make their enlargements from a 35mm negative.

At the demo

At the Sydney demonstration, two Kodak executives from Rochester, New York steered the Photo CD player through a sample disk produced from images captured with a variety of still cameras — conventional 35mm SLRs, compacts, even a disposable 'Fling' were used to record shots of beach girls, young bike riders and tourist sites in the West Indies.

The films used ranged from the high resolution Ektar 25 to ISO 125 and 400 speeds. The colour in all of the pictures, as observed on the video monitor, was more than acceptable. The disposable camera's image displayed lower definition than the others, as you'd expect. But one shot taken with Canon's Ion still-video model came in at an even lower level.

In operation

The disk is a familiar 120mm in diameter, and is coloured a rather glamorous gold — reputedly to enhance signal retrieval quality.

Once it's loaded into the player, a remote controller is used to select the frame number you want to view. Within a second or two up comes the full colour image.

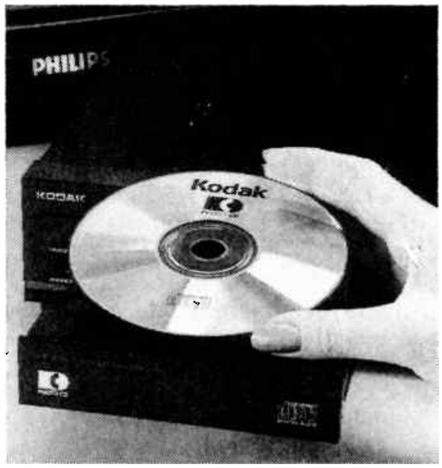
To navigate your way around the Photo CD you consult the sleeve liner, which is imprinted with a mini grid of all the pictures on the disk. Each has an index number, showing each frame's position on the roll of film — and on the disk.

Once displayed the image can be manipulated: re-framed, a detail zoomed up, or cropped or re-positioned. Leaving each frame, the player's memory stores the display settings for any subsequent replay.

Vertical pictures incompatible with TV's 3x4 landscape format may be re-framed and zoomed up to 16 times — or reduced so that the entire vertical image is shown against grey outer borders. Running the stills in forward sequence produces a slide show, as each frame progresses via a two second wipe to the next.

Each frame has an index number on the disk, so you can instruct the player to delete or 'forget' any particular image.

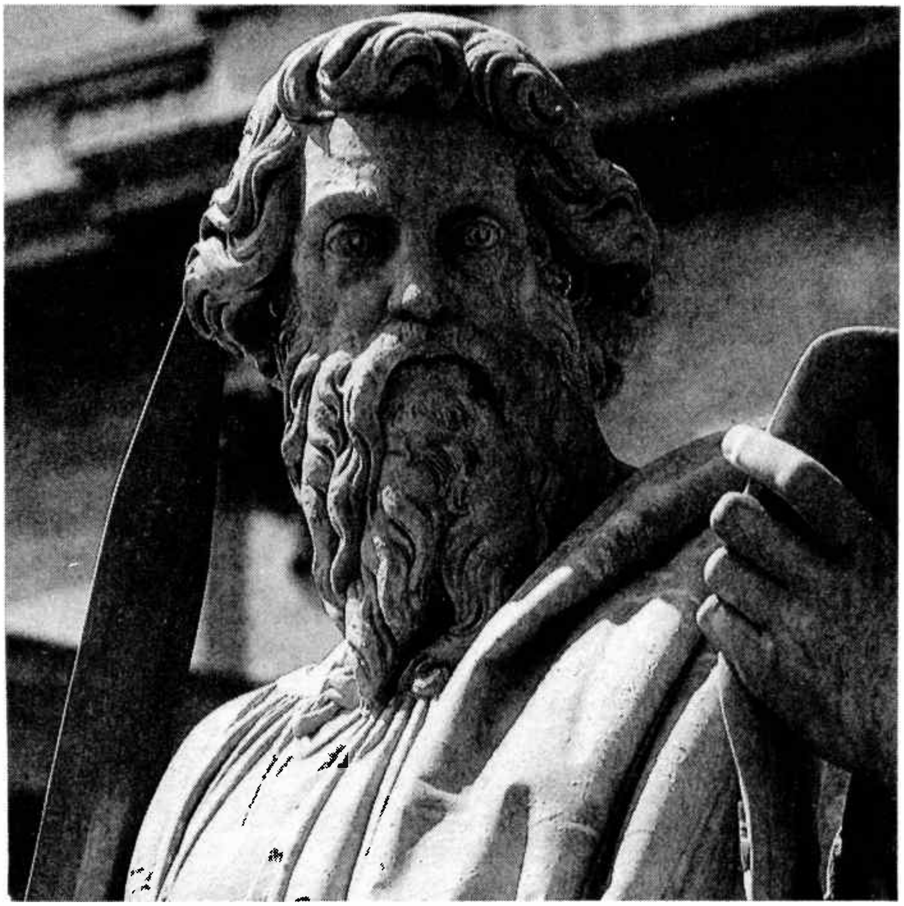
Perhaps you've taken some out of focus, or badly composed shots you're too embarrassed to show — a simple deletion of the image's address, and your status as an expert photographer is restored. If needed, this 'forgotten' frame can be restored to the full index list at a later time.



Apart from having a gold coloured metallisation, Photo CD discs are virtually identical with audio CD's.

Market prospects

Kodak claims there are currently 250 million 35mm cameras in use worldwide. These produce more than 85% of the 50 billion photos taken each



Another sample of Photo CD image quality, reproduced as before at 100% of actual size (but cropped), directly from a thermal print.

year. Today, in terms of computer image manipulation as a gateway to desktop publishing and video, there are a number of immensely capable, and far from expensive, photo retouching software applications available, both in IBM and Macintosh formats — *Adobe Photo Shop* being just one of them.

Using *Photo Shop*, Rochester's Matt Freund demonstrated how a colour image, originally shot on 35mm colour negative and retrieved from the Photo CD, could be enhanced on a Mac II computer.

The size was changed, to a degree not possible before with digitised images: at sizes from 300 to 600% no sign of definition or colour loss was evident; at 1200% colour and detail were as the original, but because of the degree of cropping available the format (vertical or horizontal) could be selected at will; only at a magnification of 24 times could evidence could be seen of the image starting to display its pixel structure — but the grain of the original silver image was already evident.

An area of the image was traced, and its hue, saturation and contrast changed; blemishes and creative retouching were accomplished — simply and completely.

I watched as a facial blemish was removed from the model's face, and a scratch on the original negative obscured.

These chores took seconds. After manipulation, a printout was made, via Kodak's new thermal printer. The quality — a year before launch — is remarkable.

Direct comparisons

Matt Freund and his US associate Steve Kristy showed direct comparisons of images printed on conventional Ektacolor photographic paper — and the new thermal paper. Three prints were shown — one printed direct from an original Kodacolor 100 colour neg of a girl, then via Photo CD and on to photographic paper. These two were virtually identical.

Then a thermal print made from the same image was shown, and here a drop in definition was evident: the colours were not as faithful, being a little over-saturated. But these components are adjustable.

The resolution of the thermal prints was given as 200 pixels per inch; that of photographic paper, 500 pixels. Each pixel carries a mix of three colours, each of which is varied over a range of 256 different levels.

One artefact which gave away the conventional print was a slight lack of edge sharpness — even the best enlarging lenses have aberrations. The thermal print, however, was sharp edge to edge. Does this mean, that whilst silver imaging will enjoy a secure place in the future of image processing, the technology of glass lenses' days are numbered?

Using Kodak's Photo CD workstation, the photo-finisher can transfer each image from a film transparency or negative onto a CD, cropping and enlarging as desired. Up to 100 images can be stored on a single disc.

Access for developers

Two Eastman Kodak software products will encourage the use of Photo CD images in computer applications — a development toolkit, and a Photo CD accessory.

The toolkit will make it easy for developers to integrate Photo CD images into software applications, allowing programmers to transfer images from a CD-ROM XA drive to a host computer, and select them by index number at any of four resolutions between 128 x 192 pixel preview resolution and 2048 x 3072 pixel full photographic resolution. Full images, or any rectangular portion, can be displayed on the host monitor over its full screen area, or within windows.

The toolkit is already available.

The Photo CD accessory gives end users access to, and control of, the images in applications not originally designed with Photo CD capability. This permits the operator to:

- Scan the contents of a Photo CD, either as an index or as a montage of images;
- Select an image or sequence of images for display in a separate window;
- Zoom, pan or scroll;
- Copy a portion of an image to a clipboard, then paste it into image-capable software (e.g., MS *Word*, Adobe *Photoshop* or a DTP package);
- Save a portion of an image in popular file formats — including TIFF and EPS.

Support

Photo CD technology has already received support from companies such as Adobe Systems, Aldus Corp, Apple Computer, Hewlett-Packard, MacroMind, Olivetti, Oracle, Sun Systems, Truevision Inc and so on.

John P. White, VP and GM of the Integration and Systems Products Division of Eastman Kodak is quoted as saying: "As leading vendors of desktop hardware and software embrace Photo CD technology, photographic imaging on the desktop will become commonplace". ■

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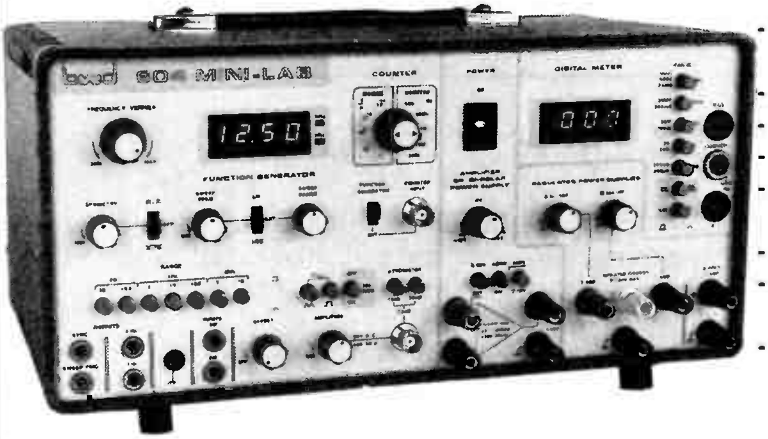

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READER INFO No. 5

SHORTWAVE LISTENING

by Arthur Cushen, MBE

Broadcasters appreciate listeners' views

International broadcasters have a problem in evaluating whether programme services provided are appreciated by listeners, as surveys are very expensive. It is only by mail from those tuned to the broadcasts that they can gauge the popularity of particular items carried in their transmissions.

On the medium wave band, listeners in Australia and New Zealand are aware that commercial stations carry out surveys from time to time.

These are designed to prove to the advertiser that they are tuned to by more listeners in their target area, whether it be a geographical location or an age group.

Based on these research figures, they are able to show advertisers the popularity of their programming. However, international shortwave is in a different category.

The cost of initiating surveys is very high, the number of respondents who listen to shortwave is not a complete population, and generally most international stations combine to survey a country which they fund collectively.

In recent years, there has been a pronounced request from broadcasters asking for comment about programme content. Last month we loked at rating the strength of the signals from the stations, but listeners should also rate the content of the programmes they hear.

Almost 80% of shortwave listeners are programme listeners, that is, they tune to the news from London, folk music from Moscow, entertaining programmes from the United States, gospel broadcasts from Ecuador, Pacific Island music from New Zealand or popular programmes from Radio Australia. The broadcasters therefore would appreciate listeners comments.

News is the leader

A well-tried programme format is gradually being adapted by international stations. For instance, an English broadcast from an international station should be 30 minutes in length. Those of a lesser time fail to give adequate coverage of news and a specialised topic.

Another concern of international broadcasters is presenting programmes on a monthly or fortnightly basis.

Often the listener fails to remember which day of the month the programme is from the Red Cross, or the DX Session from Radio Sweden. This applies to all programmes which are not broadcast on a weekly basis.

Radio New Zealand International, which recently introduced its Mailbox every second week, has overcome this problem by running an alternative programme on the other week. This way, the casual listener still can be advised of the next time his favourite programme is on shortwave. There are other essential features of the programme that the broadcaster must not change. New broadcasts must always appear on the hour, because of all the information listeners are seeking, worldwide news takes priority.

There is interest also in other stations which feature regional news — you can hear such news from Latin America, North America, Asia and Europe.

AROUND THE WORLD

AUSTRIA: Vienna has retimed its English broadcast to Australia and is now heard at 1030-1100 on 15450 and 21490kHz. Two other transmissions received are 0730-0800 on 6155 and 13730kHz; and 1130-1200 on 15430 and 21490kHz. Austrian Panorama, the weekly programme for shortwave listeners is now carried on Sundays at 1030 and 1130 on the frequencies listed above.

GUAM: The latest English schedule for KTWR, which carries gospel programmes is 0800-0912 Friday, 0800-0927 Saturday-Thursday on 15200kHz; 0827-0957 on 11805kHz; 1458-1636 Monday-Saturday and 1458-1701 Sunday on 11650kHz.

NEDERLAND: Radio Nederland Hilversum has extended its English transmission to Australia and New Zealand from Bonaire. The transmissions are: 0730-0825 on 9630, 9715kHz; 0830-0925 to 9630kHz: and 0930-1025 on 11895kHz. The former English transmission at 1030 on 11890kHz is now carrying the Dutch broadcast to Australia.

NEW ZEALAND: Radio New Zealand International, with its transmission at 1800-2200, is using 13785kHz, while the other broadcasts 2200-0700 is on 17770kHz and 0700-1210 on 9700kHz. 'Mailbox' with Tony King is heard every two weeks — on Monday at 0430, Thursday, at 0830 and Friday at 1930.

ZLXA, Print Disabled Radio Levin, has extended its service on shortwave and is heard on 3935kHz for six days a week. The schedule is Sunday 0600-0900 and Monday-Friday 0630-1000.

SWEDEN: Stockholm has retimed its English broadcast to Australia and is heard at 1130-1200 on 11960, 17740 and 21570kHz, while a further broadcast at 1300-1330 is on the same frequencies. During our afternoons, the North American Service also can be received at 0200-0230 and 0330-0400, with both transmissions on 9695 and 11705kHz.

VATICAN: Vatican Radio, after many years of broadcasting in English at 2210 for Australia, has retimed this service to 2245-2315. There has also been a change of frequency, 9600kHz, being replaced by 15105kHz; while the other channel is 11830kHz.

When you send off a reception report to a radio station, please give them some idea of the programmes that you enjoyed. After all, your mail is the only link they have with their listeners. Remember that when it comes to Government funding of an international station, they need proof of the popularity of their broadcasts to remain on the air.

Radio Nederland uses SSB

The future of international broadcasting is very much under treat because of the over-crowding of the shortwave bands. To overcome this problem, the World Administration Radio Conference has decided to introduce single sideband (SSB) broadcasting, around the year 2015.

This is forcing broadcasters to experiment with this type of transmission. Already, Sweden and Switzerland have carried out tests on SSB, but some of these tests have not been using the full SSB mode of transmission, so it is possible to receive the signals on a radio which does not have SSB facilities.

Radio Nederland is now carrying out tests on 'compatible single sideband'. This transmission to North America occurs at 0030-0125UTC, on 15560kHz. The broadcasts originate from Bonaire in the Caribbean, and the transmission will be on upper sideband. But it should also provide reasonable reception on any shortwave receiver not equipped with SSB facilities. With the lower sideband suppressed, listeners using an ordinary portable radio may find the signal a little distorted. These tests will continue until September, when a decision will be made concerning future use of compatible single sideband.

The Frequency Section of Radio Nederland, PO Box 222, Hilversum, Holland is keen to have reception reports on this test broadcast, and listeners should compare the signal to those of others received on the same band. These tests on SSB from several countries are in preparation for the World Administration Radio Conference next year, when the decision will be reviewed concerning the success or otherwise of trials on SSB operation.

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

Radio Canada suffers budget cuts

A budget cut from $20m to $12m, staff reduction from 195 to 93, the ending of all special programming in French and English, and the reduction of many other foreign languages — these are part of the re-structuring for Radio Canada International. The Canadian Government was forced to take over the operation of the shortwave service.

The Canadian Broadcasting Corporation has at last made its decision, which has caused concern at the Montreal studios. The cost is estimated at .75¢ per Canadian to keep the full service in operation. However, the External Affairs Department is now funding the Montreal operations at almost half the previous budget. The reduction in languages means that no longer are there broadcasts in Japanese, German, Czech, Slovak and Hungarian. Polish and Portugese have also been cancelled, while broadcasts in Russia have been reduced in output.

Canada will still continue to broadcast in Ukranian, Arabic, Chinese, Spanish, English and French. The English and French broadcasts will be a relay of the CBC Domestic Service; no longer will Canada be providing a direct overseas programme for its listeners. The resulting staff reductions have meant that many people in these language services have left Montreal. I'an McFarland, well known as the presenter of 'Listeners Corner' and 'Shortwave Listeners Digest' has gone to Japan, where he has been broadcasting in the English service of Radio Japan in Tokyo.

Despite these reductions in programming, the actual schedule of Radio Canada International remains almost unchanged. Broadcasts in English which are best received in the South Pacific are at 0400-0430 on 15275kHz; 0515-0600 Monday to Friday on 0605, 6150, 7295, 9750, 11775 and 17804kHz; 2130-2200 on 11880, 13670, 15150 and 17820kHz; from 2200 on 9755, 13670kHz; and through Radio Japan relay on 11705kHz. ■

YAMAHA'S DSP-A1000 SOUND PROCESSING AMP

This month, Louis Challis has been checking out the latest 'second generation' digital sound field processing amplifier, from Yamaha. It made such an impression, with its seven output channels and combination of enhanced DSP with Dolby Pro Logic Enhanced, that he was immediately reminded of an event of similar impact 50 years ago...

The year was 1941, and a small boy named Louis sat in the Embassy cinema in the heart of Sydney, watching Walt Disney's *Fantasia*. The film was screened in brilliant Technicolor, backed by a sound track which featured wonderful music — whose realism and lifelike qualities were unlike any film that little Louis had ever seen before. After his departure from the cinema clutching his mother's hand, one shouldn't really be surprised at his plea, which was to be given the opportunity to return to see *Fantasia* once more.

Although he didn't know or understand the real significance of what he seen and nobody explained it to him at the time, he had been watching the first evolutionary step in the development of spatially enhanced sound — which has long been a major element in the quest for superior realism in the cinema.

It was only much later that little Louis (or should I say 'Big Louis', by then) discovered that *Fantasia*'s sound track was amplified in true stereo, with the added bonus of a centre channel. The dialogue was appropriately centred in its correct position, irrespective of where you sat in the cinema.

It was approximately 40 years later that the basic principles Walt Disney adopted for *Fantasia* were picked up by Ray Dolby, for his 'Dolby Pro Logic' stereo surround system, and old technology was reborn once more.

Over the last 50 years there have of course been many other interesting, novel or innovative approaches tried to enhance the realism of cinema sound systems. One of the more novel, if short lived innovations, were the '3D' movies, which used loudspeakers at both the front and back of house. Some of the more enduring, as well as financially successful later attempts to enhance the visual and aural qualities of the cinema were CinemaScope and 70mm film, which introduced Wide Screen and an almost matching quality of Wide Sound.

In the early 70's, film director Stanley Kubrick's film *A Clockwork Orange* was notable not only as the first of a new generation of sickeningly violent movies, but more significantly for its pioneering adoption of Dolby A noise reduction, for the critical encoding phase of the sound track's recording.

Ray Dolby has of course devoted a considerable amount of his research team's efforts to the development of superior noise reduction systems for motion pictures. He also set himself and his team the unenviable task of developing a 360° sound field, which he believed could be encoded via a matrix system on the two channel sound track.

He believed it was possible to achieve a new level of audio realism, so that the moviegoer could be transported from the old staid two-dimensional domain through a three-dimensional sound field, without resorting to 3D stereo images and bicoloured glasses, which some of you may still remember from your youth.

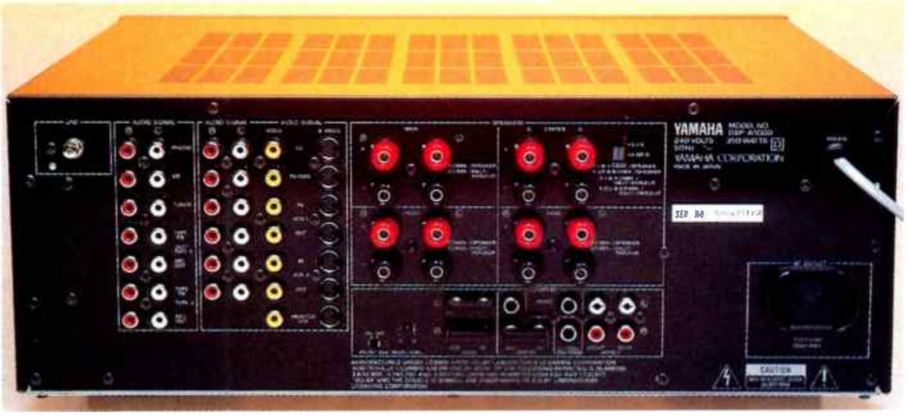
As most of us now know, the first of the new generation of films to achieve some measure of real success using such technology was George Lucas' *Star Wars*.

He rapidly improved his special effects, firstly with *The Empire Strikes Back* and even more assiduously in *The Return of the Jedi*, each of which dramatically improved on the previous films' spatial sound field qualities.

Few people realise that by the time George Lucas had produced *The Return of the Jedi*, he had mastered the complex technical problems and critical relationship between the four channels so well that the sound field in that film was truly three dimensional. It was almost completely free from the early inconsistencies which had been obvious in his *Star Wars* production.

Whilst Ray Dolby had aimed his initial R&D at the film industry, he soon realised that the consumer market was an equally if not more fertile field. So he went on to develop the Dolby B and C noise reduction systems, which were specifically aimed at the compact cassette recorder market. In the course of time that of course led to the development of Dolby SR, and to Dolby Pro Logic systems for professional users, each of which found special niches in the marketplace.

Now while Ray Dolby and his research staff worked frantically to develop their new products, a small band of researchers at the Yamaha Hamamatsu plant were quietly developing the first consumer orientated digital sound processors with the

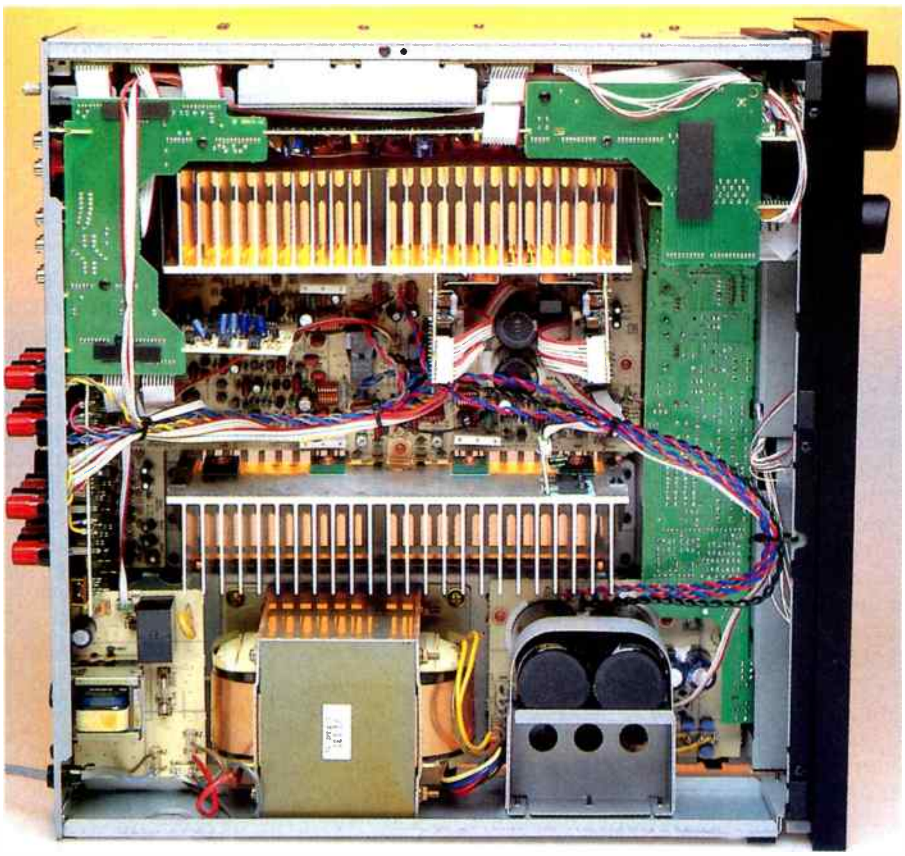


A close up of the rear panel. As you can see there' even more connectors and terminals than you'll find at the rear of most other modern amps.

acronym 'DSP', which soon found a professional market. As most of us now know, the DSP systems offered a series of exciting and at the time, almost unbelievable functional acoustical options — the likes of which had not been contemplated by Ray Dolby, nor anybody else for that matter.

The DSP processors made it readily feasible (and with an undreamed-of degree of flexibility) to modify conventional two-channel stereo material so that it could be digitally transformed to convert a room's acoustics (and almost any room for that matter) to exhibit the acoustical, spatial and reverberant characteristics of some other different room, or space.

All that was needed to achieve this exciting change was a DSP signal processor and an additional two-channel amplifier to power the rear channel speakers. In one dramatic step, the high fidelity consumer market was changed by DSP, and for some not inconsiderable time the Dolby Pro Logic con-



When you take the cover off the DSP-A1000 you discover why it weighs a good deal more than most other amps. There's a massive power transformer and two very large heatsink radiators to cool all of those output transistors.

cept and the marketing of its equipment was threatened as a result.

The time slot was late 1986 and suddenly the Home Video Theatre market assumed a new significance for the electronic industry, when it was realised what could now be achieved as a result of DSP.

The demonstrations which Yamaha (and various other interested parties) quickly organised were exciting, but of course the amount of equipment that was required and the complexity of the task involved in aligning such a system was really daunting. University degrees or even 20 years of practical experience didn't necessarily solve the problems involved.

During the ensuing period the engineers and marketing personel at Yamaha have not sat on their hands. As we all know, the industry catch cry is now 'user friendly', and if it isn't, well you may have difficulty in selling it.

Yamaha realised that they had to release amplifiers which combined DSP processors with all the other essential elements in a single package which provided the flexibility, performance and a degree of simplicity compatible with the technical incompetence of the consumer market, which is where they wished to sell the new product.

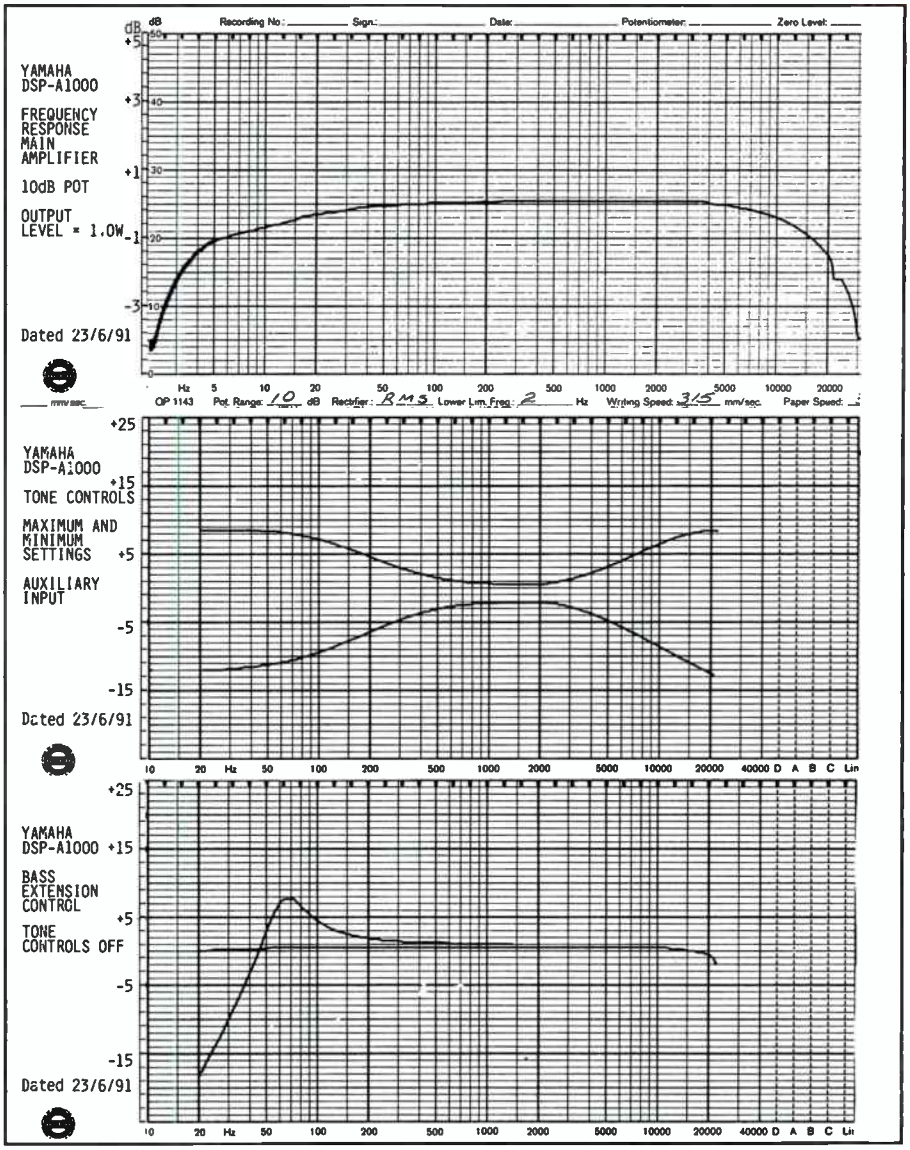
So they developed the DSP-A1000, which is one of the most innovative and exciting pieces of audio-visual equipment that I have recently had the pleasure of reviewing.

DSP, seven channels

The marketing personnel at Yamaha decided to combine seven channels of audio amplification, supplemented by an improved 'second generation' digital sound processor and all the other prerequisite audio and video preamplifier circuitry and switching controls required for a home video theatre, into one moderately large and sophisticated package.

When I first saw the DSP-A1000 in America in early January, it already had many of the reviewers oohing and aahing. Even so, the first time I perceived what this unit *really* had to offer was at a Yamaha's private trade show some two months later in Sydney.

As I discovered, the DSP-A1000 incorporates 12 primary DSP sound field programs with 23 possible variations, to suit most possible tastes in residential acoustical environments. Yamaha has designed this system to combine the best features of second generation DSP units with special features of digital Dolby Pro Logic. With these features



Three of the primary response plots for the DSP-A1000. At top is the frequency response of one of the main amplifier channels, then the tone control adjustment range and finally, the effect of the bass extension control.

you can faithfully and realistically recreate a 70mm movie theatre in your living room — or any other room for that matter, to achieve results that you would never have dreamed possible!

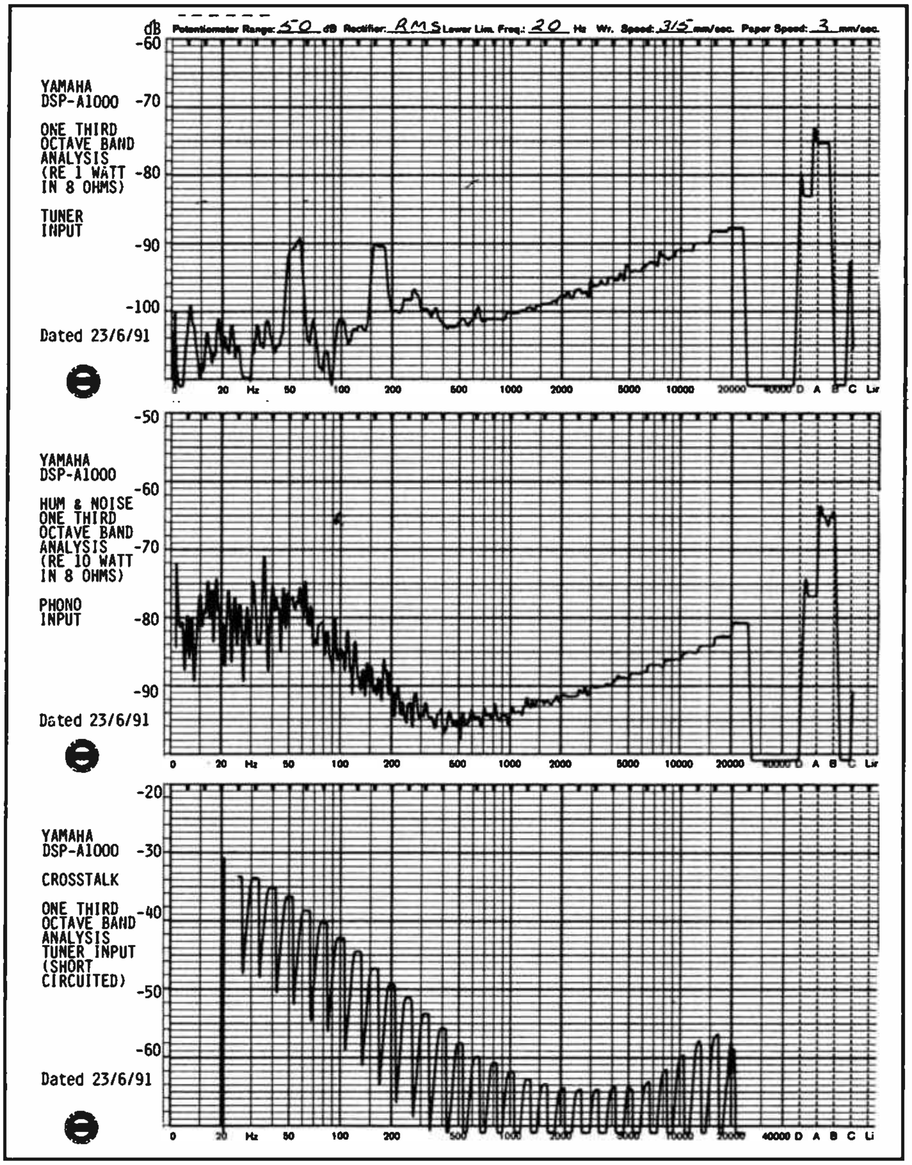
All the audio and video hardware that you require, with the exclusion of the video Laserdisc player, video recorder and of course the loudspeakers, have been adroitly combined in one neat (if somewhat heavy) package.

The unit takes the Dolby Pro Logic signals, and using its additional DSP capabilities, processes the audio signal to provide five or seven channels of audio output from the original four channels of surround sound.

The system can of course provide just four channels, and if required can even cater for three channels, but unless one is prepared to use the full potential for which the system has been designed, then one must of course suffer some degradation in performance.

The two main amplifiers and the centre channel amplifier have each been designed to provide 80 watts of power into 8-ohm speaker loads, whilst the four supplementary effects channels are each designed to produce 25 watts of DSP or Dolby Pro Logic processed surround sound into eight ohm speakers. On the rear panel of the unit there are 10 audio and five video inputs, supplemented by S-video and composite video jacks. There is also a separate pair of S-video terminals on the front panel, so that you can quickly and conveniently view the output of your new camcorder without having to turn the amplifier around to make the connections.

To simplify what might otherwise have proven to be a daunting task to



Three further plots: the noise analysis for tuner and phono inputs and the crosstalk between channels at the tuner input.

align each of the individual channels, a digital test tone generator has been incorporated.

This is provided for both the DSP and Dolby Pro Logic circuits, and is specifically required for the five-band centre channel equalisation. This also works equally well for the three-channel centre mode and for the three-channel Pro Logic modes.

The instructions and essential information are displayed on the front LCD panel of the unit, and this information can also be displayed on the TV monitor screen provided it is connected to the DSP-A1000's rear panel monitor jack.

Additional features included are a sub-woofer output connector (which I found to be invaluable), and the capability to mute the main and effects channels, as required.

Now first appearances can sometimes be somewhat deceptive, and this is especially true when one first views the front panel of the DSP-A1000. All you really notice is a power switch and a central LCD display on which the program's parameters, selected settings, adjustments and activation of control logic, are displayed.

To the right of this is a somewhat smaller TAPE-2 monitor switch, alongside which is a motorised rotary input selector for nine inputs. At the extreme right of the panel is a very large rotary volume control, which is calibrated from 0 to -80dB.

The input selector allows you to locally or remotely switch from PHONO (moving coil or moving magnet), CD PLAYER, TUNER, DAT/TAPE RECORDER, LASER DISC PLAYER, TV (or VIDEO TUNER), VCR 1, VCR 2, or AUXILIARY INPUT. Boy — that's simple, you think!

Then you look a little more closely, and discover that there is one of those neat drop-down panels.

Here it extends the full width of the unit and behind which are a few more controls, but far less than you would really expect for the amount of electronics that you know is inside.

These few controls include the INPUT TRIM control, which allows you to adjust the levels of each of the input sources and also to adjust various other level gain settings that are sellected with the small SET MENU SWITCH — which is close beside. That switch in turn allows you to nominate five different parameters for adjustment which are respectively, PRO LOGIC MODE, CENTRE MODE, CENTRE GRAPHIC EQUALISER, SUB WOOFER LEVEL, AND COLOUR — which controls the background on the TV screen in the absence of any TV program input. A separate PROGRAM TOGGLE switch sequentially selects the sound field processing programs, while the adjacent EFFECTS SWITCH allows you to turn the effects speaker channels either ON or OFF. A further switch is provided for BASS EXTENSION, which in turn is supplemented by a pair of BASS and TREBLE rotary controls; a BALANCE control; and a RECORD OUT rotary selector, through which you may switch from CD to DAT TAPE, SOURCE to VCR1, or LASER DISC PLAYER ,TV, VCR2 or AUXILIARY. Last but not least, on the right hand side of the recessed panel is a socket for your S-Video recorder and three gold-plated RCA sockets for VIDEO INPUT and AUDIO LEFT and RIGHT channels.

By this stage you are most probably firmly convinced that this is the simplest piece of audio/video equipment ever invented. Were it not for the Yamaha remote control transmitter Type RCX which has been lurking in the bottom of the carton, you would be almost correct.

The engineers at Yamaha have of course deliberately simplified the controls on the DSP-A1000 — through the simple stratagem of placing all of the more complex control functions on the remote control, so you can sit back in the middle of the room and be the virtual master of all that you survey.

Using this neat and powerful control, and in conjunction with the convenient display on your TV monitor, quite apart from duplicating all the control functions found on the front panel of the amplifier, you can also adjust the rear and centre channels relative to the main channel level. You can also exercise control over the other input devices, such as the Laserdisc player, CD player, tape deck or tuner — provided they are either manufactured by Yamaha, or by another manufacturer who provides remote controls for these items of equipment.

It matters not that they don't automatically use the same digital signals, because Yamaha (like many other manufacturers), has provided a RELEARN FUNCTIONS facility.

Using this your remote control can emulate the control functions of the other manufacturer's remote control, simply by putting the transmitters literally 'eyeball to eyeball' and activating them in accordance with the printed instructions.

In the ubiquitous manner that most of the other electronic equipment manufacturers has now adopted, each of the keys can learn two different functions, so that by switching the uppermost switch from Memory1 to Memory2 you can encode a whole new set of programming instructions into the remote control.

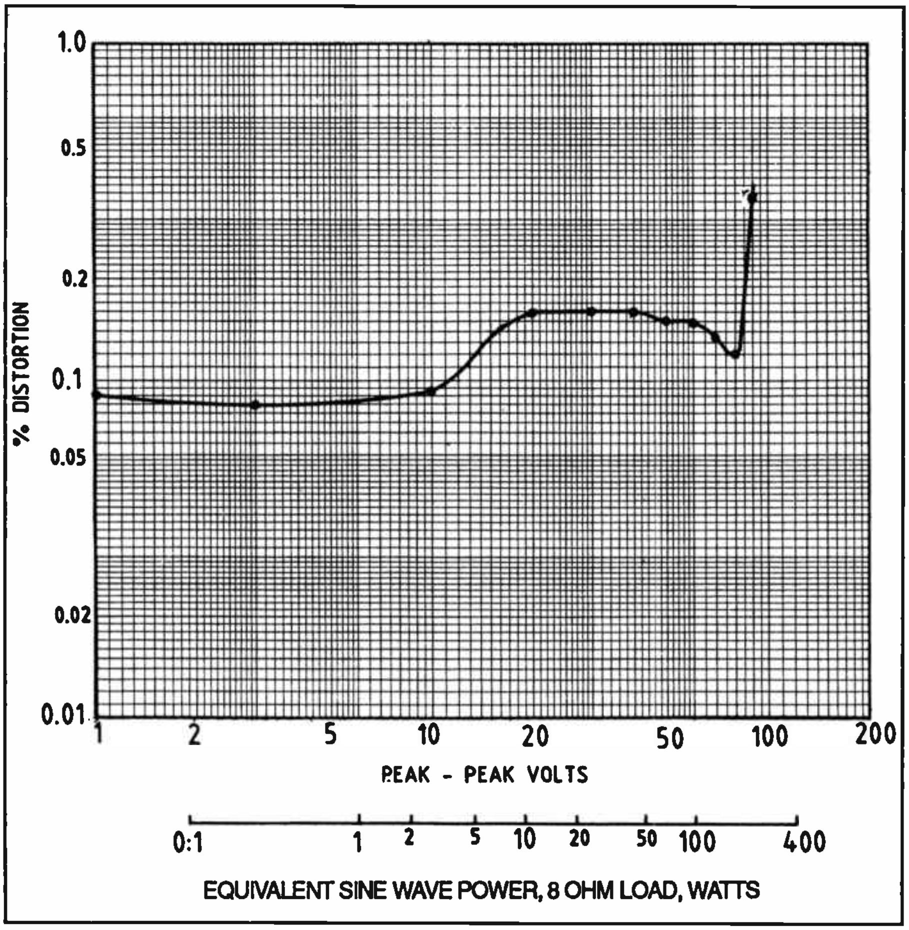
By using blank templates, which have been provided for that purpose, and on which you can print, glue or type the abbreviated coding or acronyms for each instruction, you can permanently record each of these new control functions.

Even the remote control looks simple when compared with the back of the amplifier. As you soon discover, this has a plethora of input sockets, 16 loudspeaker terminals and additional sockets to feed front and rear effect speakers, mono central amplifier speakers and outputs for a subwoofer.

A switch is also provided for front mix ON or OFF, and a very small volume control for trimming the main amplifier channel output level.

A peek through the perforated slotted cover, or better still the removal of that cover, convinces you that Yamaha engineers have applied considerable ingenuity in the development and perfection of this particular amplifier system.

Much of its sophistication and clearly its compact dimensions are the result of their development of superior large scale digital integrated circuits, which result in minuscule dimensions for many of the more critical sections of this unit.



Distortion versus output level for the Yamaha DSP-A1000, plotted using the IEC high frequency total difference method.

Objective testing

In many respects the objective testing of the unit proved to be a little different from what we would have expected. The amplifier's main left and right channel outputs and also that of the centre channel are closely limited to the claimed 80 watts output into eight ohms.

The frequency response of these three channels surprisingly is not as flat as I would have expected, and all are typically down by 1dB at 7Hz and by 1dB at 17kHz — not unlike the frequency response of many of the related and larger amplifiers used in large cinemas.

Irrespective of which input channel the signal comes through, the frequency response is essentially the same.

The application of 'bass extension' to these channels results in a somewhat unexpected boost of the signal in the 50-150Hz region, with a peak of approximately 8dB at 70Hz.

The signal to noise ratio relative to the 1W level is at least 83dB(A), with one third octave band mid-band components being at least 100dB down relative to that 1W level. The crosstalk on the main amplifier channels is only 65dB down at mid-band frequencies, and only -35dB at 40Hz — which is lower than I would have anticipated.

The IEC high frequency total difference frequency distortion figures are somewhat higher than I would have expected, even though they still below 0.15% right across their effective operating range.

Although I attempted to evaluate the characteristics of the rear and surround sound channel amplifiers, I soon found to my chagrin that the frequency response characteristics of these channels is significantly modified by the DSP processors.

Consequently in the end and after protracted attempts, I finally admitted defeat and moved onto more rewarding pastimes. I was however, able to confirm that each of those channels does in fact have a full 25W output potential into eight ohms, with all channels driven simultaneously.

Listening tests

After completing the instrument evaluation of the DSP-A1000, I was fortunate enough to be able to take it home, where I placed it in my living room and connected it up to my existing audio monitoring system — which uses a Yamaha M-80 power amplifier, and a pair of B&W 801M speakers.

I used the latter for the two main front channels and supplemented them by four Yamaha YST-SE10 speakers for the surround speakers, with a further Yamaha NS-C90 speaker in the middle for the centre channel.

For the critical subjective evaluation of home video audible enhancement, I used a Yamaha CDV-1700 Laserdisc player and a Sony 27" Profeel monitor (which as I discovered will willingly accept an NTSC signal, a critical requirement for the subjective assessment if the software you are using is recorded in NTSC).

Yamaha Australia was kind enough to provide me with some pre-recorded Laserdiscs, on which the digital sound tracks have been pre-encoded with Dolby Pro Logic four channel sound.

The evaluation material provided was *The Search For Red October*, *Dick Tracy* and *Madonna's 1990 Tokyo Concert*, all of which contain appropriate Dolby Pro Logic soundtracks (and two of which also happen to contain revealing scenes with Madonna).

With each of the system's channels correctly aligned and all seven audio channels set to the appropriate level, my family and I were almost astounded at the difference between conventional two channel stereo and seven channel DSP-enhanced Dolby Pro Logic sound.

Given the choice of high quality stereo sound and lower quality DSP-enhanced Pro Logic sound, I have no doubt that I would opt for the latter almost every time. The most exciting aspect of this system is its pervading sense of realism, and the degree to which you become totally immersed in the video.

The DSP-A1000 is moderately expensive, requires space, three good frontal speakers and at least four modest surround speakers to achieve optimum results.

Whilst the quality of the NTSC material which I used was good, I know that the quality of the PAL video discs that are about to be released are significantly better. When that material becomes freely available, then the purchase of a DSP-A1000 becomes worthwhile.

The Yamaha DSP-A1000 measures 435 x 170 x 470mm, and weighs 20kg. It has a recommended retail price of $1999.00.

Further information is available from Yamaha Music Australia, 17-33 Market Street, South Melbourne 3205; phone (03) 699 2388. ■

NEW BOOKS

BiCMOS and VLSI

HIGH-PERFORMANCE BiCMOS TECHNOLOGY AND ITS APPLICATION TO VLSIs, by Ikuro Masuda and Hideo Maejima. Published by Gordon and Breach Science Publishers, 1990. Soft cover, 215 x 140mm, 85 pages. ISBN 2-88124-456-4. Recommended retail price $US58.

This book is Volume 12 of the series entitled 'Japanese Technology Reviews'. The aim of the series is to inform people outside Japan of the results of academic research in that country and to give an insight into Japanese technology. The authors of the titles are outstanding scientists or engineers actively engaged in relevant research or development.

The book describes high-performance BiCMOS (Hi-BiCMOS) technology and its applications to VLSIs. Hi-BiCMOS technology is an advanced form of BiCMOS technology that combines bipolar transistors and CMOS FETs. This advanced technology has made it possible to achieve speed performances competitive with bipolar LSI and integration densities close to CMOS LSI.

The first three chapters of the book review basic information of device structures and circuit configurations based on the concepts of Hi-BiCMOS technology. Chapters four to six look at applications of Hi-BiCMOS: Ch.4 shows typical examples of the combined bipolar and CMOS circuits, comparing their performance with CMOS ones; Ch.5 describes applications to static and dynamic RAM; and Ch.6 deals with logic VLSI, including microprocessors.

The book is obviously a technical one, aimed at those with a good background in transistor technology and an understanding of current devices like bipolars, CMOS and MOSFETs. Each development and application is well explained with plenty of circuit schematics, graphs, tables and photos. The explanations are clearly written and easy to follow.

I found the book overwhelming because of the huge amount of information presented — but for someone familiar with the background this probably wouldn't be such a problem. It is the amount of information presented that deterred me, not any particular explanation. The success of the Hi-BiCMOS technology was very well illustrated for me by a photomicrograph of a 70MHz, 32-bit microprocessor with 529,000 transistors (98.5% of which are MOS type and only 1.5% bi-polar), fabricated with a 1.0um process.

All-in-all, a very useful book for anyone seeking detailed knowledge on the current status, applications and prospects of Hi-BiCMOS technology.

The review copy came from Gordon and Breach in New York, but the book lists their Australian address as Private Bag 8, Camberwell Vic 3124. (P.M.)

Cellular phones

USERS GUIDE TO CELLULAR TELEPHONES, ASIA — PACIFIC, by Neil J. Boucher. Published by DNA Communications, 1991. Soft cover, 215 x 140mm, 110 pages. Recommended retail price $9.95.

'The Cellular Radio Handbook', by the same author, was reviewed in *EA* in November 1991. This very thorough, technical volume was written for the industry and cost $260! So this latest 'Users Guide' fits into a completely different category. As Neil Boucher states, it is written for the cellular phone user, and provides a clear and extensive coverage at that level.

The Advanced Mobile Phone System (AMPS) used in Australia and New Zealand is extensively used throughout Asia — hence the 'Asia — Pacific' title. The AMPS system is used by roughly half of the world's cellular phones.

The early chapters of the book describe the various, and of course incompatible, systems currently in use throughout the world. Even the approaching introduction of digital cellular phones, which is necessary to expand the number of phones on the system, comes in two main competing systems. (What a shame that one universal system can't be decided on!)

Then there are practical tips to help you choose between the various types of mobile phones, antennas and batteries available. What extra features can you have? For example, do you want an automatic transfer of incoming calls if your phone is busy, or doesn't answer; or do you want to send a fax from your mobile phone? Another chapter lists the most common faults and their probable causes — very useful for troubleshooting.

The very important aspect of privacy is discussed, and we are told that there really isn't any, unless very expensive scramblers are also installed. But this position could improve with the coming introduction of the digital system.

The final nine chapters are devoted to individual countries: the type of system used in each, whether or not phones from other countries can be used (effectively and legally), the operating charges and the degree of government regulation of the system.

If you want to understand the basic workings of the cellular phone system, then this book will help you do just that. It is very easy to read and understand, and its logical progression takes you through each stage of the system: what is it, how does it work, where is it heading in the future. For its low cost, the book represents an excellent introduction to the topic of mobile, cellular phones.

The review copy came from DNA Communications, 10 Welch Street, Southport 4215. It is available by mail (postage included) at the quoted $9.95 price. (P.M.) ■

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Impressive computer simulation at

Australia's New College for Air Traffic Controllers

How do you train air traffic controllers so they're fully experienced by the time they start controlling real planes filled with live passengers? In much the same way as you train pilots to fly those planes, of course: with an accurate computer simulation of a modern control tower. A new ATC training college has just opened in Launceston, boasting a very impressive simulation system of this type.

by TOM MOFFAT

Air traffic controllers, as well as pilots, carry the lives of the world's airline passengers in their hands. Being an ATC must be one of the most demanding and stressful jobs in the world. The job pays well — but by golly, you really earn your money!

An air traffic controller must be *perfect*. There is absolutely no room for a slip-up or a lapse of concentration. Drifting away into dreamland for a few seconds could mean sending an airliner full of passengers smashing head-on into another aircraft. Not knowing where every aircraft in your area is — 'losing the picture' — can spell disaster. When you begin a job as an air traffic controller, you don't learn as you go. You must be an expert from day one.

That's what Launceston's new Central Training College for ATC's is all about: producing air traffic controllers who are fully qualified and experienced, from the first day they sit down at a console at one of Australia's air traffic control centres.

The college is part of the Tasmanian State Institute of Technology, which itself has become part of a new statewide University of Tasmania. ATC students graduate with a three year diploma, which is compressed into two years — so it's a hard slog. As well, they have to pass a government ATC rating exam at the end. But by the time they come out, they will have spent some 200 hours 'being an air traffic controller', possibly without ever working with a real live aircraft.

The Central Training College has its own large building, containing offices and classrooms. But its main feature is a gigantic room containing a complete air traffic control centre, just like the ones in Melbourne and Sydney. There are banks of consoles down both sides of the room, and peripheral devices such as computer printers in the middle. Operators wearing headsets sit in front of large radar screens and display panels; supervisors stand behind them.

The operators are talking to aircraft, and watching their progress on the radars. Others are tracking more distant aircraft, via what's known as the 'procedural' method.

But in reality the whole thing is a big fake; the signals aren't leaving the building. They're only going to the next room, via a large Ferranti mainframe computer. Most of the building, then, is an Air Traffic Control Simulator.

This is the procedural control console. The pilot submits a flight plan in advance and then files this path, notifying 'reporting points' along the way.

Air traffic control

Perhaps at this stage we should look at what an air traffic controller does — the job that the students go to the college to learn. There are actually two types of air traffic operators. Air traffic controllers work only within controlled airspace. Their main job is to prevent two aircraft being in the same airspace at the same time, so they direct pilots to maintain a certain altitude and heading.

Flight service officers, on the other hand, work with aircraft outside controlled airspace, away from the big cities. Flight service officers provide information to pilots on things like weather and other aircraft in the area, But they don't actually order pilots to fly in any particular way.

Like so many things in today's government service, the whole ATC scene is being 'rationalized'; the jobs of air traffic controller and flight service officer are being merged. So students at the Launceston centre are being trained in both disciplines.

There are two flavours of air traffic control: 'radar' and 'procedural'. Radars in general use in Australia are limited in range to 160 nautical miles (this is an aviation story, so by international convention we're talking in miles and feet). So radar can only provide a picture of activity within 160 nautical miles of the major capital cities; beyond that, it's radio only.

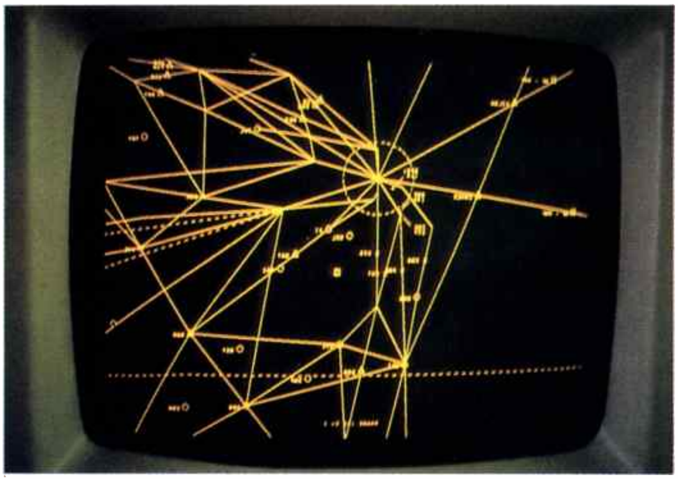
With the procedural system, the pilot submits a flight plan to advise ATC in advance of his intentions. Then as he flies along, he notifies ATC as he passes known 'reporting points' along the way. These points are usually nothing more than known intersections of latitude and longitude, particularly over the ocean.

The reporting points always seem to have really weird names, possibly so they can't be confused with other words when spoken over the radio. A couple that come to mind over Tasmania are 'Synnot', which appears to signify absolutely nothing, and 'Ironstone'. Ironstone is actually above an area of the Central Highlands which is rich in ironstone. It drives compasses wild — perhaps not so much in aircraft, but bushwalkers in the area who religiously follow their compasses find themselves sent badly off course.

Bushwalking can also illustrate the 'procedural' method. On trips such as Tasmania's Overland Track, parties advise their intentions to the ranger before they set out (the flight plan).

Then in each hut along the way (reporting point) they sign the log book to indicate that they got that far. So if they go missing, a search party can check the log books to see how far they got before they disappeared.

At the end of the journey bushwalking parties are expected to notify the rangers of its successful completion (close the flight plan). Failure to do so can result in an unnecessary and expensive search, both in bushwalking and aviation.



Left: These trainees are learning to operate the touch screens used by 'blip drivers'. At right is shown the blip driver's overall situation display. Each console can handle 20 aircraft at once, but its normally six or seven aircraft.

'I'm a blip driver'

Within the 'simulated' Air Traffic Control Centre, trainee controllers operate their radar or procedural consoles, relaying instructions to pilots over the radio and getting position reports back from them. What pilots? Well, they're big fakes too — just people sitting at other consoles in the next room.

With a little help from the big Ferranti computer, their actions are translated into blips representing aircraft on the controllers' radar screens. These 'simulated pilots' are called 'blip drivers'.

Blip drivers are occasionally real pilots, but more commonly they are ordinary people in a most unusual occupation. Blip drivers work part time, 24 hours a week. The one and only time the jobs were advertised openly, there were nearly 500 applications for 40 jobs.

Nowadays any replacement blip drivers are rounded up through the Commonwealth Employment Service in Launceston ("I've got just the job for you, Mr. X. How would you like to be a blip driver?").

Each blip driver's console has a headset and a computer touch-screen. The trainee controller might key his radio and say something like "Tango Alpha Bravo, turn right heading three-four-five and maintain flight level two-seven-zero".

The blip driver who is pretending to be the aircraft with registration number VH-TAB acknowledges the radio call, and then presses a few spots on the touch screen. This tells the computer that the pilot of VH-TAB is turning to a course of 345°, and will maintain an altitude of 27,000 feet. Back in the air traffic control centre next door, the trainee controller sees the blip on his radar screen begin travelling around to the new heading.

Each blip driver console can accommodate 20 aircraft at once, but it's unusual for a blip driver to handle more than six or seven. That's still a pretty big work load, pretending to pilot all of them at once.

As well as pilots, blip drivers are sometimes called on to impersonate other air traffic controllers working with the trainee, or even people like outback policemen during search and rescue operations.

This is the simulated air traffic control centre (just like the ones in Melbourne and Sydney) where students learn to operate the computers and terminals down both sides of the room. Supervisors stand behind the student ready to assist if needed.

The simulator

The ATC simulator's 'world' is a square of 2048 x 2048 nautical miles, big enough to cover half of Australia. It isn't a flat square, though — it's part of the sphere that represents Planet Earth. So all calculations done by the computer would involve spherical geometry.

Launceston's ATC simulator is centred on an imaginary area based loosely on Esperance in Western Australia, so it contains lots of sea area and lots of outback land.

Somewhere within the 2048 x 2048 grid, the computer can place a 768 x 768 nautical mile radar coverage area. The main grid can accommodate up to 300 aircraft at any one time. Those also within the radar grid are subject to radar control, and the rest are under procedural control. The system allows six independent exercises to take place at the same time, with up to 200 aircraft involved in any one exercise. Up to 10,000 flight plans can be held on file, for flights that may take place at other times.

As for the aircraft themselves, the system can handle 64 different types, ranging from a hot-air balloon to an F-18. Their speeds can range from zero to 999 knots, with altitudes up to 100,000 feet.

It would be interesting to try to program a hot-air balloon to do 900 knots or so, to see what the simulator (or trainee controller) would do with it!

A separate computer is provided to handle voice communication between the trainee controllers and the blip drivers. VHF frequencies are pretty straightforward, but HF frequencies can be dosed with simulated noise and interference, so controllers can get used to working distant aircraft under lousy radio conditions.

But the *real* simulator trickery is in the radar area. In real life, two types of radar are used, and the simulator imitates them perfectly. Primary radar is the big one you see at airports with an antenna scanning around and around; the one in the simulator scans between five and 15 times a minute.

Primary radar relies on echoes from the metal skin of the aircraft to determine how far away it is, and what its bearing is from the station. Primary radar provides no information about altitude.

Secondary radar depends on a gadget within the aircraft called a 'transponder', which receives an interrogation signal from the ground and responds with a four-digit identification code which the pilot enters with some thumbwheel switches prior to takeoff. Air traffic controllers know this as the aircraft's 'squawk code'. The transponder also transmits the aircraft's altimeter reading, providing the extra dimension missing from the primary radar.

Information from secondary radar transponders is mixed with information from the primary radar to provide the final radar display of all the aircraft in the area. The blips thus generated carry altitude information so they are firmly fixed in space, and they also carry a 'squawk code' so the controller knows which blip belongs to which aircraft.

As a side benefit, if any pilot has an emergency situation he need only dial in the code '7700' on his transponder and the ATC radar screen will highlight him while setting off lots of alarm bells.

The Ferranti system is able to simulate the two radar systems at once, for 300 aircraft at once, all at different locations and different altitudes and moving in different directions.

That's quite a feat, but the computer itself doesn't look all that impressive. It's just a big gray cabinet that looks like, well, a computer. But inside is a Ferranti ARGUS 700GZ main processor, several 700GL supplementary processors, a Winchester disk system and heaps of semiconductor memory.

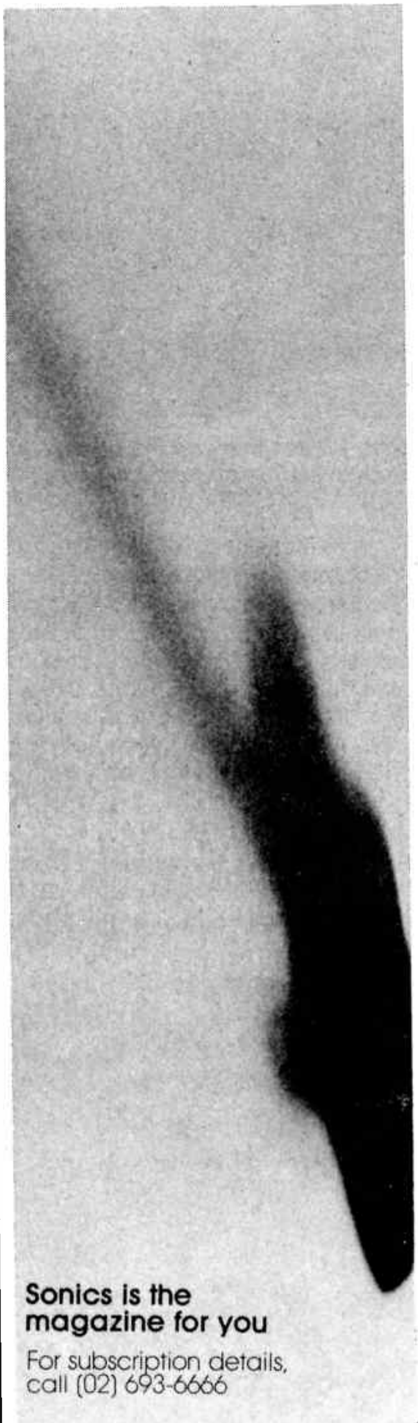
The Launceston system is the biggest Ferranti has ever put together, and it cost something like $12 million. There's a similar facility in Melbourne, but it's only about one third the size of Launceston system, which is the daddy of them all. Too bad it's only temporary, but...

The future

Within 10 years, we are likely to see the whole ATC scheme as we know it replaced by a satellite-based 'global

The Ferranti ARGUS 700GZ computer. Not very impressive you might say, but sneak a look at the price tag for the Launceston system. You just don't pay $12 million for a big grey cabinet.

Trainee air traffic controllers are shown here working at radar consoles controlled by the Ferranti ARGUS 700GZ. There are two types of radar: primary radar — the one you see at airports, and secondary — emitted from a transponder on board the aircraft.



Traffic controllers

aviation system'. A group called the Future Air Navigation Systems Committee (FANS) is working toward a system which will allow fewer ATC centres to cater for more aircraft.

One feature of the system is direct communication between an ATC and a satellite, and between the satellite and aircraft. This would eliminate the need for the sometimes noisy and unreliable HF radio channels in use today.

The satellite circuits would also cater for data transmission, making it possible for the aircraft to pass information directly to and from an ATC computer without the need for the pilot to use the radio at all. Around busy airports, normal VHF communications and secondary radar (transponders) would continue to be used.

FANS also sees a global navigation satellite that would replace every navigation system in use today, such as Omega, Loran, Satnav — the works. It's expected such a system will be implemented by 1995, using the American GPS satellites, and one from the USSR called GLONASS (sounds like Glasnost, doesn't it?).

The current VHF instrument landing systems would be replaced by a high-precision microwave ILS. Could hands-free landings become a reality?

It is also expected that aircraft will be fitted with a system that will automatically transmit position information, so ATC's can keep track of their whereabouts continuously. Let's hope they don't come up with a similar system for people!

The output of all this will be a computer-generated display of a simple map showing all the airways in a region, and where every aircraft is along each airway. This would not be a rotating, scanning, circular radar display, but just a simple colour monitor with a map on it and en-route aircraft creeping along the lines. It's obvious that when the global aviation system becomes a reality, there will have to be some big changes at Launceston. But until then, the system has a good 10-year future training new generations of air traffic controllers.

How to learn more

In these days of home computers and classy short-wave radios, it's easy to experience for yourself what an air traffic controller does.

If you have a good HF receiver, tune it to 8867kHz, upper sideband, and wait. You will soon hear controllers in places like Sydney, Nadi, and Auckland, working aircraft from many nations.

You'll hear pilots giving positions from reporting points with funny names. You'll hear air traffic controllers requesting the aircraft to change altitude. Sometimes the pilots radio back weather observations, which become part of the next day's weather forecast. Reception on 8867kHz is usually excellent.

If you live near a big city, you can listen for air traffic control activity on VHF, using AM between 118 and 136MHz or so. I was going to list exact frequencies, but the pilots' *Enroute Supplement Australia* shows heaps of them for the big cities, with different frequencies being used for aircraft flying to and from different directions. If you tune around or use your scanner, you'll find the ones for your area soon enough.

There are a few computer programs about that let you get a taste of being an air traffic controller. Look around on the bulletin boards for a thing called *Dulles*. This is a simulation of air traffic control operation around the John Foster Dulles airport in Washington DC. The action mostly involves the control tower and arriving and departing aircraft, but it gives an idea of the complexity of the job faced by real air traffic controllers.

Closer to home, if you have a Microbee, keep a lookout for a thing called *Sydney Approach*. This one is a lot simpler than *Dulles*, but it still gives the feeling of trying to handle a whole swag of aircraft at once. In your early attempts you will become frazzled very quickly and you will 'lose the picture' many times.

If you want to get the feel of it from the pilot's point of view, have a look at Microsoft's *Flight Simulator* as featured in the November 1990 issue of *EA*. You can set it up to receive control tower messages and display them on your screen, and the aircraft has a proper transponder for use with secondary radar.

If you'd like to get your hands on the big Ferranti simulator, you might want to consider a career for yourself as an air traffic controller. Places in the Launceston Central Training College are sometimes advertised in the newspapers, or perhaps you could write to the University of Tasmania — Launceston, at PO Box 1214, Launceston 7250.

As for me, I'm probably a bit old for such a thing. But if I lived in that part of Tasmania, I'd be right in there trying for one of those part-time blip driver jobs. I reckon that would be fascinating. ■

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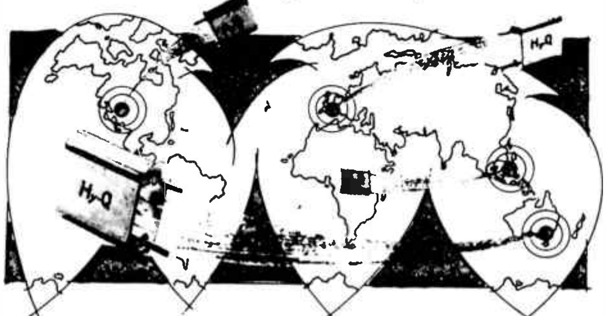

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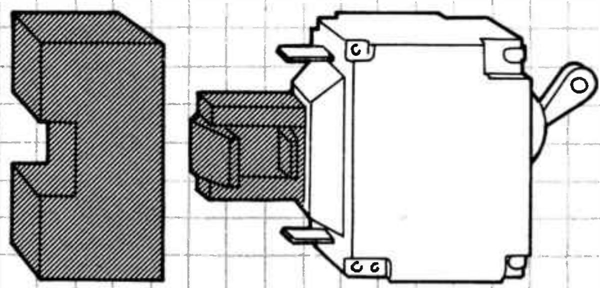

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Moffat's Madhouse...

by TOM MOFFAT

Things that work when they're not supposed to...

Do you live by the rules? Well, society says we're supposed to, but sometimes rules are there to be broken. Not rules that say we shouldn't go around murdering people; but as for some of the rules that don't harm anybody, we can break them with impunity.

We may succeed smashingly, in which case the rule breaker is declared a genius. Or we may fail, to end up with egg all over our faces.

But it doesn't hurt to defy established convention from time to time — as they say, no guts, no glory — and the results may be both satisfying and useful. Who knows, a new rule might even be named after you. What follows then, I shall egotistically call 'Moffat's Laws of Dud Antennas'.

The idea for this column came after a letter from a reader concerning my variable balun project, published in May's EA. The article sang the praises of parallel feedline for antennas, as a means of cancelling the effects of nearby electrical noise. I mentioned various types of balanced feedline, and then suggested the use of good old parallel 'speaker wire' if nothing better could be found.

'Speaker wire' in this context means the stuff that looks like miniature figure-of-eight flex. I use 'speaker wire' for just about everything around my place; I've bought several hundred-metre rolls from Dick Smith Electronics, and run it all around the house to do things like connect a receiver in my workshop to a computer in my office (for Listening Post II use). We have an intercom system running through speaker wire, and when the kids were little I used speaker wire to rig up play telephones for them. I even made a giant set of twinkly lights from a big pile of 6.3 volt globes, to string as Christmas lights on a big pine tree in front of the house.

Speaker wire is useful stuff, but there's one thing I won't use if for: speakers. For that purpose, hooking up the stereo, I use the larger mains-size figure-of-eight flex. I wouldn't want to open the Monster Cable debate again, but I've been feeding a pair of 20 year old Leak speakers, with the same crumbly old runs of flex, and they still work fine to this very day. Dare I say, better than a lot of the modern stuff?

But speaker wire as antenna feed line? The reader brought up the point that speaker wire has a capacitance of 470pF per 10 metres, and should therefore be useless on the higher HF frequencies around 28MHz. He's right to a certain extent, 470pF would certainly place a big shunt load across 28MHz energy, especially if the impedance was very high. But with a dipole of some indeterminate length, the impedance can be anything. In any case, it's pretty likely the speaker wire will act more like a transmission line than a shunt capacitor. Coaxial cable has a lot of capacity too, and it works all right.

I've used speaker wire for antenna feeder many times over the years, particularly where the antenna has to be rolled up and carried around as in a portable situation. In fact I think I learned the speaker wire trick as a Boy Scout (a short career, terminated when I got caught smoking). Scouts back then were very radio-orientated; we all learned Morse code on scout-issue key/buzzer sets, and many of us went on to become hams. And consumers of speaker wire...

Another comment from the same reader pointed out that there are few private homes in Australia with big enough gardens to take a half-wave dipole. True enough, but that was the real point of the variable balun project: to let you break the rules, and use an antenna that is too large, or more importantly, too small for the frequency in question. To quote directly from the balun article, 'It won't be perfect, but it does make a definite improvement in reception, particularly at frequencies below the antenna's half-wave figure'.

What this boils down to is that many people have built the variable balun project (I'm kicking myself now for not putting it out as a kit), and I've got lots of reports back from people saying it's made a remarkable improvement to reception, particularly in inner city areas — even when using speaker wire. In short, it works!

Here are some more examples of things that shouldn't work, but do. At one stage I lived in Reno, Nevada in the USA, a city renowned for gambling and divorces. But in reality it's a lovely place, surrounded by mountains and lakes and filled with the friendliest people you'd hope to meet. And a major industry, bigger than gambling, is railroads. Railway lines are everywhere, bisecting the city and in some cases almost running through back yards.

One back yard belonged to a ham radio acquaintance. Every night he put up with the noise of freight trains trundling along just outside his bedroom window. The guy's main interest was 160-metre operation, frequencies which require truly giant antennas for efficient operation. He got to thinking: that railway line in the back yard, all that metal...

In the dead of night, out came the wires from his bedroom window, across the yard, and at first onto the wire fence the railways had erected to keep kids and dogs off the line. Two parallel wires fanned out, intersecting the fence at two places about 20 metres apart in sort of a 'beta-match' arrangement.

This setup was promising — a definite improvement on the loaded vertical he'd been using. Could it be improved upon?

The next step, of course, was the railway line itself. He hopped the fence and connected one feeder to each end of one section of rail.

This worked much better than the fence on 160 metres, pulling in stations he couldn't even hear on his vertical. And when he transmitted, reports from the other end said his signal was many times stronger.

Now if this guy had been a rule-follower, he never even would have considered the railway line as an antenna. To be effective, an antenna must be very high, requiring a large, expensive, and council-baiting tower. Yet the railway line had an antenna height of zero. A simple 160-metre halfwave dipole should be something like 80 meters long; the railway line stretched from California to Chicago. And who knows what the joins between the individual rail sections were like? This was not an electric railway, so there was no guarantee of conductivity anywhere. Yet it worked!

Australian readers take careful note: you must NOT try this here. Just about every railway within city areas is electrified, and even though the rail is supposed to be the 'ground' side, you never know when something could go wrong, releasing the ground and letting the train conduct several hundred volts from the overhead power line into the rail and your receiver or transceiver. (*Editor: There would also be a risk of RF from a transmitter upsetting the signalling and causing an accident.*) Anyhow, electrical noise would be intolerable.

Later I moved 50km south of Reno to Carson City, and a block of flats. The landlord was interested in radio, and had no objection when I asked if I could put my ham antenna on the roof.

This worked great; a multi-band vertical with wire radials, attached to the stink-pipe above the second story. A classic, by-the-book installation; a lovely sight to amateur radio eyes, but a vile nuisance to the neighbours. One particularly snarky fellow next door said it got into his stereo (it did!) and demanded that the offending antenna be removed. The landlord bowed to the pressure, and the vertical had to go.

But the lack of a 'proper' antenna never stops a keen amateur, and after some improvisation I was soon back on the air. Because of the neighbour problem the prime requirement for the new antenna was invisibility. My flat was on the ground floor, well buried within the building. There was a little fenced courtyard at the front, and beyond that, rows of parked cars.

The only way I could see to get back on air again was to somehow make use of that fence, and a bit of wire. The total length of the fence was around eight metres, slightly more than the length needed for a halfwave dipole on the 15-metre amateur band. This would be fine, since 15 metres was my favorite band in those days.

I tacked the right length of wire around the fence, hiding it under the 4x2 timber that formed the frame for the fence. A coaxial feedline came down from the centre of the antenna and onto the ground, buried under a layer of pine chips that served as the floor of the courtyard. Totally invisible!

That night I gave the new antenna the smoke test. At that stage I was about to move to Australia, so I had been concentrating on Australian stations. And would you believe, reports were BETTER, night after night!

That silly little chunk of wire was outperforming an expensive, properly installed, commercial antenna. The neighbor, of course, still got interference, but it couldn't have been me. I didn't have an antenna, as far as he knew. He eventually gave up and moved away. Mission accomplished.

Talk about breaking the rules! Here we had an antenna operating on 21MHz — not 10 or 15 metres high, more like one meter high. Not a dipole, but more of a three-sided loop. Surrounded by a big solid building on one side, and a mass of cars on the other. Why was it better? Wouldn't have a clue. But it went like a rocket. So much for conventional wisdom.

And in the same block of flats... Reno only had two TV stations, Carson City had none. But both cities were serviced by a cable television system that picked up several San Francisco stations from the top of a 10,000 foot mountain and microwaved them down to the city, where they rode coaxial cables everywhere. One branch of the cable went right along the front of the flats, and if you paid five dollars a month or so, the company would provide a tap from the cable into your flat.

In Carson City one Reno VHF station was good, the other was useless. But the bad one eventually installed a UHF translator for Carson City, on channel 80, way up around 800MHz. I built a snazzy little 11-element beam, all of about a metre long, and installed it on the second floor railing where it could see over the cars to the translator.

It worked great, producing better pictures than I'd ever got in Reno itself. But when tuning to VHF with the little beam still connected, there were the San Francisco stations — weak, but watchable.

Amazing? No. The coax to the little beam ran alongside the cable TV coax for a short distance, and there was leakage. A leakage that I felt was there to be exploited.

After a bit of fiddling around and yet another coax run, I discovered that all I had to do was wind about five turns of wire around the cable company's coax and — Bingo! San Francisco TV, just as good as the paying customers in the flats got it.

This could obviously be construed by some people as slightly illegal, so I took special pains to make sure my little coil did not touch or interfere with the cable company's cable in any way. It was wound around it, but not touching. If the cable company's cable radiated so much, that was *their* problem.

The day of reckoning came when the cable company's technician paid a little visit. "Is that your coil?".

"Yes".

"What's it for?"

"So I can pick up your TV without paying for it."

"But you're interfering with our cable!"

"No I'm not, I'm not even touching it."

Then I suggested his company could save a lot of money with connections if they just wound little coils around their cable, instead of using those expensive fittings that puncture the cable to reach the inner conductor.

"Yeah..." And off he went, thinking.

Never again was there a complaint about my little coil.

Broke the rules again, if not the law. The outer sheath of that co-ax is supposed to act as a shield. No way! Even in that high-quality stuff used for main-line distribution, the outer sheath radiates like crazy.

Is there a useful principle here, somewhere? ■

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Tuned FM demodulators

The ratio detector and the Foster-Seeley discriminator dominated the field of high quality FM demodulators for nearly four decades, before the later advent of cheap integrated circuits made other even older methods economically feasible.

by BRYAN MAHER

Continuing on from the last chapter, we will now describe two types of tuned FM demodulators.

The four main points you may wish to recall from the previous chapter on vector diagrams are:

1. A voltage or current amplitude can be represented on paper as the length of a straight line we call a vector.
2. The difference in timing or phase angle between two AC voltages or currents can be indicated on paper by the angle between the vectors.
3. The addition or subtraction of out of phase AC voltages can be indicated by geometric vector addition or subtraction.
4. In inductive circuits voltage leads current by 90° (or if you like, current lags voltage; same thing, isn't it?) In capacitive circuits the opposite happens.

Tuned FM demodulators

Of all the tuned FM demodulators invented, two types give excellent results. The first we will describe is the *ratio detector*, shown in Fig.1.

Q1 is the final intermediate frequency amplifier of a radio or sound section of a TV receiver. Frequency modulated IF signals from Q1 are coupled to the demodulator via a transformer, composed of primary winding L1 and secondary L2.

L2 is centre-tapped at H, forming the two equal halves L2A and L2B. The whole of L2 is tuned by C2 to the unmodulated IF centre frequency fo. Inductance L4 is a high impedance 'choke' suitable for high frequencies and D1, D2 are matched fast diodes, 1N914 or similar.

The ratio detector circuit is actually distinguished by the diodes being connected in series, as shown in Fig.1. The very large tantalum or electrolytic capacitor C6 is charged by the rectified IF signal. Because of loading resistors RA + RB, the charge on C6 resides at the average peak IF voltage, positive at the top as shown. RA and RB are matched and equal.

Capacitors C1, C4, C5, C7, C21 are all chosen large enough to be very low impedance at IF frequencies, but the matched pair C4, C5 (as well as C7) are small enough to exhibit impedance at audio frequencies.

The DC charge on C6 is sufficient to cut off the diodes at most times, except on positive signal peaks.

Two signal feeds

As well as signal being coupled by the transformer action of L1/L2, the modulated IF carrier V1 is also coupled

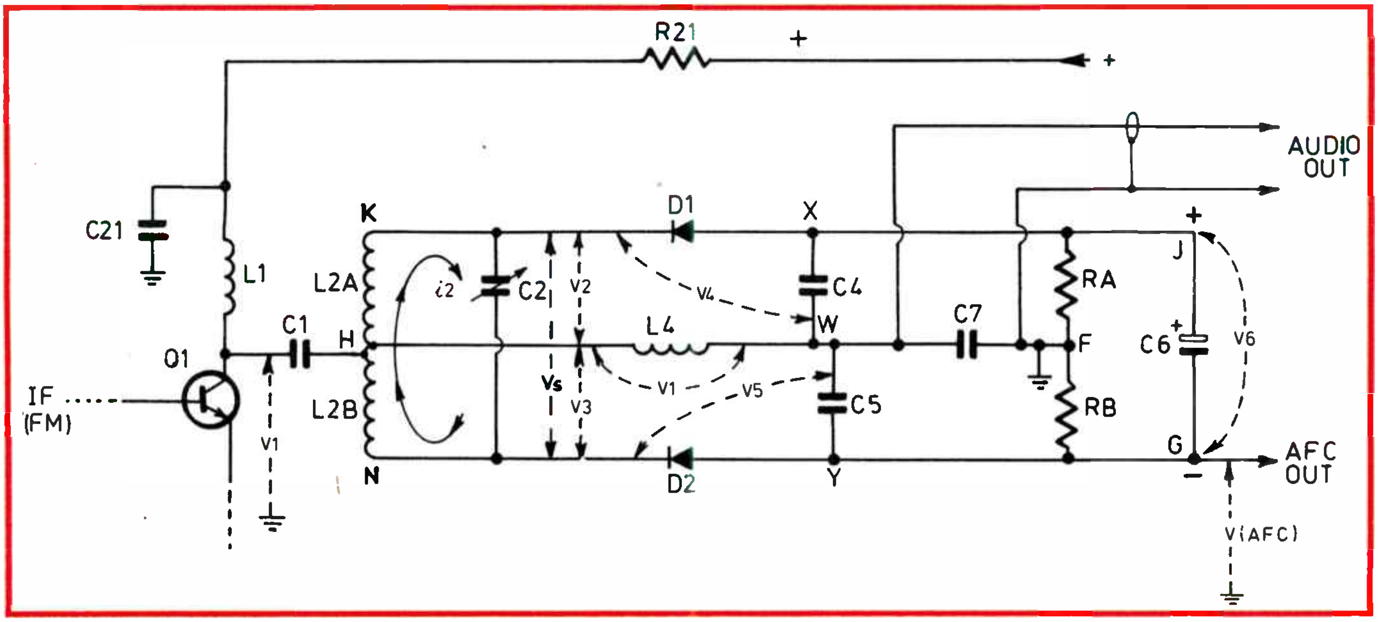


Fig.1: The Ratio Detector FM demodulator, whose operation is explained in the text. Note that RA=RB; C4=C5; L2A=L2B and D1=D2. C6 is a large tantalum or electrolytic, while C7 and C21 are IF bypass capacitors and C1 is the IF coupling capacitor.

by capacitor C1 to the secondary centre tap H. With C7 acting as an IF bypass, the whole IF signal V1 must therefore appear across inductance L4.

When the signal is unmodulated (e.g., when that vociferous disk jockey eventually stops talking), the IF signal is at centre frequency fo. In such a case, as the resonant tank L2C2 is tuned to fo, the circulating current i2 flowing around the tank is in phase with the secondary voltage Vs. As that last point is vital, we repeat for emphasis:

At f=fo, i2 is in phase with Vs.

We show this in the vector diagram of Fig.2(a). By transformer action, the secondary voltage Vs is at 180° to the primary voltage V1.

In flowing through the coil L2A, the current i2 produces a voltage drop from H to K. Because L2A is inductive, voltage V2 must lead the current i2 by 90°, as we show in Fig.2(a). Because this voltage drop is in direction H to K (ie away from the centre tap) and not K to H, we draw the vector V2 the other way around as shown.

In like manner, current i2, flowing in L2B, produces a 90° leading voltage drop V3 from N to H.

Note that both V2 and V3 are always at right angles to i2.

Vector sums

Looking again at the circuit of Fig.1, we see that the voltage V4 is composed of two voltages, V1 and V2. As these are AC voltages out of phase, we must add them vectorially as in Fig.2(a). Similarly V5 is the vector sum of V1 and V3.

By the symmetry of the circuit and because of the earthed mid point F, any audio output must arise from the difference between V4 and V5. (The next statement is essential to the explanation).

We regard V4 and V5 as vectors at IF frequencies, and take account of their phase angles. But the diodes rectify V4 and V5, producing in C4 and C5 average voltage values over many cycles.

Also the point W is bypassed to ground at high frequencies (but not for lower audio frequencies) by C7.

Average values

Therefore the voltage between W and ground can only be the difference between the average values of V4 and V5. But average values, taken over many IF cycles, have lost all sense of phase and timing.

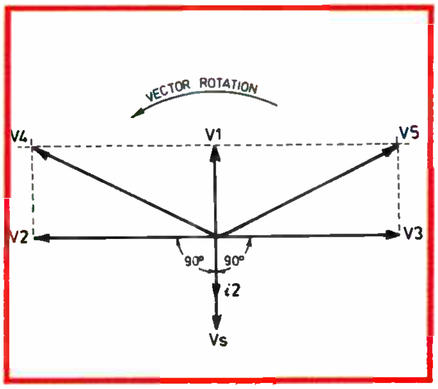


Fig.2(a): At resonance, i.e., when f=fo, current i2 is in phase with Vs, so the absolute values of V4 and V5 are equal: thus there is no audio output.

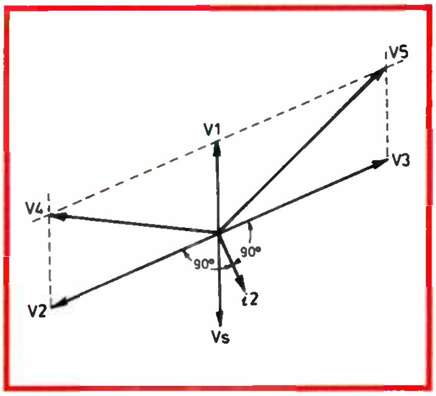


Fig.2(b): When the received signal is in downward modulation (f<fo), i2 leads Vs but V2 and V3 must be always at 90 degrees to i2. Thus resultants V4 and V5 have different absolute values, the voltage on C4 is smaller than that on C5, and their difference gives positive audio output.

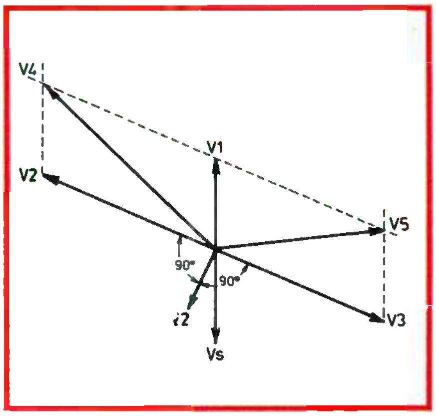


Fig.2(c): When the received signal is in upward modulation (f>fo), i2 lags V2 but (as always) V2 and V3 must be at 90 degrees to i2. Thus the absolute value of V4 is larger than that of V5, so the voltage on C4 exceeds that on C5, and their difference gives negative audio output.

So the voltage at W is the difference between the *absolute*, or peak values of V4 and V5. The absolute values of vectors in Fig.2(a) means just the length of the line, representing the voltage without any regard to its direction. (Recall that vector direction indicates phase angle or timing.)

Fig.2(a) shows that, in the unmodulated case when f=fo, both V4 and V5 have the same length. So their absolute values are equal, meaning that they have zero difference.

The voltage at W, being the result of rectified and averaged carrier, is the audio modulation signal. We have thus shown that in the unmodulated case (when f=fo) the audio output is zero. Which of course is what we wanted!

Acutely alert readers are no doubt by now silently mumbling, wanting to know what happens when that disk jockey puts a record on. I.e., when we have some modulation.

Downward modulation

On one half of the audio cycle, the FM station's transmitted signal is *reduced* in frequency by the modulation. That is, f<fo.

Each time this occurs the tank L2C2 is no longer in resonance; the tuned circuit appears as a capacitive load. Therefore current i2 *leads* the voltage which causes it, Vs. We show this diagramatically in Fig.2(b).

Despite this, the voltage drops V2 and V3 must always be at 90° to i2, due to the inductive property of the coil L2A and L2B.

Notice the new shape this gives to our vector diagram, shown in Fig.2(b). The angle between V1 and V2 is now larger than the angle between V1 and V3. Therefore as Fig.2(b) shows, V4, the vector sum of V1 and V2 is smaller than before. At the same time V5, the vector sum V1 + V3 has increased.

Thus the difference in the absolute values of V4 and V5 is no longer zero. The rectified carrier voltage drop across C5 is greater than that across C4. But the sum of voltages across C5 and C4 is constant — i.e., V6, the DC charge held by C6. Therefore the potential at W has moved in a *positive* direction, towards X. Thus is formed the positive half of the audio signal, the modulation, which is taken from W to the following audio amplifier's volume control, etc.

Notice that only audio frequencies can exist at W; the high frequency remnants of the rectified IF signal are all bypassed by C7.

Upward modulation

On the other half of each audio cycle, the FM station's transmitted signal is *increased* in frequency by the modulation. That is, f>fo.

Now the tank circuit will be on the other side of resonance, and will look like an *inductive* load, so i2 lags VS as shown in Fig.2(c). Again V2 and V3 must be at right angles (90°) to i2, which gives yet another different vector diagram.

The vector sum V4 now exceeds V5, so the rectified average IF signal voltage across C4 is larger than that across C5. As the voltage V6 across XY is still constant, this means W has shifted downwards in potential — i.e., W has gone *negative*.

Thus is formed the negative half of the audio output signal from the modulation.

Noise rejection

Consider a moment when that verbose disk jockey eventually runs out of breath. Silence reigns; if only briefly! Will you hear atmospheric noise and RFI in the audio output of the ratio detector?

If everything is ideal you will not! The ratio detector has a fundamental noise-rejecting property. Let's see how.

Any RFI or noise adulterating the received FM signal will simply change the *amplitude* of the carrier. But it will not change its frequency.

Consider what happens when V1, and hence Vs, increase in amplitude but remain at centre frequency fo. Naturally V2, V3, V4 and V5 would all increase by the same percentage. So V4 would still equal V5 and their difference would still be zero. Thus no noise output appears in the audio at W. Good point!

Now if a crash of RFI (e.g., lightning) occurs while music is playing will this noise be heard? Ideally, again no!

With modulation, V4 and V5 are unequal, and the RFI will attempt to momentarily increase both. At first glance you might expect this to cause a bigger difference in the voltages across C4 and C5, resulting in noise output.

But large capacitor C6 and the hefty charge V6 upon it now comes to the rescue. Any transient increase in signal strength cannot enlarge V6 quickly, due to the time constant formed by the capacitor and the impedance of the charging circuit.

So the ephemeral lightning signal will be lost in a brief increase in voltage drop in L2 and the diodes. It will not be heard in the audio output.

But of course if we tune to a much stronger FM transmitter, the signal received will be continually of higher voltage, (neglecting AGC action). In this case V6 will increase, but slowly, until it again matches the IF peak value.

Imperfections

The above description is idealised. In real life, tank circuits do not have infinite Q; inductances also possess some resistance and even some self capacitance.

And all circuits are plagued by cross-coupling, due to stray capacitances and the high-frequency impedance of connecting wires. Resistance in L2 spoils our lovely phase angles somewhat.

Then also there will inevitably be small unbalances in components which are supposed to be matched, and tank tuning curves are not quite linear. These imperfections lead to both small nonlinearities in performance, and some noise in the audio output in the presence of RFI.

Imperfections are often due more to imbalance in the two diodes than to any other cause. Indeed this was a stumbling block for the ratio detector at the time when twin diode vacuum tubes like the 6H6 and 6AL5 were first replaced by solid state diodes.

Applications

Due largely to its noise rejection properties and component economy, the ratio detector was the most used FM sound demodulator in Australian TV receivers for over 20 years. This is because any TV receiver is chock-full of RFI sources; high slope large voltage line and frame signals and EHT generators up to 20kV.

The ratio detector also gives us a free bonus in the automatic provision of a negative AGC signal, proportional to station carrier level. Any variation can be corrected by the changed AGC DC voltage, applied as bias to earlier IF amplifiers.

Foster-Seeley phase discriminator

An alternative tuned FM demodulator is the Foster-Seeley phase discriminator. Well known from 1940, this circuit preceded the ratio detector by about five years.

The Foster-Seeley circuit is similar to the ratio detector, at least in the left hand side.

The tuned circuit section and vector diagrams are identical, but the five essential differences are:

1. The Foster-Seeley reverses diode D2.
2. Capacitor C6 is not used.
3. The point Y is grounded (rather than F).
4. Audio output is taken from X (rather than W).
5. Audio output is derived from the sum of V4 and V5 (rather than their difference).

The immediate effect brought about by taking audio from (C4+C5), rather than their difference, is a considerably greater audio output for a given IF input.

This fact allows the IF signal to work on a shorter, more linear section of the tank tuning curve and still produce sufficient audio. Improved linearity (compared to the ratio detector) immediately results.

However because in the Foster-Seeley discriminator the audio derives from (V4+V5), and any RF noise or interference causes increases in V4 and V5, so noise is produced in the audio output. Therefore this circuit must be preceded by one or two class-C *limiter* circuits, as previously discussed.

A further disadvantage appears when receiving very weak FM signals. Under this condition the associated limiters are not fully driven into class C, as the drive is too small. In other words the limiters exhibit a *threshold* effect, and do not limit until a sufficiently large signal is encountered.

Thus the Foster-Seeley FM demodulator was a bad choice for long distance reception.

Also because in the Foster-Seeley discriminator the point Y is grounded and no C6 exists, this circuit cannot produce any AGC control voltage. So additional circuitry needs to be used.

Next time

In our next chapter we look into an even older FM demodulator circuit, known since 1932. It's called the *phase-locked loop* or 'PLL', and is the current favourite in today's solid state world.

See, just when you thought it was safe to go back to sleep, hoary old circuit ideas stubbornly refuse to die, and keep on reappearing! ■

FORUM

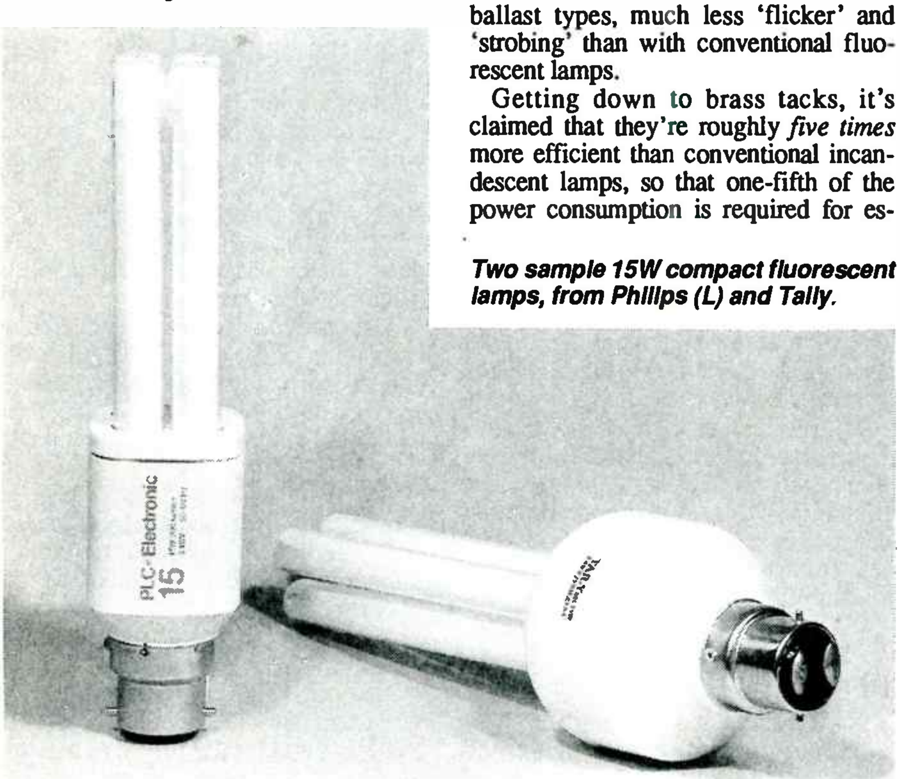
Conducted by Jim Rowe

Throwing a little light on compact fluoro's, power factor, PC's and TV's

Rather than simply continue with some of our previous topics again this month, I've decided we need a change. Let's look instead at the debate that seems to have arisen over the new compact fluorescent lamps, and whether or not they offer as much of an energy saving as their promoters would have us believe. It's an interesting topic, because the complicating factors that apply with compact fluoro's also tend to apply with quite a few other modern appliances...

I imagine that most *EA* readers will be at least aware of the so-called 'compact fluorescent' lamps, even though they may not have put them to much use as yet — perhaps because of their fairly high price tags.

Typically they're only a little larger than standard 240V incandescent lamps in physical size; samples of the latest 'electronic ballast' type are shown in the photograph. This type is easily distinguished because the characteristic 'double folded' discharge tube is naked and clearly visible, while with the earlier 'electromagnetic ballast' type the tube was less tightly folded and hidden inside an outer envelope.



Two sample 15W compact fluorescent lamps, from Philips (L) and Tally.

The big advantages claimed for these lamps, especially the electronic type, is not just that they're a lot more compact than conventional 'long tube' fluoro's; it's that they offer almost the same order of improved efficiency and longevity as conventional fluoro's, but in a much more compact and flexible form. In short, that they offer the high efficiency and long life of fluoro's, combined with the handy size and convenience of incandescents.

There are also other advantages claimed as well, including a broader and less 'peaky' light output, for more satisfying colour rendition than conventional fluoro's; and in the case of the electronic ballast types, much less 'flicker' and 'strobing' than with conventional fluorescent lamps.

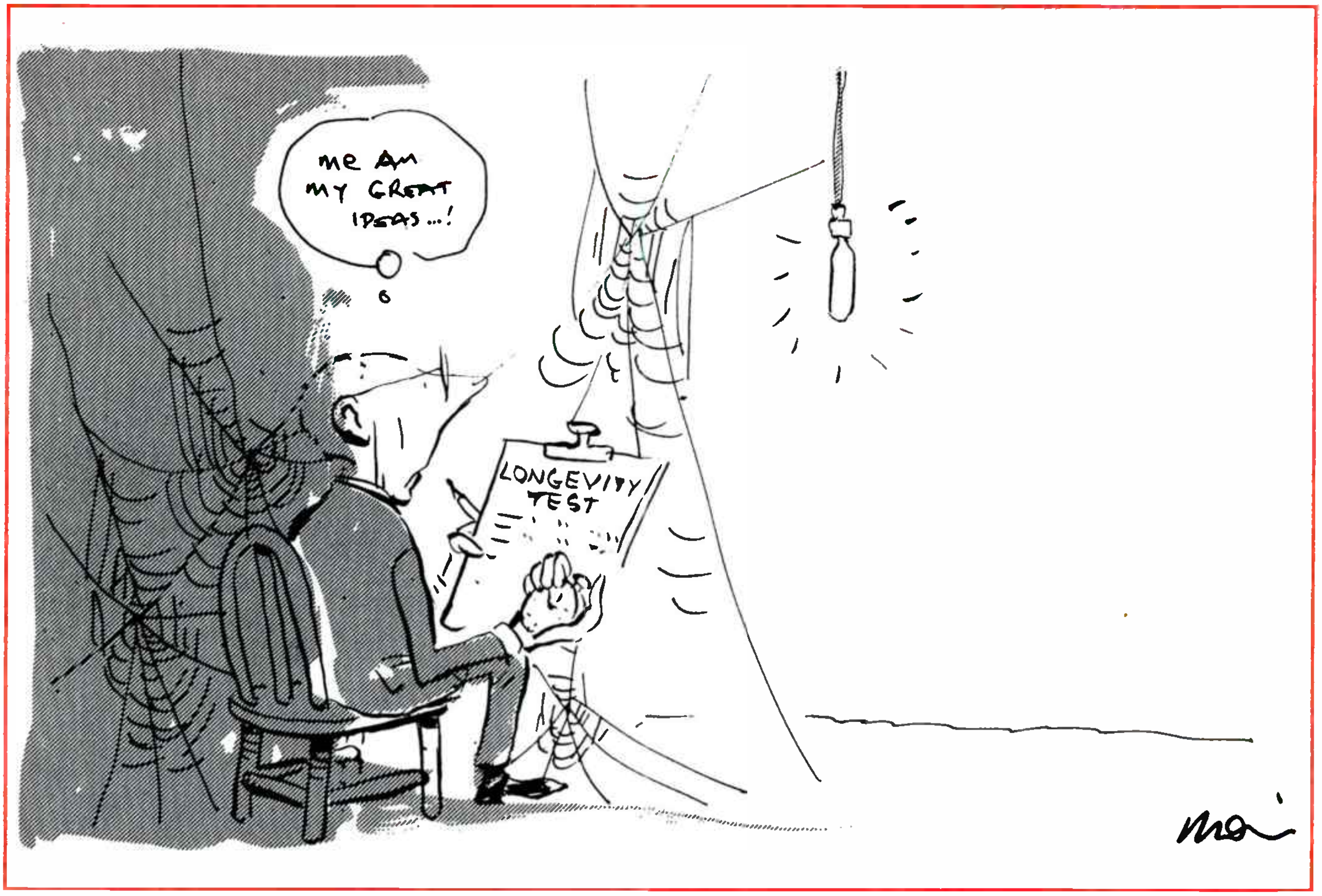
Getting down to brass tacks, it's claimed that they're roughly *five times* more efficient than conventional incandescent lamps, so that one-fifth of the power consumption is required for essentially the same light output. At the same time it's claimed that their lifetime is roughly *eight times* that of standard incandescent lamps. So there's a double saving, not just in power consumption but also in lamp replacement cost and hassle as well.

There are four basic sizes of compact fluoro currently available in Australia, with rated power figures of 9W, 11W, 15W and 20W. These have rated outputs of 400, 600, 900 and 1200 lumens respectively, making them roughly equivalent to standard incandescent lamps of 40W, 60W, 75W and 100W. In Europe there's also a 23W model, with an output of 1500 lumens. Overall lengths vary from around 127mm for the 9W models, to around 190mm for the 20W models.

This is all very impressive, of course, and not the least because superficially, the new lamps seem to be little more than a conventional fluorescent tube — shrunken in size and 'double folded' to become even more compact. But they're still essentially the same technology as a standard fluoro, with the glass tube filled with mercury vapour, a discharge plasma in the tube producing ultra-violet (UV) radiation, and a phosphor powder coating on the inside of the tube to convert the UV into visible light.

How have the manufacturers been able to achieve such a dramatic reduction in size, without sacrificing efficiency or longevity, and with an accompanying improvement in colour rendition? Curious, I asked this question of the Philips Lighting people, because Philips seems to be one of, if not the leading developer of the new lamps.

The answer seems to be double barrelled. Apparently the major breakthrough was the development of improved phosphor powders, which are



much more efficient than previous phosphors in converting UV into visible light. The new phosphors are also more able to cope with higher UV intensity, allowing them to cope with the conditions applying in a 'compressed' tube.

Along with this improvement in phosphors, I gather there have also been improvements in the techniques of stabilising the mercury vapour pressure in the tubes, allowing greater confinement of the discharge. For the electromagnetic ballast types (which Philips calls the 'SL' type) this involved development of a new bismuth/indium/mercury amalgam, while for the electronic ballast types (which Philips calls the 'PL-C' type), it involved the development of a technique using 'dead end cool spots' at the end of each straight section of folded tube, to control the vapour pressure.

Fairly obviously, the big appeal of the new lamps is that they offer the potential to save as much energy in domestic and 'fashion' lighting, as conventional 'long tube' fluoro's have saved in commercial and industrial lighting applications. And this is an important point, in this era of growing concern regarding energy conservation and better management of the world's fossil fuel reserves.

The lamps' appeal is not just on global ecology grounds, either. Manufacturers like Philips are making quite a point of the fact that since they consume only one-fifth of the power as a conventional incandescent lamp, and last about eight times as long, they also offer a considerable potential cost saving to the consumer themselves.

For example Philips note that to provide around 900 lumens of light for 8000 hours with a standard 75W incandescent lamp would cost $61.32, assuming a cost of 10.22 cents per kilowatt-hour (kWh) which was the average domestic rate charged in 1990 by the Sydney County Council. In comparison, the same amount of light could be provided for the same period with a 15W 'PLC-E' compact fluorescent lamp for only $12.26 — a saving of 80%, in terms of power cost *per se*.

Of course this doesn't take into account the costs of the lamps themselves, which is necessary for a fair overall comparison. And when you do this the saving is rather less dramatic, because the average cost of a compact fluorescent is around $25 each (all sizes), compared with incandescents at around $1 each.

Still, if we take the average life of an incandescent at around 1000 hours, and the compact fluorescent at 8000 hours, you still end up with a substantial saving. Adding eight lamps at $1 to the incandescent bill gives $69.32 for 8000 hours, whereas adding $25 for a single lamp to the compact fluoro bill gives $37.26 for the same period. This gives a saving of around $32, or 46% — not as impressive as the power saving alone, but still very worthwhile.

Mind you, 8000 hours is a fairly long time when you consider that many domestic lamps would only be on for about 5 hours maximum a day, and at this rate 8000 hours corresponds to over four years. So you could typically expect to save only around $8 per year, for each 75W domestic lamp replaced by a 15W compact fluoro. It's not likely to add up to big bickies, unless you have lots of patio and hall lights that you keep on all night...

It's also true that the overall cost saving varies with the amount of light you want, because the price of compact fluoro lamps is constant regardless of output. The 9W size costs just as much as the 20W size, so that although replacing a 100W incandescent with a 20W compact fluoro will save about $48 or 54% overall, for 8000 hours, replacing a 40W incandescent with a 9W compact fluoro will only save about $8 or 20%, for the same period.

Not only that, but like ordinary fluoro's, the compact types give their longest life when they're left on for relatively long periods. Turning them on and off frequently will apparently shorten their working life quite significantly, and will thus eat into the cost savings even further.

Still, every little bit helps, and there's also the fact that swinging over to these lamps will make a contribution towards saving energy, conserving fossil fuels and reducing the amount of carbon dioxide added to the earth's atmosphere.

Doubts expressed

So far, then, the new lamps sound like a pretty good idea — if not *quite* as you-beaut as the makers would perhaps like us to believe.

But in the last few months, there have been suggestions in the scientific press that they have a 'hidden problem' — one that supposedly makes their high efficiency more apparent than real, and cancels out their environmental advantages.

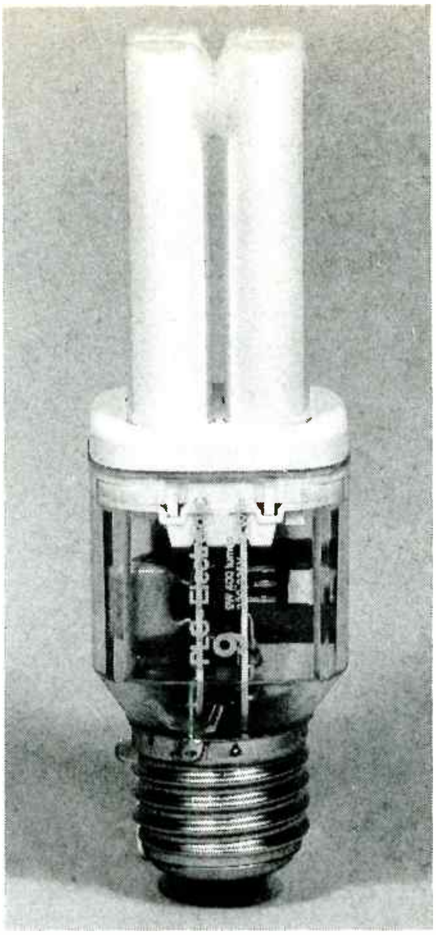
The supposedly hidden problem is one of poor *power factor*. According to the critics, some compact fluoro's have such a poor power factor that their 'real' power consumption is little or no better than the incandescent lamps they're designed to replace, despite the lower 'apparent' power registered by a domestic kWh meter.

To be honest, many of these criticisms seem to be rather confused in a technical sense, talking about things like poor power factor effectively increasing the *power* drawn by the lamps, or somehow 'fooling' your power meter into reading less than the *real* power the lamps are drawing. There's even been a suggestion that the lamps really don't save any power at all, and are thus some kind of 'con trick'. All of which is technical nonsense, of course.

But the basic point they seem to be making is that because of the lamps' poor power factor, they ultimately achieve much less saving of energy than is claimed. In short, that they're not nearly as environmentally preferable or 'green' as they seem...

Well, is it true? Let's look into it and see. First of all, we'd better have a bit of revision, for those who may have forgotten their AC theory. What exactly is power factor?

With DC, you may recall, things are pretty simple. If you connect a voltage to



A 'demo' version of the Philips 9W PLC-E compact fluoro, with its 'electronic ballast' components visible inside the transparent base.

a load, a current will flow in a manner inversely proportional to the *resistance* of the load, as pointed out by Mr Ohm many moons ago. And the power drawn by the load can be found simply by multiplying the voltage and the current drawn: *volts* times *amps* equals *watts*.

So far, so good. But with AC, life gets rather more complicated. Here there's another property of your load which can influence the current it will draw, apart from its resistance. That other property is *reactance*, and as you're probably aware this comes in two different kinds: *capacitive* reactance and *inductive* reactance. As the names suggest the former is displayed by capacitors, and the latter by inductors or 'coils'.

If your load happens to be largely resistive, like a radiator element, a jug element, a toaster element or an incandescent lamp, then things will be much the same for AC as with our simple DC case. The current that flows will be essentially *in phase* with the applied AC voltage, and the power that our load consumes will again correspond to the simple product of volts and amps. But if our load happens to have a significant reactance, along with the resistance, then complications arise. Without going into the theory, the effect of this reactance is to draw an additional component of current that instead of being in phase with the applied voltage, is shifted 90° out of phase. If the reactance is inductive, the current it draws will *lag* or be 90° behind the voltage, while if it is capacitive it will *lead* or be 90° ahead.

Note that reactive current itself is always 90°, or one quarter of an AC cycle, out of phase with the applied AC voltage. So that when the voltage is at a maximum, the reactive current will be passing through a zero, and vice-versa. This is because reactance as such does not consume energy, it merely stores it during one part of the cycle and returns it again during another part.

As a result, the current drawn by the reactive part of the load does not actually contribute to the 'real' power consumed. It is only the in-phase current, drawn by the resistive part of the load, which corresponds to consumed power.

So if we have a load like an electric motor, or a large electromagnet, which has significant reactance (in this case inductive) in addition to resistance, the total current drawn will consist of two distinct components. One will be the in-phase current, drawn by the resistive part of the load and corresponding to the power it consumes, and the other part will be the current drawn by the load's reactance. Although the latter is quite 'real' in the sense that it contributes to the current reading you get if you measure load current with an ammeter, it 'doesn't count' in terms of the load's power consumption — because it corresponds to energy stored and returned, rather than consumed. It doesn't show up in the energy consumption registered by a standard kilowatt-hour power meter, for example.

With AC, then, we can have an 'extra' component of load current, which while it's 'unreal' when it comes to the *power* consumed by the load itself, is nevertheless still flowing in the wires. And this being the case, the extra current certainly contributes to the power that is inevitably dissipated in the wires and transformers of the power distribution system, due to wire resistance and other losses. One way and another, this reactive current tends to cause additional power consumption — not in the reactive load itself, but in the power reticulation system.

Needless to say, power supply utilities aren't at all happy about people drawing much reactive current, because although it causes increased losses in the power system, this extra power isn't paid for by the customer whose loads draw the reactive current. In any case, reactive currents make it necessary to use fatter and more expensive cables, and larger and more expensive transformers — all of which adds to power distribution costs and consumption of resources.

So drawing significant reactive current is frowned upon, and rightly so. But how much is significant? Here's where power factor comes in, because this is the indicator of reactive current level as a proportion of total current.

Essentially power factor is the ratio of 'real' power, in watts, to 'apparent power', in volt-amps. In other words, the ratio between the true power consumed, equal to the product of volts and in-phase amps, to the apparent power — equal to the product of volts and total amps (PF = watts/volt-amps).

For loads that are near enough to purely resistive at 50Hz, like a toaster or an incandescent lamp, the power factor will obviously be very close to the ideal figure of 1.00, or 'unity'. But if there's any significant reactive current flowing, the power factor will fall from this figure, because the total volt- amps will rise relative to the power. For example a power factor of 0.5 means that the volt-amps has become twice as large as the power in watts, so that there is TWICE as much current flowing in the wires as is really needed to convey the load's actual power consumption.

What can power utilities do to consumers whose loads have a poor power factor? In most cases, they apply pressure to get the consumers to improve the situation, by 'correcting' the power factor of their load. This is done by adding the opposite kind of reactance, to 'buck' the existing reactive current right at the load by drawing current of opposite phase, and hence bring the nett volt-amps down much closer to the true power. So to correct an inductive load like a motor you use a carefully chosen capacitor, while for a load that is already capacitive you use an inductor.

Power factor and lamps

What has all this got to do with lamps, I hear you ask. Clearly it has very little to do with conventional incandescent lamps, because these are essentially resistive. But it has quite a lot to do with fluoro's, because these are essentially a gas discharge device and need a series impedance or 'ballast' to stabilise their operation. The familiar 'long tube' type of fluoro uses a series inductor to provide this ballast, in a simple and low-loss form. And this turns the overall lamp into an inductive load, with an intrinsically poor power factor.

Even though the reactive current drawn by a single fluoro lamp and ballast combination may be quite small, compared with say that drawn by a large motor, there are huge numbers of such lamps in use and the reactive currents would all add up — to reach frightening levels, if nothing were done. To correct for this problem, most power supply authorities require that standard fluorescent lamp fittings are fitted with a suitable power factor correction capacitor.

So much for conventional fluoro lamps; but what about the new compact fluoro's? Well, the older type use a series inductor or 'electromagnetic' ballast, just like a conventional fluoro. So they too tend to have a rather poor 'lagging' power factor.

Although this could presumably be corrected with the use of a capacitor, at present this doesn't seem to be done. One reason might be that there's probably very little room inside the base of the lamp, to fit such an additional component. Another might be that the capacitor would add further to the cost of the lamps, which is already fairly high. Still another reason is perhaps that, as yet, the power authorities haven't insisted that it be done.

The situation is rather more complicated, though, when it comes to the newer type of compact fluoro with an electronic ballast. Here the tube is actually fed via what is essentially a switch-mode power converter/inverter: the mains AC is first rectified into high voltage DC, and then fed to a DC/AC inverter running at around 45kHz to so. As well as raising the efficiency of the lamp and virtually eliminating flicker, this also allows the use of a much smaller ballast inductor.

But the catch is that here the inductor is connected on the lamp side of the inverter, not on the mains side. And at the input side of the inverter there's essentially a rectifier bridge connected right across the mains, and directly feeding a reservoir capacitor.

If you remember your rectifier theory, you'll realise that this kind of setup has one important characteristic: current is drawn essentially in the form of small pulses, at the peak of each half-cycle of the applied voltage, to replace the energy drawn from the capacitor during the rest of each half-cycle.

So with the 'electronic' kind of compact fluoro, we don't have a simple conventional power factor problem. The current is pretty well in phase with the applied voltage; the only trouble is that it's in the form of short pulses. Fig.1 shows a typical current waveform, which I found with a Philips PLC-E 15W lamp.

Why does this 'short pulses' kind of current cause a problem? Basically, because it corresponds to a current with severe waveform distortion — or a very high proportion of components which are not at the fundamental frequency of 50Hz, but at various odd harmonics: three times the frequency, five times, seven times and so on. And these high-frequency current components again make virtually no contribution to the real power consumed by the lamp, but merely add to the overall current it draws. The overall effect is therefore much the same as for a normal reactive load: higher current flow, and hence an effectively lowered power factor.

Typically, the power factor of an 'electronic' compact fluoro is some-

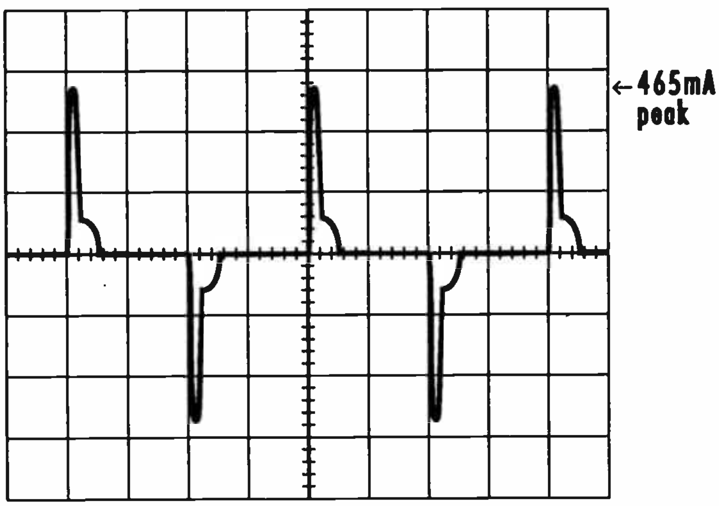


Fig.1: The current waveform I observed for a 15W 'electronic ballast' compact fluoro. Note the high harmonic content. Each major horizontal division is 5ms.

where between 0.5 and 0.6. I measured that of a Philips 15W PLC-E lamp at 0.57, meaning that it drew 110mA RMS instead of the 62.5mA RMS that would correspond to 15W real power consumption. As you can see from Fig.1, its peak current was considerably higher, at around 465mA.

Interestingly, this high harmonic content of the 'electronic ballast' compact fluoro can't be easily corrected. To do so would require fairly radical changes to the converter/inverter circuitry, and would probably either degrade the efficiency or make the lamps even more expensive. So at present, it seems to be in the 'too hard' basket.

But is it a major problem, and one that cancels out any advantage of these lamps in terms of power saving and resource conservation? Probably not, I suspect.

Why so? Well, let's look at the sums, when we compare a 15W 'electronic' compact fluoro with the 75W incandescent lamp it's meant to replace. The incandescent draws a steady current of 312mA RMS, once it's at normal operating temperature and assuming a 240V supply. In comparison, the compact fluoro draws an RMS current of say 110mA, of which 62.5mA is the resistive fundamental component and the rest is effectively harmonics. This means that the power consumed has indeed dropped to a fifth of that consumed by the incandescent — or a saving of 80%. There's no doubt about this saving; your power meter will only register one fifth of the power consumption, because that's all that is consumed.

Although the total current is higher at 110mA than we'd like, in an ideal world, the point is that it's still well down on. that drawn by the incandescent. In fact the total current has fallen by over 200mA, or 65%, so despite the harmonics we're still drawing only a little more than one-third of the current drawn by the incandescent.

In other words, changing to a compact fluoro results in a power saving of 80%, and a current saving of 65%. So we're still saving quite a lot of current, even if it's not as large a saving as with power.

More importantly, the losses in our power distribution system will fall by an even larger factor, because they vary with the SQUARE of the current level. In fact our 65% reduction in total current level will result in an 87% reduction in distribution system losses, to only a little over 12% of the value they'd have with an incandescent producing the same light output. A very significant reduction indeed, wouldn't you say?

In other words, then, changing from a 75W incandescent to a 15W 'electronic' compact fluoro lowers the power consumed by a factor of five times, the current drawn by a factor of about three, and the distribution system losses by over eight times. And by the look of it, you'd get pretty well the same improvement with all of the other lamp sizes, as well. Which makes the idea of using these lamps still sound like pretty good sense, to me.

Those harmonics

But what about those harmonics — shouldn't we try to get rid of them? Certainly it would be nice if we could, because then the reduction in current levels would match that for power levels, and the power distribution losses would go down even further, to around 1/25th or 4% of the level for incandescent lamps.

Quite apart from reducing current levels and distribution losses, getting rid of the harmonics would be a good idea anyway, because they tend to radiate a lot more than 50Hz, and cause greater electromagnetic interference with audio, radio and other signals. The whole power mains system would be much 'cleaner'.

I have no doubt that Philips and the other firms who manufacture the new lamps are looking for ways to reduce the 'peaky' nature of their current drain, to make them even more attractive from an energy conservation and environmental 'cleanliness' point of view. And that will be great, as long as it doesn't make them even more expensive...

But don't get the idea, from all this, that peaky current drain, high harmonic content and poor power factor are purely a problem associated with the new compact fluoro's. Far from it. In reality they're a much more widespread and rapidly growing problem.

The fact is that all of these things are characteristic of many electronic power supplies, and in particular the *switch-mode* power supplies that have proliferated in many different kinds of today's electronic appliances. Look inside most modern TV sets, and you'll find one; the same applies to virtually all personal computers and laser printers, and quite a few of the latest test instruments.

Switch-mode power supplies are low in cost, light in weight, very tolerant of mains voltage variations and also very efficient, making them well suited for many applications. But like the humble compact fluoro, they all have a power supply input circuit where a bridge rectifier is connected directly between the mains and a large reservoir capacitor. As a result, they all draw their current in brief pulses, at the peak of the applied AC voltage — giving poor power factor and lots of harmonics.

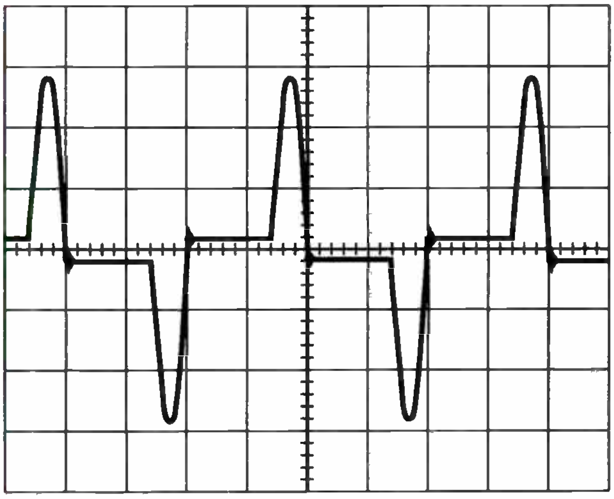


Fig.2: High harmonic currents are not confined to compact fluorescent lamps, though. Here's the waveform of an 'AT-compatible' personal computer system.

Don't believe me? Look at Fig.2, which is a fairly accurate reproduction of the current waveform I measured from a typical IBM AT-compatible PC with 1MB of RAM, a 20MB hard disc drive and a 'VGA' type video monitor. The RMS current drain measured 573mA, corresponding to about 137VA (volt-amps), while the peak current was actually around 1.33 amps. I don't have a true power meter to measure its actual power consumption, but I suspect it would be no more than 90W at most. You can see from the waveform that the current is again very 'rich' in harmonics.

I've looked at a couple of other machines, with different kinds of monitors, hard disk drives and amounts of memory.

(Continued on page 111)

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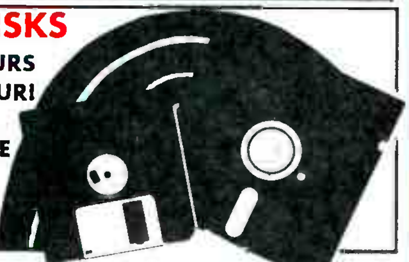

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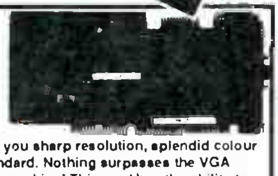

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- MX80,FX80, RX80, FX800, MX70, MX80, LX800.

C22031	$16.95	$15.25

- MX100, FX100, RX100, LQ1000

C22002	$19.95	$17.95

- LX80

C22003	$12.95	$11.95

- CITOH 8510 - 1550

C22051	$13.95	$12.50

NATIONAL PANASONIC KXM110 PRINTER RIBBON
C22034........................$19.95

IBM PRINTER LEADS

- SUITS IBM* PC/XT, COMPATIBLES
- 25 PIN "D" PLUG (COMPUTER END) TO CENTRONICS 36 PIN PLUG.
- 1.8 meters
P19029..............................$14.95
- 3 metres
P19030..............................$19.95
- 10 metres
P19034..............................$39.95

ROD'S COMPUTER TIPS

Saving your CMOS

Do you lose your CMOS setup - in other words does your battery go flat. There are a couple of probable reasons for this. Firstly most new type motherboards now have NiCad cells installed instead of the older lithium types. This means that they have to be charged for at least 24 hours initially or else the "CMOS SETUP" will be lost. All our computers are run for a minimum of 24 hours prior to delivery so this should not occur. However if you don't use your computer regularly this setup will be lost. The computer should be put "on charge" for at least 8 hours per week.
The reason for the change in batteries is that lithium types only lasted for about 12 months then had to be replaced by a technician, thus the change is a great idea! If the worst happens and you do lose your CMOS setup, don't despair; our service department can easily walk you through this procedure over the phone.
Regards
Rod Irving.

CANON LASER CARTRIDGES

Why waste your precious time & money trying to get a quality print out from a "recharged" cartridge when you can buy a brand new Canon laser cartridge from Rod Irving for only $199.00!

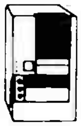
EP CARTRIDGE FOR SIDE LOADING PRINTERS
C21107.......................... $179

EP-L CARTRIDGE FOR FRONT LOADING PRINTERS
C21109.......................... $179

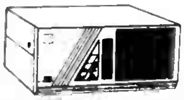
EP-S CARTRIDGE FOR TOP LOADING PRINTERS
C21108.......................... $179

COMPUTER CASES

NEW TOWER CASE!
Give your computer that professional look.
Both for $395
X11105..........................$199
Power supply to suit (220W)
X11102..........................$225



MINI TOWER CASE
200 x 415 x 330mm
with 200w power supply
X11100..........................$325



RITRON EXECUTIIVE CASE
X11089..........................$119
P.S to suit X11089.......$149

TOP OF THE RANGE AT EXECUTIVE CASE
For 386 & 486 systems
Includes power supply
X11101..........................$320

POWER SUPPLIES

POWER SUPPLY FOR IBM*, PC/XT*, & COMPATIBLES
DC OUTPUT: +5/13A -5 0.5A +12V /4.5 -12 V 0.5A
X11096.......................... $139

200W SWITCH MODE POWER SUPPLY FOR IBM*, AT* & COMPATIBLES
DC OUTPUT : +5/16A -5/0.5A +12V/4.5 -12V / 5A -12/0.5A
X11097..........................$149

UV EPROM ERASER

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..........................$99
With built-in timer
X14955..........................$169

KEYBOARDS

IBM *, XT*, TYPE 84 KEY KEYBOARD
X12020..........................$109

IBM COMPATIBLE EXTENDED KEYBOARD (101 KEYS)
X12022..........................$99

101 KEY TRACKBALL KEYBOARD
Keyboard & mouse in one
X12030..........................$199.95

KEYBOARD STORAGE DRAWER
C21083..........................$84.95

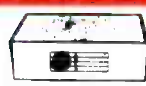
MINI VACUUM CLEANER
C21087..........................$14.95

KEYBOARD COVERS
C21089 84 KEY..........$4.50
C21088 101 KEY..........$5.95

DISK BOXES

100 x 5 1/4" ECLIPSE
C16042..........................$11.95
40 x 3 1/2" ECLIPSE
C16040..........................$8.99
120 x 3 1/2" LOCKABLE
C16039..........................$21.95
100 x 5 1/4" LOCKABLE
C16020..........................$13.95
50 x 5 1/4" LOCKABLE
C16025..........................$11.95
120 x 5 1/4" LOCKABLE
C16028..........................$19.95

PRINTER SWITCHES



RS232-2 WAY	$39
RS232-4 WAY	$69
RS232-X OVER	$69
RS232-2 WAY AUTO	$69
CENTRONICS 2 WAY	$49
CENTRONICS X OVER	$69
CENTRONICS 2way auto	$79
CENTRONICS 4 WAY	$69

PRINTER STANDS

ENCLOSED PRINTER STAND
C21055..........................$39.00

DELUX PRINTER STAND
C21058..........................$89.00

WIRE PRINTER STAND
C21054....80 column..........$24.95
C21056....132 Column..........$34.95

MICE

WITTY MOUSE
EVER POPULAR, LOW BUDGET! FREE MOUSE DRIVER & POP UP MENU SOFTWARE!
X19950..........................$49.95

QUICK MOUSE
Microsoft Compatible
FREE mouse house & mouse mat Plus FREE pop up menu software
X19955..........................$69.95

SUPER BUS MOUSE 2
DESIGNED TO FIT THE PALM OF YOUR HAND! GREAT FOR SAVING A SERIAL PORT! 2 FREE TELEPAINT DISKS!
X19951..........................$119

TOUCH MOUSE
"A Stationary Breakthrough"
Use your finger instead of your mouse. Great for saving space. Ideal for laptops
only 51 left
X19960 SAVE $60 ...$69

MICROSOFT MOUSE
The top of the range!
Supports hunderds of applications. FREE MICROSOFT PAINTBRUSH SOFTWARE BRINGS YOUR COMPUTER TO LIFE.
SAVE $90
X19958..........................$159

IBM* CARDS

XT HD CONTROLLER	$129
AT HD CONTROLLER	$149
RS232/SERIAL CLOCK	$49
MONO COLOUR CARD	$76
MULTI I/O	$99
VOICE MAIL	$139
PRINTER CARD	$29
EGA CARD	$149
DIAGNOSTIC	$795
TTL/PRINTER	$89
RAM 2M AT EXT/EXP	$225
8M AT EXT/EXP	$325
FAX CARD	$595
4 PORT SERIAL	$129
2 WAY FDD CONT (360K)	$39
RS232/SERIAL CARD	$39
GAMES CARD	$29
AT S/P/G 2 S/P/G	$49
4 WAY FDD CONT. (360-1.44M)	$129
2 WAY FDD CONT. (360-1.44M)	$80
CLOCK CARD	$39
SMART DRIVE ADAPTER IDE/FDC	$49
SMART DRIVE ADAPTER IDE I/O FDC	$89
VGA CARD 16 BIT NO RAM	$199
VGA CARD 16 BIT 250K	$229
VGA CARD 16 BIT 512K	$269
VGA CARD 16 BIT (1 MEG)	$299
VGA CARD 8 BIT 256K	$139

CHECK OUT OUR HUGE RANGE OF PRINTERS ON SPECIAL!

	Head	No.of col.	Draft Speed	No./ Fonts	Price
LX-400	9 pin	80	180cps	3	$289
LQ-400	24 pin	80	180cps	3	$489
LX-850	9 pin	80	180cps	3	$395
LQ-850	24 pin	80	264cps	3	$950
LQ-1050	24 pin	80	264cps	6	$1050
LQ-550	24 pin	80	150cps	3	$625
LQ-1010	24 pin	136	180cps	4	$795
OKI 172	9 pin	80	180cps	3	$275
OKI 380	24 pin	80	180cps	3	$650
200-GX*	9 pin	80	213cps	5 colour	$479
GSX 140*	24 pin		192cps	6 colour	$779

LASER PRINTERS
OL400 LASER PRINTER
4 PAGES / MIN 25 FONTS $1499
OL800 LASER PRINTER
8 PAGES / MIN 36 FONTS..........$2,495
OL840 POSTCRIPT LASER PRINTER
8 PAGES / MIN 35 FONTS..........$4,295

PLEASE QUOTE THIS AD FOR THESE PRICES Errors & Omissions excepted

ROD IRVING ELECTRONICS

DO YOU NEED TO SPEED UP YOUR COMPUTER?

WOW! 21 MHz Landmark

POW! 27 MHz Landmark

57 MHz Landmark GOSH!

RITRON AT
286-16 (20Mhz Landmark) $269

Processor	80286-16 CPU
Max Memory Size (on board)	4 Mbyte
Memory Type	SIP and DIP
BIOS	AMI
RAM Configurations	512K (DIP/44256x4, DIP/41256x2) 1Meg (DIP/44256x8, DIP/41256x4) 1Meg (SIP/256Kx4) 2Meg (SIP/1MBx2) 4Meg (SIP/1MBx4)
Real Time Clock	
Calendar	
Battery Back-up	
Baby AT Size	
Expansion Slots	Six 16 bit and One 8 bit
Special Features	Keyboard Typematic Rate adjustment in BIOS Power ON Password Hard Disk Boot Sector VIRUS Protection

This board is extremely versatile and internally very intelligent. It watches for viruses, stops unauthorised persons using your system and can be optimised for OS/2.
The speed switching can be done by hardware (physical switch) or by software (keyboard).
Support of EMS if fully LIM 4.0 for the full memory maximum of16 Mbyte.
Again it is easily installed by the careful electronics hobbist in under 1 Hour.
Cat. X18205

RITRON NEATSX
386SX-20 $695

Processor	20-Mhz 80386SX (Intel)
Coprocessor	80387SX(optional)
ROM-BIOS	AMI (64 Kbytes)
Chipset CS8281	82C811 CPU/bus controller 82C812 page interleave and EMS controller 82C815 address and data buffer 82C206 integrated peripherals controller(IPC)
Real Time Clock	
Calendar	
Battery Back-up	
System Memory	DIP sockets for up to 4 Mbytes and SIPP sockets for up to 4 Mbytes (total 8 Mbytes)
Architecture	ISA
Expansion Slots	Five 16-bit ISA slots and three 8-bit ISA slot
Miscellaneous	AT keyboard port Size: 22 5cm by 33cm Designed with 4 layer board to minimise RF noise Power required 5V at 4A max.
RAM Configurations	Banks 0 and 1 are normally DIP Banks 2 and 3 are normally SIP but can be jumper optioned for Banks 0 and 1. 512 Kbyte to 8 Mbyte using combinations of the
following -	41256 DIP (1 bit x 256K wide) 44256 DIP (4 bit x 256K wide) 41000 DIP (1 bit x 1Meg wide) 41256 SIP (1 byte x 256K wide) 41000 SIP (1 byte x 1Meg wide)

This baby brother/sister to the 386-33 is still a very powerful board
It offers full 386 compatability at a Hi-Tech 286 price.
Again it is very easy to install and can be done by anyone with a bit of electronics knowledge in less than 1 HOUR
Cat. X18080

RITRON EXECATIVE
386DX-33 WITH 128K CACHE $1,295

Processor	33-Mhz 80386 (Intel)
Coprocessor	80387(optional)
ROM-BIOS	AMI (64 Kbytes)
Chipset	SIS 85C310 cache memory controller SIS 85C320 bus controller SIS 85C330 data buffer
Real Time Clock	
Calendar	
Battery Back-up	
Cache type	72-pin SIMM socket with 25nS SRAM
System Memory	SIMM sockets for up to 16 Mbytes
Architecture	ISA
Expansion Slots	Six 16-bit ISA slots and one 8-bit ISA slot
Miscellaneous	AT keyboard port Size: 22 5cm by 33cm Designed to conform to FCC Class B requirements Power required 5V at 4A max.
RAM Configurations	1 Mbyte 41256 by 4 (1 bank) SIMM 2 Mbyte 41256 by 8 (2 banks) SIMM 4 Mbyte 41000 by 4 (1 bank) SIMM 8 Mbyte 41000 by 8 (2 BANKS) SIMM 12 Mbyte 41000 by 12 (3 banks) SIMM 16 Mbyte 41000 by 16 (4 banks) SIMM

This board is extremely versatile uses any version of MS-DOS above 3 0, OS/2, XENIX/UNIX and is as Hi-Tech as any computer buff really needs to go
It is as easy to install as a basic stereo system.
Just follow a few basic rules such for static precautions and component allignment
Set up the menu driven CMOS RAM as directed in the user manual and you will have a professional upgrade in less than 1 HOUR.
Cat. X18115

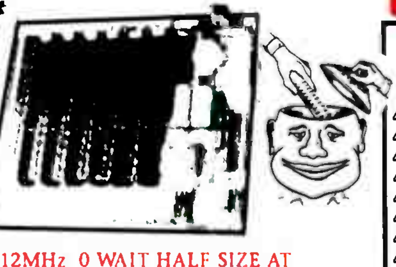
TRY TO BEAT THIS PRICE!

THE CHEAPEST XT TURBO MOTHERBOARD ON EARTH! $95

This mighty little XT motherboard has eight expansion slots and uses five low costing 1MB RAM chips to provide a full 640K memory. The ASIC chip, well known for it's reliabilityis also used. The CPU is state of the art technology. 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
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

X18037...On Special at only $95.00



286 12MHz 0 WAIT HALF SIZE AT MOTHERBOARD $195

- 6.25/12.5 MHz system clock speed
- 12MHz version 80287 -10 CPU
- Sockets for 80287 Coprocessor
- Optional independent clock for 80287
- Systems speed hardware and software selectable
- Supports up to 1 MB DIP (8 x 44256 + 4 x 41256) or 4MB SIMM RAM Capacity
- 2 XT and 4 AT Compatible Expansion slots
- Real time clock / calander with rechargable battery backup.
- Quadtel Legal BIOS
- Size: 8.75 x 8.75 inches

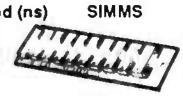
X18350....on special at only $195

UPDATED YOUR MEMORY LATELY?

EXPANDED DYNAMIC RAM RANGE

	Speed (ns)	No. of pins	1-9	10+	100+
4164-10	100	(64K x 1)	$4.95	$4.50	$3.90
4464-10	100	(4 x 64K)	$5.95	$5.50	$4.90
4464-08	80	(4 x 64K)	$6.95	$5.95	$5.50
41256-10	100	(256K x 1)	$4.50	$4.00	$3.75
41256-08	80	(256K x 1)	$4.95	$4.50	$4.25
44256-10	100	(256K x 4)	$13.95	$12.95	$11.95
44256-08	80	(256K x 4)	$14.95	$13.95	$12.95
44256-07	70	(256K x 4)	$15.95	$14.95	$13.95
1M-10	100	(1M x 1)	$13.95	$12.95	$11.95
1M-08	80	(1M x 1)	$14.95	$13.95	$12.95

	Speed (ns)	SIMMS	1-9	10+
256K x 9	80		$39.00	$37.50
1M x 9	80		$129.00	$125.00
1M x 9	70		$139.00	$135.00



	Speed (ns)	SIPPS	-9	10+
256 x 9	80		$39.50	$37.50
1M x 9	80		$129.00	$125.00
1M x 9	70		$139.00	$135.00

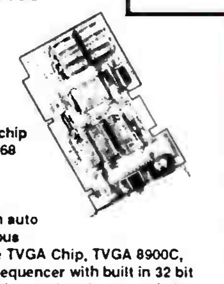
only $549

SONICA SUPER VGA MONITOR

Tube:-	14 INCH, .28mm, 90 degree, non-glossy
Signals:-	RGB analog 0.7Vpp/75 ohm unlimited colors
Seperate	Sync TTL 3.5Vpp/400 ohm Horizontal Positive and Negative Sync 29Khz - 38Khz Auto Scanning Vertical Positive and Negative Sync 50Hz - 90Hz Auto Sizing
Resolution:-	640x350, 640x400, 640x480, 800x600, 1024x768
Bandwidth:-	45Mhz
Power:-	90-270Vac 50/60Hz Auto Voltage Consumption 60W

Ensure you get the technical specifications right the first time when shopping for a Super VGA Monitor because only those that guarantee 1024x768 non-interlaced are truely Super VGA.
Monitors with Horizontal sync frequencies above 35Khz and Video bandwith of 42Mhz can claim to be in the Super VGA class.
X14532

BATTY PRICES!

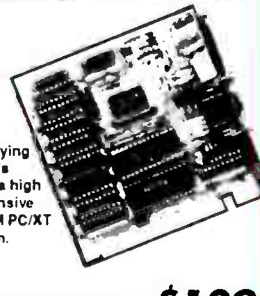


512KB SUPER VGA CARD

- Supports VGA monitors
- Uses Trident TVGA 8900C chip
- High Resolution : 1,024 x 768
- Supports 256 colours
- Supports interlaced and non-interlaced monitors
- Support PC/XT/AT bus with auto switching between 8/16 bit bus
- SPEED ENHANCMENT The TVGA Chip, TVGA 8900C, incorporates an intelligent sequencer with built in 32 bit cache delivers extreamly high speed performance in bus interface and memory update.

X18074.......................................$249

WORKS IN XT'S & AT'S



8 BIT VGA ADAPTOR CARD

The Smart VGA Adaptor is a VGA interface employing Realtek Semi-Conductor's chips and software. It is a high performance and inexpensive interface medium for IBM PC/XT /AT or compatible system.
The Smart VGA Adaptor performs far beyond the normal VGA standard.
X18071.......................................$129

ROD IRVING ELECTRONICS est. 1977
FOR THE SERIOUS COMPUTER USER

ACN. 005 428 437
MELBOURNE: 48 A'Beckett St. Ph: (03) 663 6151. Computer sales: Ph 639 1640
NORTHCOTE : 425 High St. Ph: (03) 489 8866
SYDNEY: 74 Paramatta Rd. Stanmore. N.S.W. Ph: (02) 519 3134
MAIL ORDER: 56 Renver Rd, Clayton Vic, 3168. Ph:Local 543 7877
Mail Order Hotline: Ph: 008 33 5757
MELBOURNE DEALER
BLUESTAR COMPUTERS: 271 Maroondah Hwy, Ringwood. Ph: (03) 870 1800

These postage rates are basic postage only up to 5Kg. Road freight, bulky & fragile items will be charged at different rates

Postage rates	
$1 - $9 99	$3.00
$10 - $24 99	$3.50
$25 - $49 99	$4 50
$50 - $99 99	$6.00
$100 - $199	$7.00
$200 - $500	FREE
$500 PLUS	FREE

008 335757 HOTLINE

ROD IRVING ELECTRONICS

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

SURGE/SPIKE SAFETY PLUG

Stand alone

3 pin plug

Plugs into socket adjacent to the equipment that you want to protect. All outlets on a power board can be protected by inserting the Triangle Surge/Spike Plug into any of the free outlets. Green safety neon glows when power is on.
Approval No. V88029
Total energy rating: 225 Joules (10/1000us)
Protection level: 275V Nominal, 475V Peak.
Response Time: Better than 10 nanoseconds. Automatic reset.

X10060................$25.00

SURGE/SPIKE SAFETY CORD SET 3 pin MAINS plug to 3 pin IEC plug

Plugs directly into your equipment and replaces your existing cord-set. Clear moulded plugs at both ends with green safety neons that glow when power is on.
Approval Numbers: V88029, V900297, V85006.
Total Energy Rating: 225 Joules (10/1000us)
Protection level: 275V Nominal, 475V Peak.
Response Time: Better than 10 nanoseconds. Automatic reset.

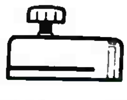
X10080.................$39.50

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



DISK NOTCHER

Converts 5 1/4" single sided floppy disks to double sided, by placing an appropriate notch in the floppy disk jacket.

C21070................. $7.95

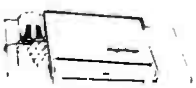
THE BUTTON SPIKE PROTECTOR

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 varister 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

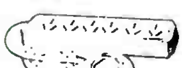
$42.95



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 On special was $24.95
Now.......$14.95



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

QuickShot joysticks

Quick Shot offers the most complete selection of video game controllers in the market. Models are available to suit all the most popular video game machines and just about any playing style.

QS-123 WARRIOR 5
IBM COMPATIBLE (15 PIN
C14208..........$59.95
APPLE & IBM COMPATIBLE (9 & 15 PIN CONNECTORS)
C14211..........$62.95

QS113PC IBM PACK INCLUDING JOYSTICK ADAPTOR CARD (15 PIN)
C14216..........$59.95

QS-123 PC IBM PACK INCLUDING JOYSTICK ADAPTOR CARD (15 PIN)
C14217..........$74.95

QS-129N/F SPACEAGE CONTROL NINTENDO & MULTISYSTEM COMPATIBLE (7 OR 9 PIN)
C14214..........$39.95

QS-130N/F DELUX DIGITAL NINTENDO & MULTISYSTEM COMPATIBLE (7 &9 PIN)
C14209..........$39.95

QS-131 NEW BASIC ATARI / COMMODORE -9 PIN
C14218..........$19.95

HS-3000 HANDY SCANNER INCLUDES FREE SOFTWARE! PC PAINT BRUSH & 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.................. $269

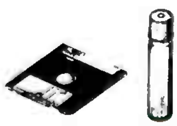
GENI SCAN COLOUR SCANNER

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!
Draw shapes, modify objects alter colours & edit a palette of 256 colours using the commands on your pop-up menus. You can even design your own font type size.
• 105mm scan width , multi scan up to 300mm
• 64 shade levels

X19930.............. $895

DUST COVER

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



HEAD CLEANER DISKS

It only takes a minute amount of dust, dirt or magnetic oxide particles on your drive heads to cause problems: errors, downtime or an expensive service call. Regular use of a head cleaner will keep your drive free of trouble causing dirt and help keep your system up and running. These disk cleaners are simple to use, and include cleaning solution and instructions

• 3 1/2"
C12560.................$4.95
• 5 1/4"
C12555.................$4.95

HAVE THE CUTEST MOUSE IN THE HOUSE WITH THESE GREAT NEW PRODUCTS!

MOUSE COVER

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

C21069....................$7.95

MOUSE CLEANING KIT

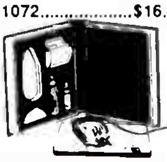
Keep dust and dirt from damaging your mouse with this handy mouse cleaning kit. This special rounded tool will find its way into all the hard to get at places. The kit also comes with cleaning fluid and 5 soft cloths to keep your mouse spotless!

C21071................$9.95

MOUSE KIT

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

C21072..................$16.95



MOUSE GIFT SET

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

C21074.................$19.95

COMPUTER CLEANING KIT

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

C21077..................$19.95

VIDEO ACCESSORIES

VHS VIDEO HEAD CLEANERS

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

A11456......... ....$16.95

VIDEO / AUDIO TRANSMITTER

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

A16150 Normally..$95.95
NOW ONLY.....$84.95

AUDIO ACCESSORIES

CRYSTAL LOCKED WIRELESS MICROPHONE AND RECIEVER

MICROPHONE SPECIFICATIONS:
Transmitting Frequency: 37 1MHz
Transmitting System: crystal oscillation
Microphone: Electret condenser
Power Supply: 9V battery
Range: 300 feet in open field
Dimensions: 185 x 27 x 38mm
Weight: 160 grams

RECIEVER SPECIFICATIONS:
Recieving Freq: 37 1MHz
Output Level: 30mV (maximum)
Recieving System: Super heterodyne crystal oscillation
Power Supply: 9V Battery or 9V DC power adapter
Volume control
Tuning LED
Dimensions: 115 x 32 x 44mm
Weight: 220 grams

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

COMPACT DISC CASES

Packet of 3 standard replacement compact disk cases.

A10030..........................$6.99

UPDATE YOUR MOTHERBOARD WHILE PRICES ARE LOW

286-12/16..........................$245
286-16/21..........................$275
386SX-20/27........................$695

008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS! LOCAL ORDERS & INQUIRIES CALL (03) 543 7877

ROD IRVING ELECTRONICS - No.1 FOR IC'S & TRANSISTORS

SCR's TMAG UJT

SC141D........$1.95
SC141E........$1.95
SC142E or Teccor
S4008L Triac.$2.25
SC146D........$2.85
SC151D........$2.95
C103B or
MCR100-6......$0.90
C106D Equiv. Tag
X0403DE......$1.50
C122D.........$2.50
C122E.........$1.95
2N2646........$1.95
2N6027........$1.20

2N SERIES

Description..........$
2N918..........$1.00
2N2219.........$0.90
2N2369.........$1.00
2N2646.........$1.95
2N2904.........$1.10
2N3019.........$1.90
2N3055.........$2.00
2N3563.........$0.35
2N3564.........$0.30
2N3566.........$0.30
2N3569.........$0.30
2N3638.........$0.30
2N3641.........$0.30
2N3642.........$0.30
2N3643.........$0.30
2N3644.........$0.30
2N3645.........$0.30
2N3771.........$6.95
2N3772.........$5.70
2N3773.........$7.95
2N3819.........$1.50
2N3866.........$2.95
2N3904.........$1.00
2N3906.........$1.00
2N4033.........$2.20
2N4258.........$0.40
2N4356.........$0.50
2N4360.........$1.50
2N4342.........$1.50
2N4401.........$0.30
2N4427.........$3.90
2N5484.........$1.50
2N5088.........$1.00
2N5089.........$1.00
2N5401.........$0.35
2N5458.........$0.90
2N5459.........$1.00
2N5485.........$1.15
2N5486.........$1.30
2N6027.........$1.20
2N6125.........$1.90
2SD350.........$6.95
2SJ49..........$9.95
2SJ56..........$14.50
2SK134.........$9.95
2SK176.........$14.50

BRIDGES

1.5 AMP
Description.........$
WO2 200V....$0.80
WO4 400V....$0.80
6 AMP
KBPC604 400V
.....................$2.50
KBPC607
1000V..........$2.75
10 AMP
KBPC1004
400V...........$3.50
KBPC1007
1000V..........$4.50
25 AMP
KBPC2504
400V...........$6.50
KBPC2510
1000V..........$7.35
35 AMP
KBPC3504
400V...........$6.50
KBPC3506
600V...........$6.75
KBPC3510
1000V..........$8.40

TRANSISTORS

AC128..........$2.95
BC107..........$0.80
BC108..........$0.80
BC109..........$0.80
BC212..........$0.30
BC318..........$0.30
BC327..........$0.30
BC328..........$0.30
BC337..........$0.40
BC338..........$0.40
BC546..........$0.30
BC547..........$0.15
BC548..........$0.15
BC549..........$0.15
BC550..........$0.30
BC556..........$0.30
BC557..........$0.15
BC558..........$0.15
BC559..........$0.15
BC639..........$0.80
BC640..........$0.80
BD139..........$0.90
BD140..........$0.90
BD237..........$0.90
BD238..........$0.90
BD650..........$1.95
BD649..........$1.65
BD647..........$1.80
BD681..........$2.00
BD682..........$2.00
BF115..........$1.00
BF180..........$1.20
BF199..........$0.60
BF245A.........$1.95
BF469..........$1.20
BF470..........$1.20
BFY50..........$1.50
BFY90..........$3.00
BU208A.........$4.90
BU326A.........$4.95
BUX80..........$5.95
BU806..........$7.95
MFE131.........$2.90
MFE3001........$9.90
MJ10012........$5.95
MJ802..........$7.80
MJ15003........$9.50
MJ15004........$9.70
MJ15024........$9.60
MJ2955.........$2.95
MJ4502.........$8.50
MJE340.........$2.00
MJE350.........$2.50
MJE2955........$4.90
MJE3055........$3.90
MJE13007.......$4.95
MJE13009.......$9.95
MPF131.........$2.90
MPSA06.........$1.00
MPSA13.........$0.50
MPSA42.........$0.80
MPSA43.........$0.50
MPSA93.........$0.50
MPF102.........$0.90
MPF109.........$0.90
MPSU56.........$1.75
PN100..........$0.25
PN200..........$0.25
TIP31B.........$1.00
TIP31C.........$1.20
TIP32B.........$1.00
TIP32C.........$1.20
TIP41A.........$1.90
TIP41C.........$2.00
TIP42A.........$1.90
TIP42C.........$2.00
TIP49..........$1.90
TIP50..........$2.20
TIP53..........$2.50
TIP112.........$2.50
TIP116.........$2.50
TIP117.........$2.50
TIP120.........$2.90
TIP122.........$1.95
TIP125.........$2.90
TIP127.........$1.95
TIP147.........$4.95
TIP2955........$2.25
TIP3055........$1.95

DIODES

1 AMP
Description..........$
1N4002 200V..$0.10
1N4004 400V..$0.10
1N4007 1000V.$0.20
3 AMP
Description..........$
1N5401 50V..$0.40
1N5404 400V.$0.40
1N5408 1000V.$0.65
GERMANIUM DIODE
Description..........$
OA47...........$1.50
OA90...........$0.40
OA91...........$0.75
OA95...........$0.75

400mW ZENERDIODES

1N746A 3V3..$0.25
1N747A 3V6..$0.25
1N748A 3V9..$0.25
1N749A 4V3..$0.25
1N750A 4V7..$0.25
1N751A 5V1..$0.25
1N752A 5V6..$0.25
1N753A 6V2..$0.25
1N754A 6V8..$0.25
1N755A 7V5..$0.25
1N756A 8V2..$0.25
1N757A 9V1..$0.25
1N758A 10V..$0.25
1N962A 11V..$0.25
1N759A 12V..$0.25
1N964A 13V..$0.25
1N965B 15V..$0.25
1N966B 16V..$0.25
1N967B 18V..$0.25
1N968B 20V..$0.25
1N969B 22V..$0.25
1N970B 24V..$0.25
1N971B 27V..$0.25
1N972B 30V..$0.25
1N973B 33V..$0.25
1N974B 36V..$0.25

1W ZENER DIODES

1W ZENER DIODE
Description..........$
1N4728 3V3...$0.35
1N4729 3V6...$0.35
1N4730 3V9...$0.35
1N4731 4V3...$0.35
1N4732 4V7...$0.35
1N4733 5V1...$0.35
1N4734 5V6...$0.35
1N4735 6V2...$0.35
1N4736 6V8...$0.35
1N4737 7V5...$0.35
1N4738 8V2...$0.35
1N4739 9V1...$0.35
1N4740 10V...$0.35
1N4741 11V...$0.35
1N4742 12V...$0.35
1N4733 13V...$0.35
1N4744 15V...$0.35
1N4745A 16V..$0.35
1N4746 18V...$0.35
1N4747 20V...$0.35
1N4748 22V...$0.35
1N4749 24V...$0.35
1N4750 27V...$0.35
1N4751 30V...$0.35
1N4752 33V...$0.35
1N4753 36V...$0.35
1N4751 75V...$0.80

5W ZENER DIODES

5W ZENER DIODE
Description..........$
1N5339B 5V6..$1.50
1N5342B 6V8..$1.50
1N5349B 12V..$1.50
1N535B 15V...$1.50
1N5361 27V...$1.50
1N5359 24V...$1.50
1N5363 30V...$1.50
1N5372 62V...$1.50

CRYSTALS

Description..........$
1MHz...........$6.00
1.8432MHz......$7.50
2MHz...........$3.00
2.4576 MHz.....$2.00
3MHz...........$4.90
3.57954MHz.....$3.00
4.00 MHz.......$3.00
4.19430MHz.....$3.00
4.433618MHz....$2.00
4.44 MHz.......$2.00
4.9562 MHz.....$3.00
5MHz...........$2.00
6 MHz..........$2.00
6.144 MHz......$3.00
8.00 MHz.......$3.00
8.86723MHz.....$3.00
10 MHz.........$2.00
11 MHz.........$3.00
12.00 MHz......$3.00
14.318 MHz.....$2.00
15 MHz.........$2.00
16.00 MHz......$3.00
20.00 MHz......$2.00
24 MHz.........$3.00
48MHz..........$2.00
32.768KHz......$2.00

IC's - H, HC

Description..........$
74HC00.........$0.75
74HC02.........$0.75
74HC04.........$0.75
74HC08.........$0.75
74HC10.........$0.75
74HC11.........$0.75
74HC14.........$1.60
74HC30.........$0.60
74HC32.........$0.80
74HC42.........$0.90
74HC74.........$1.10
74HC85.........$1.40
74HC86.........$1.10
74HC123........$1.40
74HC132........$1.25
74HC138........$1.40
74HC157........$1.25
74HC151........$2.25
74HC164........$2.25
74HC174........$1.40
74HC244........$2.00
74HC245........$2.50
74HC273........$2.75
74HC367........$1.85
74HC373........$1.80
74HC393........$2.75
74HC4040.......$1.65
74HC4060.......$3.95
74HC4066.......$1.70

SERIES 4000

Description..........$
4000...........$0.75
4001...........$0.45
4002...........$0.55
4006...........$1.55
4007...........$0.45
4008...........$1.70
4009...........$0.90
4010...........$0.90
4011...........$0.45
4012...........$0.45
4013...........$0.70
4014...........$1.00
4015...........$0.90
4016...........$0.70
4017...........$1.35
4018...........$0.50
4019...........$0.80
4020...........$1.40
4021...........$1.50
4022...........$1.45
4023...........$0.45
4024...........$1.60
4025...........$0.45
4026...........$1.10
4027...........$0.85
4028...........$1.15
4029...........$1.50
4030...........$0.50
4033...........$2.75
4035...........$2.25
4040...........$1.20
4042...........$1.50
4043...........$1.20
4044...........$1.25
4045...........$4.90
4046...........$1.00
4047...........$1.90
4049...........$0.60
4050...........$0.60
4051...........$1.20
4052...........$1.20
4053...........$1.20
4060...........$2.50
4066...........$0.80
4068...........$0.50
4069...........$0.50
4070...........$0.50
4071...........$0.50
4073...........$0.50
4075...........$0.50
4076...........$1.90
4077...........$0.50
4078...........$0.50
4081...........$0.50
4082...........$0.50
4093...........$0.80
4098...........$1.90
45104..........$7.25
4503...........$1.30
4510...........$1.40
4511...........$1.45
4512...........$1.40
4514...........$2.60
4515...........$1.90
4516...........$1.60
4518...........$1.50
4520...........$1.00
4522...........$1.90
4526...........$1.90
4528...........$1.95
4532...........$2.65
4536...........$6.50
4538...........$1.20
4543...........$2.50
4556...........$1.25
4584...........$1.00
40014..........$1.50
40175..........$2.00

74C SERIES

Description..........$
74C00..........$1.00
74C04..........$1.00
74C08..........$1.00
74C14..........$1.75
74C74..........$1.00
74C86..........$1.50
74C90..........$2.50
74C192.........$3.50
74C221.........$3.95
74C244.........$3.95
74C373.........$8.95
74C906.........$2.90
74C922.........$14.95
74C928.........$13.95
74C948.........$24.50

74S SERIES

Description..........$
74S04..........$1.20
74S08..........$1.50
74S30..........$1.00
74S32..........$1.00
74S132.........$3.50
74S133.........$1.20
74S138.........$2.50
74S139.........$3.30
74S174.........$3.50

74F SERIES

Description..........$
74F00..........$0.25
74F04..........$0.25
74F32..........$0.25
74F74..........$0.25
74F109.........$0.50
74F138.........$1.00
74F151.........$1.20
74F153.........$1.20
74F157.........$1.20
74F194.........$2.41
74F244.........$3.72

74LS SERIES

Description..........$
74LS00.........$0.30
74LS01.........$0.60
74LS02.........$0.60
74LS03.........$0.60
74LS04.........$0.75
74LS05.........$0.75
74LS08.........$0.60
74LS10.........$0.30
74LS11.........$0.75
74LS13.........$0.90
74LS14.........$0.75
74LS15.........$0.80
74LS20.........$0.90
74LS21.........$0.90
74LS27.........$0.90
74LS30.........$0.30
74LS32.........$0.60
74LS379........$0.70
74LS38.........$0.80
74LS42.........$1.20
74LS47.........$1.80
74LS48.........$1.80
74LS74.........$0.40
74LS75.........$1.20
74LS76.........$1.00
74LS85.........$0.85
74LS86.........$0.60
74LS90.........$1.20
74LS92.........$1.20
74LS93.........$1.50
74LS95.........$1.20
74LS107........$0.90
74LS109........$0.90
74LS112........$0.70
74LS123........$1.30
74LS125........$1.00
74LS126........$1.00
74LS132........$1.00
74LS138........$0.80
74LS139........$0.80
74LS145........$1.50
74LS147........$2.50
74LS151........$1.20
74LS153........$1.00
74LS155........$0.50
74LS156........$1.50
74LS157........$1.20
74LS158........$1.00
74LS160........$1.50
74LS161........$1.00
74LS162........$0.50
74LS163........$1.10
74LS164........$1.40
74LS165........$1.20
74LS166........$1.25
74LS168........$2.10
74LS174........$1.20
74LS175........$0.70
74LS181........$4.00
74LS191........$1.20
74LS193........$1.20
74LS195........$0.50
74LS196........$1.20
74LS221........$2.00
74LS240........$1.40
74LS241........$0.95
74LS243........$1.10
74LS244........$2.20
74LS245........$2.95
74LS257........$1.20
74LS258........$1.20
74LS259........$2.25
74LS266........$0.70
74LS273........$1.00
74LS323........$5.50
74LS352........$2.20
74LS365........$1.00
74LS366........$1.00
74LS367........$1.00
74LS373........$2.00
74LS374........$2.00
74LS375........$1.00
74LS393........$1.00
74LS629........$5.95
74LS640........$1.00

74 SERIES

Description..........$
7400...........$0.80
7402...........$1.00
7403...........$1.00
7404...........$0.30
7406...........$0.40
7407...........$0.50
7408...........$1.00
7409...........$1.00
7410...........$1.20
7414...........$1.50
7416...........$0.50
7430...........$1.00
7432...........$1.00
7438...........$0.80
7442...........$1.50
7445...........$1.00
7446...........$1.20
7447...........$1.75
7473...........$1.20
7474...........$0.40
7475...........$1.20
7476...........$1.50
7483...........$1.10
7490...........$1.20
7493...........$1.25
74121..........$1.55
74123..........$0.50
74125..........$1.00
74126..........$1.00
74150..........$1.90
74154..........$2.50
74157..........$1.30
74161..........$1.20
74164..........$1.20
74177..........$1.95
74193..........$1.50
74195..........$1.00
74197..........$1.20
74283..........$2.45
74290..........$0.90

IC - D/A, A/D

Description..........$
DAC0800........$4.95
DAC0808........$4.90
ADC0800CN......$29.95
ADC0803........$13.50
ADC0804........$7.95
ADC0808........$13.00
ADC0820LCN.....$27.95
DAC0832........$7.95
DAC1020........$16.28
11C90..........$16.50
DAC1220........$22.95
DAC1408........$1.00
AD590J.........$12.95

IC LINEAR

Description..........$
AY-3-1015......$11.95
AY-3-8910......$19.95
AY-5-8116......$14.50
CA3028.........$3.95
CA3086.........$1.20
CA3130E........$2.90
CA3130T........$3.95
CA3140E........$1.30
CA3140T........$2.95
CTS256A........$45.50
DM2502.........$13.50
LF347..........$1.40
LF351N.........$1.20
LF353..........$1.60
LF356N.........$1.50
LF357..........$2.95
LF398..........$5.90
LM301H.........$1.50
LM301N.........$0.50
LM302H.........$6.50
LM305H.........$1.50
LM307CN........$1.50
LM308..........$0.50
LM309K.........$2.85
LM310N.........$4.95
LM311..........$1.00
LM324..........$1.20
LM331..........$6.00
LM339..........$0.60
LM348..........$1.00
LM349..........$2.95
LM358..........$1.40
LM361..........$4.95
LM380N-14......$1.95
LM380N-8.......$1.50
LM381..........$4.95
LM382..........$3.50
LM383..........$4.95
LM384..........$3.50
LM358-1........$1.40
LM387..........$2.75
LM390..........$2.95
LM392..........$1.50
LM393..........$0.60
LM394CH........$7.95
LM395T.........$9.95
LM395K.........$7.95
LM396K.........$16.50
LM399H.........$7.50
LM711..........$1.20
LM725..........$7.50
LM733..........$1.50
LM741..........$0.60
LM747..........$1.50
LM748..........$1.10
LM759..........$3.90
LM833..........$2.10
LM1830.........$4.90
LM1871N........$7.50
LM1872N........$8.60
LM1886.........$9.10
LM2907-14......$3.60
LM2907-8.......$5.10
LM2917-14......$2.50
LM2917-8.......$4.80
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When I Think Back...

by Neville Williams

Vintage Radio Receiver Design — 4
How the superhet was 're-discovered'

In the early 1930s, superheterodyne receiver design was rationalised and simplified to such an extent that it rendered the TRF principle virtually obsolete, for both domestic and professional applications. The progressive developments which brought this about will be examined in this and following articles.

In the Newnes-Butterworths Book *Radio, TV & Audio Technical Reference Book* compiled by S.W. Amos and published in 1977, there is apt reference to the 're-discovery' of the superhet in the early 1930s, and a subsequent period of progressive 'consolidation' that led up to the war years, which saw intensive development of a quite different kind.

Amos does not explain who or what led to the so-called re-discovery around 1930, beyond a brief reference to an unnamed company catering for the home construction market and 'massive' concentration on the subject of receiver design by the technical press.

I, personally, cannot recall ever having seen an article on the subject, but it appeals to me as one holding considerable potential interest as a paper or thesis for anyone having a mind to carry out the appropriate research of patent files and other literature.

In the meantime, I lean to the view that the radio industry worldwide desperately needed a configuration that offered a way around the inherent limitations of the TRF approach in the way of gain and selectivity; that, whatever the 'trigger', sheer competitive commercial pressure maintained the on-going momentum that was evident in the consequent research and development.

In Australia, the motto of the radio industry was 'a set in every home', with individual manufacturers doing their level best to ensure that as many of the sets as possible bore their particular trademark.

However, without getting involved in the exact how, when, where or why, it is possible to nominate various developments which transformed a seemingly involved design concept into receivers that were relatively easy to mass-produce and eminently suitable for use by non-technical listeners.

If Australian manufacturers tended to incorporate similar technology in their respective models, it was because they had to evaluate each new development, irrespective of its source, as soon as it was publicised in trade literature or technical journals.

They simply had to keep abreast of their competitors, or be perceived as 'behind the times'.

Improvements essential

Back in 1925, despite their commendable gain and selectivity, early superhet receivers had peculiarities which, to say the least, were discouraging to potential non-technical buyers.

As explained in the June article, they exhibited double-spot tuning effects, image reception and spurious radiation from the inbuilt oscillator. A few manufacturers persisted with them, but most passed them by.

While the release of mains type screened-grid valves — sharp cutoff and variable-mu — significantly upgraded the design of TRF receivers (see last issue) they were no less a key element in the re-development of the post-1930 superheterodyne. For example, the provision of an RF amplifier stage ahead of the frequency changer became a routine option, isolating the local oscillator from the antenna and providing readily controllable gain, plus up-front selectivity to help deal with image and double-spot tuning effects.

In the frequency changing stage, a single sharp cutoff RF tetrode or pentode could fill a dual role as both mixer and local oscillator. (The so-called 'autodyne' frequency changer is explained later, in connection with Fig.4).

Again, in the IF (intermediate frequency) amplifier section, a single variable-mu tetrode or pentode could provide adequate and controllable gain, feeding into the detector and audio system. For such an approach, only one extra valve would be involved to achieve an order of gain and selectivity that would be unattainable from a comparably priced TRF. But the story does not end there.

Complete Remler coil kit for a 1920s-style superhet, as advertised in 'Wireless Weekly' (July 29, 1927) by Wiles Wonderful Wireless of Goulburn St, Sydney. The IF transformers carry terminals similar to those of audio transformers.

Higher IF

The tuning and radiation problems of the early superhets were compounded by the comparatively low IF (intermediate frequency) then being used — commonly in the region of 50-60kHz. As a manageable supersonic frequency, it was accepted as a natural choice in the quest for high selectivity.

A further consideration was that the early designs had to rely on triode valves, and the intrinsic grid/plate capacitance of these posed less of a problem in the supersonic frequency range, thereby making it easier to secure high, stable gain from a multi-stage IF channel.

Not surprisingly, perhaps, IF coupling transformers of the period were routinely styled like interstage audio transformers, with connecting terminals for P, B+, G and C- (Fig.1). The prime difference was that, instead of being responsive over the audio range, they were so wound as to be self-resonant at a supersonic frequency — hopefully one that was suitable.

Curiously, advertisements of the period make little or no reference to the *actual* resonant frequency of particular transformers, or to alignment precautions, if any. They simply suggested that constructors be careful to use only a complete matched set of IF transformers designed for the particular receiver.

With the release of screened grid (tetrode and/or pentode) valves, stability and gain ceased to be a problem in the RF and IF channels alike. As a result, engineers had the option of designing superheterodyne receivers around a much higher intermediate frequency, thereby making the image and double-spot tuning problems more manageable.

The first figure to emerge by industry consensus as a new IF standard was 170kHz — subsequently amended to 175kHz — and seen at the time as a radical departure from 50-60kHz. It meant that the oscillator frequency would differ from the signal by 175kHz and that potential tuning 'images' or 'second spots' would be displaced by 2 x 175 or 350kHz. Compared with the previous 2 x 60kHz or 120kHz, the ability of the signal input tuning circuits to reject the unwanted images would be considerably enhanced.

Reasons for agreeing upon a new international industry standard IF included the following:

- The characteristic preference of engineers for an orderly, rather than a random design approach, particularly with an increasing international exchange of technical ideas and information.
- To facilitate the production of compatible coil kits and IF transformers by independent and/or international component suppliers.
- To avoid unnecessary confusion in the radio service industry, with a multiplicity of intermediate frequencies to which different receivers might need to be aligned.

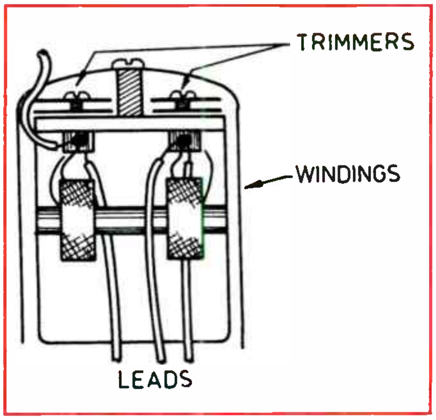


Fig.2: The construction of an early 1930s-style IF transformer. Two lugs on each of the alignment trimmer capacitors at the top provide rigid anchor points for the fine wires from the coils and for the heavier outgoing insulated leads.

Practical IF transformers

If the early 50-60kHz (supersonic) IF coupling transformers were patterned on their audio frequency counterparts, their 175kHz equivalents were unmistakeably envisaged as 'RF' (radio frequency) components, housed in a light-gauge aluminium shield can.

In a few early examples, the primary and secondary windings were simply jumble wound between bakelite cheeks on a common spacer, each being resonated by a separate compression type trimmer capacitor, accessable from outside the can. The two windings would be separated by just the right amount to ensure an appropriate order of signal transfer and selectivity.

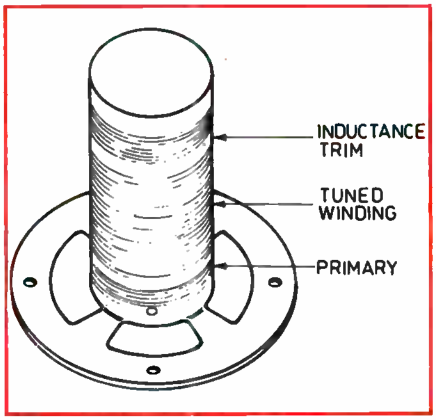


Fig.3: A simple 'solenoid' style coil wound on an Australian made Lekmek tubular former. The leads were anchored to metal clips fitted into holes around the lower end of the tube.

More commonly, the coils were honeycomb-wound towards either end of a composition or bakelised cardboard former, and subsequently stabilised by immersion in a low-loss wax or varnish. Mounted inside a common shield can, they were likewise resonated by compression trimmers, with leads running out through the top and/or down through the bottom of the can to the associated circuitry (Fig.2).

With all coils resonated deliberately and precisely to the one frequency — nominally 175kHz — after connection into circuit, the chances are that the selectivity curve would compare favourably with the 1920s-style IF channels, despite the greater complexity and lower frequency of the latter. This was because of the more casual approach to system resonance that was characteristic of the earlier designs.

Certainly, 175kHz superhets earned a reputation in the 1930s for high selectivity — too high, in fact for many listeners, who lamented the loss of upper treble by reason of sideband cutting.

The procedure for aligning the 'new look' superhet receivers, including the IF channel, will be detailed in a future article. In the meantime, one innovation led to another.

Single-dial tuning

A side-effect of selecting a higher IF was that it increased the discrepancy between the tuning range of the signal frequency and local oscillator circuits. For a broadcast band tuning range of 550kHz to 1600kHz, the frequency ratio was/is 1:2.9. For an IF of 175kHz, the required oscillator tuning range becomes 725 to 1775kHz, with a ratio of only 1:2.45.

To provide single-dial tuning — a prerequisite for family receivers in the 1930s — the designer of a superhet needed to arrange that, for a given rotation of the tuning mechanism, the oscillator would always be 175kHz above the selected incoming signal frequency. In other words, the respective circuits had to 'track' each other, right across the dial. The most obvious approach was to provide a ganged capacitor in which the oscillator tuning section used fewer and/or somewhat smaller plates, so shaped that the oscillator followed the required frequency law. This approach was, in fact, employed fairly commonly overseas, where the cost of designing and producing a customised ganged capacitor could often be absorbed in high-volume production budgets.

Fortunately for smaller production runs, a simpler alternative was devised. This involved the use of a conventional ganged capacitor with identical sections, and a specially selected 'padder' capacitor connected in series with the oscillator tuning section.

The oscillator coil would be designed with deliberately fewer turns such that, at the high frequency end of the band, it could be resonated 175kHz above the signal frequency using the normal alignment trimmer. At the low frequencies, the series 'padder' would reduce the effective maximum value of the tuning capacitor and, by making the padder adjustable in the manner of a compression trimmer, the oscillator frequency could be kept substantially in step with the signal tuning circuit(s) across the entire band.

That the series padder approach was vital in the design of domestic superhets is evidenced by the fact that some 25 engineering papers on this subject were published here and overseas, in the period 1931-41. These explored the principle, the mathematics and the potential accuracy of circuit tracking based on the use of a padder capacitor. It was certainly important in Australia where, for the minor cost of a compression type padder, local manufacturers could use perfectly standard two, three or four-gang capacitors, as might otherwise be used for a TRF.

The tuning dial would be calibrated to suit the brand of gang — Airzone, AWA, Stromberg, or whatever — and adjusted for the correct indication of frequency and/or station call as part of the alignment procedure, to be discussed in a future article.

Tuning coils

In regard to the associated tuning coils, the aerial input coil could well be identical for either TRF or superhet. With a somewhat higher inductance primary winding, RF coils could also serve in either type of receiver. Whereas, however, a family size TRF might typically use two RF coils, a 175kHz superhet would more commonly use only one, along with a special oscillator coil, as already mentioned.

In the early 1930s, tuning coils were mostly solenoids: wound with enamelled solid wire, single layer on 0.75 to 1.25" diameter cardboard or moulded formers (19-32mm). Depending on the inclination of the designer, primary windings would be wound adjacent to the earthy end of the tuned winding, or overlaying it with woven 'cambric' insulation between.

Normally, the coils would be separately shielded by aluminium cans, of at least double the coil diameter and with similar clearance top and bottom. If the cans were too small this would reduce the inductance and efficiency of the coils; if they were too large they would be unnecessarily cumbersome and costly.

At my first job in Reliance Radio, we used coils wound on Lekmek moulded formers, about 35mm in diameter, with three integral moulded legs supporting the coil above a moulded base mounting ring. The inductance was finely trimmed during manufacture by manually spacing a few turns at the top, after which the winding would be stabilised with wax or varnish (Fig.3).

Lekmek style coils worked well, but they had one unfortunate weakness: they didn't like being bolted down to anything but a dead flat surface. Bolt them too firmly to a chassis with residual curvature and the base ring would crack, leaving the assembler with the option of confessing their aberration or saying nothing and hoping that the fine crack would pass unnoticed.

I/we were much relieved when Reliance went over to coils wound on waxed cardboard formers with metal-lug supports, which were much more tolerant of abuse!

As we shall see later, coils and IF transformers underwent a cycle of changes during the following years, aimed variously at making them more compact, more efficient, more economical to produce and, in some cases more amenable to advertising hype!

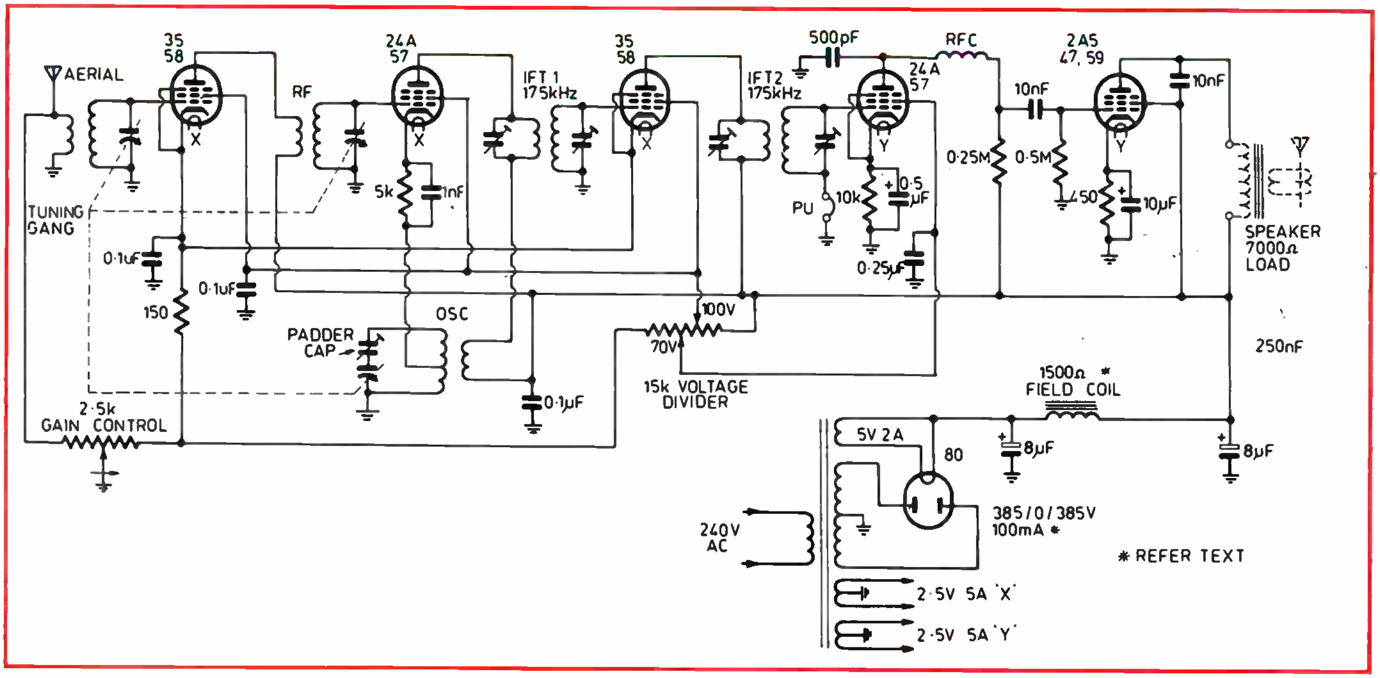


***Fig.4:** A circuit typical of five-valve mains powered 175kHz superhets from the early 1930s. Features like special-purpose frequency changing valves, automatic gain control and audio negative feedback had yet to appear.*

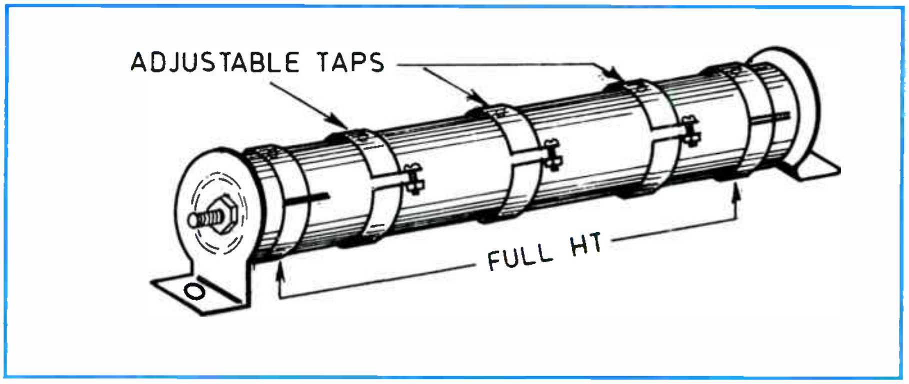


Fig.5: Commonly used in 1930s-style receivers, voltage dividers were prone to troubles due to loose clips. Treat them gently, to avoid fracturing the fine resistance wire with which they are wound.

Typical circuit

To gather together much of the foregoing discussion, Fig.4 suggests a typical circuit for a 5-valve mains powered 175kHz superhet receiver from the early 1930s. It is not a reprint but, rather, one cobbled together from circuit practices of the period, with the front-end configuration very like that of the much publicised *Wireless Weekly* 'Champion'.

Checking through the circuit from the front end, the aerial coil would normally have been of conventional solenoid design, as already mentioned, with a low impedance (e.g., 20-turn) primary adjacent to or overlaying the earthy end of the secondary. As such, it would have been appropriate for direct connection to a conventional outdoor antenna.

In the earliest examples of such a receiver, the RF amplifier valve would have been a type 35 five pin variable-mu tetrode. This was subsequently superseded by the type 58 six pin variable-mu pentode, with its suppressor grid (G3) tied externally, as shown, to the cathode. The cathode and screen feed will be discussed soon.

The RF coil coupling the RF amplifier to the frequency changer would have had a secondary identical to that of the aerial coil, plus a primary winding having at least twice as many turns as the aerial primary to be more compatible with the high anode impedance of the RF valve. Consistent with earlier remarks, the second valve is shown as an 'autodyne' frequency changer — or self-oscillating mixer. In keeping with this dual role, it called for an overbiased, sharp cut-off valve such as the original five pin 24 or 24A, or the later six pin 57. Autodyne circuits could be configured in a number of ways, and a collector of vintage receivers has to be prepared for such variations. The arrangement shown was probably the one preferred by many designers, because the oscillator tuned circuit operated at cathode rather than anode potential.

Autodyne & IF channel

In this kind of stage the RF input signal is applied to the grid in the normal manner, with the cathode substantially inert at the signal frequency by reason of the cathode bypass and a low impedance tapping on the oscillator coil, which is resonant at an entirely different frequency. At the same time, the valve is operating as a cathode coupled oscillator, at a frequency determined by the oscillator tuned circuit — this time with the grid inert by reason of its own differentially tuned signal circuit. By very nature, the circuit depicted does not provide an inbuilt path for the oscillator signal back towards the antenna.

However, signal and oscillator energy are both present in the actual electron stream and, in consequence, because of the non-linear mixing or intermodulation that takes place, multiple frequencies appear as components in the anode current. These include the oscillator frequency (Fo), the incoming signal frequency (Fs), along with the sum and difference products (Fo+Fs) and (Fo-Fs). In addition, natural harmonics 2Fo, 3Fo etc., and 2Fs, 3Fs and so on are also present, plus their sundry sum and difference components.

Fortunately, the sharply tuned circuits in IFT1 tend to reject all such components except the difference frequency (Fo-Fs) which, by front-end design, is 175kHz. This wanted signal is passed on to the IF amplifier — another 35 or 58 — and thence to the anode bend detector. The screen grid pins of the first three valves are wired together, bypassed to earth by a single 0.1uF capacitor and fed from a 100V tapping on a 15k ohm, so-called 'voltage divider' resistor.

Voltage dividers

Connected across the HT supply, a voltage divider typically drew about 20mA and dissipated about 5 watts. Years before high wattage vitreous enamel resistors became commonplace, voltage dividers were mostly wound on cardboard formers with lightly insulated resistance wire, slightly turn-spaced, and lacquered to hold the wire in position. However, a narrow strip was masked off during lacquering to expose the wire along the former, the wire thereafter being lightly abraded so that adjustable clips could tap off intermediate voltages between 0 and (say) 270V — see Fig.5.

Voltage dividers served also to place a fixed load on the HT supply, thereby limiting the peak voltage from the directly heated rectifier at switch-on, before the remaining indirectly valves had time to warm up.

Unfortunately, voltage dividers also created their share of service calls — by reason of the generated heat shrinking the cardboard former and cracking the lacquer, causing intermittent contact between the clips and the wire. But in all fairness, fixed resistors in those days did not in themselves offer a very attractive alternative.

If replacement of a voltage divider is necessary in a vintage receiver, the most obvious course nowadays is to substitute a series string of 3W or 5W ceramic resistors, mounted on a tagstrip. Appropriate values, totalling about 15k, can be estimated from the position of the tappings along the original resistance element.

In Fig.4 the low potential end of the voltage divider returns to earth via the 2.5k gain (or volume) control. Depending on the setting of the control, the consequent cathode bias voltage for the RF and IF amplifier valves varies from the requisite minimum of 3V (maximum gain) to about 40V, where the gain of the variable-mu valves would be extremely low.

Furthermore, as the earthed contact in the potentiometer approaches the end remote from the voltage divider, it simultaneously shunts the aerial connection to earth in the manner of a local-distant switch. By specifying a 2.5k potentiometer, the shunting effect on the aerial circuit is less abrupt than it would be with a higher value control.

The audio system

The anode-bend detector calls for a second sharp cutoff tetrode or pentode — a 24A or 57 — with a modest screen voltage and a deliberately high bias, ensured by the 10k cathode resistor.

Operating close to the cut-off bend in the anode current current characteristic, the instantaneous current can rise with positive-going half-cycles of the RF signal but it cannot react to the same degree to negative half cycles. As a result, rectification takes place, with the valve responding principally to positive- going contours of the amplitude modulated carrier envelope.

In effect, an amplitude peak at the grid produces an upward surge of plate current and a downward surge of plate voltage. The 500pF bypass and RF choke in the plate circuit together suppress the RF or carrier component, such that the plate current excursions become a pure audio signal suitable for transfer to the output valve. Hence the term 'anode-bend' detector. Note that the lower end of the IFT2 secondary winding returns to earth via two pickup terminals, normally mounted on the rear of the chassis and bridged by a scrap of tinned copper wire. Although not taken all that seriously at the time, it was a facility costing next to nothing that provided a feed point for the rather primitive magnetic gramophone pickups of the day.

In older receivers, the output valve would most likely have been a 47, with a directly heated or filament type cathode. In the absence of a cathode, as such, the bias would have been provided by returning the centre-tap of winding 'Y' to earth through the 450 ohm resistor and 10uF bypass, instead of direct.

Type 47 output valves had the advantage of drawing normal current almost from switch-on, but they were prone to grid current problems — resulting, in many cases, in gross distortion and a limited service life.

Type 59 valves were much better in this respect, but were less rugged than they should have been, suffering more than their fair share of internal shorts. By far and away the best of the three types shown on the circuit was the 2A5, which became the prototype of the popular 6.3V equivalents the 42 and 6F6-G.

Power supply

The power supply shown conforms to a basic configuration which was more or less standard throughout the 1930s and, as such, warrants comment beyond the mere addition of likely component ratings. The power transformer provides the requisite filament/heater windings, plus a centre-tapped high-tension secondary to feed a full-wave valve type rectifier. The pulsed DC output was/is delivered typically to an 8uF liquid or gel-filled can-type electrolytic capacitor and thence to the field coil of an electrodynamic loudspeaker, doubling as a filter choke. This is followed by a second 8uF electrolytic, which provides the final filtering, as well as maintaining the DC supply line at virtual earth potential in respect to audio frequencies. We shall have more to say later about loudspeaker field coils.

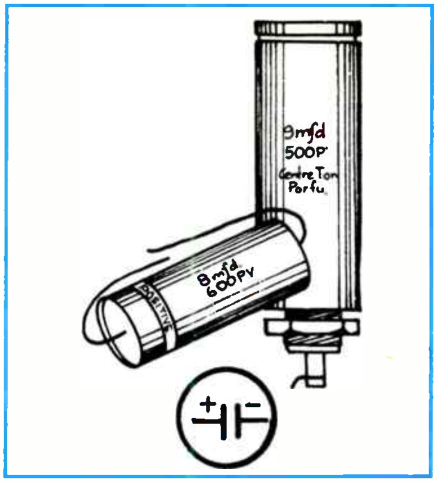


***Fig.6:** A traditional can-type electrolytic capacitor and its more recent, smaller gel-type tubular equivalent. If not earthed to the chassis, can types had to be insulated with large fibre washers.*

In the early 1930s, power transformers were commonly supplied by specialist component manufacturers, who pro,oted selected 'catalog' lines, available from stock at the best price. Receiver manufacturers used them, wholesalers carried them on their shelves, and they were routinely specified in technical journals for home-built equipment.

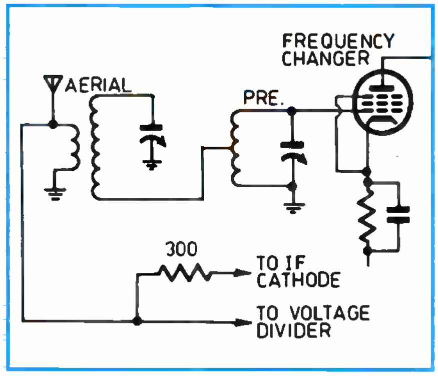


***Fig.7:** Pre-selector tuning offers similar selectivity to that of an RF stage, but without the gain or the gain control facility offered by a variable-mu valve.*

For reasons which I can now only surmise, most stock power transformers carried a centre-tapped high tension secondary winding rated at 385-0-385V RMS and variously designed to cope with DC loads of 60, 80, 100 or 125mA, according to the nature of the receiver.

Voltage/current levels

Contemporary valve curves show that, under no-load (warm-up) conditions, a type 80 rectifier, fed with 385V RMS input, would deliver peak pulses of around 525V to the filter input capacitor.

Since 525 also happened to be the peak voltage (PV) rating of then-practical can-type electrolytic capacitors (Fig.6), it is reasonable to assume that 385 RMS represented the highest secondary voltage which could be countenced with a capacitor-input filter system.

While can-type electrolytics were said to be tolerant of high peak voltages, the 525PV rating would obviously been exceeded with an over-voltage mains supply. It was certainly not uncommon for liquid-filled electrolytics to 'sizzle' at switch-on, and one might even explode, on occasion, by reason of internal pressure. Perhaps that is why special 600PV types were in high demand for the filter input, when limited supplies ultimately appeared on the market.

In the case of Fig.4, the drain of the voltage divider would lower the peak voltage across the input electrolytic to about 505, leaving a small safety margin. With a directly-heated 47 output valve, also having a similar warm-up time to that of the rectifier, the peak voltage across the first electro would be un-likely to exceed 425V — a very comfortable margin.

Depending on the ultimate DC supply voltage, the valve complement and the setting of the gain control, the DC load current of the receiver illustrated would be around 90mA, suggesting the choice of a power transformer rated at 100mA. At 90mA, the measured voltage across the input filter capacitor would be about 410. By subtracting from this figure the required 270V HT 'rail' voltage (250V + 20V cathode bias) we arrive at a desirable voltage drop across the field coil of 135V. Based on a current drain of 90mA, this works out at about 1500 ohms resistance for the field coil and a field wattage dissipation of just over 12W, which would be appropriate for an everyday 8" (200mm) diameter electrodynamic loudspeaker. These figures have been shown on the circuit as preferred values.

While loudspeakers with 1500-ohm field coils could be obtained from suppliers, they were less common than 2000 ohm or 2500-ohm fields. If, for a vintage receiver as in Fig.4, a collector needs to replace the original electro-dynamic loudspeaker, they may well have to make do with a higher resistance field.

Either of the abovementioned values should work out well enough. For sure, the voltage drop across the field would be increased, but not in direct proportion because, with a reduced supply voltage, the valves will draw significantly less anode and screen current. Based largely on 'guesstimation', I would expect the subsitution of a 2000-ohm field to result in a filtered HT voltage of around 255V at a current level of about 85mA. The field wattage would be something over 13. Repeating the exercise for a 2500-ohm field coil suggests a HT voltage of just under 250V at around 75mA, with a field wattage of just over 14. In short, increasing the field resistance as indicated would reduce the filtered HT supply and, with it, the available output power — but not to the point where it would seriously prejudice the subjective behaviour of the set.

Cutting costs

While the performance of a receiver along the lines of Fig.4 was outstanding, relative to its cost, it raised the question as to whether there might be scope for an economy version with an adequate performance for non-critical areas. Accepting that it could be housed in a cheaper cabinet and powered from an 80mA transformer by cutting back on the HT current, could such a set also get by without the RF stage?

Superficially the answer was 'no', because reduced front-end selectivity could allow stations across the lower frequency end of the band to be affected by images from stations further up the band by twice 175kHz, or 350kHz.

As a compromise, RCS Radio and other coil manufacturers came up with a preselector coil which, in conjunction with the normal aerial coil, offered adequate up-front selectivity (Fig.7). It still called for a three-gang tuning capacitor, but eliminated the RF valve and the heater/anode load it imposed on the power transformer.

While preselector tuning was a well-known option at the time, receiver manufacturers came up with a preferred alternative which obviated the need for a special coil and a third section on the tuning capacitor: namely a still further increase in the intermediate frequency. How the new configuration evolved will form the subject of a future article.

(To be continued) ■

THE SERVICEMAN

Frustration and deja vu, when resurrecting old colour TV's

This month I have two interesting stories, both of which come from Queensland. Both tell of the resurrection of old but still serviceable colour TV sets based on Philips chassis (one KL9A, the other K9), and the first gave me a strong whiff of that familiar perfume '*deja vu*'.

Unfortunately, neither of these sets might have survived if it had come down to a strictly commercial repair. Both took much longer than they should have done, for different reasons.

The first story, from S.McB. of Townsville, tells of a sequence of troubles with a Kriesler colour TV. The set turned out to have an obscure fault that caused expensive damage.

One can speculate that it may not have been quite so expensive if S.McB. had been a bit more experienced. Yet at the same time, I wonder if I would have found the fault any sooner than he did.

S.McB. tells the story thus:

I've never had any formal training with TV/video repairs, but have essentially taught myself from textbooks and several years experience working with closed circuit TV systems, at the heavy industrial chemical processing plant where I worked for seven years.

Most repairs were on the video cameras as these were generally installed in very hostile environments. On the other hand, the monitors were usually in clean, air conditioned control rooms.

(As a little aside here, readers may recall my own story of the CCD camera that kept flipping the picture upside down. That camera spent its days staring into a furnace, and was fitted with a terrestrial lens that could be detached by an operator and used as a telescope to examine the interior walls of the firebox.)

So although most of my experience was on cameras, I occasionally had to repair the monitors and anyone who discounts the danger of EHT supply voltage from colour CRT's has never had hold of the ultor lead from the high brightness, high resolution display tubes used in industrial process control systems. I've still got the scar of a 1.5cm burn, sustained eight years ago from just such equipment.

But now to my story.

My parents have a 1981 vintage Kriesler 66cm CTV, which recently decided to take an unplanned retirement. The set was a model 66-124 fitted with a 59-09 chassis, and had given nine years of troublefree service. Right up to its recent demise it had presented a picture which outclassed many modern sets. Thus, when my mother said she was going to call for service, yours truly volunteered to do the job. After all, was I not a qualified electronics technician with some experience, albeit limited, with colour TVs?

So off came the back of the set — to reveal a Philips 30AX CRT and a Philips KL9A chassis. I had no information on this model, so I contacted Philips with the idea of purchasing a full service manual. I was told that they had KL9A manuals available, but had never heard of a Kriesler set fitted with this chassis. They suggested that I recheck the labelling on the rear panel, but all this proved was that I was right all along.

The people at Philips insisted that there was no such beast, so I politely offered to bring it in to show them. (I had the feeling that I would have to drop it on their toes before they would believe me, but I resisted the temptation.) They remained doubtful about my probity, but promised to double check with their superiors in Sydney. In any case, they were sure that I would only need the KL9A manual, if the Kriesler was indeed fitted with that chassis. So I obtained a copy and set to work.

Problem number one appeared as soon as I settled down behind the set. The manual showed the KL9A as being a live chassis model. Yet the Kriesler had a large mains transformer fitted inside its commodious cabinet. I traced the wiring from the transformer to the U450 mains PCB, then suddenly realised that this too was different to the KL9A.

But while I was sitting there mumbling profanities, the Philips people rang to apologise for any inconvenience, as their Sydney office had confirmed that the Kriesler model really did exist. Even better, they were faxing up details of the differences between the Kriesler 66-124 chassis and the standard KL9A chassis.

These details were soon in my hands and I was glad to find that the major difference was in the U450 mains board, as I had already found. So back to the set, and I was in a much better frame of mind now that the Philips people and I were all smiles again. But Murphy saw to it that the smiles wouldn't last too long.

The problem with the set was that it wouldn't keep running. It would start up, but two seconds later would shut down — only to repeat the process indefinitely.

My first thought was 'hiccupping', and the second thought was a faulty tripler. This could be easily tested by *removing the connection between the line output transformer overwind and the input to the tripler. This done, the set came good with full sound, all channel indicators working, but of course, no picture. A spark gap test showed that the transformer could deliver a decent arc, so everything pointed to a faulty tripler.*

After a visit to the local parts supplier, a new tripler was fitted and the Kriesler fired up with a perfect picture. (Well, programme content excepted!)

So a few moments later, after I had refitted the cabinet back and rolled the set back on its (convenient) castors, I stood back to admire my handiwork and reflect on the ease of the job. After only two minutes I came to earth with a thud when the set began to hiccup again, just as before. I was not amused, and assumed that the new tripler was a dud.

The parts shop manager was surprised to see me back again so quickly, and was even more surprised to learn why I had returned. He confirmed that the tripler was the correct replacement and declared that he had never before had complaints about the brand. Nevertheless, he agreed that the law of averages would dictate that sooner or later he would get a dud. He accepted the return of the first tripler and replaced it with another of the same type and brand.

There are no prizes for guessing what happened next. The set ran with the new tripler for three minutes and then began hiccupping again, just as before. And similarly, disconnecting the tripler restored sanity to the protesting power supply.

I could not convince myself that I had got two dud triplers in a row, so it had to be something else. The 2SD350A line output transistor was a possibility, and although it checked out perfectly on my transistor checker, I replaced it just the same. But the Kriesler still hiccupped just as before.

Flyback transformer?

So, I reasoned, if it wasn't the tripler and it wasn't the line output transistor, what about the line output transformer? However, this still managed to supply quite a healthy arc without any distress, so it didn't look as though it was faulty in any way that mattered. Which took me right back to the tripler(s).

I contacted a friend who is the local TV technician, to see if he had a secondhund tripler that I might try. As it happens, he had an old Rank Arena set that had been junked because of a dud tube, so we removed the tripler from the carcase. After fitting it to the Kriesler, I crossed my fingers and switched on.

The set sprang into life and soon displayed a first class image. But for how long?

Ten minutes later everything was still going along smoothly, and I was fast coming to the conclusion that the two new triplers I had tried must have both come from a faulty batch.

Now satisfied that all was well, I reached for the power switch, preparatory to securing the PC boards and replacing the cabinet back. But the set wouldn't wait to be switched off. It turned itself off just as my finger reached the switch!

Now I was really hopping mad. Again, disconnecting the tripler restored all the other functions. I went through all the checks of parts that might cause the problem, even to heating and freezing them in turn, but I found no abnormalities. So it had to be the line transformer, even though it could still deliver a decent arc.

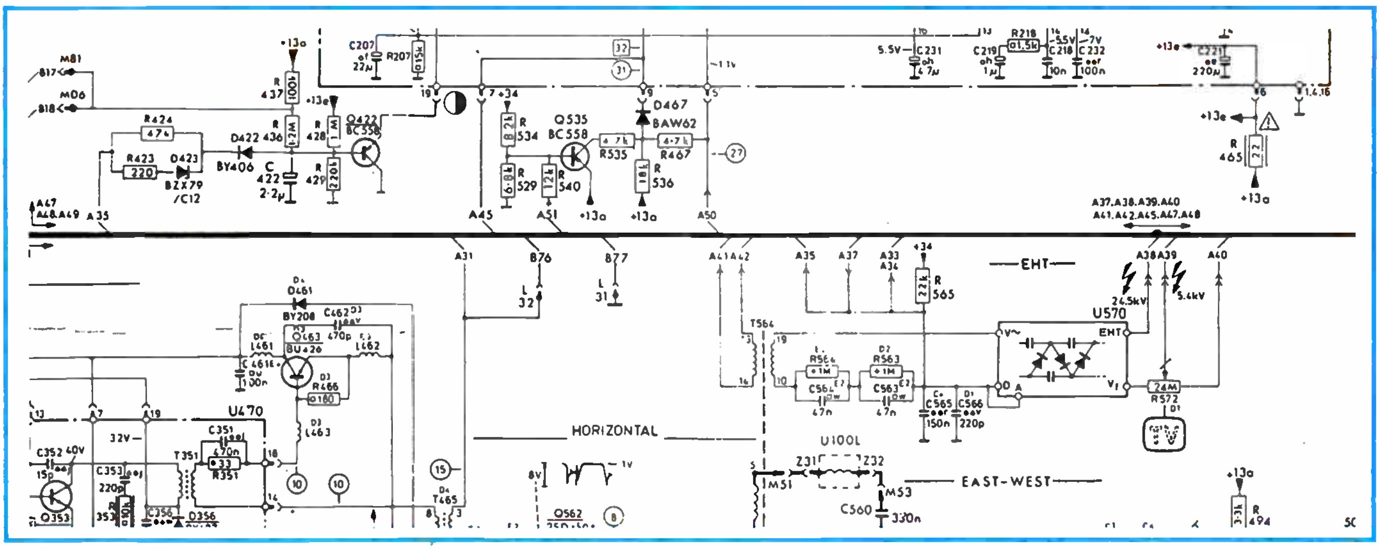
My friend offered me a salvaged transformer, which I duly installed in the Kriesler along with another secondhand tripler. As was now becoming normal, the set rose from the dead once again and I settled down to wait upon further developments.

While I was awaiting what was now becoming the inevitable, I studied the original line transformer — but it appeared OK, at least on the outside. If it was faulty, it could only be shorted turns or something like that inside the windings. Anyway, the set had been running for 10 minutes or so when I had a sudden recollection. Some months ago EA's Serviceman had related a story about a faulty transformer in a KL9A, which showed a tiny black dot on the overwind.

So with the set still running happily, I moved closer to the window and re-examined the overwind more carefully. Sure enough, there was a tiny black blob, about the size of a pinhead, on the underside of the overwind. No wonder I couldn't see it when the transformer was fitted in the chassis.

A sigh of relief appeared due, now that I realised that I had copped the same fault that had worried The Serviceman. Although I considered the coincidence a bit rude, I was happy that it was all over. But what is it they say about Pride and its relationship to a Fall?

I checked the EHT and found it a bit low, at 22.8kV rather than the specified 24.5kV. Then while I was thinking about the difference probably being due to a different tripler to that specified, my nose told me that all was not well. Something was burning.



Here is the relevant section of the schematic for the Kriesler 66-124 CTV, which used a modified Philips KL9A chassis. The EHT transformer overwind and tripler are at lower right, while Q422 the contrast control transistor is at upper left.

Oh, no — smoke!

I frantically searched for the source of the smell, only to find a very fine stream of smoke coming from the line output transformer. Almost on cue, the now familiar sound of hiccupping took over from the programme sound. My mental state now defied description, and the fact that the set was on castors made the idea of rolling it off the nearest balcony very tempting. I removed the line output transformer (again!) to enable a closer inspection. I half expected to find a repeat of the first failure but instead found something quite unexpected. As I lifted the transformer off the PCB, I happened to glance at the area of board that had been concealed by the tranny. I noticed a very faint crack in the coating on capacitor C564, one of two 47nF caps between the bottom of the overwind and the earthy end of the tripler. A closer look told me that its partner, C563 was in even worse condition, being covered in a mass of hairline cracks. A gentle prod on C563 caused it to literally fall apart, in little pieces. And C564 didn't take much persuasion to follow suit. Both capacitors were the old style 'candy bar' polyester types. They were replaced with newer polypropylene types of similar values. Although the 1M resistors R563 and R564 both looked to be OK, I replaced them just in case. A new line transformer was fitted (my parts supplier was becoming a rich man!), and the set once more returned to the land of the living. A check of supply voltages showed that all were spot on, and the set continued to run perfectly for 30 minutes or more without smoke or any other signs of trouble. At last!

Before closing up the back, I decided to work backwards, to see which of the many parts I had replaced were in fact still serviceable. The final score was two all: two dud transformers, two dud triplers and two dud capacitors. The first tripler, the one I returned to the supplier, was probably good, and he subsequently told me that this was just so. The original line output transistor was also a good one.

The question still remaining is — in what order did the breakdowns occur? I suspect the capacitors went first, thus taking out the tripler and then the transformer. Of course, the capacitors were last to be replaced, so they were able to kill a second tripler/transformer combination before they were finally arrested, tried and condemned to the rubbish bin.

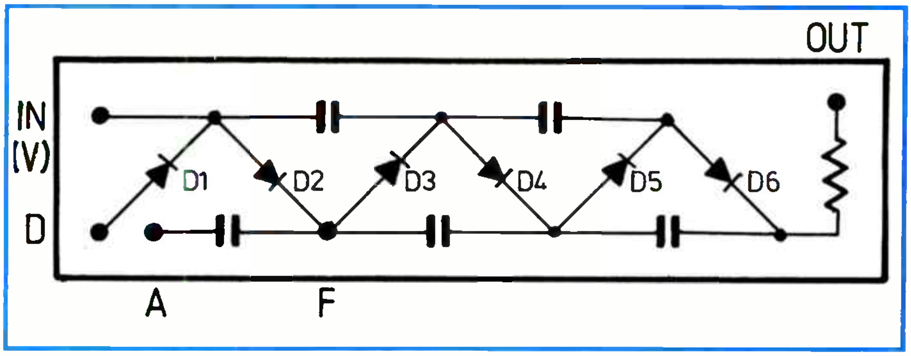


Fig.2: The actual schematic for the inside of the voltage tripler, as discussed in the Serviceman's explanation following this month's first story.

Well, Mr McB. Now you know how I felt, the day I found two faulty transformers in a row. Admittedly, mine were in different sets, so the problem was not so economically frustrating as yours.

Working out what happened in this set requires a bit of circuit analysis, and it is helpful to know just how the tripler is arranged internally. Although it is not shown on the diagram, there is actually an internal diode connected between points V and D, with cathode to point V (Fig.2). In this configuration it is possible to develop a voltage at point D which is proportional to the EHT current (that is, the beam current) and to use this as the control voltage for the beam current limiter.

The chain of capacitors C563, C564, C565 and C566 form a low impedance path to ground, for the high frequency AC pulses from pin 10 on the line output transformer. However conditions are quite different for DC voltages. Here, the earth return is not at the tripler as in so many other sets, but via lead A35 to the base of Q422, the contrast control transistor. Thus, the contrast (and therefore beam current) can be varied automatically by the load on the EHT generator. The control voltage is developed across the internal diode in the tripler and is used in several other parts of the circuit, via leads A33, A34 and A37.

In S.McB's case, what almost certainly happened was that the faulty capacitors C563 and C564 went short circuit. This would remove the 2M of series resistance from the internal diode/EHT overwind circuit and would allow massive currents, both AC and DC to flow around the circuit.

The reason why the set appeared to come good when the tripler was removed from the overwind was simply that the excess current was removed. Similarly, without the excess current, the spark test would indicate that there was nothing wrong with the transformer.

(Incidentally, the spark test imposes on the transformer conditions very much like those in the fault condition. If continued for more than a fraction of a second or so, it could cause failure of an otherwise good transformer! It is not a practice to be recommended.)

In the fault condition, the beam current limiter would not be working, which would account for the bright, clear picture reported by S.McB. I've commented before that the beam current limiter would be better described as a contrast limiter, and this is a good example of how it works.

Happier tale

Now for our second contributor this month. He is K.D., from Taringa in Queensland, and he tells another one of those heartening tales of worthy old TVs rescued from the junk-heap. This is the story, in his own words:

I am very much an amateur serviceman, but my friends still expect me to be able to fix everything from toaster ovens to televisions.

I have read 'The Serviceman' for 10 years, and have noted the plethora of problems seen in the Philips K9 chassis. Secretly, I hoped that I would never have to service one. Then a friend acquired a non-working K9 for $10 at a garage sale... Nothing was known of the history of the set, outside the fact that it had once belonged to a major hire company.

My friend was going to keep the K9 as a source of spares for his parents' K9, but I volunteered to have a look at the set as there was no colour TV at the place where I was living. The possibility of replacing a monochrome portable with a 26" colour set was just too attractive to pass up.

The first fault was obvious: the power supply was disconnected and laying loose in the bottom of the cabinet. A previous repair attempt had left the power supply board in a sorry state. Too much heat had been applied to many of the solder joints, with the result that the tracks had lifted off the board and there

Fault of the Month

Pye T-29 CTV chassis

SYMPTOM: (1) Bright flashes across screen, particularly when the set is touched or bumped. (2) Bright white screen with retrace lines, leading to power supply overload and shutdown.

CURE: (1) C816 (47uF 25V electro) dry jointed. (2) C816 (same cap) open circuit. This capacitor feeds luminance information from the luminance inverter Q82 to the buffer Q88. Although it is AC coupled, the lack of luminance upsets the bias on Q88 and leads to the bright screen. The excess beam current in this condition results in power supply shutdown.

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.

was flux everywhere. I managed to clean the board up and connected it back into circuit, ready for the big test.

The set produced a picture — complete with retrace lines, poor colour, bad convergence and intermittent sound. To top it all off, it also shut down after about 10 minutes. So it appeared that I had a set with multiple faults; although even at this stage I had the impression that the picture tube was still in good condition and that this particular K9 might be worth repairing.

The set was one of the dustiest that I have ever come across, so I cleaned it off with a soft paint brush and the vacuum cleaner. After that, a close visual inspection showed no less than nine resistors which had been cooked to the point where the paint had been burnt completely off and the carbon film exposed. The set also made use of many 'liquorice-allsorts' capacitors. Twelve of these were badly cracked; in some cases the connecting leads fell off when I unsoldered the capacitor. Despite their physical state, all of these components were still functional, as replacing them did nothing for the operation of the set.

Of course, by now I was hooked — there was definitely no way this set was being consigned to the shed as a source of spares. With the dust gone, one fault was easy to spot. The HT was arcing about merrily because the ultor cap had gone hard with age and pulled away from the tube. I didn't have any of the special silicone grease normally used for this sort of job, but a thin bead of neutral curing silicone sealant solved the problem. A check of the electrolytic capacitors in the vertical circuits revealed the cause of the retrace lines. C265, a 22uF unit was open circuit — or more to the point, it just wasn't there! All that was left on the board were two rusty leads. I subsequently found the capacitor amongst the dust inside the vacuum cleaner.

I tackled the intermittent sound next, so I could at least use the set while I solved the other problems. (My flatmates didn't like an unusable, half stripped TV set in the loungeroom.) The fault only took a few seconds to locate — the volume control itself (R110) was faulty.

When I removed the board carrying the slider controls, I could see why. The whole thing was a sticky mess, as if soft drink or something similar had been spilt into it. It took me a couple of hours, but I managed to clean it and restore the controls to normal operation. I watched a movie on the set, but I found the picture very hard on the eyes. It took me quite a while to realise that the whole picture was jittering up and down by two millimetres, at a rate of about 3Hz.

For the want of a better place to start, I tried the vertical hold control. On the K9 this is R24, a 47k preset in the frame control module U33. In this set the control had been wound back to zero resistance. At any other setting the picture would roll continually. I cleared the electrolytic capacitors in the module, but on the basis of the condition of capacitors in the rest of the set, I replaced three suspect 'liquorice-allsorts capacitors (2 x 39nF and 1 x 390nF).

Continued on page 99

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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.
Chapter 2 covers photographic methods of producing PCB's and Chapter 3 deals with most aspects of designing your own printed circuit board layouts.

S.W., AMATEUR RADIO & COMMUNICATIONS

COMMUNICATION (Elements of Electronics-Book 5)
BP89 **$11.00**
A look at the electronic fundamentals over the whole of the communication scene. This book aims to teach the important elements of each branch of the subject in a style as interesting and practical as possible.

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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

AERIAL PROJECTS
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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.

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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.

25 SIMPLE INDOOR AND WINDOW AERIALS
BP136 **$6.00**
Written for those people who live in flats or have no gardens or other space-limiting restrictions which prevent them from constructing a conventional aerial system.
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
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Shows you how to build 25 simple and inexpensive aerials for operation on the medium wave broadcast band and on the 60, 75, 90 and 120 metre tropical bands. Designs for the 49 metre band are included as well.

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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.

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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.

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Help is given to the reader in understanding the technical specifications of the equipment he is interested in buying.

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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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BP144 **$16.00**
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.

THE SIMPLE ELECTRONIC CIRCUIT AND COMPONENTS
BP62 **$12.00**

ALTERNATING CURRENT THEORY
BP63 **$12.00**

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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.
BOOK 3: Follows on semiconductor technology, leading up to transistors and integrated circuits.

ELECT. & COMPUTER MUSIC

ELECTRONIC MUSIC PROJECTS
BP74 **$9.50**
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
BP246 **$12.95**
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
SOLD OUT
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
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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
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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.

TV, VIDEO & SATELLITES

AN INTRODUCTION TO SATELLITE TV.
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.

To order, simply fill in the coupon, remembering to included the code numbers and $5.00 postage and handling. If the coupon is missing, write down the names, code numbers and prices of the books you require. Include your name, address, ph number, plus cheque, money order or credit card details (card type, card number, expiry date and signature) and send it all to Federal Publishing, Freepost No.3, P.O.Box 199 Alexandria, NSW 2015. Don't forget to sign all orders.

SAFE AND SIMPLE HELIUM-NEON LASER

It may seem rather incredible, but this 0.8mW gas laser project fits inside a medium size jiffy box, and if you have your own 12V DC supply, you need to solder two wires, fit a resistor and that's it. It's simple, safe to build and costs $160. This project is ideal for schools and experimenters alike. We also describe a simple 'laser engine' you can build.

by PETER PHILLIPS

This project was developed by Oatley Electronics, and it has to be the simplest laser project ever. As the photographs show, construction is simply a matter of connecting the DC-DC converter to the tube, fitting a ballast resistor and connecting the unit to a 12V DC supply.

To make the unit complete, a 12V DC regulated power supply module is also included, designed to operate off a 16V AC plug pack. This module can also fit inside the case, giving a totally self-contained, mains operated laser. A feature of the project is its inherent safety. Readers may recall the laser project described in July 1990, which included numerous warnings and the decision by Oatley Electronics to supply kits to adults only. While the project was extremely popular, quite a few people were frightened off by the warnings.

The principle of operation of this new laser project is the same as the previous one, but technology advances have made it smaller and, thanks to the DC-DC converter module, safer and simpler to construct. And surprisingly, the laser tube is rated at around 0.8mW, despite its small size. As well as presenting constructional details of the laser in this article, we describe a neat little 'laser engine' that can be used with the laser project to create an almost endless range of laser images. Again this comes from Oatley Electronics, and like the laser, is simple and very cheap.

The inverter

The heart of the project is the DC-DC converter. In previous laser projects, the high voltage supply section required to power the laser tube usually consisted of a discrete component high voltage DC supply constructed on a PCB.

Because the tube needs a high voltage to fire it (8kV or so), then a lower operating voltage to run it (1kV), most circuits combined a voltage multiplier and a voltage doubler. Such a circuit requires a relatively large PCB, and can deliver a lethal voltage if contacted.

Hence the warnings published in the July 1990 article.

It is therefore rather amazing that this entire section has now been encapsulated in a module about the size of a 'D' cell. The converter (supplied with the kit for this project) is designed specifically to power an He-Ne 1mW laser tube and is manufactured in the USA by Plasmatronics.

The specified input voltage is from 12V to 18V DC, although tests have shown that it will successfully operate the tube with a DC input as low as 8V.

An interesting feature of the device is that as the input DC voltage is increased, the DC current taken by the converter *decreases*.

Typically, at 8V the input current is 500mA, dropping to 360mA at 12V then to a value of around 280mA at 18V. In other words, the DC input power is essentially constant at around 4 to 5W, making battery operation possible. But if the DC input exceeds 18V, the converter may self destruct — so be careful.

The laser tube used in this project requires an 8kV firing voltage and an operating voltage of around 1.2kV at a current of 2.8mA. Thus at 12V DC operation, the input power is 4.36W and the output power is 3.36W, giving an efficiency of around 78%. Not bad, given the small size of the converter.

So where's the safety aspect you say, considering this device can deliver these kinds of voltages?

In fact, the output current of the converter is limited to around a few milliamps, and although a nasty shock could result, theoretically there is insufficient current to make the shock lethal.

However, we don't recommend you try this, as any electric shock is unpleasant, and under exceptional circumstances, a low current *might* possibly be lethal. However, because everything is encapsulated, the only likely contact point is at the anode of the laser tube.

The DC supply

To allow the project to operate from the mains, Oatley Electronics has designed a regulated power supply that delivers 12V DC to the converter. To keep things safe, a 16V AC plug pack is used to power the regulator.

The circuit of the regulator is shown in Fig.1, and uses an LM317T, TO-220 adjustable regulator IC. The output voltage is set by RV1, and for the values shown, can be adjusted from 1.4V to 14V.

As shown in the photo of Fig.2, a heatsink is required for the regulator IC. Although not necessary if the regulator is being used with the laser project, if you decide to use it for other purposes, the heatsink should be insulated from the IC.

Otherwise construction of the PCB is simply a matter of loading and soldering the components according to the layout diagram of Fig.3.

The recommended input voltage to the regulator is 16V AC and a 16V/900mA plug pack is suggested. As for the laser, a kit of parts for the regulator which includes the plug pack is available from Oatley Electronics (see end of article). Naturally, the regulator unit should be tested and adjusted to around 12V to 14V before using it with the laser.

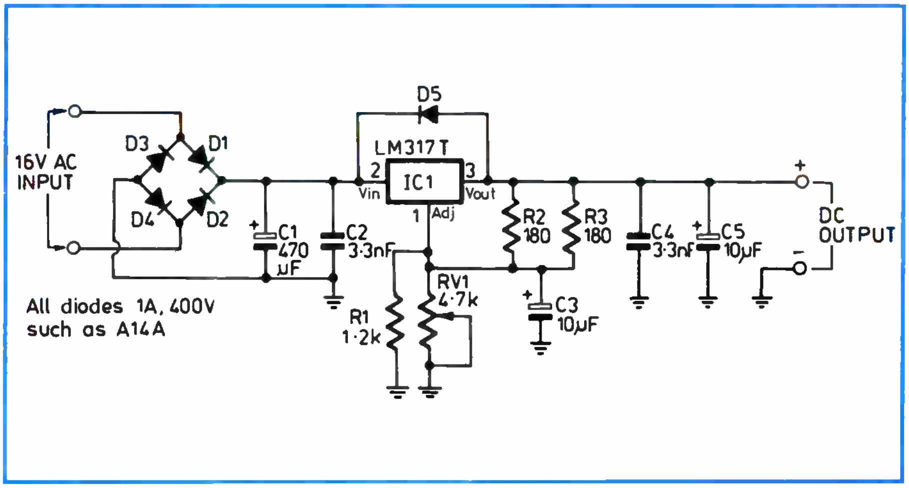


Fig.1: The circuit of the regulator is very standard and uses an LM317T adjustable voltage regulator IC. The output voltage can be varied from 1.4V to around 14V with RV1, and D5 protects the regulator against reverse voltages when the power is turned off.

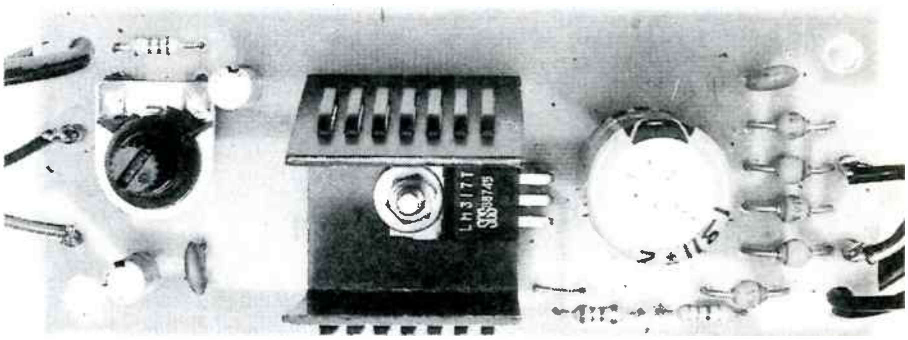


Fig.2: This shot shows the voltage regulator PCB fully assembled. The heatsink doesn't need to be insulated from the regulator IC, as the PCB fits inside the jiffy box. It may be necessary to bend the heatsink to prevent it touching the laser tube.

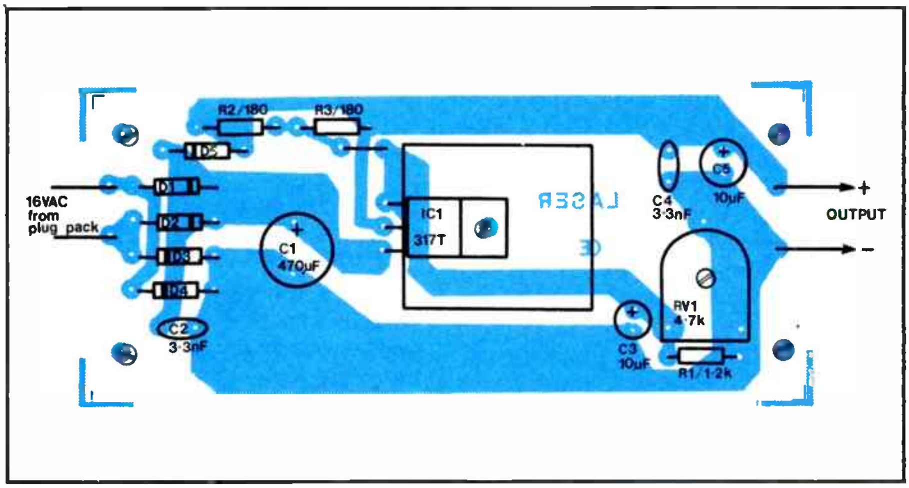


Fig.3: The layout of the regulator PCB is shown here. As usual, make sure the polarity of the electrolytic capacitors and the diodes is correct.

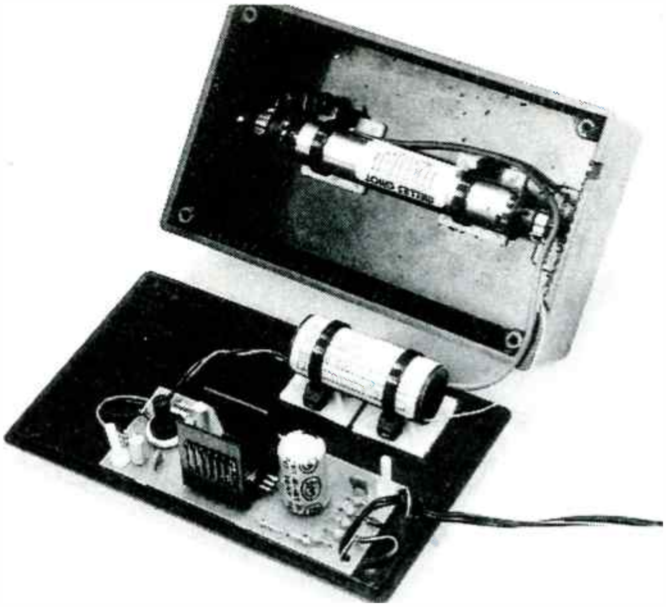


Fig.4: The inside view of the case is shown in this photo. The regulator PCB is attached to the lid with nylon nuts and bolts, the converter and the tube are both fixed with adhesive mounts. Although difficult to see, the ballast resistor is at the top left of tube.

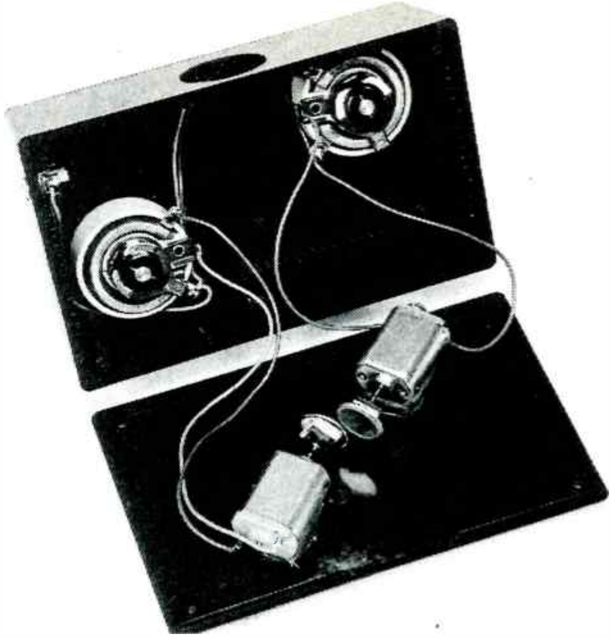


Fig.6: This simple laser 'engine' can be used to create circles, squares, flowers and other shapes by deflecting a laser beam onto a wall via the two rotating mirrors.

Construction

The photo of Fig.4 shows how everything is fitted inside the jiffy box. Before starting, first drill a 7mm hole at one end of the box, aligned to allow exit of the laser beam. We fitted the tube in the centre of the box, and accordingly drilled the hole 17mm from the bottom, as measured from the outside.

If the regulator PCB is to be included, drill holes in the lid of the box for the 4mm nylon screws that support the board. Also file an exit slot in the case for the AC input leads. The converter is attached to the box with two adhesive bases that are held with tie straps fitted around its body. Locate the converter next to the regulator PCB and connect it to the 12V regulator (or in fact any 12V DC supply) with the red and black wires from the converter (red is positive).

The mounting procedure for the tube is similar, although some care is required in handling. The laser beam exits from the anode end of the tube, and this end therefore faces the exit hole drilled in the case. Both ends of tube look similar, and the anode end of the tube can be identified as having the greatest distance from the internal metal work (cathode) of the tube. To verify, you should be able to see the connection from the metal work to the *cathode* end.

As well, the vacuum exhaust point of the tube is at the cathode end. The connections to the tube are made with clips that fit around the cathode and anode ends of the tube. To avoid damaging the tube, don't solder to the clips while they are fitted to the tube.

As shown in the block diagram of Fig.5, a 150k/2W ballast resistor is connected in series between the positive output of the converter and the anode of the tube.

This resistor can be supported by soldering one end to the anode clip and fitting the other, soldered to the positive output lead of the converter, under the strap holding the anode end mounting base.

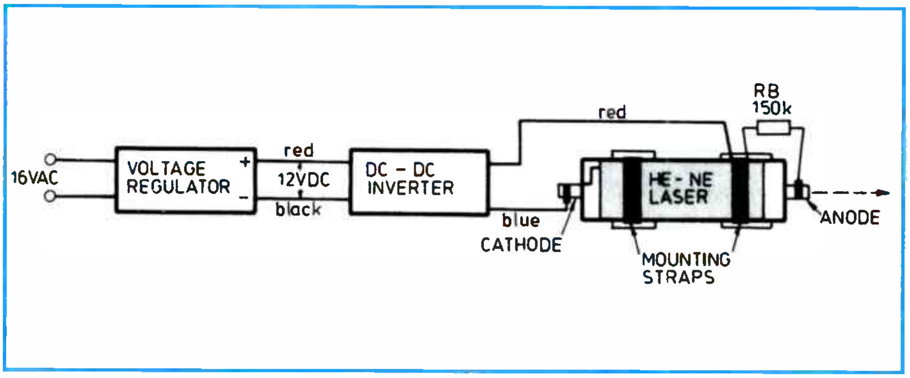


Fig.5: The three sections of the project interconnect as shown in this diagram. The ballast resistor RB has one lead soldered to the anode clip and the other lead is held to the body of the tube under the nylon strap from the anode end adhesive mount. The positive output lead (red) of the converter then connects to this end of the resistor.

Testing

Once everything has been mounted and connected, it's simply a matter of turning on the supply. The laser tube should fire immediately, producing the characteristic red laser beam.

Apart from wiring errors and problems with the regulator board (which should have been tested beforehand anyway), there is not much to go wrong.

As usual with any laser, avoid direct eye contact with the beam. Oatley Electronics are supplying a warning label with the kit, and this should be glued to the top of the case, as shown in the lead picture. Also avoid touch-

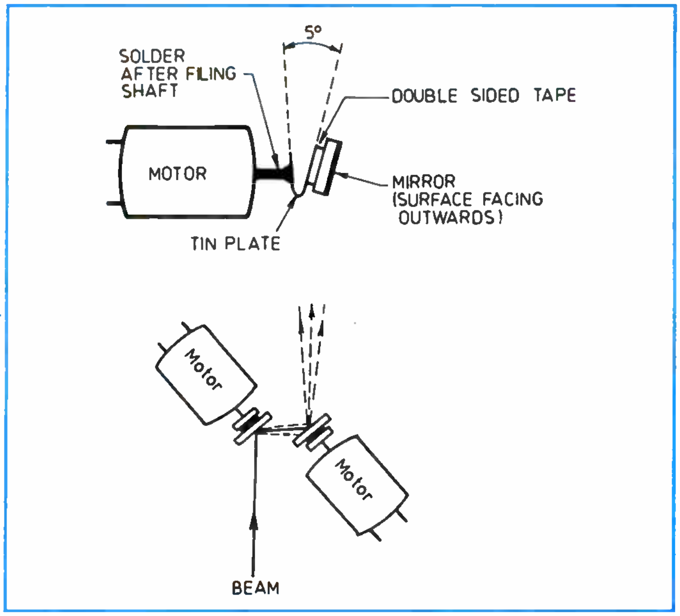


Fig.7: This diagram shows the mechanics of our laser 'engine'. Experiment with the position of the mirrors to minimise vibration.

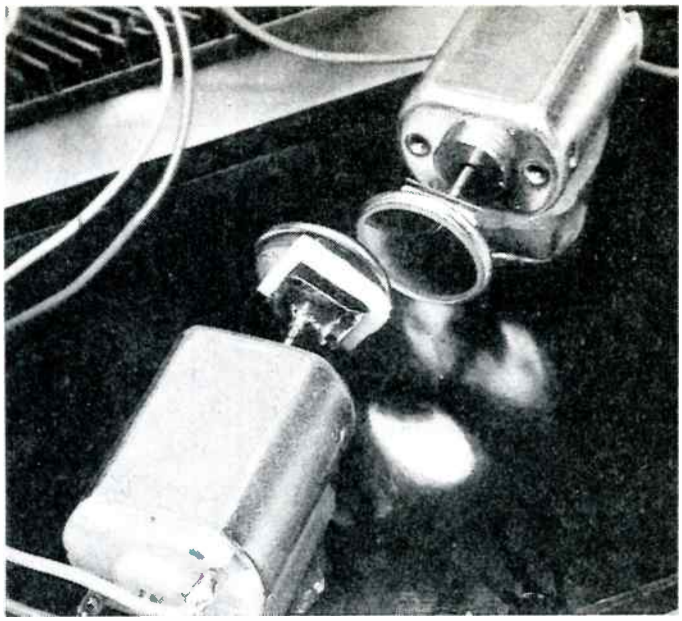


Fig.8: A close up shot of the motors. Dental mirrors were used on the prototype, available from most dental suppliers. Mirrors will be supplied in the kit for this project.

ing the anode end connection, even after power has been turned off, as the internal capacitors in the converter can hold sufficient charge to deliver a shock.

Laser 'engine'

A laser beam needs to be deflected mechanically using mirrors, and all laser printers incorporate a laser 'engine' to cause the beam to trace the required printout onto the drum of the printer. A laser printer engine is therefore mechanically sophisticated and expensive. In principle, two mirrors are moved a tiny amount by the electronics and the laser beam is arranged to deflect from these mirrors onto a surface.

Although it is possible to purchase disposals-type laser engines, a much cheaper method is to build the simple system shown in the photo of Fig.6. The system has two small DC motors with mirrors fitted to the shafts as depicted in the diagram of Fig.7. As shown, a piece of thin tinplate in first soldered to the shaft of the motor, then the mirror is fixed to the tinplate with double-sided tape. The tinplate is then bent at an angle of around 5°, although you will need to experiment to get the best effect.

The photo of Fig.8 gives a close-up view of the assembly. Everything can be fitted inside a jiffy box, and we attached the motors to the underside of the lid with silicone glue. Although dental mirrors were used in the prototype, the kit of parts for this project will include

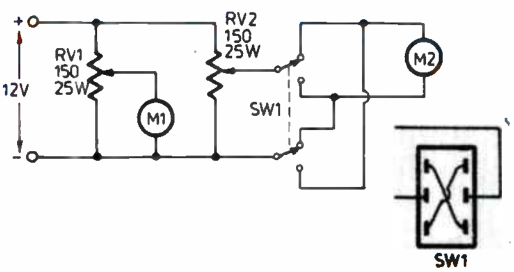
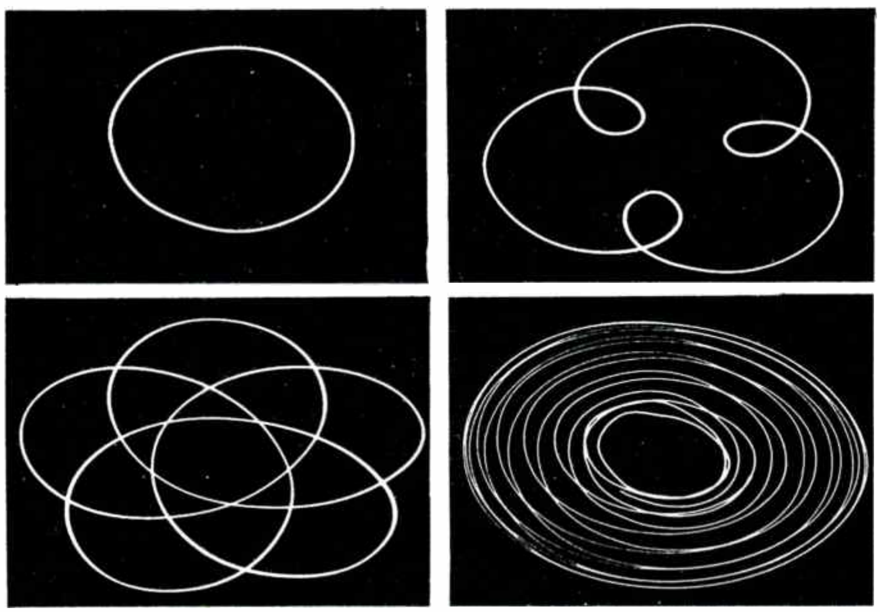
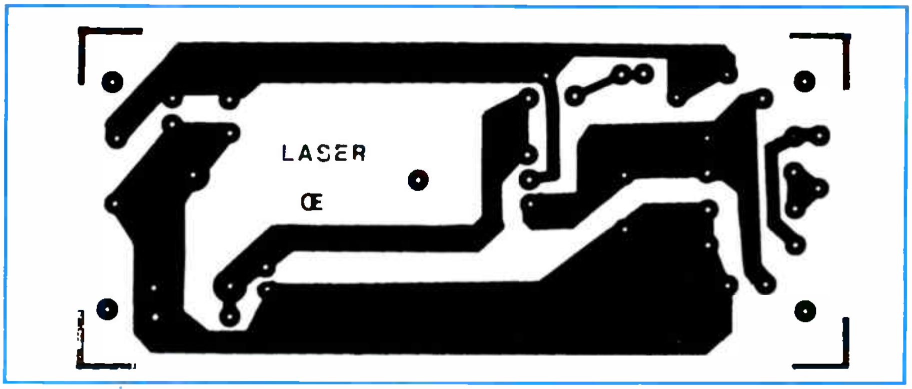


Fig.9: No PCB required here! The two potentiometers are wire-wound, 25W types and control the individual speeds of the motors. By reversing the direction of one motor, a different set of patterns can be obtained.



These shapes were produced by the laser beam and the laser 'engine' and show the sort of displays that can be obtained.

Helium-neon Laser



This PCB pattern is for the voltage regulator. Note that the artwork is copyright to Oatley Electronics but can be used by individual constructors for non-profit purposes.

square section, front surface mirrors. It is important that the aluminised surface (gold colour) faces outwards, as this is the reflective surface. If you reflect the beam from the normal silver surface, the thickness of the glass will cause the beam to diffuse.

The circuit diagram for the system is shown in Fig.9. The motors are individually controlled by the wire-wound potentiometers and the switch reverses the rotation of one motor only.

The pots and the reversing switch can be fitted to the jiffy box, and wired together with hook-up wire.

Note that the reversing switch was added after the photos were taken, so don't follow the wiring of the photo of Fig.6. The switch wiring is shown on the circuit diagram in Fig.9.

Once you've built the laser and the laser engine, the rest is up to your imagination. We described other applications in the July 1990 article, which also includes quite a lot of information about laser tubes and how they work.

There are numerous laboratory type exercises that can be conducted with a laser beam, and even holography (three dimensional photographs) is not beyond the realms of the school laboratory.

There are numerous books on the topic of lasers and their applications, and Oatley Electronics have indicated they intend stocking some of these, including some on holography. ■

Parts List

Resistors

All 1/4W, 5% unless otherwise stated:

R1	1.2k
R2,3	180 ohm
RB	150k, 2W
RV1	4.7k trimpot

Capacitors

C1	470uF 63V electrolytic
C2,4	3.3nF ceramic
C3,5	10uF, 25V electrolytic

Semiconductors

D1-5 A14A power diodes

IC1 LM317T adjustable voltage regulator

Miscellaneous

PCB 40mm x 100mm coded Laser OE; plastic case 50 x 90 x 160mm; 4 x stick-on rubber feet; 4 x cable ties and stick-on bases; 240V-16V/900mA plug pack, heatsink, 0.8mW He-Ne laser tube, 12V DC-DC inverter for laser tube; warning label; nylon screws and nuts.

Laser deflection unit

Potentiometers

RV1,2 150 ohm 25W, wire-wound

Miscellaneous

DPDT switch; 2 x 12V DC motors; 2 x front surface mirrors 14mm square; tinplate, double-sided adhesive tape; hook- up wire; plastic case 50 x 90 x 160mm; 4 x stick-on rubber feet.

Kits of parts for these projects 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.

Laser kit: includes laser tube, inverter, case, mounts $160.

Voltage regulator kit: includes PCB, all components and plug pack $28.00.

Motor kit: includes motors, pots, mirrors, switch $15.

Post and packing charges $3 to $5.

The PCB artwork for the project is copyright to Oatley Electronics.

OATLEY ELECTRONICS-EA 'ANYTHING GOES' COMPETITION

Win some great prizes in our 'Anything Goes' competition! All you have to do is send in suggested applications for the Helium-Neon Laser project (September edition) OR the Night Viewer (October edition). We'll be awarding the prizes for the ideas that are most imaginative and useful. There are five major prizes and 40 runner-up prizes, with a total prize value of over $4000!

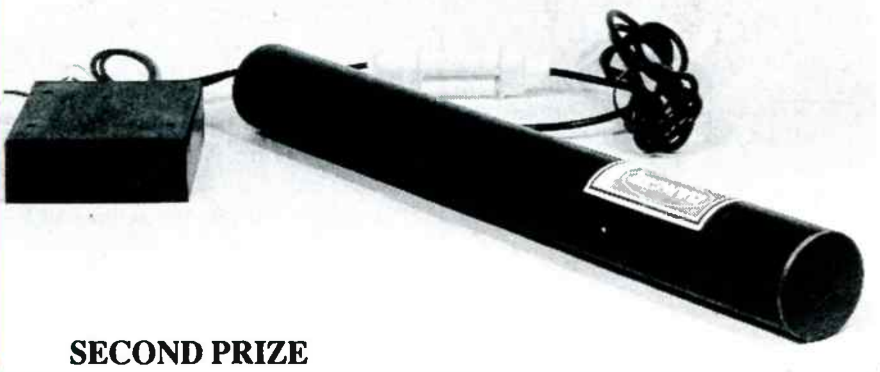
There's no limit to the sort of entries you can submit — they can be complex or simple. For example, it might be an application in education, science, measurement, physics, entertainment, photography (which can include holography), surveying, home use and so on. Or you may have found a way of improving either of these projects. Anything goes, providing it's not proprietary and it's got something to do with lasers or night viewers!

FIRST PRIZE

Here's what you can win:

- *FIRST PRIZE:* A fully constructed, very sensitive 'sub starlight' night viewer. These are not generally available and can produce useful images in light levels of around 10^{-14} — virtual darkness. Also features an automatic light level control. (Value $1595)
- *SECOND PRIZE:* A 7mW helium-neon gas laser head with a commercial mains power supply. A complete system that's ready to go. (Value $520)
- *THIRD PRIZE:* A kit of parts for the night viewer as published in the October edition of *EA*. (Value $299)
- *FOURTH PRIZE:* A 1mW laser head with a commercial laser supply that operates from 12V. (Value over $259)
- *FIFTH PRIZE:* A laser kit comprising a 2mW laser head, with commercial mains power supply. (Value $210)
- *PRIZES 6 to 25:* A complete kit of parts for the PIR alarm module as described in *EA* for May 1989. (Each kit worth $47.85 — total prize value $957).
- *PRIZES 26 to 45*: A complete kit of parts for the stereo VU meter as described in *EA* for June 1987. (Each kit worth $14.90 — total prize value $298).

SO 45 PEOPLE WILL WIN A PRIZE!



SECOND PRIZE

How's that for a competition for everyone? Total prize value is $4138, simply for submitting an idea. Entries will be judged on their usefulness, originality and general appeal to other readers. All diagrams and written descriptions in your entry should be presented clearly. Ideally you will have proven your application and supplied sufficient information to allow us to publish details, for the benefit of other readers.

To enter, simply send your entry to:

'Anything Goes' Competition,
Electronics Australia,
PO Box 199,
Alexandria, NSW 2015

Competition closes 30th Nov. 1991.

All winners will be advised by mail and results will be published in the February 1992 edition of *Electronics Australia.*

All prizes have been donated by:
Oatley Electronics,
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

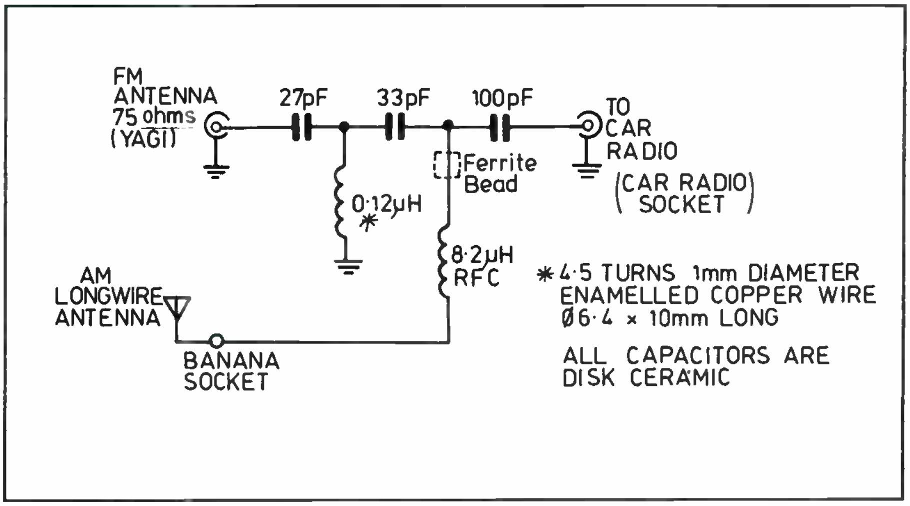
AM/FM car radio antenna

Some friends of mine live in an isolated area and run a 12V house from solar, wind and water power.

Their electronic entertainment comes from a good quality car radio/cassette player. In their locality, a long-wire antenna for AM and a multi-element Yagi for FM are necessities.

The problem is that a car radio can accept only one of these antennae at a time. This circuit allows the inputs from these two types of antenna to be combined.

The FM signal passes through a high pass filter to reduce any unwanted frequencies below about 80MHz. The AM signal passes through a series inductance, comprising an RFC and a ferrite bead, to present a high impedance to FM frequencies.



The 100pF capacitor, connected in series, is needed to match the input circuitry of the car radio at AM frequencies. You will need to tweak the radio's antenna capacitor trimmer for maximum signal. The original circuit was built in a small metal box with a 75 ohm TV socket, a banana socket and a car radio socket. The lead from the box to the car radio was made as short as possible (about 200mm) and used two car radio plugs and a length of low capacitance, car antenna coax cable.

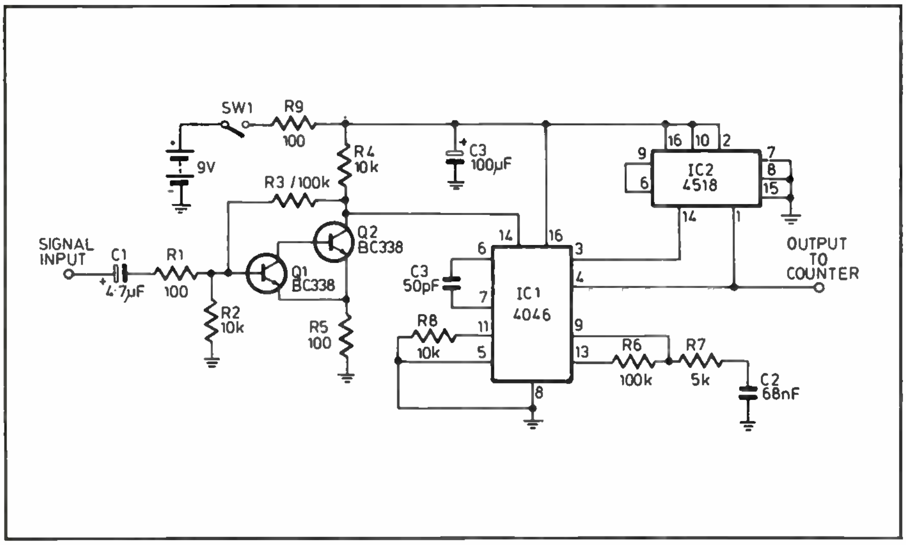
Ross Dannecker,
Rockhampton, QLD $30

High-resolution LF adaptor for counter

Often we need to make high resolution measurements of low frequencies, but find that most universal digital frequency counters are unsatisfactory.

With an input frequency range of 10Hz to 10kHz, this adaptor can increase your digital frequency counter's resolution to 0.01Hz. It does this by producing an output which is exactly 100 times the input frequency.

The heart of the circuit, IC1, is a phase-locked-loop (PLL) chip, the 4046, which consists of a voltage-controlled oscillator (VCO) and two different phase comparators. Only the second comparator is used in this application. The VCO is set up to cover a range of 0-1MHz by R8 and C3. IC2 is a 4518 dual BCD counter which divides the VCO output from pin 4 by 100, then feeds the signal back to the phase comparator (pin 3). The comparator compares the original input (pin 14) with the input (pin 3) from IC2, and adjusts its output (pin 4) until they are the same.



To do this, an error signal from pin 13 is fed to a low-pass filter comprising R6, R7 and C2, with feedback to the VCO via pin 9. The VCO continues to adjust its output until a stable point is reached when the signal and comparator inputs are equal in both phase and frequency.

At this point, the output frequency is exactly 100 times the input frequency. Transistors Q1 and Q2, with resistors R1-R5 form a Schmitt trigger to transform the input signal into a rectangular wave form. This is needed as IC1 is triggered by the positive edge of input signals to its comparator.

W. Liu,
Ashfield, NSW $40

Crystal oven

This is the crystal oven which I installed in my rather elderly 1978 *EA* frequency counter. In conjunction with a custom-ground 3.579545MHz 75°C HC-6/U crystal, it gives a stability of better than one part in two million.

The crystal lives in a plastic foam-lined 35mm canister, sandwiched between a power resistor to heat it and a BC178 transistor to sense the temperature. I used the BC178 because it has a quick temperature response from its metal can, which is earthed.

But a BC558 would probably work just as well (and BC178s are becoming hard to find). The sensing transistor is connected so that it amplifies its own temperature-dependent emitter-base voltage drop, and the 741 compares this voltage with the approximately 5.1V derived from the zener diode.

The 2.7M resistor provides hysteresis to ensure that the 741 switches sharply. The 1.2M resistor and 10uF capacitor combination has the effect of turning the circuit into a low frequency variable duty cycle oscillator, once the crystal temperature stabilises.

This gives better temperature control than a simple on-off circuit. The LED indicates when the heater is on, and its voltage drop ensures that the BD136 switching transistor switches fully off.

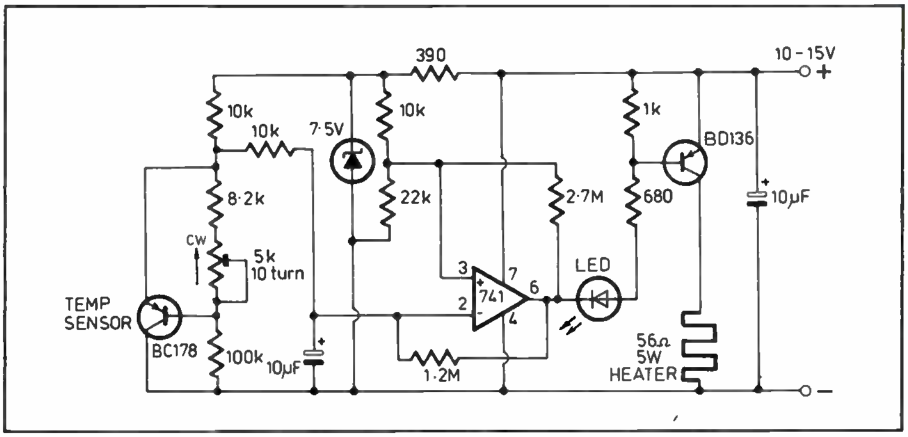
I calibrated the original by attaching leads to a 1N914 diode, sleeving it with heatshrink tubing and connecting it to a digital multimeter on a 'diode' resistance range.

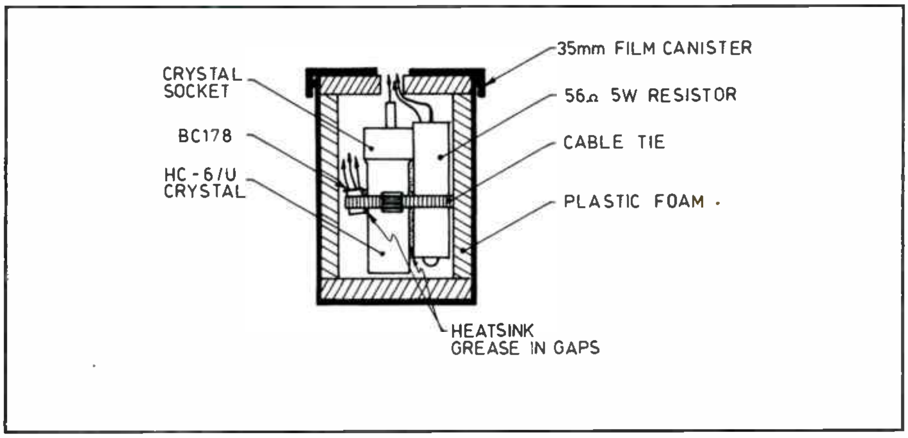
I immersed the diode in 75°C water and noted the meter reading, then temporarily attached the diode to the crystal in its oven and adjusted the 5k pot until the meter gave the same reading.

The tricky part is finding a thermometer which can read up to 75°C — I used a dairy thermometer. If it's found that the circuit keeps going from full-on to full- off instead of stabilising in the oscillating mode, then reducing the 1.2M resistor should solve the problem.

This circuit could be useful as an electronic thermostat in other applications.

Bob Parker,
Carlton, NSW **$45**





12V battery regulator

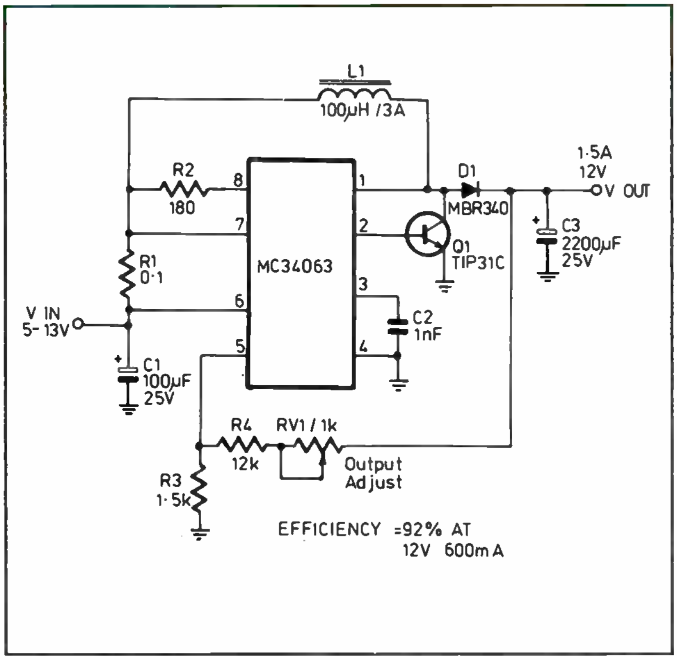
This circuit was designed for an application which required a constant 12V supply from a 12V lead-acid gel battery.

It provides this, supplying 12V output from full charge to half charge on the battery. The circuit is simple to construct, is very effective, and runs at a high level of efficiency, thereby saving precious battery power.

At the centre of the circuit is the MC34063, a Motorola DC to DC converter. This chip handles the timer, voltage regulating pulse width modulation and current limiting aspects of the circuit.

An external NPN transistor (TIP31C) is used to boost the output capacity of the chip. L1 was wound on an Amidon 26-mix iron powder toroidal core. If a lower output current (60mA or less) is required, then Q1 can be deleted and the coil can be switched directly through the MC34063's output transistor. Leave the collector at pin 1 joined to the coil and output diode, and connect the emitter at pin 2 directly to ground.

Steve Garland,
Maroubra, NSW **$35**



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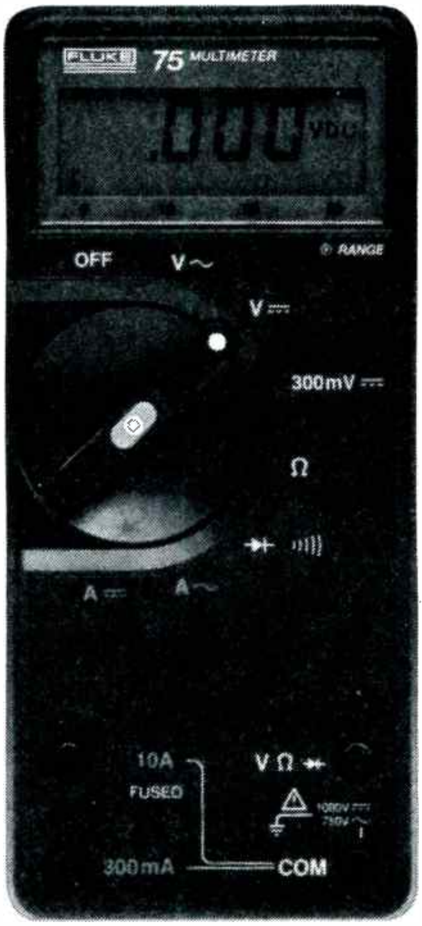

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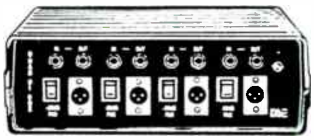

At last, a practical solution to the problems confronting stage and studio performers needing to connect several devices to a mixing box! This mains powered (requires M-9527 plug pack) Quad 'DI' box kit has significant advantages over battery powered versions and will replace up to four separate direct injection (DI) boxes... at a fraction of the cost. It's easy to build and comes with all components, PCB, case and silk screened & pre-punched front and pre-punched rear panels.

Cat K-5012 EA 6/91 **$79.95**

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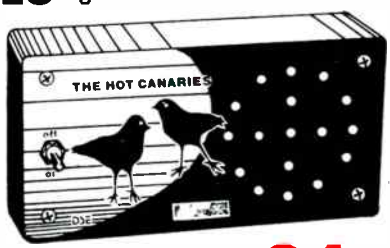

Give the budgie its freedom and let Hot Canaries rule the roost. Baffle the cat as these two birds sing their electronic socks off. They begin slowly, then sing rapidly through ascending trills as they compete for virtuoso supremacy. The kit comes with a cat-proof case, PCB, all components, and front panel label.

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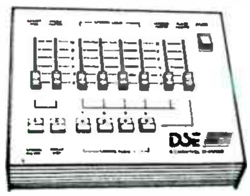

This superb 4-channel lighting controller is designed to take the rigours of commercial use in theatres, discos and music group applications. It's powered from a 240VAC 15 amp outlet and can control a total lamp load of 2400 or 3600 watts. The chaser can be operated automatically, or you can flash each channel manually. It comes with a fully pre-punched black case with silk screened front panel and all components

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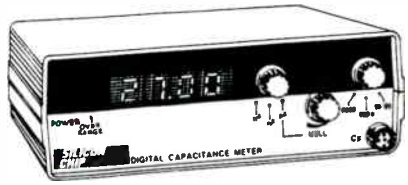

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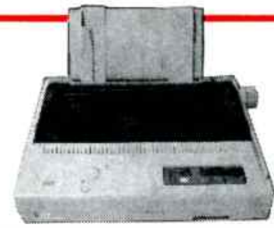

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Construction project:

SPEECH PROCESSOR FOR TRANSCEIVERS

Increase your 'talk power' with this simple but effective little unit. It connects in-line with your existing microphone, and acts as a preamplifier, compressor and speech filter. As a bonus, it also automatically generates a 'beep' each time the PTT button is released, to signal the end of your 'over'.

by ROB EVANS

If you've ever watched a level meter that's responding to a human voice, you may have noticed just how much higher the peaks are than the average speech level. This effect is particularly troublesome when a voice is used to modulate the carrier in a radio transmitter, where the peaks can cause over-modulation and frequency 'splatter'.

To avoid this problem, the operator usually adjusts the microphone gain control to a point where the speech peaks are only *just* providing 100% modulation.

In this case however, the soft sounds are often barely heard at the receiving end, despite the clean nature of the signal. In short, the problem lies with the ratio between the loud and soft components (or dynamic range) of typical human speech.

The simplest way of improving this situation is to pass the audio signal through some form of hard-limiting circuit, before it's applied to the transmitter. In this way, the mic gain can be increased for a stronger signal at the receiving end, and when the mic signal exceeds a preset volume level, the waveform is simply 'chopped off'. When clipping does occur however, the resulting speech signal is rather unintelligible, and contains a large number of high-order harmonics which are difficult to filter out — so this solution is less than satisfactory.

A more successful method of controlling the dynamic range is to use some form of *compressor*, or ALC (automatic level control) circuit.

With this arrangement, the maximum signal level is restricted by a special amplifier stage, which is able to reduce its gain in response to large signal peaks. The transceiver's mic gain can then be set to a higher level, and the average level of modulation increased by a substantial degree.

With this in mind, we have developed a simple circuit to perform the required compressing/limiting function, and included a number of other features to make the unit even more useful.

The final design presented here uses common low-cost components, and results in a substantial increase in a transmitter's overall communication ef-

ficiency. The main extra feature to be included in the speech processor is a circuit which delivers a short audio tone (indicating 'over' or 'Roger') at the end of each transmitting period — or in fact, as the transceiver's press-to-talk (PTT) button is released. To allow the tone to pass through the activated transmitter, the PTT action needs to be slightly delayed past the point where the operator actually releases the button — this has been achieved by adding just one CMOS chip, a relay (optional), and a few extra components.

Other than that, we've included substantial audio filtering through the circuit, so as to restrict the signal's energy to the nominal 300Hz to 3kHz speech bandwidth. Again, this improves intelligibility at the receiving end and makes the most efficient use of the available transmitter power.

The circuit itself can be powered from any 12 volt (or thereabouts) DC power source, and is housed in a standard diecast aluminium box to provide RF shielding. Also, indicator LEDs have been included to show the operator when the compression and 'over' circuits are operating.

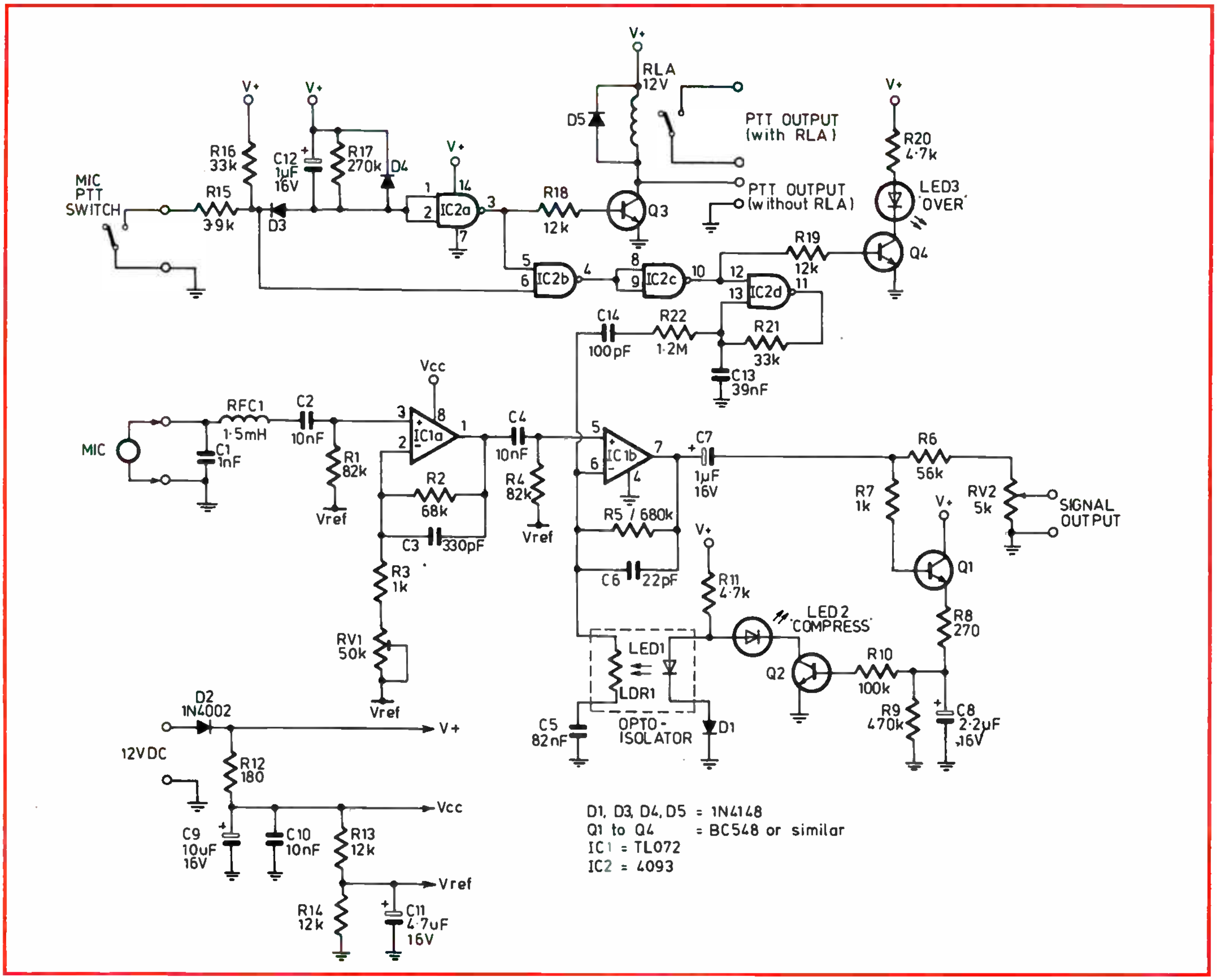
Circuit description

The circuit of the Speech Processor can be divided into two main areas: the delayed-PTT section based around IC2 as shown in the top half of the schematic diagram, and the audio preamplifier/compressor formed by IC1 and its associated components in the lower half of the diagram. Both parts of the circuit operate in quite a straightforward manner, and should be quite easy to faultfind — should the need ever arise.

The low-level microphone signal is applied to the preamp/compressor section at C1 (which provides a low impedance path to any stray RF energy), and via RFC1 (which effectively blocks any remaining high-frequency signals) to the high-pass filter composed of R1 and C2. This filter rolls off the unwanted low-frequency content of the incoming speech signal, and provides a DC biasing path to Vref (around 6V) for IC1a.

IC1a is configured as a standard non-inverting amplifier stage, with the gain set by the combination of R2, R3 and RV1 — this will be anywhere between 2.3 and 69, depending upon the setting of RV1. The overall gain of the stage is reduced at high frequencies by the feedback action of C3, which helps to reduce the unwanted higher-order harmonics of the speech signal.

The output at pin 1 is then transferred to the following non-inverting amplifier (IC1b), via a further high-pass filter



The full schematic diagram of the Speech Processor. The gain of the microphone preamp (IC1a and IC1b) is automatically varied by the opto-isolator (LED1 AND LDR1), while IC2 extends the PTT period and provides the 'over' beep.

composed of C4 and R4; as before, the input is biased to Vref via R4. This second stage forms the compressor part of the circuit, with the gain (mainly) set by components R5, LDR1 and C5.

Assuming for the moment that LDR1 has a resistance of about 15k (more of this later), the stage will have a gain of about 45 at the middle speech frequencies (say 1kHz) since C5 will offer a relatively low impedance under these conditions. At very low frequencies on the other hand (say below 200Hz), C5 will present a much higher impedance and the stage gain will be substantially lower. So in effect, this is yet a further high-pass filtering action to reduce the audio bandwidth. Also, as in the previous stage the higher frequencies are rolled off by the effect of C6.

The combination of all of these cascaded low and high-pass filters reduces the processor's overall frequency response to our desired range of around 300Hz to 3kHz, with reasonably steep cut-off slopes at either end. The amplified and filtered signal at the output of IC1b (pin 7) is then passed to the processor output via the coupling capacitor C7, and an output attenuator composed of R6 and RV2. This reduces the processor's output signal a suitable level for the normal microphone input of a transceiver.

Compression

The compression action of the processor is controlled by the circuit based around Q1, Q2 and the linear opto-isolator formed by LDR1 and LED1.

Since the gain of the second preamp stage (IC1b) is dependent upon the resistance of LDR1, which in turn depends on level of light transmitted to its surface by LED1, we can easily control the processor's output signal level by varying the current through the LED section of the opto-isolator.

With the circuit components as shown, a standing current of around 2mA flows through LED1 (as set by R11), which ultimately sets LDR1 to a resistance of about 15k, and the preamp stage to a gain of 45.

However, if transistor Q2 is turned hard on, the current from R11 will be shunted to ground via LED2 and Q2's collector, rather than via LED1 and D1 — this occurs since Q2 will now represent a much lower resistance than D1.

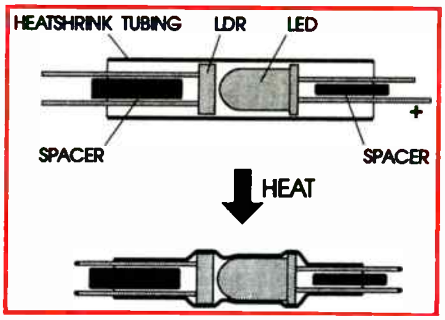
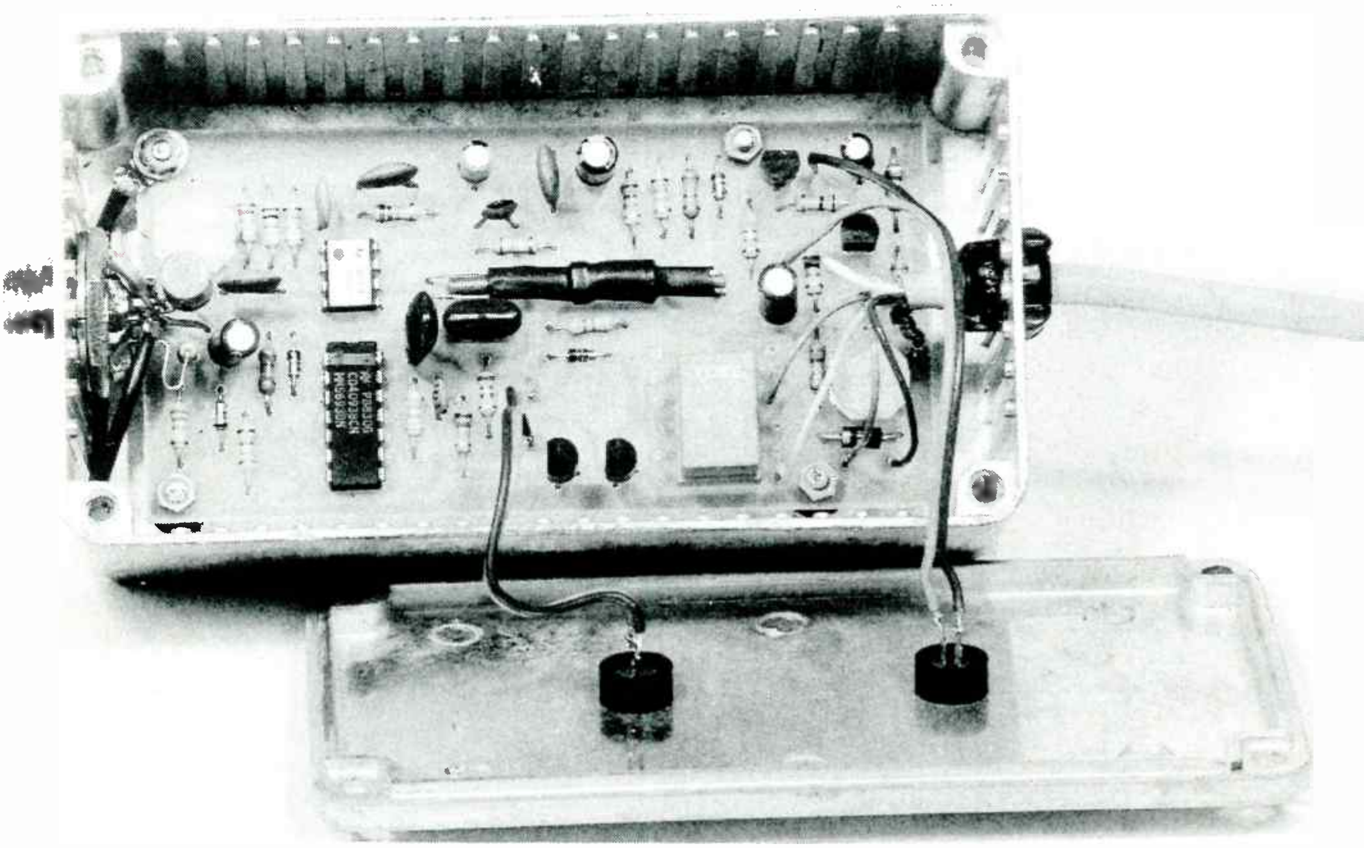


Fig.1: The construction technique for the opto-isolator. Simply slide the components into the heatshrink tubing and apply heat.

As you would expect, LED1 will now extinguish, LDR1 changes to a very high resistance (many megohms), and the stage gain drops to around unity. The processor's overall gain has now dropped by a substantial degree, and LED2 is illuminated to indicate this condition — that is, that the unit is compressing.

In practice, the circuit uses Q1 to continuously sense the output signal level, and ultimately change the bias on Q2 (and the circuit gain) accordingly.

Incidentally you may be wondering why have we used a 'home-made' opto-



An inside view of the completed processor. Note that a couple of components (namely RFC1 and R15) are connected between the PCB and the microphone input socket, and the grounding wire is terminated at one of the PCB mounting bolts.

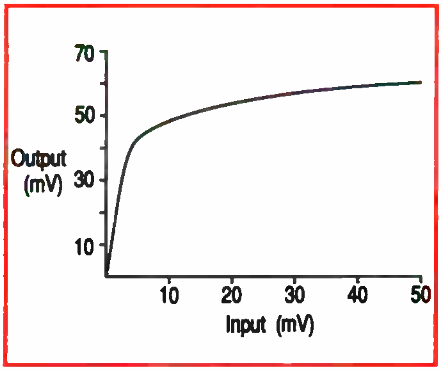


Fig.2: The audio compression curve for the processor's preamp stage. While the curve's shape remains the same, the values along each scale will depend on the settings of RV1 and RV2.

isolator to perform this gain control function, instead of a standard 'ready made' opto-coupler like the familiar 4N28. The short answer is that standard couplers are essentially digital devices, and not suitable for the kind of linear control we need here.

A simple LED/LDR combination as used here gives the right control characteristic, at very low cost.

The processor's high-level output signal is passed via R7 to Q1, which ostensibly acts as an emitter follower for any signal more positive than its emitter potential. Therefore, as the output signal swings below ground potential (the negative half of the cycle) Q1 is reverse biased, while C8 is charged via R8 as the output swings in a positive direction.

In this manner, C8 will charge to the peak voltage level of the output signal's positive excursions (less the 0.6V drop across Q1's base/emitter junction). Since the voltage across C8 sets Q1's emitter potential, the transistor will remain reverse biased until C8 begins to discharge (via R9 and R10) or the signal level increases. So in effect, this part of the circuit behaves as a positive peak rectifier, with a buffered input.

The resulting DC signal then provides the bias current for Q2, which as mentioned above, ultimately sets the overall gain and output signal level of the processor.

In this way a gain control loop is established only when the signal at R7 exceeds a peak level of about 1.2 volts, where both Q1 and Q2 are beginning to conduct and the circuit gain is forced to drop.

The response time of the DC control signal at C8 is tailored by the circuit components R8 and R9, which set the capacitor's charging (attack) and discharging (release) rates respectively.

'Roger' overtones

The circuit shown in the upper half of the schematic diagram uses RLA's contacts to repeat the action of the mic's PTT function, but with slight additional delay in the releasing action to allow the 'over' tone to be transmitted. If the transceiver's PTT action can be toggled by a simple grounding switch (that is, connecting the PTT line to 0V), RLA can be omitted and Q3's collector used as a direct PTT switch.

In the circuit's steady-state conditions, both the anode and cathode of D3 are held at a high level (V+) by R17 and R16 respectively. When the mic's PTT switch is activated, both points are immediately pulled to a low potential via R15, which rapidly charges C12 (via D3) and provides a low logic level to the input of IC2a. The resulting high level at the NAND gate's output activates Q3 (via R18) which in turn either energises RLA to close the output PTT contacts, or serves this function itself.

When the PTT switch is released however, D3 is reverse biased and C12 can only discharge via R17, causing a slowly rising potential at the input of IC2a. Only when the gate's input threshold voltage is reached (after about half a second) does its output snap low, turning off Q3 and de-energising the relay — thus we have a delayed PTT action.

During static conditions and when the PTT switch is held on, one of IC2b's inputs is always low, causing its output to remain high. During the short 'extension' of the PTT period however, both inputs (pins 5 and 6) are momentarily high, forcing the output of this gate to go low for around half a second. This level is inverted by IC2c and applied to one input of IC2d (pin 12) as a high-going pulse. IC1d is arranged as a simple gated oscillator, with a frequency set to about 500Hz by the combination of C13 and R21. To produce the final 'over' tone, we have elected to use the triangle waveform appearing at pin 13 of IC2d, rather than the usual square-wave signal (at pin 11) with its excessive upper harmonics.

When pin 12 pulses high, the tone is coupled to the second mic preamp stage via R22 and C14, which attenuate and filter the waveform by a large degree. In fact, most of the attenuation is performed by C14 — which at the same time minimises the effect of the DC shift which occurs as the oscillator starts.

As an indication of the 'over' tone period, the positive-going pulse at pin 10 of IC2c forward biases Q4 via R19, which in turn illuminates LED3 via the current limiting resistor R20. The LED current has been restricted to a modest 2mA level so as to match the brightness of the 'compress' indicator LED2.

By the way, D4 and D5 have been included as component protection diodes — D4 offers a discharge path for C12 when the power supply is disconnected, while D5 suppresses the back-swing voltage generated by RLA's coil when Q3 turns off.

The final small section of the schematic produces the power supply rails for both the analog and digital parts of the processor's circuit.

The nominal 12V DC source is passed to the majority of the circuit via the protection diode D2 (V+), while the more sensitive preamp section based around IC1 is supplied via the filter components R12, C9 and C10 (Vcc). Finally, a reference supply of half Vcc's potential is generated by the voltage divider R13 and R14, and then filtered by C11 (Vref).

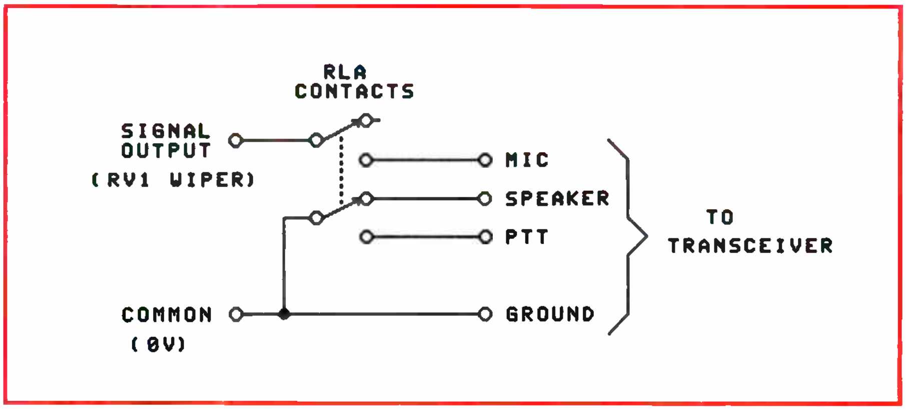


Fig.3: A suggested wiring arrangement to suit some tranceivers (usually CB) which use a DPDT switch in their matching microphone unit.

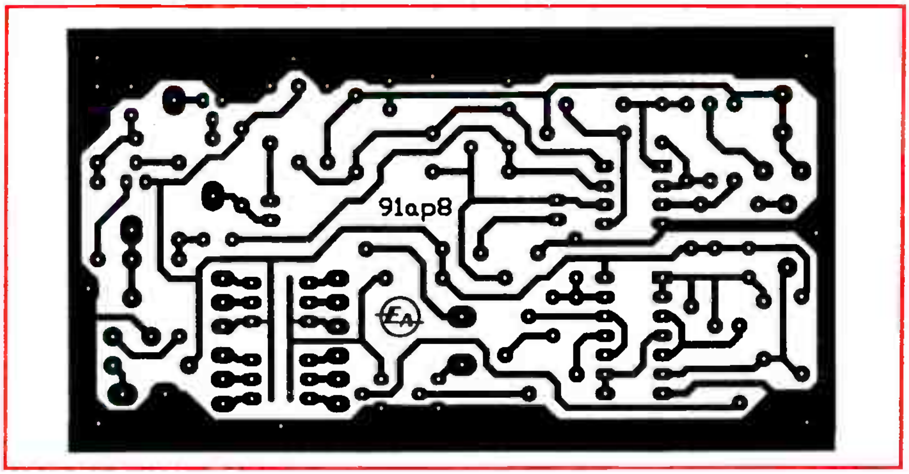
Speech Processor

Construction

The majority of the Speech Processor's components mount on one small printed circuit board (PCB), measuring 102 x 56mm and coded 91ap8, which neatly fits into a standard 120 x 40 x 65mm aluminium diecast box. The microphone connects to a matching socket at one end of the box, while the processed signals are passed on to the tranceiver via a length of four-core shielded cable, which is terminated in an appropriate mic plug.

Start the construction by assembling the opto-isolator as shown in Fig.1. First, slide the LED and LDR into a short length of 6mm heatshrink tubing so that their surfaces are just touching, and insert a couple of small spacers to prevent component legs from shorting together — short pieces of insulated hookup wire make suitable spacers.

Then apply heat to the heatshrink tubing, while making sure that the spacers remain between the legs of the components. The completed opto-isolator should then be tested with a multimeter to check that the LDR is at a very high resistance (since no light should be falling on its surface), and to determine which is the positive leg of the LED.



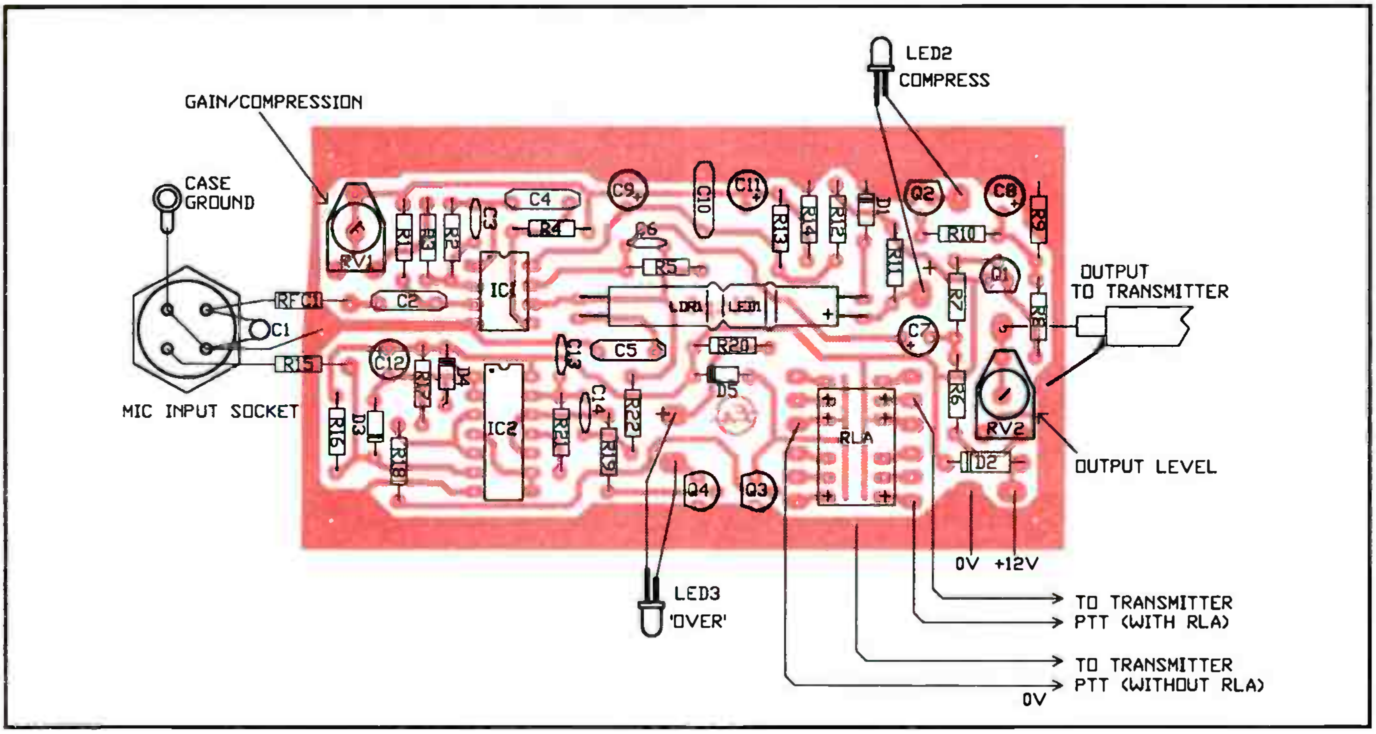
A full sized reproduction of the PCB artwork, for those who wish to copy the pattern and make their own circuit board.

The isolator's four legs can now be bent to suit the layout of the PCB.

The circuit board can now be loaded with all of the components, including the opto-isolator. As usual, take particular care with the orientation of the polarised parts such as electrolytic capacitors and semiconductors — refer to the component overlay at all times.

If you've elected to install RLA for the PTT function, you will need to find out which of the relay's pins connect to the coil, and the connections for the normally open contacts. The PCB has been designed to suit a wide variety of DIP-style miniature relays, by simply running the coil-connecting tracks close to all connections and joining each relay pin to external pads.

If your relay's coil pins don't match the position of the two thin tracks on the PCB, simply cut these and remake the connections in the appropriate place. PCB pins should now be added to the board at all external connection pads (as shown in the component overlay diagram), and the completed PCB assembly attached to the bottom of the



Refer to this component overlay and wiring diagram during the construction of the Speech Processor — pay particular attention to the orientation of polarised components. Note that by performing minor surgery on the PCB (see text), a number of different DIP-type relays can be used as RLA.

box with small screws, nuts and insulated spacers. The final wiring arrangement will depend upon how you plan to connect the 12V power source and the type of mic input socket — which of course will need to match that of the tranceiver mic input.

For example, you may wish to add an extra socket (say a 3.5mm-type) to the box for the power supply connection, and run the four-core shielded cable to a microphone plug which matches the tranceiver socket. Alternatively, a reasonable length of two-core cable could be run out of the box for a direct connection to the power source.

Note that components RFC1 and R15 are wired between the PCB and the input socket, rather than mounted on the board itself, and capacitor C1 is connected directly between the input pins on the mic socket. The RF choke should be mounted as close to the input pins as possible for maximum RF rejection, and a grounding wire connected between the input socket and the case (as shown in the overlay diagram). Finally, the two LEDs can be installed in the front panel, and wired to the appropriate PCB pins.

By the way, some CB transceivers use a double pole switch inside their matching microphone to perform the PTT changeover action. The switch is wired so that the transceiver's speaker is disconnected during 'transmit' and the microphone is disconnected during 'receive', as well as providing the usual PTT line which activates the transmitter.

In this case, a relay with double-pole changeover contacts can be fitted to the speech processor, so as to mimic the function. Since all of the potential relay pins are joined to pads on the PCB, it shouldn't take much effort to connect its contacts to the appropriate places — see Fig.3 for a typical wiring arrangement.

PARTS LIST

1 PCB 102 x 56mm, coded 91ap8
1 120 x 40 x 65mm diecast aluminium box (or similar)
1 Panel-mount socket to suit microphone plug
1 Miniature 12V SPST relay, DIP pin spacing (optional)
1 1.5mH RF choke

Semiconductors

1 TL072 dual opamp
1 4093 CMOS quad Schmitt NAND gate
4 BC548 (or similar) NPN transistors
4 1N4148 (or similar) diodes
1 1N4002 (or similar) power diode
1 OP12-type miniature light dependent resistor (LDR)
3 5mm LEDs

Resistors

All 0.25W: 1 x 1.2M, 1 x 680k, 1 x 470k, 1 x 270k, 1 x 100k, 2 x 82k, 1 x 68k, 1 x 56k, 2 x 33k, 4 x 12k, 2 x 4.7k, 1 x 3.9k, 2 x 1k, 1 x 270 ohms, 1 x 180 ohms.
1 50k miniature PC-mount horizontal trimpot
1 5k miniature PC-mount horizontal trimpot

Capacitors

1 10uF 16V PCB-mount electrolytic
1 4.7uF 16V PCB-mount electrolytic
1 2.2uF 16V PCB-mount electrolytic
2 1uF 16V PCB-mount electrolytics
1 82nF metallised polyester
1 39nF metallised polyester
3 10nF metallised polyester or ceramic
1 1nF ceramic
1 330pF ceramic
1 100pF ceramic
1 22pF ceramic

Miscellaneous

LED mounting hardware, 6mm heatshrink tubing, four-core shielded cable, cable clamp, light-duty hookup wire, small plastic spacers, solder tag, PCB pins, small screws and nuts etc.

Setting it up

The initial adjustments and tests should be completed before connecting the Speech Processor to a tranceiver. First, connect the power supply and microphone to the unit, and push the PTT button — if a relay has been fitted to the PCB, you should hear a slight 'click' as it pulls in. When the PTT button is released, the 'over' LED should illuminate for a moment, then the relay should drop out.

Next, speak into the microphone and adjust the preamp gain trimpot (RV1) so that the 'compress' LED is just flashing with each speech peak, with the mic held at a normal distance. If all is well, connect the processor to the tranceiver and adjust the output level trimpot RV2 for about the same *peak* RF modulation level as with only the microphone plugged in directly. Presumably, this should be close to 100% — except that thanks to the Processor, the average speech volume and transmitted power should now be substantially higher.

For a more thorough setup/test procedure, the processor's audio output can be connected to a (high gain) test amplifier and speaker, before connecting the tranceiver. This will allow you to check the quality of the output signal, and the volume level and pitch of the 'over' tone.

Once you are satisfied with the results, the transceiver's mic input can be connected and the processor output level set as mentioned above.

Possible changes

Due the variation in component parameters and nominal microphone output levels, it's possible that the Speech Processor may not perform quite as expected — despite the fact that the circuit is operating correctly. While RV1 can be used to alter the circuit's gain over quite a wide range, the final output level *does* depend on the strength of the mic signal and the light sensitivity of the LDR.

After constructing a number of opto-isolators with different LEDs and LDRs, we found that with around 2mA flowing through the LED (as in the actual circuit), the LDR could present a resistance anywhere between 10k and 50k. As it happens, the range of adjustment provided by RV1 is more than enough to compensate for the resulting change in gain of the output stage (IC1b) — which of course depends upon the resistance of the LDR. Different types of LEDs don't seem to effect the opto-isolator's performance, by the way.

However, if your mic has an unusually high or low output level and the LDR is at one extreme of the abovementioned resistance range, you may have to alter the value of R11 for the unit to perform correctly. This change has the effect of altering the nominal current through LED1, and consequently the standing resistance of the LDR.

Some constructors may wish to test the opto-isolator *before* it is installed in the PCB. In this case, simply measure the resistance of the LDR, while changing the current through the LED. When you find what LED current corresponds to an LDR resistance of around 15k (a little higher is fine), calculate the appropriate value for R11 and assemble the circuit board with these components installed.

The other possible anomaly with the processor's operation concerns the duration and pitch of the 'over' beep. Since the timing of these functions is dependent upon the input voltage at which the NAND gates change state (as well as the surrounding component values), any difference in this threshold level will have a marked effect.

We've found in the past that the input threshold of 4093 CMOS chips can vary quite significantly, depending upon the manufacturer. In this case, the answer is to vary the value of the associated components to achieve the correct timing periods — this will be R17 for the 'over' tone duration, and C13 or R21 for the corresponding pitch. ■

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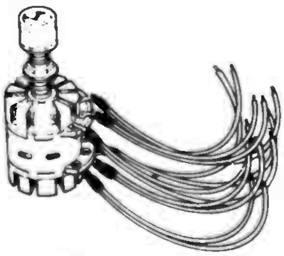

Car HiFi woofer

You don't see this very often. These are 8" honeycomb woofers designed for car HiFi use. They have a metal grill over the cone, a huge 20 oz (.57kg) magnet, foam roll surround, black frame and silver honeycomb diaphragm. Power handling 35 watts rms, sensitivity 93dB, frequency response 60Hz to 12kHz, impedance 4Ω.

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$49.95 a pair

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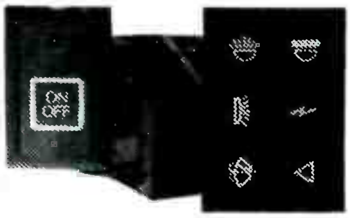

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This carry case will accept a 6.5Ah gell battery. It is ideal for video camera users or for hand held 12 volt spotlights for shooters, night bush walks etc. It has leads for connecting to battery inside case (positive is fused) and a cigarette lighter socket is mounted on the side. It has a strap for hanging on shoulder (removable) and a belt loop. The top has a zipper to hold the battery in. Limited quantity.

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TA12 Standard vinyl case that holds up to 12 cassettes in their cases.
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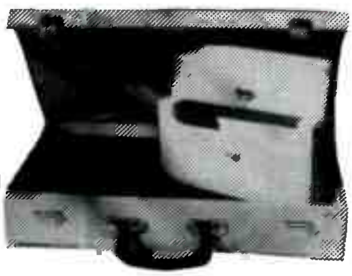

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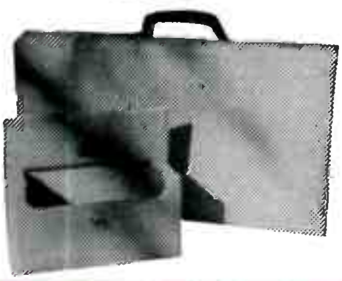

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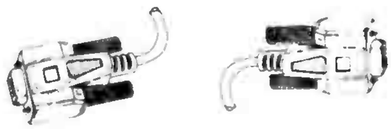

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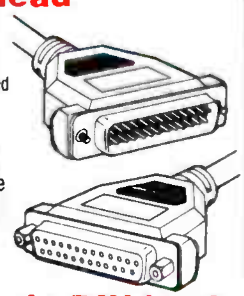

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Hook up 14/0.25mm, 18 gauge OD 2.4mm. 5 colours - black, green, red, white, yellow. 12mts per colour. Total length 60 metres. Arista catalogue price $5.95 per colour. Total $29.75.
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HUW6

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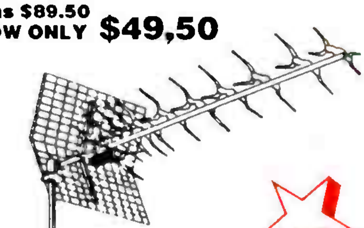

91 Element

Specs - Gain: 15-19dB, Channels: 21-69, Frequency: 470-862mHz, Boom: 20mm square, Overal length 2214mm, Finish: elements and boom anodised.
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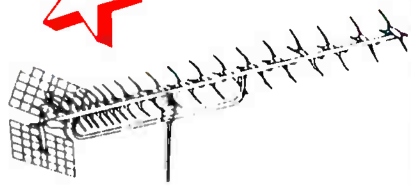

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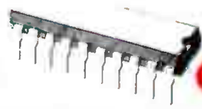

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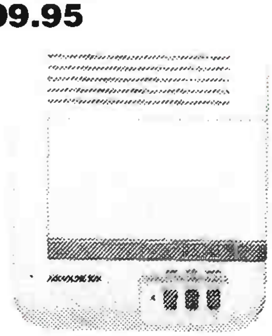

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3) Passive Infrared detector. One supplied with the kit and more can be purchased separately if necessary. Range is 10 metres.
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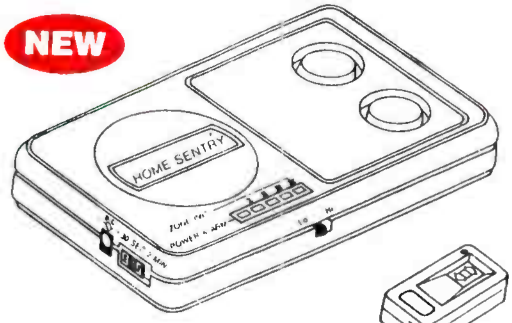

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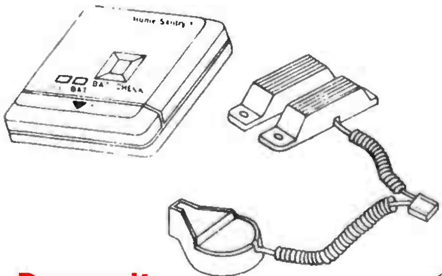

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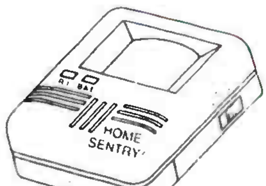

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Includes keypad and reed/magnet. You will require a second one of these if you enter/exit from the back door, as well as the front.
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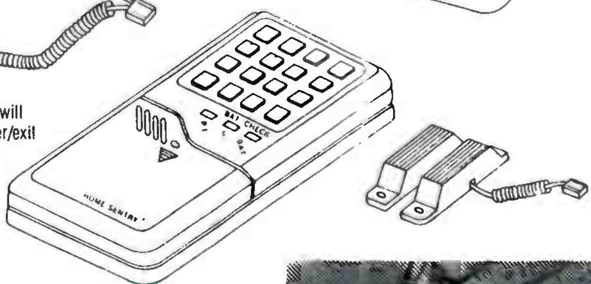

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10, 11,12, 13, 15, 16, 18, 20, 22, 24, 27, 20, 33, 36, 39, 43, 47, 51, etc

So, you get 10 of every value, a total of 170 values, 1700 resistors in all and they are bandoleered for easy sorting.

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Buy this pack and you will NEVER be short of any resistor again.

To buy all these resistors on an individual basis (i.e. 5¢ ea) it would cost you $85. This pack costs well under 1/2 that price and there is a limited quantity.

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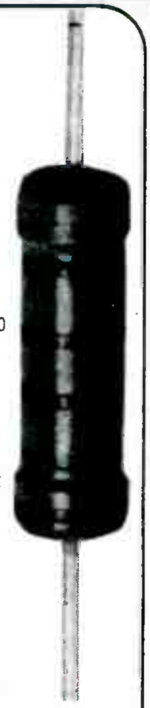
Less than 2¢ ea



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NEW KITS

MASTHEAD AMPLIFIER

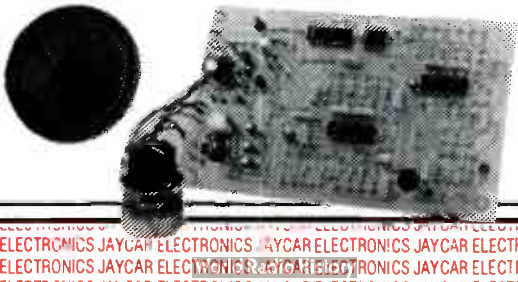
Refer Silicon Chip Aug 91.
This masthead amplifier kit is easy to build install. It will give around 18dB of gain from 40MHz to 1GHz which is right across the UHF and VHF bands plus FM bank (88-108MHz) as well. The Jaycar kit includes the special 24V AC power supply. Beware of other kits which don't supply this. Also includes PCB, jiffy box, mast clamp, OM 350 and all specified components.
Cat KC-5097 **$44.95**

DIGITAL TACHO KIT

Refer Silicon Chip Aug 91.
This LED digital tachometer features a 4 digit readout that indicates from 0 - 9900 RMP. It works from Kettering to Hall Effect systems and with 4, 6 and 8 cylinder cars. The Jaycar kit is a short form version, everything is supplied except the box and front panel - as we feel many constructors will want to mount it in the dash.
Cat KC-5098 **$34.95**

PC VOICE RECORDER KIT

Refer Silicon Chip Aug 91.
Can record messages up to 20 seconds long. Store them on hard or floppy disc and then replay them when you wish. The Jaycar kit includes all specified components except the plugpack and zippy box. The software is available from Silicon Chip.
Cat KC-5099 **$32.95**



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STUDIO 3-55L SPEAKER KIT

NEW

Refer Silicon Chip Sept 1991.

At last, a high quality speaker kit at a very reasonable price using quality components. Jaycar and Silicon Chip proudly announce the Studio 3-55L 3 way speaker kit. The kit incorporates the Magnavox 12W, 12" woofer, sealed 5" midrange driver and the fabulous Philips AD11610/T8 dome tweeter. Power handling is 80 watts programme. Drop into any Jaycar store for a demonstration (not Concord). The kit is available in two parts. Part one includes the drivers, crossovers, terminals, faders, innerbond, screws, cable etc. Part two includes the two fully build black cabinets with all holes cut and speaker grill fitted.

Part 1: Speakers etc
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Part 2: Cabinets
Cat CS-2482
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TOTAL $529

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Refer Silicon Chip June 1991

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The Jaycar kit includes pre punched and silk screen case, original C and K switches, original slider pots (Jaycar supplied the samples to Silicon Chip) and all specified components. Beware of kits with non original parts.

Cat. KC-5096
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Cat KA-1737
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Ref: EA August 1991

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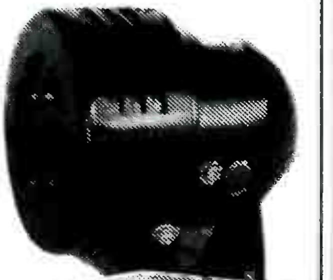

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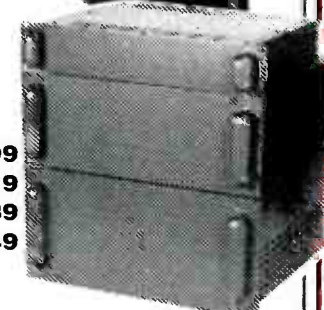

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ICOM'S IC-24AT: A 'TECHNICAL' REVIEW

Like many of the latest generation of hand-held transceivers designed for VHF and UHF, Icom's new and very compact IC-24AT dual bander also offers the ability to receive over a wider range than the 2m and 70cm amateur bands on which it transmits. Here's a different kind of review which presents the results of a thorough series of tests on the IC-24AT, including measurements of sensitivity and image rejection 'out of band'.

by LEW WHITBOURN, VK2ZIP

This is not a full review. It does not give photos or comprehensive details of operational features. These are readily available in the numerous advertisements, or the comprehensive colour brochure available from Icom. There was also an excellent review of the normal kind by Tom Moffat VK7TM, in *Amateur Radio Action* (Vol.13 No.1).

However the complexities of modern radios, especially dual-band radios, make it almost impossible for a single review to cover everything that a prospective buyer would want to know. This is especially true of the current generation of VHF/UHF radios with wide receive coverage, as epitomised by the IC-24AT 2m/70cm dual-band handheld.

Such radios are commonly touted as being powerful scanners, as well as amateur two-way radios. But they are difficult to compare in this area, because no specifications are given for the out-of-band receive performance. So the need for a full technical review of the receive performance of these radios has never been greater.

This review presents the signal and image sensitivity of the IC-24AT over its whole range, along with subjective comments about overload performance. It also addresses issues such as current drain, transmitter power and efficiency, as well as external powering and battery charging arrangements. These are important properties of a hand-held radio, which are seldom treated fully in a review.

The radio used for this review was an IC-24 on loan from Andrews Communications at Maroubra, NSW. Although originally destined for some other market (e.g., the Japanese domestic market), it is being sold by Andrews with identical features to those of the IC-24AT sold locally by Icom. Its presence in the Australian market place adds a very worth-while dimension of choice to prospective buyers.

The local Icom offering comes with a BP-82 (7.2V 300mAh) battery pack which delivers about 2.5W of power on either the 2m or 70cm bands — but not for long! Meanwhile Andrews offer the IC-24 with either the BP-84 (7.2V 1000mAh), BP-85 (12V 340mAh) or the BP-90 'dry-cell' pack, which I used very successfully with six 700mAh rechargeable cells. With this pack the radio delivers about 2W on both bands and gives quite respectable battery life, at significantly reduced cost.

In the following sections on receiver sensitivity and image rejection, all sensitivities are given as the number of microvolts (RMS) at the antenna socket to produce 12dB of receiver quieting.

VHF performance

Fig.1 shows the sensitivity of the IC-24AT in the aircraft band 108-136MHz and VHF hi-band, from 138 to 174MHz and beyond. The receiver has a genuine AM detector in the air band from

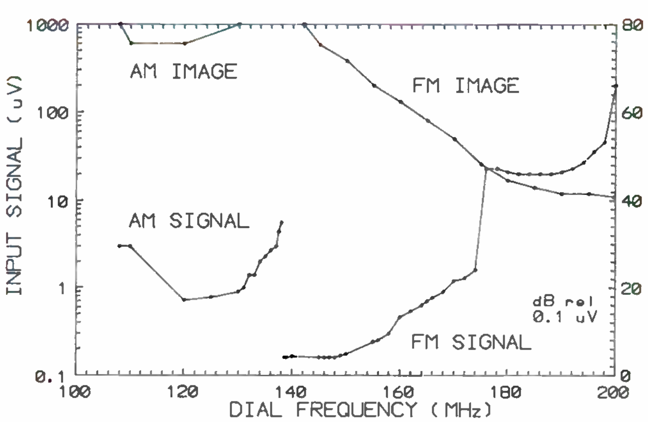

FIG. 1 IC-24 AM/VHF HI-BAND SENSITIVITY

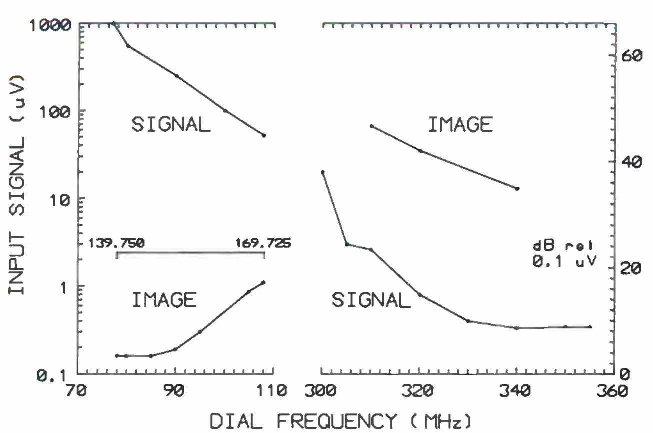

FIG. 2 IC-24 80 & 300 MHz SENSITIVITY

108MHz to 137.995MHz precisely, as verified by feeding AM and FM signals to it and observing also that the receiver current drain is slightly higher in the airband.

Sensitivity is not outstanding in the aircraft band, but is a useable 1uV from about 116MHz to 132MHz. In hi-band, the sensitivity is a very good 0.17uV from 138 to 149MHz and then slowly deteriorates to 1.6uV at 174MHz. Image rejection is quite reasonable and is at its best in the amateur band.

I discovered that the IC-24AT switches from high side local oscillator injection below 138MHz to low side injection at 138 MHz and above. There is a small range (a few hundred kHz) above 138MHz where the radio does not receive, presumably because its VCO reaches the low end of its range there. This would probably vary from radio to radio. The good sensitivity across the 138-174MHz band is achieved with the help of 3 track-tuned stages in the VHF front end. Overload performance is quite acceptable as a result of this approach.

On a North Ryde repeater site, with a half-wave antenna connected, the only signs of distress noted were strong LCD S-meter indications. With the normal 'rubber ducky' antenna the receiver was not stressed at this site or in the city of Sydney. I was not able to identify the source of the track-tuning varicap tuning voltage as being the VCO control voltage. However, this seems likely. In view of that, I wonder if the track tuning is 'upside down' in the air-band, which would explain the strange variation of sensitivity there, as shown in Fig.1.

Apart from the airband the IC-24AT throws in another couple of bonus bands in the VHF region — which stops, as far as the digital display is concerned, at 354.995MHz. The next step above that is 0 MHz! The sensitivities on these further bands, from about 78MHz to 107.995MHz and from about 300MHz to 354.995MHz, are shown in Fig.2. The lower of these, in the VHF mid-band is actually useless, as shown in the figure. Sensitivity is greater than 100uV over most of the region, whereas the sensitivity to the image, which lies between about 140MHz and 170MHz is basically a replica of that shown in Fig.1.

This is not so much a criticism of the radio, as it is of reviewers who would say that it receives in this band — just because the VCO does not happen to be unlocked there! As in the air-band, the radio uses high-side injection in mid-band and the track tuning is clearly still working as for high band. Above 330MHz, however, the sensitivity is quite good, with acceptable image rejection. Criticisms aside, it is amazing that all the coverage described above is obtained from the one receiver front-end. It is, in fact, excellent in the amateur band and over most of the VHF hi- band. Genuine AM detection in aircraft band is a nice bonus!

It is not completely clear to me how this is done. The IC-24AT uses a Toko TK10487M B FM receiver chip at an input IF of 30.875MHz on all bands and all modes. There is some unusual FET-switched biasing around the 455kHz filter connections to the chip, which is activated by a line to the detector unit labelled HR5S on the circuit diagram. It seems possible that this line tells the detector to demodulate AM.

I wonder whether this is a (quite successful) 'kludge' by Icom, or whether it was conceived by Toko, and I am still trying to get application notes on the chip. This could be of more general interest since other radios such as the Yaesu FT-411 use the same IF chip and can tune parts of the aircraft band. Stay tuned for further developments!

(For anyone trying to understand the Icom circuit diagram I offer the following insights: L is for low-band or VHF and H is for high-band or UHF. R5 is probably 'Receiver 5 Volts' and S is probably 'Switched'. So why would HR5S tell the detector to demodulate AM on the Low band? My guess is that LR5S has to be on for all Low band operation, whether AM or FM.)

TABLE 1: RECEIVER DRAIN

Receiver unmuted, currents in mA:

F (MHz)	80-108	108-135	140-170	300-350	420-480	800-945
I-cont.	55	60	55	77	56	70
I-save 1	13	16	13	16	13	16
I-save 2	7.5	8	7.5	8.5	7.5	8.5

TABLE 2: BATTERY PACKS & SIZES

Type No.	# Cells	Voltage	Capacity (mAh)	Height (mm)	Efficiency Factor (J/m)
BP-81	6	7.2	110	30	26.4
BP-82	6	7.2	300	40	54
BP-83	6	7.2	600	59.5	72.6
BP-84	6	7.2	1000	76	94.7
BP-85	10	12	340	76	53.7
BP-86	6				
BP-90	6	7.2	450-700	59.5	84.7

UHF performance

Fig.3 shows receiver sensitivity and image sensitivity from about 415MHz to 486MHz. The front end uses fixed-tuned helical filters and low-side injection throughout this region.

It had been retuned by Andrews Communications before the test, to sacrifice a bit of sensitivity below 438MHz and optimise coverage up to 470MHz and beyond. I think they got it just right, since all the amateur FM simplex and repeater output frequencies are above 438MHz. The receiver has a sensitivity of 0.24uV at 438MHz and deteriorates to 1uV at 470MHz, which is still quite useable. The 3.4uV sensitivity at 477MHz would allow monitoring of some UHF CB repeaters.

The UHF receiver has good overload performance and was not badly affected even by connection to a UHF collinear antenna at a repeater site. It was perfectly OK with the 'rubber ducky' on that site or in the streets of Sydney.

The bonus at UHF is reception from 800 to 945MHz. Fig.4 shows sensitivity to signal and image in that region. Signal sensitivity is poor below 870MHz, where it suddenly drops to a quite useable 1uV. The image, which is 61.75MHz lower, does exactly the same thing! This means that frequencies between about 802MHz and 870MHz can be monitored with 1uV sensitivity by using the image.

It is impossible to know whether signals received at dial settings between

Icom's IC-24AT

870 and 945MHz are signal or image, but the band is not very crowded up there so receiving two frequencies at once might be considered advantageous. Of course, you have to avoid the cellular phone band, which is somewhere up there. I did hear quite a number of commercial repeaters above 830MHz using the standard rubber ducky antenna, by dialing up frequencies above 890MHz. Signal strength was greatly improved by using a purpose-built droopy groundplane antenna with elements 100mm long. Once again, all this UHF performance comes from a single UHF front end. I can't see how it switches from 450 to 900MHz! The performance in the amateur band is excellent.

Odd observations

Although this is not a full review, I will mention just a few operating features that caught my attention. For instance, audio is lost momentarily every time a key is pressed. The dial light can be turned on indefinitely by pressing 'Function' + 'Light' simultaneously, which is nice. The antenna length is 160mm. It does not seem to work as well as single-band (VHF and UHF) antennas of the same length, in their corresponding bands.

There are several scanning features worth mentioning. There are 40 memories, each set up to store offsets or split band frequencies, subaudible tone status, etc. It is possible to use these as two banks of 40 channels for scanning purposes. Memories can be designated to be 'skipped', of course.

One quirk here is that the mute still opens briefly as the scanner skips through an occupied channel. A new feature is that memories can be used to designate frequencies to be skipped during programmed scan (i.e., scan between specified limits). This is a marvellous new feature, introduced at the same time by Icom in their IC-2SA/E, IC-4SA/E single band hand-helds and in the IC-R1 pocket scanning receiver.

Note, however, that scan skip is not a lot of use if you are scanning in 5kHz steps. This is a bit of a nuisance in parts of VHF hi-band, where 5kHz steps have to be used to accommodate the mixed 25kHz and 30kHz channel spacings. Icom, please add 15kHz and 30kHz to your list of available step sizes (5, 10, 12.5, 20 and 25kHz currently available) on future models!

A very nice feature on scanning is that a twist of the rotary tuning knob on the top panel can be used to reverse scan direction or to skip an occupied channel.

A feature of programmed scan that I also noticed on the IC-2GAT is that if the VFO is not between the scan limits when scan is initiated, the radio will first scan to one of those limits before commencing programmed scan. Scan speed is 7.3 channels per second regardless of step size or scan mode.

Receiver drain

Table 1 shows the currents were measured between the battery pack and the radio. There was no appreciable difference for supply voltages between 7.2V and 12V.

'Save 1' refers to a battery saver cycle time of 0.5s and 'save 2' to a cycle time of 2.0s. The saver does not operate during scan. (This is an option on the IC-R1). The display light increases these currents by 13mA (at 7.2 or 12V). Current drain increases to about 80mA with the mute open without a signal, or with a signal and normal audio levels. At maximum volume these currents increase to 170mA (no signal) and 130-150mA (maximum audio).

Transmitter performance

The IC-24AT has two transmitters, VHF and UHF, and four power settings for each. This means that lots of measurements need to be made in order to characterise its transmitter performance, and it is hard to summarise these results in the normal tabular form. In order to make sense out of all these measurements I have found it necessary to present them in graphical form, as shown in Figs. 5 to 7.

Fig.5 shows the output power as a function of supply voltage, from 5 to 13.6 volts, for all four power settings of both VHF (solid line) and UHF (dashed line) transmitters. Icom call the four power settings HIGH, LOW3, LOW2 and LOW1 in decreasing order. It is clear that the VHF transmitter is generally slightly more powerful than the UHF transmitter, except on high power with a supply of about 10 volts.

The curves show that the four power settings that are available at high supply voltages (10V or more) collapse down to just two settings at low supply voltages. The handbook implies that this collapse is complete at supply voltages of 7.2V (6-cell NiCad packs) but it is clear from Fig.5 that this is not quite the case. There are in fact three power settings still available at 7.2V, two of these being between one and two watts and about 0.5W apart. Users not aware of this might get a little less power out of their radios than they expect. Note also that output power does not increase as the supply voltage is increased above about 12V. Fig.6 shows total transceiver current as a function of supply voltage, for all output power settings on both VHF and UHF. The currents drawn on

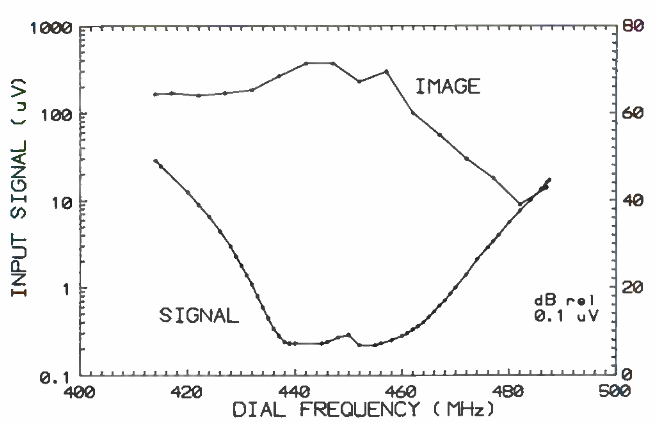

FIG. 3 IC-24 400-500 MHZ UHF SENSITIVITY

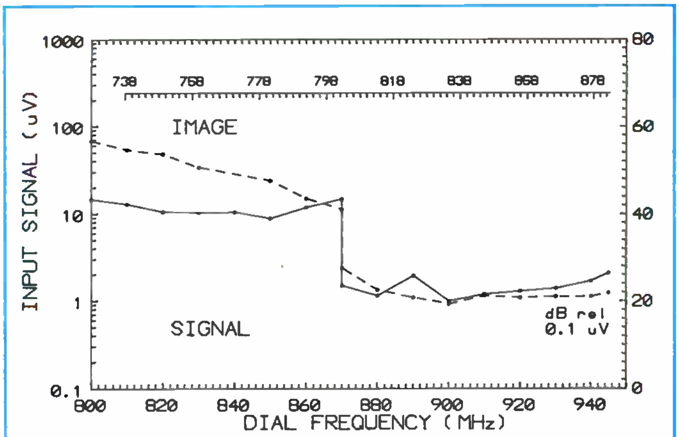

FIG. 4 IC-24 800-950 MHZ UHF SENSITIVITY

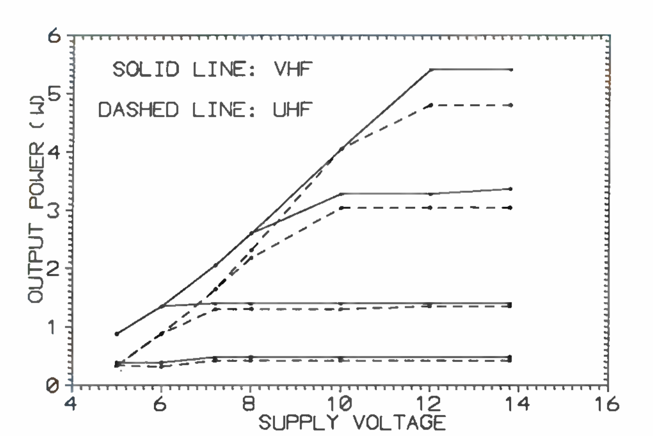

FIG. 5 IC-24 POWER VERSUS SUPPLY VOLTAGE

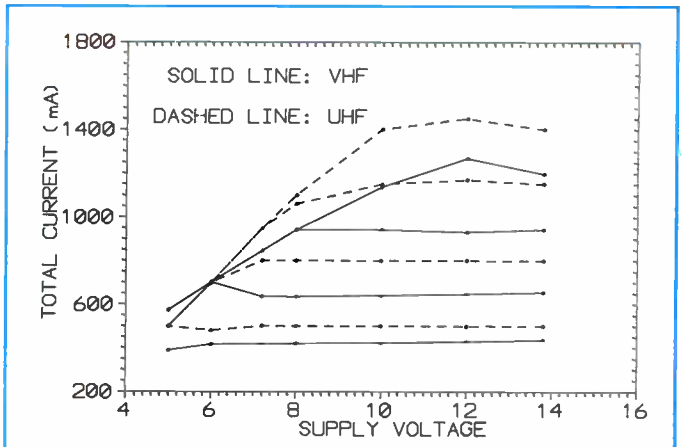

FIG. 6 IC-24 CURRENT VERSUS SUPPLY VOLTS

the different power settings collapse together at lower supply voltages in the same way as the output powers shown in Fig.5.

Finally, Fig.7 shows overall transceiver efficiency as a function of supply voltage for all output power settings on both VHF and UHF. Not surprisingly, the VHF transmitter is the more efficient. Both transmitters show peak efficiencies on their maximum power settings and for supply voltages of about 10V. Both maintain good efficiency at supply voltages down to about 6V.

I think this is a result of a concerted engineering effort to give good performance on 6-cell NiCad packs, which was not the case with some of the earlier VHF and UHF hand-held radios. A result is that supply voltages in excess of 12V (which is what you get from 10-cell packs under load) only serve to increase transceiver dissipation, without any increase in output power.

External power/charging

Earlier Icom radios with external power sockets, such as the IC-02A(T), IC-04A(T) and (I think) the IC-32-AT dual band hand-held used 2.1mm coaxial DC sockets and small internal relays for changeover and reverse polarity protection (see my article in *Electronics Australia*, December 1990 for more details on these). The IC-24AT is too small for this and uses a 1.3mm DC coaxial socket, with the switching contacts of this socket used for DC changeover.

This creates a few design problems, especially since the switching contacts are on the outside conductor of the plug/socket, which Icom has always used as negative with such connectors. (Yaesu always do it the other way, but I think Icom's choice is more logical, as it avoids having a live outer exposed when the plug is pulled out of the radio and floating around the floor of a car for instance.)

The result is some quite elaborate circuitry for reverse polarity protection from both external power and the battery pack (perhaps to beat users who put cells into the dry-cell packs backwards?); overvoltage protection; and constant-current charging of the fitted battery pack when external power is supplied.

A further complication of having the power changeover on the negative or chassis side of the supply is that the battery packs now need *three* rather than two contacts: labelled '+', '-' and 'E'. Inside the radio 'E' connects to the chassis, while inside the battery pack 'E' seems to connect to the negative terminal of the battery (i.e. '-'), via a diode set up to pass current in the charging direction only.

Meanwhile back inside the radio 'E' connects to '-' via the switching contacts of the external power socket, which are opened when a plug is inserted. If you find this confusing don't blame me. I'm just telling it how it is, but I don't mind telling you that I got very confused too!

This arrangement seems to be foolproof. However note the following: If you tape over the 'E' contact on the battery pack the radio will still power the radio, but will not charge when external power is applied — which might be useful sometimes. Indeed I did all of the measurements using a BP-90 dry cell case full of NiCads, and the charging worked fine. So it would be wise to tape over the 'E' contact, if using ordinary dry cells...

If, on the other hand you tape over the '-' contact of the battery pack, it will no longer power the radio, but its batteries will still charge if external power is applied. I can't think of a use for this, but note the following: the normal charging current is near 60mA for all supply voltages above about 12V, but this rises to about 80mA when the '-' contact is taped over. I don't think this is indicative of any problem, but it is indicative of the complexity of the external powering and protection circuits. I think I would prefer a relay!

Battery packs

A list of the battery packs for the IC-24AT is shown in Table 2. The BP-86 is listed in the Icom brochures as being for six AA cells, but the BP-90 supplied with the radio performed this role admirably, so the BP-86 is a bit of a mystery.

In view of the observed charging behaviour of the BP-90 noted in the previous section it seems possible that the BP-86 is meant for dry cells and the BP-90 for NiCads, in which case the only difference would be the charging contact and internal diode in the BP-90. Or perhaps Icom had a change of heart and decided to leave a gap for more models in the range, for instance a 12V pack of greater capacity.

Note that I have listed alongside the BP-90 the range of capacities of currently available AA-size NiCads, but I have calculated its volumetric efficiency factor for the 700mAh size, which is what I used. (Note that the relative efficiency factor is given in Joules/metre of battery pack length, since they all have the same cross-sectional area of 49 x 33mm.)

The BP-90 is extremely solid and well made. The reason for its great height is that it has to hold the 50mm-long AA cells vertically: its 49 x 33mm transverse dimensions do not allow any alternative. The pity of this is that, to my eye, the IC-24AT looks long with this pack and ridiculously long with the BP-84. *Continued on page 89*

Vintage Radio

by PETER LANKSHEAR

Rewinding audio coupling transformers

Interstage audio transformers are the most unreliable component encountered in the repair and restoration of early radio equipment. Used in practically every pre-1930 radio, their mortality rate from corroded windings was extremely high, and few receivers will be found with their original transformers intact. But like output transformers, they can be rewound.

Professional rewinders are often neither interested in, nor able to handle such small transformers as were used to provide interstage coupling in the audio section of early receivers. Sometimes it is possible to dig into a winding to bypass the open-circuited section, but this is an unsatisfactory method. Desperate restorers have even been known to resort to installing hidden transistorised coupling stages and in the United States, it is possible to purchase miniature transformers to conceal inside original cases.

By using the simple equipment for winding output transformers described in the March 1991 column, rewinding of audio coupling transformers is a practical proposition, and with care and a bit of patience, not difficult. First though, we should look at some background to the history and basic theory of audio transformers.

A long history

The first audio transformers, known as 'induction coils', were produced more than a century ago to match the low impedance of carbon microphones to telephone lines, and are still used today in vast numbers. Their construction was in turn based on the even earlier medical and spark coils, made with primary and secondary windings wound on 'open' cores consisting of bundles of straight iron wires. Automotive ignition coils are, of course, their direct descendants.

As the first valve audio amplifiers were used as telephone 'repeaters', it is not surprising that many early valve coupling transformers were similar to telephone induction coils. However, open cores are not very efficient, and were soon improved by making the core wires several times longer than the winding and folding the ends around so as to enclose the completed transformer.

These were known as 'shell' transformers or 'hedgehogs' (there is no record of Australian versions being called 'echidnas'!). Examples can be found in some of the early Atwater Kent sets.

Miniature versions of the silicon steel laminated cores used for mains transformers were found to be superior to iron wires, and before long were being used in a great variety of shapes and sizes. As anode currents were only a few milliamperes, laminations were usually interleaved, rather than butt jointed.

Performance limitations

Three parameters — inductance, leakage inductance, and distributed capacitance — are of major importance in audio transformer design. Inductance, which governs low frequency response, is dependent on number of turns of wire, core area, and core permeability.

General purpose triodes have an anode impedance of the order of 10,000 - 15,000 ohms, and suitable primary windings must have sufficient inductance to have an impedance at least equal to this at the lowest frequency of interest. In practical terms, this means that the primary inductance must be at least 50 henries for an adequate response.

Leakage inductance results from incomplete coupling between windings, and is related to their physical size and separation, being greatest with large

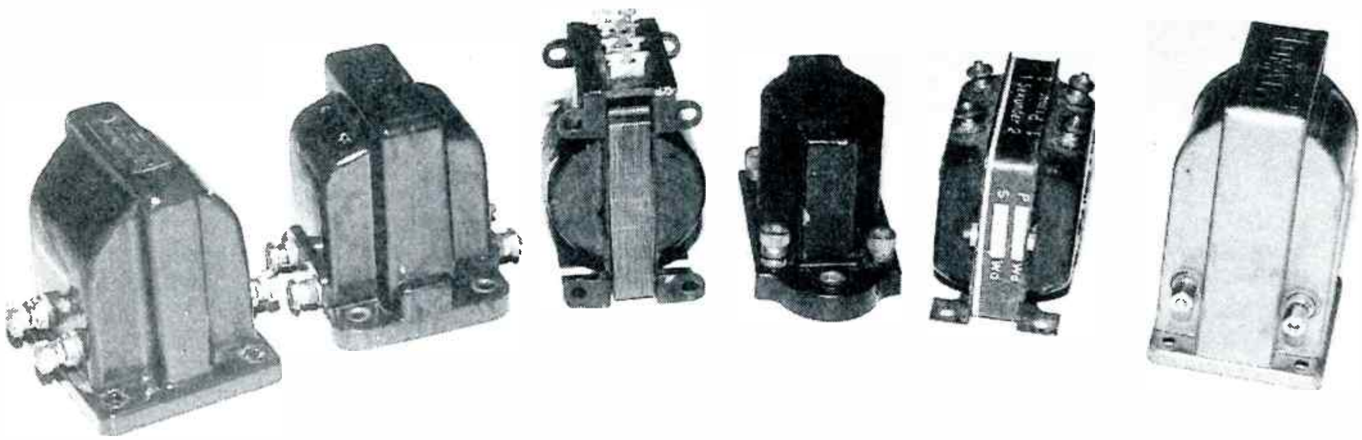

Fig.1: Typical interstage transformers. From the left are an Emmco, a Telsen, an RCA, a Philips, a Primo and an AWA.

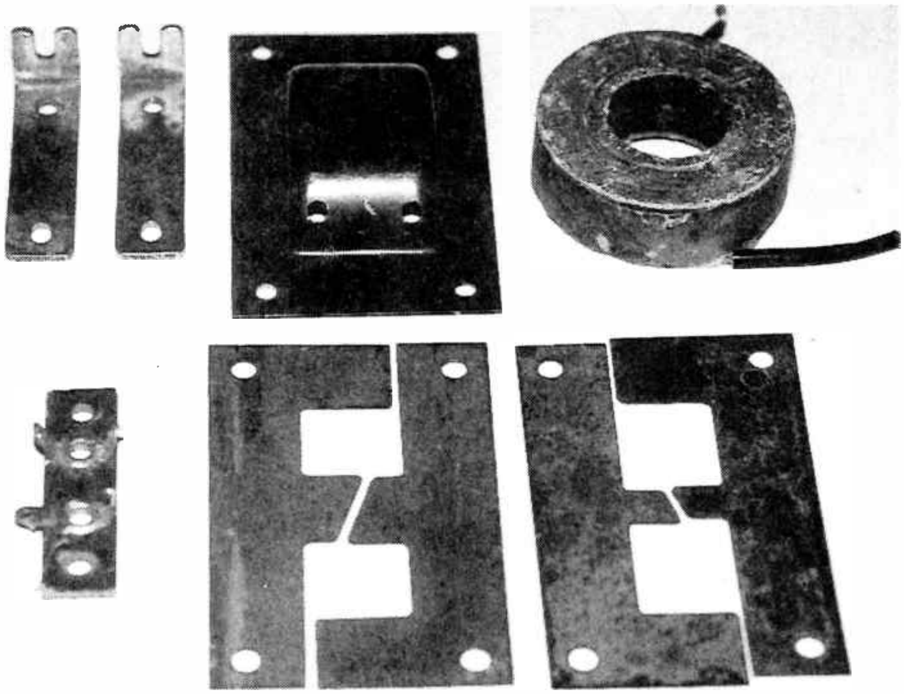

Fig.2: One reason why commercial bobbins are not suitable for audio transformers. Round windings were easy to make, but needed odd-shaped laminations with two or more sizes of centre leg.

windings. One effect of leakage inductance is to restrict high frequency performance, by acting as a choke in series with the transformer.

Winding capacitance bypasses high frequencies and resonates with leakage inductance to produce a peak in the frequency response of the transformer.

Compromises

Audio transformer design involves serious compromises. To have adequate inductance, the windings must be of large physical size with many turns of wire — the very factors which increase capacitance and leakage inductance.

For a reasonable amount of leakage inductance and winding capacitance, using simple winding configurations, the transformer must be physically small, and therefore have a limited winding space. Obviously, to maximise the number of turns, the wire must be as fine as possible. Fortunately, resistance is not a problem, but fine wire is fragile and very vulnerable to corrosion. The finest diameter that can be handled easily is about 0.08mm (44 SWG), and many transformers were wound with this gauge.

Interstage transformers provide a voltage gain, governed by the ratio of turns on the primary and secondary windings. Primaries require a large number of turns to provide a good low frequency performance, and the size of the associated secondary winding is severely restricted if leakage inductance and winding capacitance are to be kept at reasonable levels.

As a general rule, the maximum step up ratio for acceptable audio quality was 5:1, and for reasonable quality was limited to a 3:1 turns ratio.

The reality is that many audio transformers were not engineered, but made empirically and with economy a prime factor. Some early constructional articles specified the weight of wire rather than an exact number of turns!

Various techniques, most of them too expensive for competitively priced transformers, can be used to minimise the design problems. A late development was high permeability core steel, requiring fewer turns for a given inductance. Most potent in minimising winding capacitance and leakage inductance is splitting windings into 'pies', or by sandwiching them in sections. However, transformers encountered in restoration projects are not likely to have many refinements, most just having the secondary wound on top of the primary.

With all the problems and expense, it is not surprising that after 1930, with improved valves and resistors becoming available, and with better understanding of R-C coupling, interstage transformers were generally avoided.

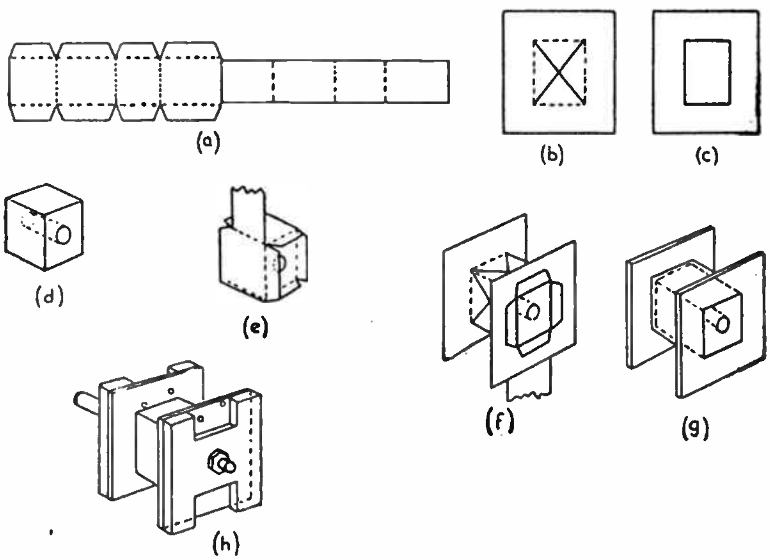

Fig.3: Making a bobbin. First cut heavy paper or thin card to form the centre strip (a), allowing about 0.5mm clearance around the core. The two inner cheeks (b) have diagonal cuts to form flaps, while the outer cheeks (c) have core clearance holes. The wooden mandrel (d) should be 'square', an accurate fit within the bobbin and about 0.5mm shorter than the centre leg of the core. Make sure that the hole is parallel to the sides, or the bobbin will wobble. Wrap the centre strip around the mandrel (e), gluing with polystyrene cement. Then glue the inner cheeks in position (f), being careful not to get glue on the mandrel. Wrap a single layer of paper around the centre. Then fasten the outer cheeks (g), coating with varnish when the glue sets. Finally make up two end support washers from heavy aluminium sheet or hardboard, with slots to provide clearance for the winding leads as in (h).

There were several different terminal identification codes used for interstage coupling transformers. Anode connections are most commonly labelled 'A' or 'P' (for 'plate'). High tension terminals are usually 'B+', 'B' or 'HT+'. 'G' is of course the grid terminal, but the grid bias return can be 'F', 'C-', 'C' or 'GB' (for 'grid bias').

Some transformers were marked 'IP' (inside primary), 'OP' (outside primary), 'IS' (inside secondary) and 'OS' (outside secondary). Reference books disagree completely as to the preferred sequence of connection for transformers marked in this way, although most consider that 'OS' should be the grid connection.

Rewinding

Audio coupling transformers can be rewound without complex equipment. The method to be described is basically that for output transformers in the April 1991 column, using a hand drill.

As with output transformers, random winding without any destructive interleaving paper will result in a more reliable transformer than the original. Be warned, though: more patience is required, as the wire is finer and there can be as many as 10 times the total number of turns used for output transformers.

There was no standardisation of interstage transformer cores, and suitable commercially made bobbins are unlikely to be available. Fig.3 shows an easy way to make them from thin card or heavy paper. The laminated construction results in surprisingly tough bobbins, which should be thoroughly coated with polyurethane varnish before winding.

To count the turns on the original winding would be very difficult. If, as is often the case, both windings are wound with the same gauge of wire, all that is necessary is to fill the available space in the proportions of the original turns ratio, as randomly wound fine wire occupies much the same space as paper and layer winding.

For example, allowing for insulation, a standard 3:1 transformer primary should occupy about 25% of the window space and the secondary 75%. As a guide, a typical primary winding will have 5000 turns.

First dismantle the original winding, noting any unusual details and the sequence of connections. Now pull the winding apart to ascertain the wire gauge. Chances are it will be in the region of 0.08mm. A micrometer is a considerable help here. Otherwise the diameter of the wire can be calculated by neatly winding a layer of the wire one centimetre wide on a pencil, and counting the number of turns (n). The formula 10/n will then give the diameter in millimetres.

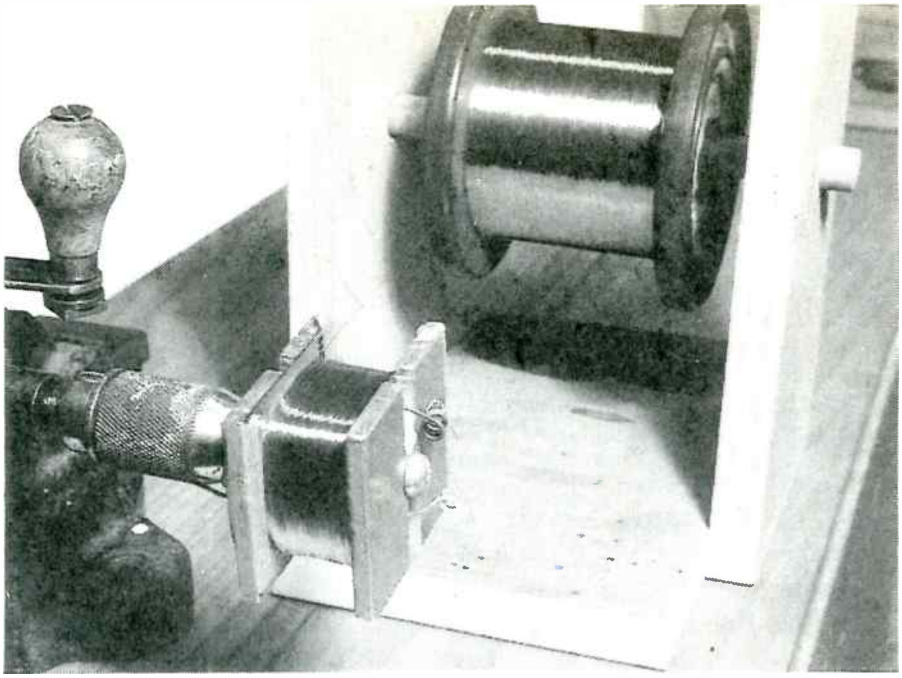

Fig.4: Rewinding of an AWA 'Ideal' transformer in progress. Narrow strips of cellulose tape have been used to hold the cheeks of the paper bobbin against the end washers. Otherwise, the fine wire used is likely to slip between the cheeks and the end washers, during the winding operation.

Set up the winding equipment, and solder a fine stranded leadout wire to the winding wire. With a hot iron it is possible to solder many modern winding wires directly, without first removing the enamel, and it is worth trying. If this does not work, gently remove the enamel with 400 grit abrasive paper.

With a darning needle, make a hole in the bobbin and thread the lead through. Position the lead so that it occupies the full width of the bobbin, and insulate the join with a slip of plastic tape; then proceed with the winding, keeping it as level as possible.

The fine wire requires very careful handling. If a break occurs, twist the ends of the wire together, and after soldering, insulate with a fold of cellulose tape.

Varnish winding

As winding proceeds, keep a tally of your turns of the drill handle. Regularly apply coats of polyurethane varnish, to lock the windings rigidly and prevent damage and distortion during reassembly. Be careful not to get any varnish between the bobbin and the end plates.

For a 3:1 ratio transformer, fill about 1/5 the winding space with the primary winding and terminate with another stranded lead, again allowing it to cross the full width of the winding. Apply two or three layers of varnished, waxed or plastic coated paper before winding on the secondary, making sure of a neat fit with no gaps at the edges.

Now wind on the secondary, terminating the leadout wire in the same manner as the primary. With the full number of turns completed, connect a flexible lead, this time taking a full turn round the winding before passing it through a suitable hole in the side of the bobbin. Allow the varnish to harden, finish off with a layer of tape or varnished paper and trim the sides of the bobbin to the contour of the winding.

All that remains is to check continuity of the windings with an ohm meter, and reassemble. The result should be a transformer with a performance comparable to the original, and a much greater life expectancy.

In trying it out, be very careful not to short circuit the anode terminal to ground. Modern 'B-battery eliminator' power supplies are often capable of providing enough current to burn out the fine wire used in audio transformers.

Driver transformers

Although classed as interstage transformers, the pushpull driver transformers for class AB and B amplifiers popular in battery and some mains equipment during the 1930's were different from conventional audio transformers. They were in fact specialised output transformers, required to deliver power to the grids of the output valves.

Instead of a step up, they had a step down ratio, and could be wound with heavier gauge wire than found on interstage transformers. Turns ratios varied considerably, valve manuals quoting primary to secondary ratios of between 1.5:1+1 and 5:1+1.

If exact details are not available, a reasonable compromise would be to have a primary winding of 4500 turns of 0.1mm wire, with secondary windings of 1500 turns each. ■

Radio Preservation Society of New Zealand (Ferrymead)

In response to our call inviting vintage radio clubs and societies to send in details of their activities, we have received information about a group with the above name, operating in the Ferrymead Historic Park in Christchurch, New Zealand. The information comes from the Society's secretary, Mr George Wealleans.

Founded in 1984 by a group of 18 enthusiasts, the Society is one of about 16 operating within the Park, which operates on the 'living museum' concept. The RPS runs a museum of vintage radio equipment in one of the buildings in the Park, with many models on display to the public. It also operates an amateur radio club station with the callsign ZL3RPS, with the idea of promoting the benefits of amateur radio to the public.

Having acquired a considerable amount of ex-broadcasting equipment, the Society is also negotiating with the New Zealand broadcasting authorities to obtain a licence to operate a 'historical' radio station, on the AM broadcast band. It is hoped to broadcast vintage recordings, news items and so on, in keeping with the Society's motto of 'Preserving Yesterday, Today, for Tomorrow'.

Membership of the Society is open to all interested people, costing $15 per annum including a capitation fee to the Ferrymead Park Trust, plus a once-only joining fee of $5. A newsletter is produced at roughly monthly intervals.

Further information is available from the Secretary, Radio Preservation Society, 269 Bridle Path Road, Christchurch, New Zealand.

Icom's IC-24AT

Continued from page 85

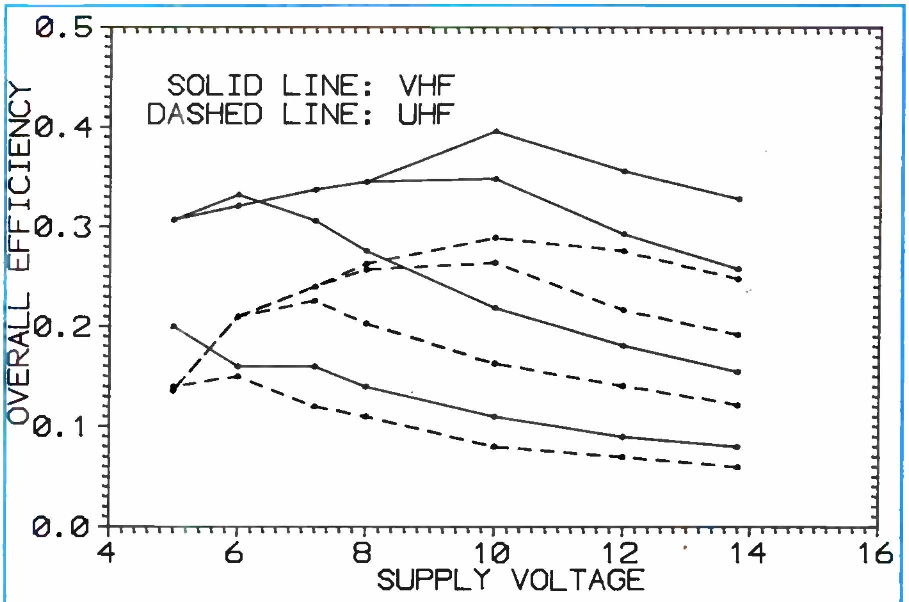

FIG. 7 IC-24 EFFICIENCY VERSUS SUPPLY VOLTS

The 52 x 34.5mm cross-sectional dimensions of the radio are greater than those of the batteries, which were obviously designed to go with the slimmer IC-2SA/E and IC-4SA/E radios, exacerbating the effect. The IC-24AT would have looked much better with a battery pack of matching transverse dimensions, which might then have been engineered to hold the cells horizontally and be correspondingly shorter.

The IC-W2

Yes, this review is about the IC-24AT, but I can't resist saying a few words of comparison with the W2 — based on holding it for two minutes and studying the circuit diagram.

Firstly, the VHF and UHF receiver front-ends of the IC-W2 are virtually identical to those of the IC-24AT, so I would expect receiver coverage to be very similar. Secondly, there are plenty of differences. The W2 has two full receivers, i.e., not just one IF like the IC-24AT, and can therefore receive on VHF and UHF simultaneously. (It uses two MC3372M IF chips, configured identically for VHF and UHF, so I wonder whether it will detect AM on the airband.)

The IC-W2 even has two external speaker sockets. These look like 3.5mm stereo sockets, at least one of which carries a microphone input. I don't think the old speaker microphones will work with the W2, but I might be wrong about this.

It also uses a new type of external power connector, one that I have not seen before. According to the circuit diagram, however, the changeover switch is still on the negative side of the supply and the power switching and charging arrangements are all virtually identical to those of the IC-24AT, as described above.

The big deal with the W2, of course is its twin receivers. Indeed, I understand that the 'double' in W refers to the fact that it has 'double' receivers. Although not absolutely new, this is perhaps new for a 'micro-sized' hand-held. In the language of another manufacturer, Icom has now progressed from the 'dual-band' IC-24AT to the 'twin-band' IC-W2.

Conclusion

The IC-24AT is so far the smallest of the dual-band 2m/70cm hand-helds. It offers very wide receiver coverage, with a very well behaved receiver that can even demodulate AM on the air- band. It cannot receive simultaneously on both VHF and UHF, but this would be of little consequence for many users. The battery options offered by Andrews Communications give purchasers the opportunity to buy an Icom handheld with a battery pack of reasonable capacity.

The IC-24 comes with a very comprehensive operating manual and full, large size (>A3), block and circuit diagrams.

Thanks to Lee Andrews of Andrews Communications, Maroubra for the loan of the review unit. ■

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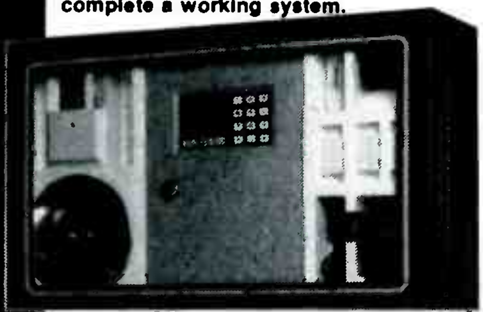

The kit comes complete with the following components: • One Alarm Panel • One Passive Infrared Detector (P.I.R.) • One AC Power Pack • One 8 Ohm Horn Speaker • Three pairs of Magnetic Reed Switches • One 12V/1.2AH Rechargeable Back Up Battery.

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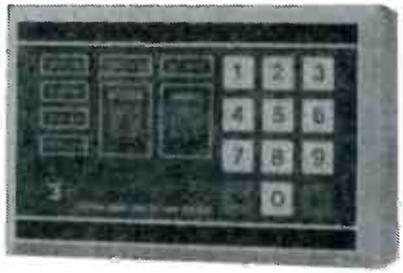

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See S.C. April '91

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See S.C. April '90
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Fast Charger For Nicad Batteries

See S.C. Jan/Feb '91
This Nicad Fast Charger is designed to operate from a 12V car battery. It can charge nicad battery packs from 6-12V at currents up to 6A, or you can wire the circuit to charge battery packs up to 30V at reduced current.

K 1660 **$129.00**

Inverters for Fluorescent Lights
See S.C. Feb '91

These DC-AC inverters, are suitable for fluorescent lights rated up to 16 and 40 watts. Fantastic for camping, back yard sheds etc.

K 6350 16W Version **$35.95**

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See S.C. March '91

This simple Beta Tester will test and measure the gain of most bipolar transistors. You simply connect the transistor, press the button, rotate the knob until the LED lights, and read the gain from the calibrated dial scale.

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Using your PC to control radio gear - 1

Many modern communications receivers, scanners and amateur radio transceivers have a built-in ability to communicate with a computer. This is the first of two articles describing ways to link such radio equipment to your personal computer, to enhance its operation.

by TOM MOFFAT, VK7TM

Don't panic! This is not going to be a computer article. I've always thought of computers as tools; nothing more. So we're now going to look at ways to use the tool to do something really useful, to automatically control a receiver or transceiver.

Why would anyone want to do that? The obvious application would be if the radio was at one place, and you were at some other place with a computer. You could easily send commands along a phone line to tune the radio and change its modes or memory channels. I believe the Department of Transport and Communications already does this with its remote monitoring sites. But consider some other possibilities:

You have a big list of interesting frequencies on the HF bands, stuff like space shuttle channels and military frequencies and diplomatic teletype circuits. You're sitting in front of your radio and you want to methodically work your way through them, listening on likely frequencies for interesting traffic. You could use one of those printed lists — a 'frequency register' — and manually tune the radio to each frequency with the dial or keypad. But if the list were on a computer disk file, and the computer and radio were tied together, you could simply position the computer's cursor to an entry on the screen and then hit a key. The appropriate frequency, and mode, would be instantly loaded into the radio.

What about a radio amateur in a contest, working the maximum number of stations in the shortest time. He could keep a traditional log on paper, recording the station's callsign, the time, the frequency, and the mode, along with signal reports.

With computer control the same amateur could type in the other station's callsign and signal report, and then hit a key to make the computer do the rest — suck in the frequency and mode from the radio, add the time from the computer's time-of-day clock, and record the whole works as an electronic log entry in a disk file.

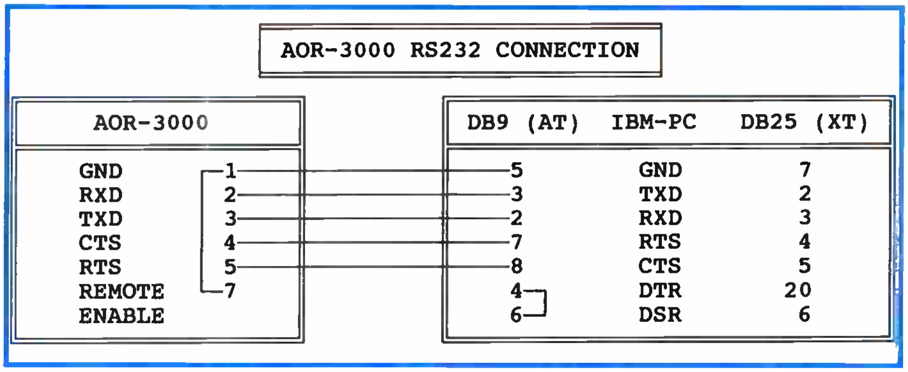
A computer controlled radio can provide some insights into characteristics of the radio spectrum. I have a friend, a consulting engineer, who needed to test the long-term reliability of some marine frequencies. He could have gone to his radio and tuned them in every hour or so, recording signal strengths in a logbook. Instead he employed an Icom IC-735 receiver/transceiver and a computer to check the frequencies automatically and record the results on disk. He just started the thing up and left it to do its stuff, unattended.

The author's AR-3000 scanning receiver. In this first of two articles he describes how to monitor its operation and control its reception simply and easily from a PC, using some short BASIC programs and an interface cable.

Those are only a few ideas; the possibilities are boundless. In this series of two articles we will look at the general techniques of communication between computers and radios, with some specific examples based on the AR-3000 scanning receiver and the above-mentioned Icom IC-735.

Although this isn't really a 'computer article', there will of necessity be some program listings which I'll try to explain clearly.

Most of the programs are really nothing more than demonstrations containing useful routines you can pinch for your own purposes (although there is a sneaky scanner). This whole project has grown to the extent that there's no way we can publish listings of all the



software that's been developed. Therefore I've decided to offer readers the lot on disk — routines and programs for AOR, Yaesu, and Icom radios, written in Basic, C, and Assembler, for computers such as IBM and its compatibles. If you live in Australia or New Zealand, send $25 to the author C/- 39 Pillinger Drive, Fern Tree, Tasmania 7054. You'll get in return a 5-1/4" MS-DOS disk containing all the source code plus compiled executable programs.

Talking/listening

It would be safe to say that just about all HF radio gear made today, as well as most VHF/UHF stuff of the base-station variety, has some kind of computer control feature. Some manufacturers are a big vague with the details, hoping to make you pay extra for the information you need to control your radio. Others (particularly Yaesu) disclose all in their instruction manuals.

Some early computer control schemes were one-way only; the computer could control the radio, but the radio sent nothing back to the computer. There was no way, for instance, to read the radio's current frequency without looking at the dial.

Nowadays it's just about all two-way. Your computer sends commands to the radio, and the radio changes its frequency or mode or memory channel or whatever. But there are many different ways a radio can respond back to the computer. Some will speak only when spoken to, issuing a message to confirm receipt of a command, or perhaps returning frequency data.

Other radios babble away all the time, and your computer must be able to handle this diatribe coming into it as it goes about its chore of sending commands out. The AR-3000 is a real motor-mouth. Still other radios let off a burst of data in response to something other than the computer.

Many Icom radios for instance send frequency and mode information toward the computer whenever you touch the tuning control or a mode button. You can either use this data, or discard it. You certainly can't ignore it, or the computer will go bonkers.

The physical connection between computer and radio is usually a serial line operating at TTL voltage levels (+5 and 0 volts). There may be one line incoming and one line outgoing. In the case of Icom, one wire is used for both directions, so every effort must be made to ensure both ends don't try to send at once.

Now let's look at specific applications. These will all involve the common IBM-PC type computer, although the techniques can certainly be applied with other machines. In the first instance the computer language used is good ol' GW-BASIC (for Gee Whizz), which comes with most IBM-PC type computers.

RESPONSE program

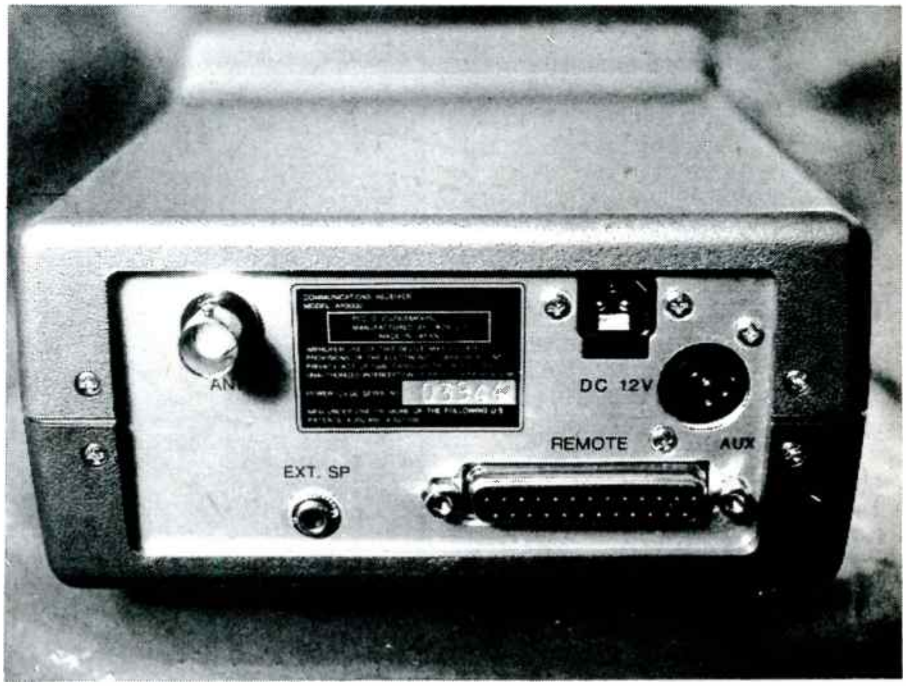
Before attempting computer control of a radio for the first time, you must know what kind of info the radio is going to send toward the computer in response to various stimuli. The radio may burst forth when it gets a command from the computer, or when you touch the radio's controls, or it may send continuously. Here's a little program (listing 1) that will let you see what the radio does on its own — that is, without any commands from the computer.

It's a little shortie only five lines long, if you ignore the explanation part. But we're going to analyze it in considerable detail, since it represents the basis of setting up a computer for receiver or transceiver control.

We begin by opening a communications channel, a standard and well-documented process in GW-BASIC. COM1 is the RS-232 port we will use, 4800 is the baud rate (make sure it is the right one for your radio), N is no parity, 8 is 8 data bits, and the two commas together signify the default number of stop bits, one.

The CS100 means use the clear-to-send line from the radio, but wait for 100 milliseconds before complaining about a communications error. DS and CD disable the other handshake lines which are NOT needed for radio control. They're normally used for modems only.

The statement in line 70 is a quick and dirty way to see if anything has come in on the RS-232 port before at-



The rear of the AR-3000 scanner, showing the DB25 interface connector at lower right. The table at the top of this page shows the connections required between this connector and the PC's RS-232 port for both a DB9 and DB25 connector.

tempting to read it. BASIC produces an EOF (end-of-file) indication when the port is empty; the program keeps running around in circles at line 70 until there's no EOF indication. It then assumes a character is present, reads it, and continues with the rest of the program.

Line 80 collects one byte from the RS-232 port. This form, INPUT$, will accept anything, not just proper ASCII characters, so you can look at information that the radio might send as straight binary data or binary-coded decimal. Line 90 converts the byte into a decimal number representing an eight-bit binary byte. The value is printed on the screen as a number between 0 and 255, followed by a space.

Line 100 makes the program look for another incoming byte. This keeps going until you force BASIC to stop with the CTRL-BREAK command. At 4800 bauds the screen will fill pretty quickly with byte numbers separated by spaces, so be ready to stop it smartly.

You can now inspect what your radio is telling you.

With a system like Icom's you will get a burst of data whenever you touch a control. The AOR AR-3000 sends data continuously. Look for repeating patterns, and for characters like carriage return (code 13) and line feed (code 10).

Once you KNOW for certain what the radio is sending, it's a lot easier to write a computer control program and make it work.

You must remember, especially when using BASIC, that you must take account of every byte coming in from the radio, even if you just receive it and then throw it away.

Now let's see how we can hook up the AR-3000 to a computer, to extend the radio's capabilities considerably:

AR-3000 receiver/scanner

Most radios require an external interface to convert the radio's TTL data signals to the RS232 standard (+10 and -10 volts) used by computers. But the AR-3000 has it built in. There's a 25 pin connector on the back of the radio, just like the one you'd find on a modem or printer.

The pinouts are pretty much as would be expected, except for a connection which must be made between pin 1 and pin 7 to energize the remote control facility. Interconnection is a bit tricky since the 'handshake' signals are used. Fig.1 shows the correct way to do it for both the AT- and XT- type serial port.

Listing 1: RESPONSE.BAS

```
10 REM This program waits for a
       byte
20 REM to come in on the line
       and then
30 REM displays its ASCII number.
40 REM Press <CTRL-BREAK>to stop
50 REM
60 OPEN "COM1:4800,N,8,,
       CS100,DS,CD" AS #1
70 IF EOF(1) THEN 70
80 A$=INPUT$(1,#1)
90 PRINT ASC(A$);" ";
100 GOTO 70
```

You can use the Response program to test out the connection, and see what the AR-3000 is up to during remote control. One thing that becomes evident is that the radio communicates in human-readable ASCII form instead of binary data. Knowing that, we can apply the next program:

SETMEM program

This is a little demo program (listing 2) showing how to select a memory channel in the AOR scanner, and what happens when you do. Most computer-controllable radios can do this, although every one does it in a different way.

Listing 2: SETMEM.BAS

```
10 REM Select a channel in the
      AR-3000 receiver and read
      its contents.
20 REM
30 INPUT "Channel number
      (0-99)";X
40 IF X<OR X>99 THEN 30
50 C$=STR$(X): C$=RIGHT$(C$,
    (LEN(C$)-1)): REM REMOVES
     LEADING BLANK FROM ENTRY.
60 IF LEN(C$) <2 THEN C$="0"+C$:
    REM ADDS A LEADING ZERO
    TO A SINGLE DIGIT.
70 OPEN "COM1:4800,N,8,,
    CS100,DS,CD" AS #1
80 I=INP(&H3FC)
90 I=I OR 2: REM TURN RTS ON
100 OUT &H3FC,I
110 PRINT#1, C$;"Z": REM THE
    COMMAND TO SELECT A
    MEMORY CHANNEL
120 FOR I=1 TO 10: NEXT I
130 IF INPUT$(1,#1) <>CHR$(13)
    THEN 130
140 LINE INPUT#1,A$: REM
    COLLECTS A WHOLE LINE OF
    ASCII FROM THE RADIO
150 I=INP(&H3FC)
160 I=I AND &HFD: REM TURN
    RTS OFF
170 OUT &H3FC,I
180 PRINT A$: REM PRINTS THE
    RESULT ON THE SCREEN.
190 CLOSE
```

Here the problem is to organize your data into a form the radio will accept. You can't just type 'channel 2' and expect it to go to channel 2. The AR-3000 wants to be told '02', with the leading zero, followed by the letter Z which is that radio's channel- select command.

We attack the problem at line 50 by immediately converting the entered channel number into an ASCII string. Then we use the RIGHT$ function to remove the leading blank from the string (actually space for a minus sign if the number is negative).

Line 60 looks to see if the string is only a single digit long, and if so, it adds a zero at the front. String C$ should now range from '00' to '99', a channel number ready to send to the radio.

First we must open the communication line, exactly as in the Response program. But then we must tell the radio we have something to send. One would expect this to happen as part of the OPEN procedure, but in GW-BASIC at least, this doesn't appear to be the case. So we must do it manually.

Each COM port has a RTS (request-to-send) line which connects to the CTS (clear-to-send) line on the other end. In the AOR scanner, this seems to be interpreted more as 'get ready, something is about to happen'. Lines 80, 90, and 100 set the RTS line high.

We immediately follow this with the channel number, set up earlier in the string variable C$, and then the letter 'Z' which is the AR-3000's set-channel command. These are sent to the radio via the PRINT#1 command.

The radio is then expected to respond, but here comes the cruncher: the microprocessor in any radio is usually pretty slow (there's no real need to be fast, and faster processors generate more noise), and the computer may be looking for a response before the radio has got its act together. This almost always produces a communications error, and the program bombs.

So, after the command is sent, we put in a little time delay (line 120) before trying to receive a response. Once the radio starts sending, it may emit a heap of gibberish before it gets to the information you want. The AOR scanner usually responds with a signal to indicate its squelch is closed, and perhaps a few other bytes, before it comes across with the goods.

Experiment via the Response program has shown that the radio sends a carriage return (ASCII code 13) before it finally sends the data we want. Line 130 keeps reading characters and

Listing 3: SCAN.BAS

```
10 REM "Learning scanner" for
     the AR-3000 receiver.
20 REM
30 CLEAR
40 ON ERROR GOTO 320:
   REM CONTINUE EVEN IF
   COMMS ERROR
50 OPTION BASE 1
60 DEFINT H,I,M,N
70 M=100: H=1: REM M = MAX
   CHANNELS IN FILE,
   H = NUMBER FOUND SO FAR
80 DIM TIMES%(M),
   STRENGTH$(M), FREQ(M)
90 INPUT "Start frequency
   (MHz)";F
100 INPUT "End frequency
   (MHz)";E
110 INPUT "Frequency step
   (kHz)";S
120 K=INT(F*1000): S=INT(S):
   E=INT(E*1000): REM
   CHANGES K & E TO kHZ
130 OPEN "COM1:4800,N,8,,
   CS100,DS,CD" AS #1
140 F=K: REM RESETS START
   ING FREQ INTO F AT THE
   START OF EACH SCAN
150 I=INP(&H3FC)
160 I=I OR 2: REM TURN RTS ON
170 OUT &H3FC,I
180 PRINT#1,USING "#####.###";
   F/1000;: PRINT#1," N"
190 FOR I=1 TO 10: NEXT I
200 IF INPUT$(1,#1) <>"A" THEN 200
210 INPUT#1,A$: IF A$<"%" THEN 210
220 I=INP(&H3FC)
230 I=I AND &HFD: REM TURN
   RTS OFF
240 OUT &H3FC,I
250 IF A$="%" THEN 320
260 PRINT A$;: PRINT USING
   "#####.###"; F/1000
270 FOR I=1 TO H: REM
   H=HIGHEST "FOUND"
   ENTRY SO FAR
280 IF F=FREQ(I) THEN
   TIMES%(I)=TIMES%(I)+1:
   GOTO 310
290 NEXT I
300 H=I: TIMES%(I-1)=1:
   STRENGTH$(I-1)=A$:
   FREQ(I-1)=F
310 IF I>M THEN 360
320 IF INKEY$<>"" THEN 360: REM
   TOUCH ANY KEY TO STOP
   SCANNER AND SAVE FILE.
330 F=INT(F+S): REM
   "FREQUENCY" INCRE-
   MENTED BY "STEP".
340 IF F<=E THEN 150: REM DO
   NEXT FREQ IF NOT PAST "END"
350 N=N+1: GOTO 140:
   REM N =
   NUMBER OF SCANS
360 OPEN "SCAN.LOG" FOR
   APPEND AS #2
370 FOR I=1 TO H-1
380 PRINT#2,TIMES%(I),
   STRENGTH$(I),USING
   "#####.###"; FREQ(I)/1000
390 NEXT I
400 PRINT#2,: PRINT#2,DATE$,
   TIME$," Number of complete
   scans: ";N
410 PRINT#2,
420 END
```

throwing them away until it has seen a CHR$(13).

At long last, the moment we've all been waiting for: the radio switches to the new channel and then sends a readout of everything to do with that memory channel, as a complete line of ASCII characters terminated by a carriage return. This is precisely the kind of thing the LINE INPUT#1 function in line 140 is looking for, so it reads the whole character string from the radio, just as if the radio had reached out with little fingers and typed the line on the keyboard and then hit ENTER.

Lines 150-180 turn the RTS signal back off again, and then the received string of characters is printed on the screen. In the case of the AR-3000 scanner, what you get is somewhat different from what the instruction manual says you will get. An example is:

#01XZ10000Y129610000Q

where:

#01 tells us we have just selected channel 1;

X means the attenuator will be switched off when using that channel;

Z10000 means the tuning step associated with that channel is 100.00kHz;

Y129610000 is the frequency, 1296.1MHz; and

Q is the code signifying narrow-band FM.

Another example shows how smaller numbers are formatted:

#02WZ 2500Y 43500000Q

where:

#02 — we've got channel 2;

W — the attenuator will be switched on for this channel;

Z 2500 — the tuning step is 25kHz (note the space...);

Y 43500000 — 435.0MHz (note the space again); and

Q — narrow-band FM.

Once you see what these responses look like, you can use the various BASIC string functions to pick the useful bits out of them; for instance, to read a whole bank of memory channels into a disk file. You can then use another program to write them back again later.

The SCAN program

Here we use computer control techniques to produce a dastardly thing called a 'learning scanner'. This program scans across a given block of frequencies, over and over, with a step size between channels which you specify. Every time it finds an active frequency it checks it against a list it is keeping, and if the channel hasn't been found before, it adds it to the list.

Fig.2: Typical log from SCAN.BAS

```
122    I    460.800
  4    E    461.025
 15    C    460.100
 12    G    461.325
  4    J    463.900
  8    C    463.600
  3    B    460.000
  1    D    460.050

10-19-1990    10:14:36
Number of complete scans:  121
```

If the channel is already on its list, the computer takes note of how many times it has been found as the scan repeats. It also records the relative strength of the signal. This goes on *ad infinitum*, for several hours if need be, until you press any key. The program then adds the new frequencies it has found to a disk file called 'SCAN.LOG'.

What you end up with is a list containing every active channel encountered during the run of the program, how many times it was encountered, and how strong it was. At the end of the list the computer adds the date and time the scan was stopped, and a count of how many times the frequency range was scanned. This can run up to several hundred times over a couple of hours.

What we really have here is a fairly slow-moving time integrating spectrum analyzer, if that's the correct term. It will do a detailed investigation of radio activity on a particular part of the spectrum over a given period of time. Among other things, the information will reveal what frequencies are active enough to deserve a permanent place in your scanner's memories.

Fig.2 is an example of how this works; it's the file generated by a scan of 460-465MHz in the commercial UHF band during the first hour or so of a working day.

There were 121 complete scans. The signal on 460.8MHz is a spurious generated by the radio; it shows 122 occurrences since scan number 122 had already started when the program was stopped.

The letters in the second column are the AR-3000 scanner's way of reporting signal strength, ranging from A (squelch just open) to L (very strong).

The channels 460.100 and 461.325 were fairly active during this time, both at reasonable strength. The 460.050 channel only appeared once, so it may have just been a burst of noise, although it was fairly strong with a level of 'D'.

The program uses techniques we have used before (listing 3). It first asks for the starting and ending frequencies for scanning, and then the step.

The step is entered as kHz, since this is common practice. But the start and end frequencies are entered as MHz so they must be converted to kHz before use. The whole system works in integral numbers of kHz, to prevent errors as the step is added each time.

The RS-232 channel is opened as before, and then the computer sends a 'set frequency' command to the radio. It then waits for a response, expecting a '%' if the squelch is closed (no signal) or a strength indicator between 'A' and 'L' if a signal is present.

If the response is '%' the computer simply adds the kHz step value to the current frequency and sends the new frequency to the radio with another 'set frequency' command.

If the frequency is active, the computer searches an array of memory locations containing frequencies it has already found active, and if the current one is there it simply increments a counter in the array 'TIMES'.

If the frequency hasn't been encountered before in the scan, it is added to the end of the array, along with its strength letter and a TIMES count of 1.

The program then goes back to the start of the scan, sending yet another frequency incremented by the step.

The arrays are set up to hold 100 active channels. This could of course be more, but 100 is a lot of 'new' channels to find in one session! If the array becomes full the program saves the whole works to a disk file and exits. Otherwise the user can stop it at any time by pressing any key.

Note that the RTS line is turned on only long enough to send a frequency and await a response, and then it is turned off again.

If the radio is allowed to send continuously the computer's RS-232 receiving buffer quickly becomes constipated, particularly during the time the computer is searching its array of frequencies it already knows about. When the buffer fills up the program will bomb out with 'Communications overflow error'.

Note that during all this activity the BASIC language will receive and store whatever comes in from the radio. We have tried to minimize this effect by switching the radio's data transmitter on and off. This bit of trickery seems to work, sort of, but it's still possible BASIC will complain about some small technicality in its RS-232 system and bomb out. The statement in line 50 is a safety net to catch the error and make the computer jump to the next frequency and press on regardless. It would be a shame to lose the whole record of activity after several hours of scanning.

These, then, are some pretty fundamental methods of controlling a radio from a computer. My only complaint is that they're not very elegant.

We have to trick BASIC into doing this or that, we have to rely on time delays to prevent the communications getting scrambled, and we even have to put in an error trap so the program continues to run even if something goes wrong. It works, but it's rough.

In the second of these articles we'll tackle Icom radios in a much more satisfactory way. We will go right down to the IBM's chip level with some custom machine-code RS-232 routines that are Icom-smart (you like that?).

We'll forget about BASIC and get into the 'C' language to produce some computer control procedures that are as smooth as a baby's bottom. ■

Experimenting with Electronics...

by PETER MURTAGH

2 — Flashing LEDs

Last month we used two transistors, acting as an oscillator, to make a simple siren. This month our two transistors will form a simple flipflop, which will flash two LEDs on and off at whatever speed you want.

As discussed last month, we will continue to limit our designs to using separate components and to power them with an ordinary 9V battery. And we will continue to give the physical layout for both strip-board and printed circuit board construction.

Also — following a reader's suggestion — from now on we will include a photograph of the circuit layout on a breadboard. The breadboard approach is ideal for the dedicated experimenter, because it allows easy interchanging of different value components as well as re-using these components in future projects. Breadboards consist of a plastic block containing several series of holes, electrically connected together in rows or columns. Beneath each hole is a small spring clip to grip the component.

The photo of our board shows the horizontal rows labelled A and B (four rows of 25 holes), with the vertical columns labelled a-e and f-j (two independent sets of 30 columns of five holes each).

The smallest breadboards we found advertised in catalogs cost between $11-$15. Not all boards are the same size, and not all include the horizontal rows as standard.

Decide what size you require, because the bigger the size, the greater the cost. But we do recommend that you end up with a board which has both rows and columns of holes, as shown.

Project No.2

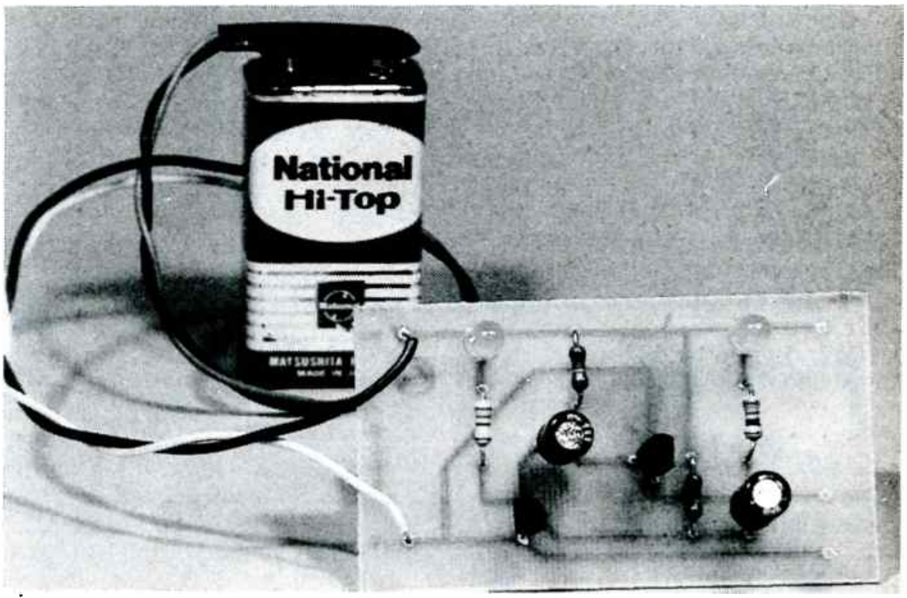
This month's circuit is a simple astable flipflop, or *multivibrator*. Two transistors are connected together so that they take it in turns to conduct, and switch on a LED. The time it takes for the two capacitors to charge and discharge determines how quickly the LEDs flash on and off.

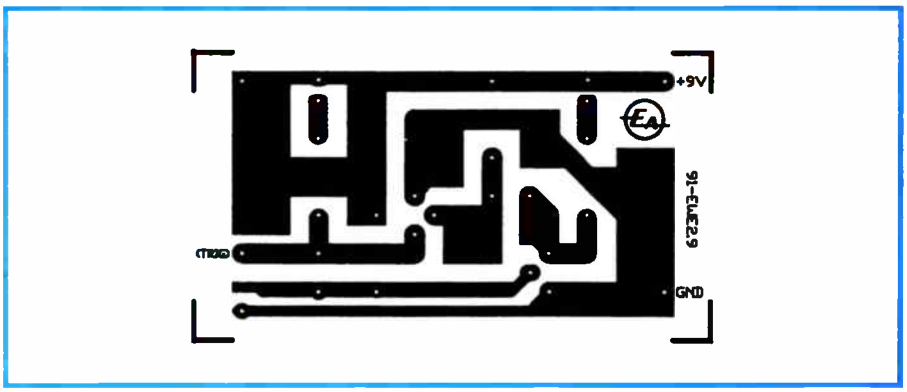
Next month we will use this month's flasher to replace the switch in last month's siren. This explains why the two patterns given in this article are larger, apparently, than they need to be.

Next month those extra rows of holes on the strip-board pattern or the extra terminals on the PCB pattern will definitely be needed.

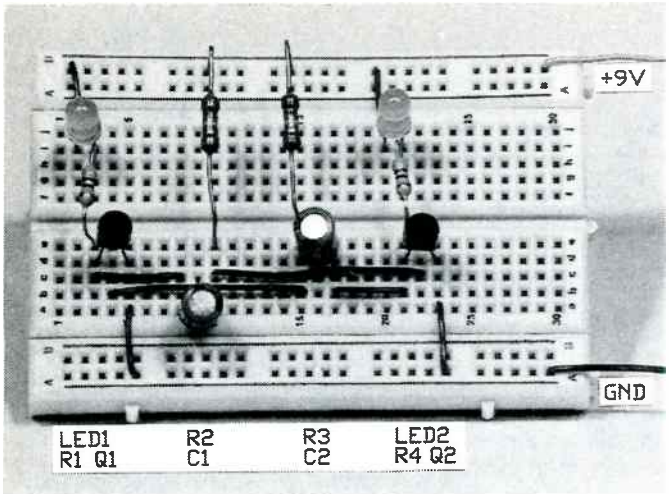
Construction

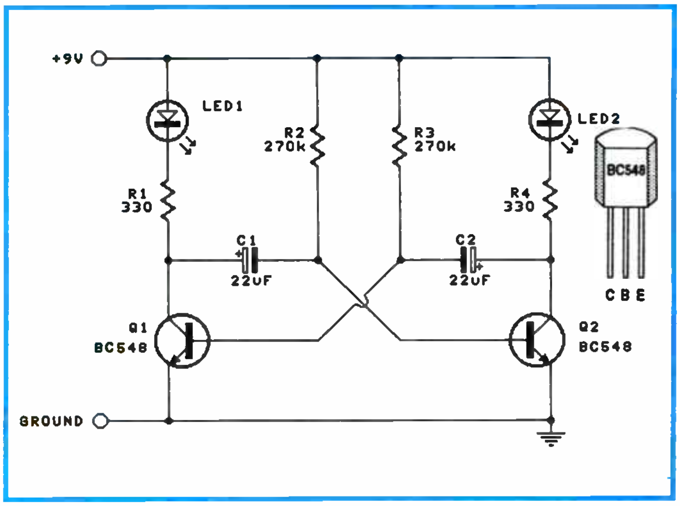
If you are using strip-board, first mark the spots on the copper strips where the tracks have to be broken. These are shown on Fig.1 with small crosses.





A full size reproduction of the PCB artwork for those who wish to make their own boards. The very heavy tracks reduce the amount of etching required, which will save both chemicals and time.





Using a breadboard is the ideal approach for experimenting with components of different values. It also allows all components to be re-used.

As well as helping you to understand the circuit, the schematic diagram should clarify any doubtful connections for breadboard users.

As explained last month, using the V-shaped tip of a 3mm (1/8") drill bit, just cut through the copper track at these points. Be careful not to damage the parallel tracks on either side, or drill right through the strip-board.

Insert and solder the resistors, capacitors, LEDs and transistors, making sure that capacitors C1 and C2, LED1 and LED2 and transistors Q1 and Q2 are all inserted the correct way around. Otherwise the flasher won't work.

How do you determine the correct orientation? Which lead is which? Start with the capacitors: the *negative* ends of the electrolytic capacitors are easy to identify, because negative signs are stamped on the casing, with an arrow head pointing to the negative lead. The LEDs: the *positive* leads on the LEDs are the slightly longer ones. And finally the transistors: the collectors on the BC548 transistors are on the left, as you look at the flat face of the transistor with its three leads pointing down (see schematic diagram). Having identified the various leads, refer to Figs.1 and 2 for the correct orientation.

Strip-board: In Fig.1 you can see that it is the negative ends of both capacitors that are shown closer to the top of the diagram, while it is the positive leads on both LEDs, and the collectors of both transistors, that are shown towards the top.

Printed circuit board: Fig.2 shows the negative end of capacitor C1 towards the right of the diagram, while the negative end of C2 is towards the bottom; the positive leads of both LEDs are closer to the top; the collector of transistor Q1 is towards the top, but the collector of Q2 is towards the bottom.

Note that this PCB design has thick rather than thin tracks on it, and, wherever possible, the copper has been left in all unused areas. This will save you time and money, as much less copper has to be etched away from the board. Having correctly inserted these components, solder them to the board. Then connect the battery, and the LEDs should flash. *Breadboard:* The photo shows how to position the various components. If you can't see exactly where to place every single component lead, then refer to the schematic diagram. This will tell you which components are joined to which, so it should not be hard to work out which holes to use.

Changes

The time constant which determines the flashing rate depends on resistor R2 and capacitor C1 for transistor Q2; on R3 and C2 for Q1. Our values of 270k and 22uF turn each light on for a bit over one second. The larger the resistor or capacitor value, the slower the LED

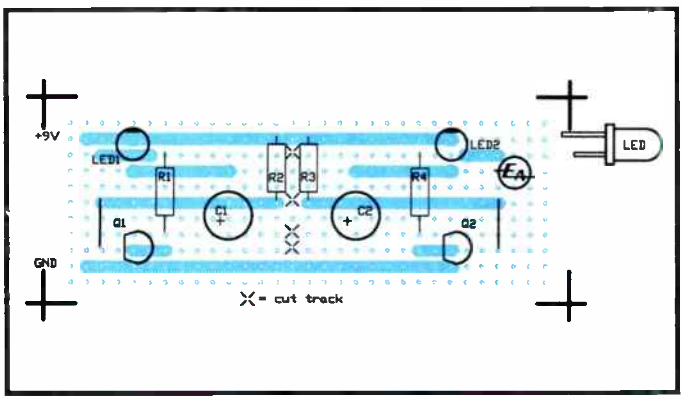


Fig.1: Where to insert components if you are using strip-board. Remember to leave the two extra columns of holes at the right for next month's project.

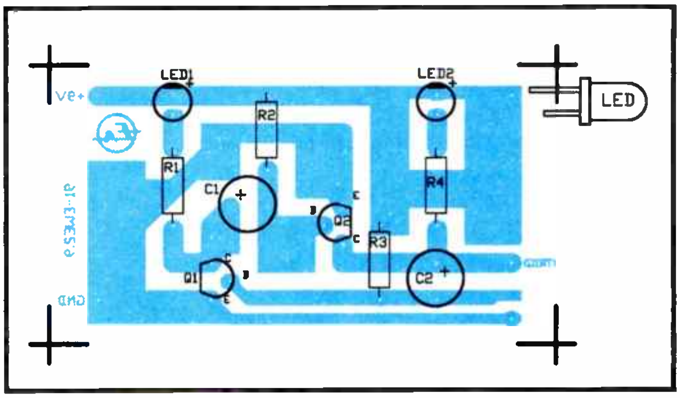


Fig.2: The PCB overlay. The 'TRIG' connection is also for next month's modification. Take care with the correct orientation of all components.

flashes. We tried capacitor values of 10uF, 22uF, 47uF and 100uF. This gave a reasonable spread of flashing times. Of course, similar variations can be obtained by changing the resistor values. And of course the two LEDs don't have to turn on for the same length of time either, so C1 and C2 or R2 and R3 don't have to be the same value.

Our final values of 270k and 22uF were chosen because they fit in with our plans for next month (mentioned early in this article). These two values give a suitable flashing rate for the rise and fall time of our siren.

PARTS LIST

Miscellaneous:

1 9V battery
2 LEDs

Resistors:

All 1/4W, 5%:
R1, R4: 2 330 ohm(orange-orange-brown)
R2, R3: 2 270k (red-purple-yellow)

Capacitors:

2 22uF 25V PC-mount electrolytic

Semiconductors:

2 BC548 NPN transistors

How it works

As soon as power is supplied, a small leakage current flows through the bases of transistors Q1 (via R3) and Q2 (via R2). The two capacitors C1 and C2 also start to charge up. This occurs before either of the two transistors start to conduct.

Theoretically, both transistors are identical, and so should both switch on together. But in practice small differences mean that one of them will start to conduct before the other. Let's assume that Q1 switches on first. Immediately before Q1 switches on, the positive ends of both C1 and C2 are about 5V and their negative ends are close to 0V (ground voltage). The moment Q1 switches on, its collector voltage rapidly drops to about 1V, which means that the voltage at the positive end of C1 also drops. But while the applied voltage can change very quickly, the charge stored in C1 cannot change so quickly — it takes time. So in order to maintain the same 5V potential difference between the two sides of the capacitor, the voltage at the negative side of C1 drops to minus 4V.

Also, since the -4V side of C1 is connected to the base of Q2, this negative voltage turns transistor Q2 hard off. Now the charge on C1 starts to leak away via R2. How long it takes depends on the size of C1 (how much charge is stored) and the size of R2 (how hard it is for the discharge current to flow). Our values of 22uF and 270k mean that this process is reasonably slow, taking a few seconds.

As this discharge current flows, the voltage at the right hand side of C1 gradually rises, until it reaches a level which is high enough to turn on transistor Q2. It is now capacitor C2's turn to react — it starts by turning Q1 off and then it too slowly discharges until Q1 turns back on. And so the cycle continues, with each transistor switching on and off in turn, and lighting up each LED in turn.

Transparencies

As mentioned last month, as a special offer for this series of projects only, *EA's* reader services will continue to offer high contrast, actual size transparencies (negatives) of PCB patterns for only $2 (price includes postage).

These negatives will make it a lot easier for those who wish to make their own printed circuit boards.

Happy experimenting — and don't forget to send us your ideas for future circuits. ■

THE SERVICEMAN

Continued from page 57

That cured the jitter, and the vertical hold control could now be set back to about mid-position. Now I had only to give the set a quick once-over to restore it to its former glory. Or so I hoped. The amount of green in the picture wasn't quite right, and the adjustment — R157 (4.7k 2W potentiometer) didn't provide enough range. Then the scrunching sound from the pot alerted me to the real problem. The wirewound element had burnt out where the wiper had been sitting.

I couldn't find a suitable replacement pot, so I fiddled the values of a couple of 1W fixed resistors until I was able to restore the green content of the picture to more or less normal. I was just finishing off the colour adjustments when the blue failed momentarily. This was another fault which I hadn't seen earlier. A hard thump to the side of the cabinet (I was becoming very frustrated by this time) revealed that it was a mechanically sensitive fault. After much tapping I narrowed the fault to the picture tube base board. It was so touch sensitive that I couldn't narrow it down any further. I measured the various voltages associated with the blue gun, where the socket pins were soldered to the board. They remained steady, even when the fault was present. After all the hours I had spent on the set, I hoped that it wasn't going to be a fault in the tube itself. I unplugged the board from the picture tube, and the cause of the fault fell to the floor. One of the connectors in the picture tube socket was in three pieces. The metal of the connector wasn't corroded, just broken.

My guess is that when the board was fitted to the tube base at some stage, possibly even in the factory, the pin had missed the centre of the connector and had slid up beside the metal connector clip, breaking it off but still allowing electrical contact. It must have been just holding on, and when I replaced R157 I disturbed the board enough to finally break the connection. Luckily, I had an old valve socket from which I was able to salvage a suitable connector. Adjusting the convergence and geometry was a little tricky. I didn't have a pattern generator and while SBS broadcasts a test pattern, the UHF reception in our flat was horrible and then relied on downconverting the signal in a video recorder. It wasn't a practical proposition.

However, all was not lost. I have access to a Commodore 64 computer with a modulated RF output, so a small BASIC program was quickly written to generate the required patterns. You can't easily use modern PC's with their various video modes to do that sort of thing, so the old Commodore seemed most appropriate for the Philips. So at last I had a fully functional set, for the total cost of about $20. I don't know which fault had caused the set to be junked in the first place, especially given that the power supply was disconnected, albeit without any apparent fault. I wonder how many otherwise quite functional sets have been junked for the want of replacing a handful of deteriorating components and a general overhaul.

Thanks, K.D. I enjoyed that story, and I'm sure our readers did too. It just goes to show that old sets need not die. All they want is a bit of 'TLC' to restore them to the bosom of the family! Like K.D., I wonder what the original fault was in the K9. In fact, it must have been in a horrible condition even before it was junked. Why don't owners get minor faults fixed, before they become major ones?

That's all for now. I'll be back next month with more stories from the service workbench. ■

Construction Project:

SSB Receiver for the 80m amateur band - 1

Here's the first of two articles presenting the design for an SSB receiver for the 3.5-3.7MHz amateur band. The design is simple and inexpensive, yet offers good performance. It should be an ideal project for the newcomer looking for a simple first receiver, as well as the experienced amateur who would like to build a second receiver.

by LEON WILLIAMS, VK2DOB

Before I obtained my amateur licence, I built a simple direct conversion receiver that tuned to the 80-metre amateur band. With it I listened to many amateurs far and wide, using both phone and Morse.

The thrill of building your own receiver, hearing those first signals and adjusting it for best performance has remained with me all these years. After I passed my licence I made my first contacts using the same receiver and a companion DSB transmitter. What has become apparent to me is that you do not need a complicated and expensive receiver to receive signals adequately on the 80m band. Indeed at night, when signals of S9 plus abound, even the simplest receivers coupled to a good antenna work very well.

There has been much talk recently about the lack of home construction of equipment by amateurs. This project aims to stimulate amateurs and prospective amateurs to construct a receiver, and have the satisfaction of saying 'I built it myself'.

The receiver to be described is a superheterodyne ('superhet') design, meaning that the signal frequencies are heterodyned or mixed with a variable frequency oscillator to provide a fixed intermediate frequency.

This has the advantage over a direct conversion receiver that the main gain stage and bandwidth determining components can be tuned to a single fixed frequency. For a single-sideband or SSB receiver this allows the use of a narrow band crystal filter to filter out the unwanted sideband.

Normally a superhet receiver is relatively complex, but this receiver takes advantage of modern ICs to simplify the design and construction considerably.

The receiver is designed around the NE602, an eight-pin IC made by Signetics and reasonably priced. In fact two of these chips are used, and I obtained mine from Stewart Electronics. Inside the NE602 is a self biased double-balanced mixer, as well as an oscillator directly feeding the mixer.

I estimate that currently the receiver should cost around $110 to build, assuming that you buy all new components but etch the PCB and fabricate the metal case yourself as described in the second of these articles. This cost is very low considering the order of performance it provides.

Block diagram

Fig.1 shows the block diagram of the receiver. The 3.5 to 3.7MHz signal from the antenna is first applied to a two-pole bandpass filter (BPF) that passes the tuned signal, but greatly attenuates unwanted out of band signals.

The wanted signal is coupled to the first NE602 mixer IC1. Here it is mixed with the 4.5 to 4.3MHz variable local oscillator to produce an intermediate frequency of 8MHz.

This is then filtered by the crystal sideband filter to remove the unwanted sideband. From here it is amplified by IC2 the IF amplifier. The gain of this stage is made adjustable, to try and even out the audio level from received signals of greatly varying strengths.

The signal from the IF amplifier is then fed to IC3 (the second NE602), where it is mixed with an 8MHz beat frequency oscillator (BFO) to produce the audio signal.

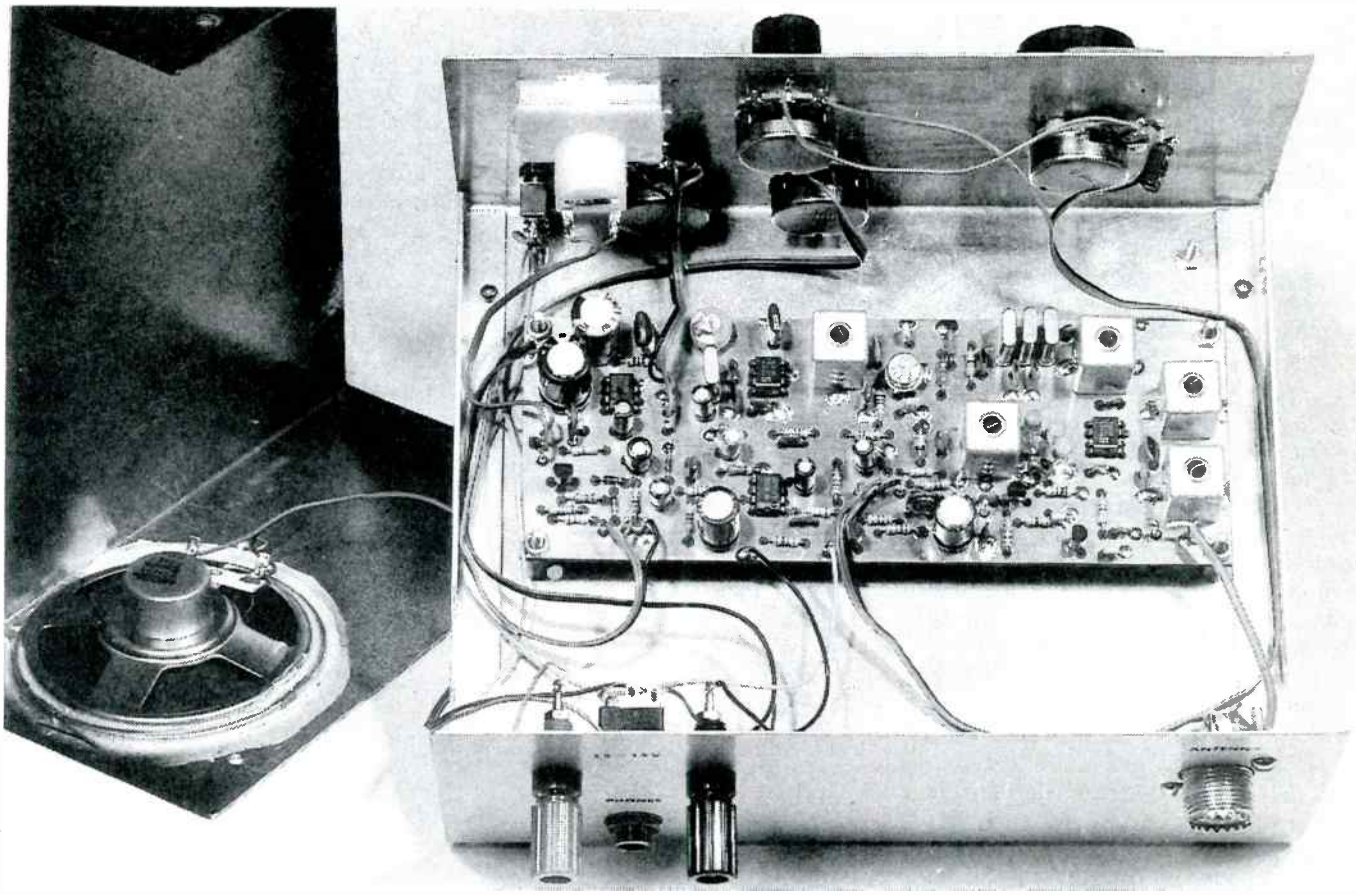
The low level audio signal from IC3 is amplified by IC4a and then split in two directions. One output goes to the volume control and onto the audio power amplifier IC5, to drive the speaker or headphones.

The other is further amplified by IC4b and rectified to produce a DC voltage proportional to the received signal, which is fed back to the control pin of IC2 to achieve automatic gain control (i.e., audio-derived AGC). The DC produced from the rectified audio is also used to drive the receiver's S meter, as shown.

Circuit description

Now let's look at the circuit of the receiver in more detail. The complete schematic is shown in Fig.2. The signal from the antenna is link coupled by L1 to the first bandpass filter L2 and C1. The ratio of L1 and L2 matches the the 50-ohm antenna impedance to the loaded impedance of the filter. C3 and L3 form the second bandpass filter, which is capacitively top coupled to the first by a small capacitor C2.

In practice the two filters are tuned to slightly different frequencies, to obtain a broad response for the 80m band but with steep sides. L4 matches the input



A general view inside the receiver, showing where everything goes. Most of the components are mounted on a compact printed circuit board measuring 170 x 64mm. The only exceptions are the front panel controls, S-meter, rear panel connectors and the speaker — which mounts in the lid.

impedance of the mixer IC1 to the second filter. As mentioned earlier, IC1 contains a mixer as well as an oscillator. The data for the NE602 shows a range of supply voltages from 4.5 to eight volts. This design uses IC6 as a regulator for IC1, which provides five volts; C5, R1 and C4 provide further filtering.

Pins 1 and 2 are the input pins to the mixer, and pins 4 and 5 are the output pins. This design has used the inputs and outputs in a balanced configuration, which aids in both performance and stability. The oscillator connections are at pins 6 and 7, with pin 6 the base and pin 7 the emitter of a transistor. Normally this device would use a crystal or a frequency synthesizer here, but to keep things simple I have used the internal transistor to form a voltage-controlled Colpitts oscillator. C12 and C14 are the main feedback components while C11 couples to the tank components L5 and C13.

Frequency variation is accomplished by using a variable capacitance diode D1 and varying the voltage across it. The diode used is in fact a 15V 1W Zener diode, which is easier to find and cheaper than a dedicated Varicap, and in this circuit works just as well.

Obviously it is very important to ensure that the voltage source used for tuning D1 is clean and stable. This role is filled by IC7, another 78L05 three-terminal regulator connected to provide about 9 volts. Its output voltage is stepped up by resistors R3 and R4, while C7, C8, and C9 help to filter out any noise that may otherwise cause frequency modulation of the oscillator.

VR2 is the main tuning control, while VR1 is the fine tuning control which varies the tuning voltage by a smaller amount. Preset pot VR3 is used to set the frequency range, while R5 is used to make the tuning more linear over its range. The output signal from IC1 is filtered by L6 and C6 to pass the 8MHz sum frequency and reject the 1MHz difference frequency. L7 couples the IF signal to the crystal sideband filter, with R6 and R7 ensuring a proper termination.

The crystal filter used here is called a crystal ladder filter, and is different from most lattice type filters in that all the crystal elements are on the same frequency. This filter has become very popular among experimenters, due to the availability of cheap crystals that are mainly intended for computers.

The value of the coupling capacitors C20 - C23 were found by experiment and have remained unchanged even after using different batches of crystals. This arrangement provides a very good filter at an affordable price.

Notice that due to the choice of the

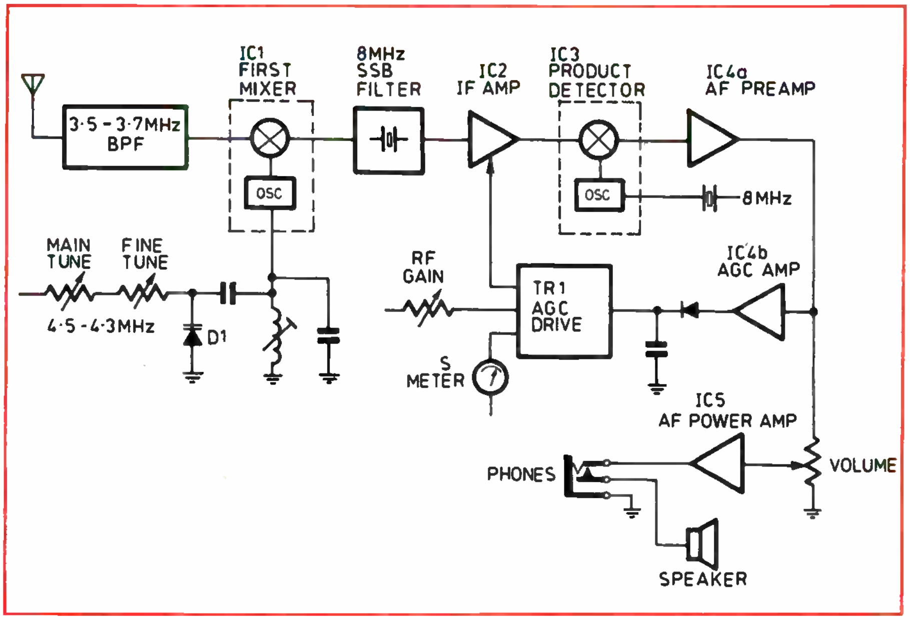


Fig.1: The overall block diagram of the receiver, which tunes from 3.5 to 3.7MHz. A pair of NE602 chips are used, one for each oscillator-mixer.

PARTS LIST

- 1 PC board, 62mm X 170mm, code 91rx9
- 1 Metal case, 200 x 90 x 170mm (W x H x D)
- 1 76mm round loudspeaker
- 1 S meter, 250 uA min. edgewise type
- 1 Miniature SPDT toggle switch
- 4 8MHz crystals (X1-4)
- 5 5mm coil former assemblies with cans (L1, L2, L3, L4, L5)
- 1 SO239 socket, panel mounting
- 2 Binding posts, 1 red and 1 black
- 1 6.5mm stereo phone socket with DPDT switch

Resistors

All 1/4W 5%:

- 1 10 ohm (R25)
- 1 22 ohm (R1)
- 3 100 ohm (R8, R20, R28)
- 1 150 ohm (R4)
- 2 220 ohm (R3, R13)
- 2 330 ohm (R6, R7)
- 2 560 ohm (R11, R12)
- 1 1k (R27)
- 1 1.2k (R9)
- 1 1.8k (R23)
- 2 2.2k (R10, R16)
- 1 3.3k (R24)
- 3 4.7k (R5, R14, R15)
- 1 15k (R21)
- 1 22k (R18)
- 1 27k (R22)
- 1 47k (R2)
- 1 68k (R17)
- 1 470k (R19)
- 1 1M (R26)

Potentiometers

- 1 200 ohm trimpot (VR6)
- 1 500 ohm linear pot (VR1)
- 2 10k linear pot (VR2, VR5)
- 1 10k log pot (VR4)
- 1 20k trimpot (VR3)

Capacitors

- 1 4.7pF ceramic (C15)
- 1 18pF ceramic (C2)
- 1 47pF polystyrene (C13)
- 1 56pF ceramic (C30)
- 7 100pF ceramic (C6, C20-23, C26, C39)
- 1 120pF ceramic (C31)
- 3 330pF polystyrene (C11, C12, C14)
- 2 470pF ceramic (C1, C3)
- 3 1nF ceramic (C17, C35, C10)
- 2 47nF greencap (C32, C44)
- 11 0.1uF monolithic (C4-5, C9, C16, C18, C24-25, C27-28, C34, C37)
- 1 1uF 16VW electrolytic (C38)
- 5 10uF 25VW electrolytic (C7-8, C29, C36, C43)
- 1 22uF 16VW electrolytic (C40)
- 1 47uF 16VW electrolytic (C41)
- 2 220uF 25VW electrolytic (C19, C33)
- 2 470uF 25VW electrolytic (C42, C45)
- 1 60pF horiz. mount trimmer (VC1)

Semiconductors

- 2 NE602 mixer/oscillator (IC1, IC3)
- 1 CA3028 RF amplifier (IC2)
- 1 LF353 dual low noiso op-amp (IC4)
- 1 LM386 AF power amp (IC5)
- 2 78L05 5V voltage regulator (IC6, IC7)
- 1 MPF102 FET (TR2)
- 1 BC548 transistor (TR1)
- 3 1N914 diode (D3-5)
- 1 5.6V 1W zener diode (D2)
- 1 15V 1W zener diode (D1)

Miscellaneous

4 x knobs, 1 large and 3 small; scrap of perspex sheet for dial pointer; 18 x PCB pins; 4 x 12mm brass spacers; 3mm screws and nuts; white card for dial; hookup cable, ribbon cable, shielded cable, earth lug.

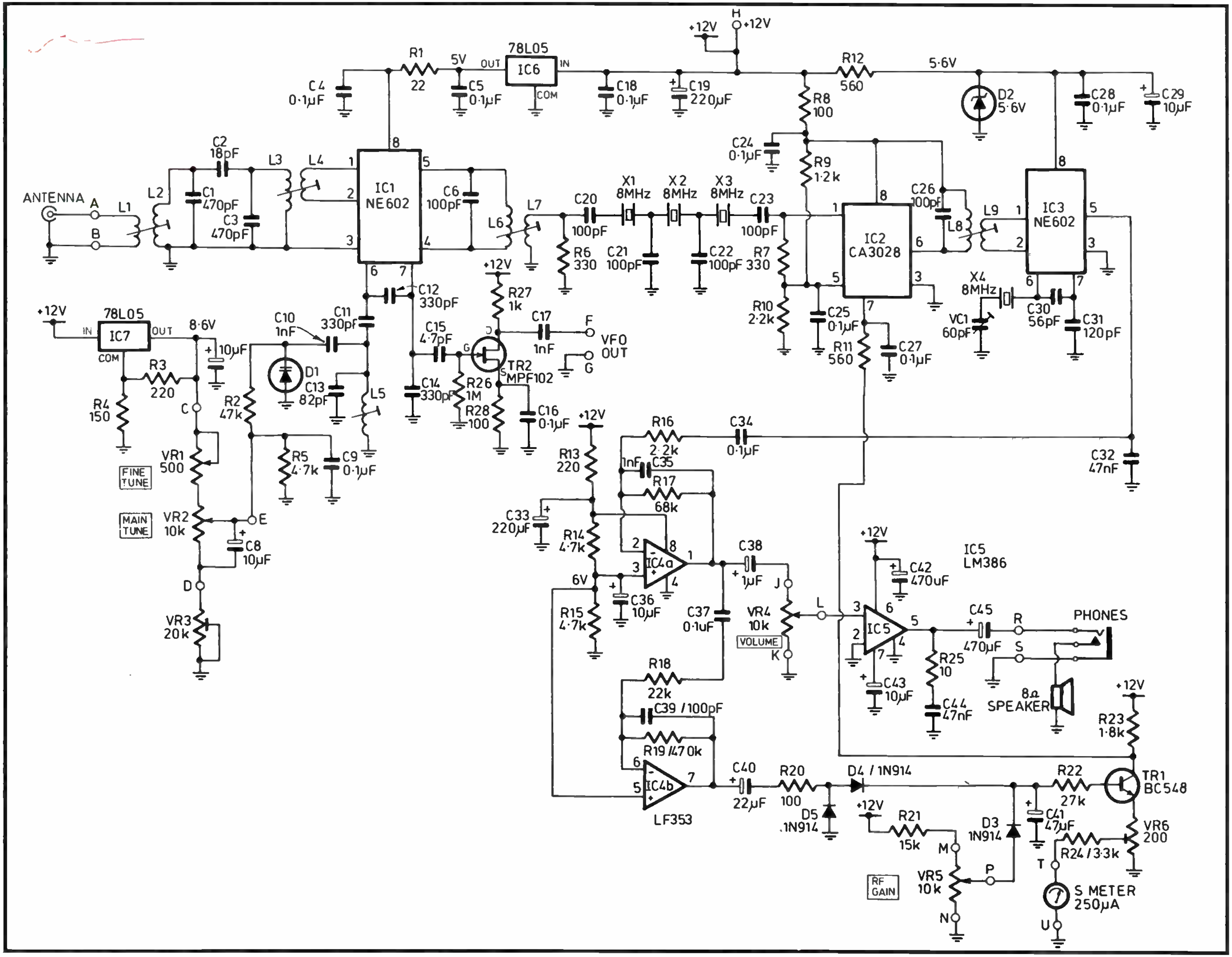


Fig.2: *Here's the complete schematic for the receiver. As you can see, it's quite straight forward — thanks to the use of the NE602 chips for the oscillator-mixer stages, and the CA3028 chip for the IF gain stage. The FET buffer stage around TR2 allows the first local oscillator output to be measured with a counter if desired, without disturbing its operation.*

SSB Receiver

mixing frequency there is no sideband inversion — that is, the LSB 3.5MHz received signal becomes a LSB 8MHz signal. This is important, because the slope of the filter is not as steep on the low side as the high side.

The 8MHz IF signal emerging from the crystal filter is then amplified in IC2, a CA3028. This is about the only device available at the moment that is a stand-alone RF amplifier with gain control, at a reasonable price. Pin 7 is the gain control pin and exhibits maximum gain with about 10 volts applied and minimum gain at around 2 volts. The output is at pin 6 and filtered here by L8 and C26.

L9 link couples the IF signal into the balanced inputs of the product detector IC3. IC3 is again a NE602, as used for the first mixer, and as before two frequencies are mixed to obtain the wanted frequency. The difference here is that the wanted frequency is audio, rather than radio frequencies.

The beat oscillator uses a 8MHz crystal X4, with feedback components C30 and C31. VC1 is used to pull the crystal frequency to the upper side of the sideband filter frequency response.

The recovered audio signal appears as output on pin 5 and the HF components are filtered out by C32. The power supply requirements this time are less stringent and so a zener diode D2 is used, to provide about 5.6 volts.

The low level audio signal is then amplified by IC4a, one half of an LF353 dual low noise op-amp. R16 and R17 set the gain at about 30. R14 and R15 set a half-VCC point for the non inverting input of the op-amps, and is filtered by C36. The values for C34, C35 and C38 are chosen to roll off the audio frequency response. The output of IC4a is applied to the volume control and then fed directly to the audio power amplifier IC5. A LM386 is used here, and provides enough output to drive a speaker or headphones for most situations. Also connected to the output of IC4a is the AGC amplifier, which uses IC4b the other half of the LF353. The gain of this stage is set to about 20 by R18 and R19.

The output at pin 7 is capacitively coupled to a voltage doubling rectifier D4, D5 and C41. R20 is used to limit charge current and avoid overcharging with a strong quick change of input signal. The DC voltage developed across C41 supplies base current to TR1 through R22. Trimpot VR6 supplies a current proportional to the recovered audio, and hence the input signal, to drive the S meter. The AGC system works as follows. With no signal at the antenna terminals, there will be very little audio signal at IC4b pin 7 and hence minimal DC across C41.

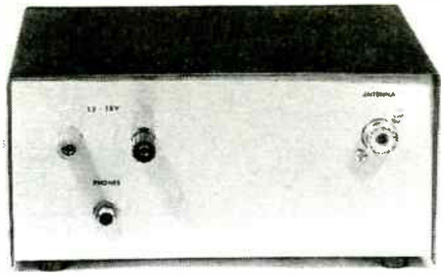
Transistor TR1 will be turned off, and its collector voltage will approach 12V. As the collector is connected to pin 7, the gain control pin of IF amplifier IC2, this high voltage will cause IC2 to operate with its highest gain. When a signal is tuned in, audio appears at IC4b pin 7, is rectified and C41 develops a corresponding DC voltage across it.

This provides base current for TR1, which draws current through R23 and hence its collector voltage drops. The lowering of the collector voltage in turn lowers the gain of the IF amp. This system results in a relatively constant output level for a large change in antenna input levels. As this is an audio-derived AGC system rather than an RF-derived circuit, there are some shortcomings typical of these circuits.

For example it can have trouble coping with very strong signals. This is the reason for the inclusion of RF gain control VR5, which is used to apply a voltage to C41 via D3 — adjustable between zero and just under the maximum that the AGC system will deliver. This stops the capacitor from discharging in between breaks in signal, and therefore avoids 'pumping'.

I have found this circuit to work very well, and the RF gain control is not required very often. It is, however, handy under noisy band conditions — where the RF gain can be reduced with the RF gain control to mask the noise, and allow the desired stronger signals through. The oscillator in IC1 is very sensitive to loading on pin 7. If it is required to measure the frequency at this point, either during alignment or as a permanent connection for a frequency counter, a buffer circuit is needed.

This is formed by TR2 and its associated components. Pin 7 of IC3 is not as sensitive to loading as IC1, and may be coupled to directly using a small capacitor (to drive the balanced modulator of a matching transmitter for example).



The rear panel is not exactly cluttered. The battery connections and phone socket are on the left with the antenna input on the right.

Construction

The complete receiver, including a 76mm speaker, is built into a compact metal case measuring 200 x 90 x 170mm. And inside the case, most of the components mount on a double-sided PC board measuring 170 x 64mm, and coded 91rx9. The only components not mounted on the board are the various front-panel controls, the S meter, the rear-panel connectors and the speaker. As this design is specifically intended to encourage home construction, we'll be describing virtually every aspect of making it — including etching your own PC board, and building up your own metal case.

You won't need to do either of these if you don't want to, as suitable ready-made cases are already available and it's almost certain that etched PC boards will be produced by manufacturers such as RCS Radio and Jemal.

But there's a special satisfaction to be gained by doing these things for yourself, so why not give it a try?

We'll begin in the next article with etching your PCB, following this with wiring it up, making the case, final assembly and then testing and alignment. I hope you'll stay with us. In the meantime, the full parts list for the receiver is included in this article to allow you to start acquiring the components you'll need.

(To be continued) ■

ROD IRVING ELECTRONICS - No.1 FOR COMPONENTS

008 335757 HOTLINE

ROD IRVING ELECTRONICS

BNC PLUGS AND SOCKETS

BNC MALE PLUG

	1-9	10-99	100+
P10514	$2.50	$2.25	$1.50

BNC PANEL SOCKET

	1-9	10+	100+
P10516	$2.50	$2.25	$1.50

BNC CRIMP PLUG

	1-9	10-99	100+
P10530	$2.95	$2.75	$2.00

BNC SOLDERLESS TWIST ON PLUG

	1-9	10-99	100+
P10531	$2.50	$2.25	$2.00

CANNON PLUGS AND SOCKETS

CANNON TYPE 3 PIN CHASSIS MALE

	1-9	10-99	100+
P10962	$3.50	$2.95	$2.50

CANNON TYPE 3 PIN LINE FEMALE

	1-9	10-99	100+
P10964	$3.95	$3.50	$2.90

CANNON TYPE 3 PIN CHASSIS FEMALE

	1-9	10-99	100+
P10966	$4.95	$4.50	$3.50

CANNON TYPE 3 PIN LINE MALE

	1-9	10-99	100+
P10960	$4.50	$3.50	$2.50

COMPUTER CABLES

- Six conductor shielded computer interface cable.

	1-9M	10M+	100M+
W12670 - CIC6 6 con.	$1.30M	$1.10M	$1.00M
W12672 - CIC9 9 con.	$1.60M	$1.50M	$1.20M
W12674 - CIC12 12 con.	$2.50M	$2.20M	$1.90M
W12676 - CIC16 16 con.	$3.50M	$3.20M	$2.50M
W12678 - CIC25 25 con.	$3.90M	$3.40M	$3.00M

Put a few of these in your parts box! CRYSTAL SPECIALS

	1-9	10-99	100+
Y11007 2.304 MHz	$2.00	$1.50	$1.00
Y11009 2.7648 MHz	$2.00	$1.50	$1.00
Y11018 3.93216 MHz	$1.50	$1.00	$0.75
Y11025 4.75 MHz	$1.50	$1.00	$0.70
Y11033 5.0688 MHz	$1.00	$0.75	$0.50
Y11045 6.667 MHz	$1.00	$0.75	$0.50
Y11061 10.6445 MHz	$1.00	$0.75	$0.50
Y11082 18MHz	$1.00	$0.75	$0.50
Y11100 27MHz	$1.00	$0.75	$0.50
Y11105 32MHz	$1.00	$0.75	$0.50
Y11110 36 MHz	$1.00	$0.75	$0.50

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Transmitter L19990.......	$2.95	$1.95
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WOW ! FROM $1.00

D TYPE IDC PLUGS

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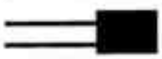
	1-9	10+
RED 5mm Z10159	$1.10	$1.00



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12V DC. 1.7 Watt 0.14 Amp
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Independance: 8 ohms.
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Q10560 MU650-20V	$12.95

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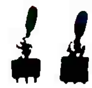
2SK134	$6.90	$6.50
2SK176	$9.50	$8.90

TOGGLE SWITCHES



	1-9	10+
S11010 S.P.D.T	$1.20	$1.10
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H11800 ..10g...$2.00
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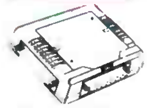
POCKET AUTO AB SWITCHES



- 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

WIRELESS MICROPHONE

Tuneable:92-104MHz
Freq response: 50-15kHz.
Range: over 300 feet in open field.
A10450..........$24.95

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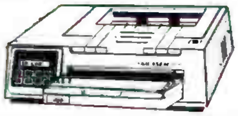

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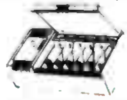
High strength corosion resistant aircraft grade aluminium construction.
- Durable anodized abrasion resistant finish.
- Non-slip knurled grip.
- Adjustable light beam angle.
- Key ring tail cap
- Spare bulb in side tail cap

Mini size - length 87mm
A15066....................$9.95
pocket size - 150mm
A15068....................$11.95



NBC-2 BATTERY CHARGER

Nickel cadmium battery charger for charging up to six batteries simiitaniously. Charges UM3, UM4, & UM5 nicads. Charging circuits are automatically selected depending on the physical size of the battery and the charger. Charging time 10-14 hrs. 240V AC mains operated. Requires NM4 or NM5 charging modules if UM4 or UM5 batteries are to be charged.
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INDOOR ANTENNAS

UHF/VHF/FM INDOOR TELESCOPIC ANTENNA
- High gain 75 ohm coaxial cable antenna with separate UHF & VHF dipoles
- Built in UHF/VHF mixer
- Frequency range 40-890MHz

L15033.............$24.95

UHF/VHF/FM TUNABLE INDOOR ANTENNA
- 75 ohm coaxial cable antenna with separate UHF and VHF dipoles / receivers.
- Built in UHF/VHF mixer
- Frequency range: 40-890MHz

L15038.............$41.95

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300 mA PLUG PACK
- 240 volt AC input to switchable DC output
- 1.8 metre cord with interchangable plugs
- Polarity reversable plugs and sockets
- Supplied with 1/1.3/2.1/2.5mm Dc and 2.5/3mm phone plugs

M19004.............$23.95

500 mA POWER PACK
- 240 Volt AC input to 500mA DC output
- 1.6 metre cord with unique plug system
- Polarity reversable socket
- 2.5/3.5 phone & 2.1/2.5mm DC plugs supplied.

M19005.............$23.95

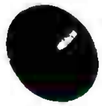
SPEAKERS

8" DOPED PAPER CONE
- High compliance rubber surround.
- 45 watts RMS
- Dark grey cone
- Black dust cap
- Black round frame

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

10" HIGH POWER WOOFER
- With ribbed black paper cone. • 40 watts
- Black dust cap
- Cloth edge
- Rubber mounting seal

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



10" DOPED PAPER CONE
- High compliance rubber surround.
- 60 watts RMS
- Dark grey cone
- Black dust cap
- Black round frame

C10238..........$59.95

AUDIO ACCESSORIES

EL CHEAPO HEADPHONES

For those who don't require expensive high performance headphones, these economical headphones are ideal.
A14001............$9.95

AUTOMATIC CASSETTE HEAD CLEANER

Cleans head (rec/pb) with mechanical action. Also cleans capstan and pinch roller at the same time. Includes bottle of cleaning fluid.
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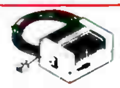
CASSETTE SALVAGE AND REPAIR KIT

Complete set of repair parts. Also containing mylor splicing tape with splicing bar and razor blade.
A10009............$3.95

TELEPHONE ACCESSORIES



TELEPHONE EXTENSION BELL

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Colour: Cream
5 metre length extension cord.
Features US type plug. Use with Y16025 US/ Australian adaptor.
Y16042............$29.95

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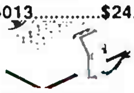
Allows 15 metres of telephone cable to be neatly wound in a portable storage container.
Colour: cream.
Y16013............$24.95



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MINI STEREO EARPHONES

Impendance: 32 ohms
Sensitivity: 96dB
Freq. response: 40-10,000Hz
Cord length: 1.2m
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POPULAR DELUX HEADPHONES

These headphones have large soft ear cushions as well as having individual left & right channel volume control.
A14005...........$34.95

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

L15040.............$9.95

MIXERS

FIVE CHANNEL STEREO AUDIO MIXER
- Compact portable mixer with independant bass and treble controls and 2 power analogue output VU meters.
- 2 x stereo magnetic turntable inputs
- 2 x stereo line inputs
- Output sockets for both amplifer and tape deck.

A12013.........$249.95

FOUR CHANNEL STEREO AUDIO MIXER
- Compact portable desk mount or panel mounting stereo mixer with 5 band graphic equalizer and twin LED display VU meters.
- 3 x stereo magnetic turntable inputs switchable
- 3 x stereo line inputs-switchable
- Headphone monitoring on all channels
- 18 dB talk over switch
- Output sockets for both the amplifier and tape deck

A12012.........$399.95

6/9/12 VOLT DC 500MA PLUG PACK
- 240 V AC input to regulated 6/9/12 volt DC output.
- Specially designed for Walkmans & portable audio
- Intergrated circuitry prevents audio system hum.
- 1.8 metre cord with interchangable plug system.

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240 V AC input to 13.8 V DC output
- Designed specifically for alarm panels
- 1.8 metres with bared ends.

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- 240 V AC Input to regulated 12 V DC output
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8" FULLRANGE
- Twin cone speaker with white paper cone ideal for public address column speakers.
- 30 watts RMS
- Foam edge
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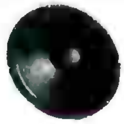

12" HIGH POWER WOOFER
- With ribbed black paper cone • 50 watts
- Black dust cap
- Cloth edge
- Rubber mounting seal

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

6" HORN & LINE X'FORMER
- Weatherproof plastic horn with 100 volt line transformer
- 15 watts RMS
- Adjustable metal bracket

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

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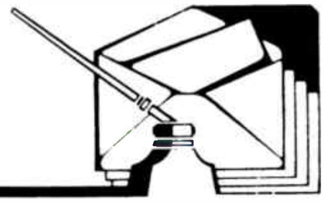


Encouraging the next generation

We're not short on variety this month. From basic circuits to current generation CD players — we cover them all. But the main thrust seems to be letters from young readers, a trend I hope to encourage. And there's also a bit of argument thrown in, I'm glad to say.

It's always gratifying to receive letters from younger readers. I try to publish at least one each month, as one of the roles of *EA* is to provide information for beginners in electronics.

That's not to say we older readers can't learn, but it's somewhat sobering to realise how much a beginner has to learn these days. It's no longer a case of read a few books, experiment with some bits and pieces, then hang out the 'Technician' sign.

I can still remember the day, many years ago now, when my father woke up one morning and gleefully announced that 'he had figured out how TV sets work'. The next week he resigned his job and went into the TV repair business. His training was minimal, but his customer satisfaction was sufficiently high to feed the family. Try that now, and see how far you get!

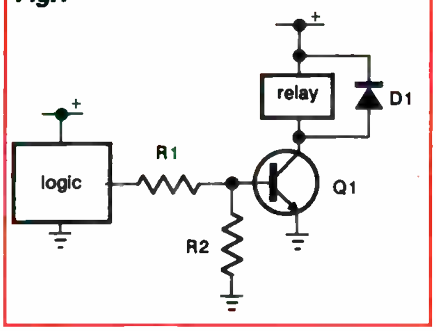
Based on the letters we receive, it's obvious that the readership of *EA* covers all ages, which I categorise into three generations: those under 20, those over 60 and those in between. It's difficult to say where the bulk of the readership lies, and for this reason *EA* tries to accommodate everyone.

Our future lies with the younger generation, so I especially want to invite letters from younger readers. If I can't help, I'm sure other readers can. And to prove it, we start with a correspondent who gives assistance (perhaps unwittingly) to a younger reader.

CMOS interfacing

This letter is in response to my request for interesting design ideas, and concerns interfacing a relay with CMOS logic. This is a common requirement, so it's an idea that has many applications:

Fig.1



Your request for suitable design ideas has provoked me to present the following.

Relay driving from CMOS or other low powered logic is a recurring problem, in that ordinary relays require more current than most logic outputs can provide. A current gain buffering element is required, and usually a transistor is chosen for the purpose.

Most designers are aware that relay coils are inductive, to the point that rapid turn-off of the current can generate voltages high enough to destroy the transistor. It is therefore usual to shunt the coil with a diode, polarised to only conduct when the coil is turned off. A typical circuit is shown in Fig.1.

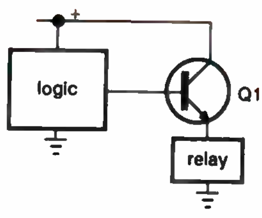
But there is a more convenient way, given by the circuit of Fig.2. Note the significant reduction in component numbers and PCB space.

When the transistor is connected as an emitter follower in this way, it serves as an inductive quench, which is every bit as effective as the separate diode in Fig.1. Lenz's law governs the situation in which the inductance of the coil opposes any attempt to change the current flowing in the coil. Whereas in Fig.1 without the diode, there is no way after switch off to maintain the (transient) coil current without breaking down the transistor, in Fig.2 the coil current can continue to flow (until the stored inductive energy is dissipated) through the emitter in the usual direction.

Of course, there is one consideration which may cause preference for Fig.1. In the first circuit it is not necessary to drive the relay from the same voltage as the logic, whereas in Fig.2 it is. A lot of logic runs from 5V, while 5V relays are relatively rare compared (say) to 12V relays, so there is an inducement for TTL designers to use the circuit of Fig.1. On the other hand, Fig.2 should be the choice of those using CMOS at 12V, as I often do. (Gordon Wormald, Florey ACT).

Thanks for an excellent idea, Gordon. Expanding on your description, in Fig.2, the relay is turned off when the output of the gate is a logic 0. When this occurs the emitter of the transistor will become negative, due to the back EMF of the coil, and the base-emitter junction of the transistor will then be forward biased. Therefore the transistor is held on until

Fig.2



the emitter voltage is less negative than 0.6V, and current will flow from the supply via the collector-emitter circuit of the transistor.

Because the relay is in the emitter circuit, it is necessary to power the transistor with the same supply voltage. Otherwise any extra voltage is lost across the transistor, as the emitter voltage cannot exceed the base voltage. This is perhaps another reason for CMOS, as the output voltage for a logic 1 of a typical TTL gate is usually around 3.5V, while for CMOS it is usually very close to the supply voltage.

A clever idea and as it turns out, the writer of the next letter may well be able to use this circuit.

Microbee interface

Remember the Microbee? It seems so long ago when computers were 8-bit and interface cards could be built on single-sided PCBs. Despite the popularity of 16-bit machines, there is no doubt that an 8-bit computer is both an excellent teaching aid as well as a useful system. The next letter is from a younger reader who wants information on interfacing motors to his Microbee. He writes:

I am 13 years old and I have just acquired a Microbee 64K. I am using it to control Lego motors, etc. The only problem is that I don't have a circuit for any type of D to A converter. Do I need one for the Microbee? If so could you supply me with such a circuit. Also, I need a relatively simple circuit for modifying a monochrome TV to use as a monitor.

Thanks for a great magazine, maybe you could include a programming section. (J.B., Glen Waverley Vic).

Controlling motors with a computer doesn't usually require a D to A converter, J.B. Often, a computer controlled motor just does three things: forward, reverse and stop, which simply involves electronic switches that are operated by the computer.

I'm not familiar with the Microbee, but I imagine it allows access to the data and address buses. If not, there's likely to be some sort of output port, perhaps for a parallel connected printer.

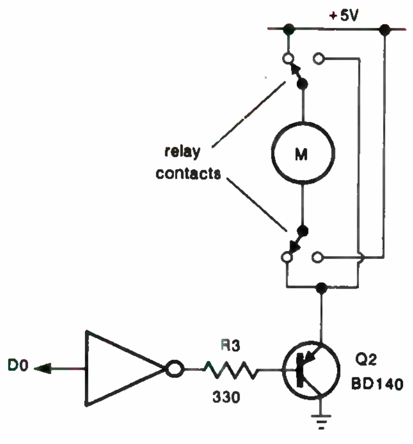
The Lego motors you are using are designed to run from 5V and can be switched with a transistor such as a BD139 or a BD140. To get forward and reverse requires four transistors and the circuit can become a bit tricky. An easier way is to use a relay that is switched by a transistor. You could use the circuit of Fig.1 described previously to drive the forward-reverse relay, although you'll need to experiment with the resistor values. Try 1k for both to start with. (Or you might even try the circuit of Fig.2 which has no resistors).

The relay needs to have two double-pole contacts and is wired to the motor as I've shown in Fig.3. This is the same as a reversing switch, in which current flows either one way or the other through the motor.

To start and stop the motor, I suggest adding transistor Q2. When Q2 is on, motor current can flow to ground, otherwise the motor current is interrupted. Notice that I've used a PNP transistor. With this arrangement the transistor will conduct when the output of the inverter is a logic 0. This is the best way to drive a load with a TTL gate, as the current capability of the gate is higher for a logic 0 than for a logic 1.

I've not specified the type of gate, as quite a range can be used such as 74LS04, a 74LS00 (with both inputs joined together) and so on. Because of its limited drive capability, a CMOS gate may not be able to operate this transistor.

Fig.3



The interface then needs two data bits from the computer — let's say data bit 0 and data bit 1. If data bit 0 is used to operate Q2, the motor can be turned on with a logic 1 and off by making D0 a '0'. The direction is then controlled by data bit 1.

Converting a TV set into a computer monitor can be rather difficult unless you know a fair bit about TV. Basically, you need to connect the composite video output of the computer to a point in the TV set that can accept this signal. This is usually just after the IF and video detector stages. However, I suggest you seek guidance from someone with technical experience, as it is very easy to damage the computer due to incorrect wiring from the TV set.

Over the years, both *EA* and *ETI* have run programming sections, and you might do best to look back over old issues. Unfortunately, to run an 8-bit programming section now would probably bring cries of 'old fashioned'.

The next topic stays in the digital arena, but here I'm stumped. But then, so's the writer...

CD subcode

Not all letters in these columns get an answer. Let's face it, with technology racing ahead at light speed, keeping up with everything is virtually impossible. I'm printing the following letter in the hope that answers will be forthcoming from readers who can help our correspondent. I'm rather interested as well.

I recently purchased a Teac CD player and found it has a digital output socket. I wondered just exactly what was coming out of that mysterious socket, and what I could do with it.

Experimenting with bit-stream DACs and capturing and editing data with a computer came to mind. I also heard a rumour that CDs contain a list of track titles buried in something called 'sub-code', which should be accessible to a computer via this digital output.

Thus enthused, I tried to find out about the data format used. The owner's handbook was no help, stating 'connect this to the input of a digital amplifier'. It did say that the signal level was 0.5Vp-p.

The service manual wasn't much better, and had no mention of data format. The circuit diagram showed the digital output coming from one pin of an 80-pin LSI IC. The output is buffered by parallel connected CMOS gates and then transformer coupled to the socket, which is floating.

I understand that one can connect the digital output of a 'Brand X' CD player to the input of a 'Brand Y' digital amplifier (and presumably, to a 'Brand Z' DAT) — so there must be a standard. But where does one find out about it?

The technicians at Teac Australia agree that there must be a standard, but they don't know what it is, and talking to a hifi salesman is like talking to a brick wall. I don't suspect a sinister conspiracy, but I can't find anyone who knows. Perhaps I should write to Mr Teac himself.

Do YOU guys know anything about it? If so, I'm sure it would make an interesting article. Something along the lines of 'The Dummy's Guide to Digital CD Interfacing'. It would need to answer questions like: What is eight-fourteen modulation? What is sub-code and what information does it carry? Is sub-code *transmitted between each audio sample and if so, how does one separate subcode and audio data?*

And also: Is oversampling done before the digital output and does oversampling affect the sub-code? How are the left and right samples identified? How is the clock recovered? Is Manchester coding used? And so on...

Your article should contain timing diagrams and everything needed to design an interface for this digital output. Impossible? How about it? (G.L., Ringwood Vic).

Your CD manual is better than mine, G.L. I own a Technics SL-P1 CD player and the user manual states that 'the compact disc subcode is output through this socket'. It goes on to say 'this socket is provided for system connections with future components' and concludes 'Do not connect any components to this socket"!

I have always been intrigued by the function of the subcode socket, and I've wondered if it could be used to allow a CD-ROM to be read from a conventional CD player. If anyone can supply details, I'm sure we would all be most interested.

Inverters

Getting back to a topic I can help with, we have another letter from a younger reader.

I am a first year electronics student, and I want to make a static inverter from one of the kits that are currently available. Could you please tell me how they work. How do they produce AC from a DC source? (J.F., Guildford NSW).

The principle is very simple J.F., although the circuit can sometimes be a bit complex. Basically, the incoming DC is 'chopped' by a transistor, then fed to a transformer. Because the DC is now AC, it can be transformed to any required voltage. For a DC output, the output of the transformer is then rectified and filtered with a capacitor.

There are a large number of different circuits that can achieve this, and they all need some sort of oscillator that drives the switching transistor. In some circuits, the inverter is also the oscillator, in which the transformer serves as part of the timing section for the oscillator.

Many circuits use two switching transistors, arranged in push-pull. Because of the inductance of the transformer, diodes are also needed to protect the transistors against the back EMF of the transformer. A simple principle, but the circuits can be quite tricky!

And now to a bit more discussion on ion flow. I'm not sure that I totally agree with our next correspondent, although maybe I've misunderstood the point he makes.

Ions DO flow!

In the June edition, I included a letter that stated (more or less) that in a liquid, ions travel much more slowly than electrons. The correspondent suggested that as electron flow (current) was around half the speed of light — as measured by experiment, it was therefore ludicrous to suggest that ions also travelled at this speed.

The following letter argues against this. See what you think...

In liquids, unlike gases, ions are formed by the spontaneous break-up of the dissolved substance. The negative electrode in a solution of silver nitrate becomes coated with silver, which indicates a movement toward that electrode. (Interestingly a silver ion carries the same elementary charge as the hydrogen ion whereas a copper ion carries twice that, and an aluminium ion three times.)

All ion charges in solution are small whole number multiples of an elementary charge, as discovered by Faraday in 1833. Metal atoms are carried by positive ions, and the motion of these ions in the electric current involves a detectable transport of matter.

Both ions and electrons attain extremely high velocities when accelerated in a vacuum. (The destruction of the cathode in a gassy picture tube and the use of 'ion traps' to prevent a dark ring on the phosphor screen due to ionic bombardment are well known). The mass of a hydrogen ion is some 2000 times that of the electron, hence the damaging effect in spite of a considerably lower velocity.

In a solution the movement of both ions and electrons, in terms of systematic velocity is quite slow. Although the electrons rush around within the atoms at huge speeds, the progress of an individual electron through the solution is slow and commensurate with the movement of a single ion moving in the opposite direction. The combined effect of these currents account for the electron flow in the total circuit. Were this not so, a charge would be accumulated somewhere in the circuit and Coulomb's work would be a nonsense.

In a solid, such as a one metre length of copper wire (composed of copper atoms, the electrons of which orbit at tremendous velocities all the time), the systematic velocity is quite slow. With a few volts applied, it is only about one centimetre per second; a speed determined by the strength of the field (applied voltage), and the time between collisions of orbiting electrons. This concept is the pathway into an understanding of Ohm's law and suggests why, with increased voltage and agitation of the orbiting electrons, the wire gets hot.

The argument that ions don't flow is based on the false assumption that the systematic flow of electrons in a circuit is one of great velocity, compared to which ions, due to their relatively enormous mass, cannot compete.

The truth is that in a liquid, ions do flow, as do electrons. But their systematic (not orbiting, in the case of electrons) progress is quite slow. (D.L., Tumblong NSW).

As I understand your letter D.L., you are saying that current flow is not much faster than ion flow, although electrons are in fact moving at high speeds around their individual atoms. The analogy that comes to mind is a column of ants, where individual ants rush everywhere but straight ahead.

Unfortunately, while this concept is perfectly reasonable, the original correspondent states that he actually *measured* the speed of the current and came up with C/2 (half the speed of light).

I can agree with you about ion transfer in a vacuum, but I'm not sure about a velocity for current of one centimetre per second in a copper wire. This equates to around 36kph, a speed that could be exceeded by the average cyclist. Perhaps I've misunderstood the explanation, and the concept is probably akin to pushing a solid bar at 36kph. In this analogy, movement is detected at the other end virtually simultaneously to the originating movement, although the speed of the movement is quite slow.

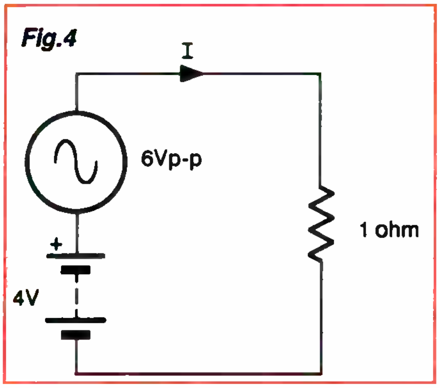
In any case, it's an interesting subject and one that's perhaps not as well understood as we think.

Cascading 4017's

In the June edition I provided a circuit in response to a young reader (A.P., Werribee), who wanted to know how to cascade two 4017 counters. A letter from B.J. of Hahndorf in SA has pointed out that another circuit is shown in the November 1988 edition, on page 95. An advantage of this other circuit is that more than two counters can be cascaded. In fact, it seems the correspondent designed the circuit! Thanks for this information, B.J., and I hope A.P. is reading these words.

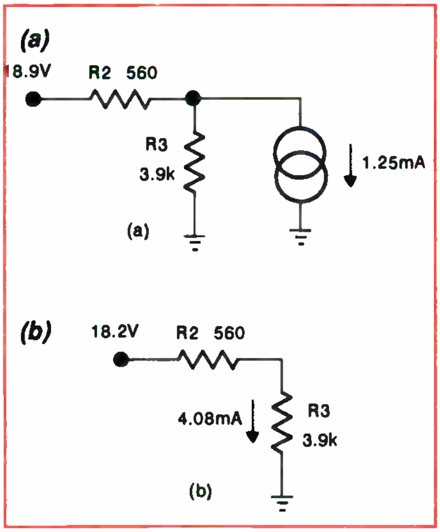
What??

This month's problem has been supplied by Bill Marshall, of Chatswood in NSW. He asks: for the circuit of Fig.4, calculate the RMS value of the current and the voltage. Neglect any internal resistance of the sources.



Answer to August's What??

The current in ZD1 is 14.67mA, and the current in ZD2 is 4.08mA. The trick is to first find the current in ZD2, which is best explained with the circuit of Fig.1(a). The available voltage to supply this part of the circuit is VZ1 - VZ2, giving 24 - 5.1, which equals 18.9V. The voltage drop across R2 caused by the constant current is then subtracted from



this voltage, giving 18.2V as shown in (b). Ohm's law then gives 4.08mA.

To find the current in ZD1, first calculate the current in R1, which equals (60 - 24)/1.8k — giving 20mA. Then determine the total current flowing in R2, which equals the current in ZD2 plus the constant current of 1.25mA — giving 5.33mA. Subtract this from the 20mA previously calculated and you're left with 14.67mA. ■

NOTES & ERRATA

VARIABLE TAPPED BALUN FOR HF (May 1991): Author Tom Moffat advises that his stock of toroidal cores is now exhausted, and as a result he is no longer able to supply them. Suitable alternative toroids for this project should be available in the Neosid and Amidon ranges. For further details we suggest you contact Neosid Ltd., 23-25 Percival Street, Lilyfield 2040 (phone (02) 660 4566) or RJ & US Imports, PO Box 157, Mortdale 2223. ■

NEW KITS RELEASED

Dick Smith Electronics has advised that it has released kits for the following *EA* projects:

QUAD DI BOX (June 1991): A full kit, complete with pre-punched front and rear panels and silk-screened front panel. Coded K-5012, the kit is priced at $79.95.

FAN SPEED CONTROLLER (July 1991): A full kit in a plastic case, complete with pre-punched and silk-screened front panel. An all-plastic pot is also included, for greater safety. Coded K-3086, the kit is priced at $39.95.

Jaycar Electronics has advised that it has released a kit for the following *EA* project:

LOW COST 18V/1A BENCH SUPPLY (August 1991): A full kit, complete with Scotchcal front panel and meter panel, and with a pre-cut heatsink. Coded KA1736, the kit is priced at $79.95.

NOTE: This information is published in good faith, from advice received from the advertisers concerned. *Electronics Australia* cannot accept responsibility for any errors.

FORUM

(Continued from page 42)

They all give much the same results — a very peaky waveform, and an average power factor of around 0.6. I suspect if you check most modern TV sets, you'll get very similar figures (but be VERY careful when making such measurements — looking at mains current waveforms requires special equipment, and of course strict safety procedures).

You can see, then, that the problem of 'peaky' currents, high harmonic content and poor power factor is by no means confined to the new compact fluoro lamps. It's much more widespread, as switch-mode power supplies are becoming very widely used in a lot of equipment.

The overall problem will certainly have to be solved, or our power distribution systems will become very 'dirty', and we'll need to use considerably larger cables and transformers than would otherwise be needed.

But in the meantime, this is hardly justification for not using the new compact fluorescent lamps. All things considered, these still seem a worthwhile step forward. Don't you agree?

My thanks to George Sprague, of Philips Industries, for his help in obtaining most of the technical information that I needed to prepare this article. Philips also very kindly loaned me the 'demo' compact fluorescent lamp shown in the second photo, so we could show you what's inside the base of these lamps. ■

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.

September 1941

Australian valve bases: All bases used on Radiotron Australian-made receiving valves are now manufactured in the factory of Amalgated Wireless Valve Company at Ashfield.

A very high grade of plastic is used, and tests which have been conducted show that the electrical properties are in every way equal or even superior to imported bases which have been used up until recently.

Our short wave reporters: Although a comparative newcomer compared with some of the older short-wave listeners, Mr A.T. Cushen of Invercargill, New Zealand, has moved into the front rank of listeners in that country.

Mr Cushen first commenced listening just over two years ago. During the above listening period, he has reported about 800 stations in 96 different countries which is indeed a very good effort.

Another 'super' bomb: An element which, if contained in a 10lb bomb, would blast a hole 25 miles in diameter, more than one mile deep, and wreck every structure within 100 miles, is being developed by American scientists.

The US government has taken control of the scientists working on the application and control of the discovery, and is driving them to develop it for war purposes.

September 1966

STC telephones in Vietnam: Australian troops in Vietnam are using a portable telephone manufactured in Liverpool NSW for communication in difficult terrain.

The 'K' phone can be used as either a field or office telephone from either its own internal 3V battery or from a central or common battery. The electronic components and battery are contained in a small unbreakable nylon case sealed against humidity, water, dust and mud.

With a range of 10 miles, manufacturers visualise the unit will have many applications outside military use to serve communications need in industry, commerce and agriculture: on construction sites, in tunnels and excavations.

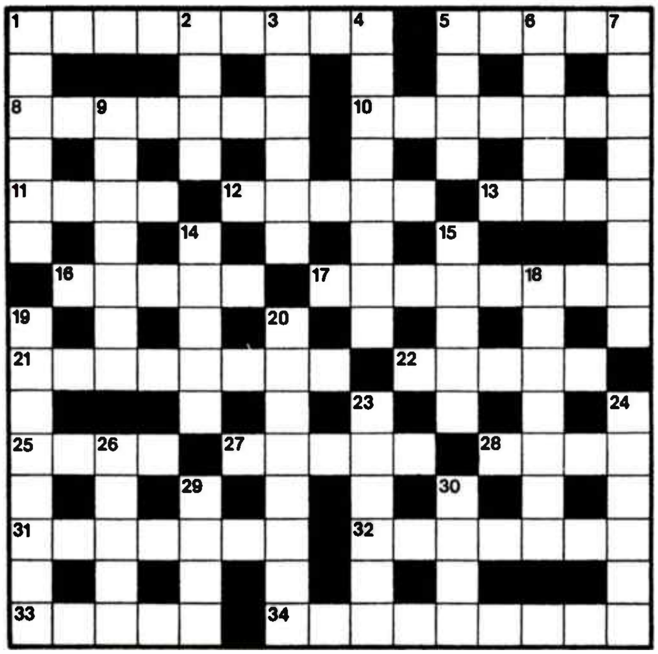
Satellite TV: An amateur radio operator in New Jersey, USA, has been successful in producing pictures transmitted from a weather satellite on home constructed equipment. The weather photos came from ESSA 2, the twelfth in the Tiros weather satellite series.

The success of the experiments has proved that amateur operators anywhere in the world can obtain good weather pictures by adding a few relatively inexpensive items to their existing receivers.

Transistorised stethoscope: A stethoscope with a transistorised amplifier for industrial use is now available in Australia. Applications include maintenance and inspection of engines, motors and machinery, or any situation where noise detection is of significance.

The self-contained unit uses a long-life mercury battery, and is claimed to be sensitive enough to detect irregularities in the flow of liquids. ■

EA CROSSWORD



ACROSS

1. Video camera. (9)
5. Greek letter, symbol for compressibility. (5)
8. Orbiting masses. (7)
10. The study of electronic organ development. (7)
11. Radiate. (4)
12. Conducting wires. (5)
13. Shock. (4)
16. Keep hair-dryers away from these! (5)
17. Superseded. (8)
21. Electrified substance. (8)
22. Collimated radiation (pl.) (5)
25. Programmable memory. (4)
27. Speed of wave energy transfer, —— velocity. (5)
28. Top quality in electronic reproduction. (4)
31. Said of a single-step operation. (3-4)
32. Initiate. (7)
33. Brand of printer, laptop, etc. (5)
34. Device for message security. (9)

DOWN

1. Common conductor. (6)
2. Digits. (4)
3. Morse signals. (6)
4. Metallic element. (8)
5. Control hardware. (4)
6. Output instruction for computer system. (5)
7. Compound with element 33. (8)
9. Generate a lifelike effect. (7)
14. Letter used as symbol for angle. (5)
15. Resinous substance with electrifying properties. (5)
18. Reducing light intensity. (7)
19. Non-radio ground wave detector. (8)
20. Again transcribes data. (8)
23. Electric instrument, possibly. (6)
24. Reflector. (6)
26. Activates switch, etc. (5)
29. Useful form of 30 down. (4)
30. Layer of small dimension. (4)

SOLUTION FOR AUGUST

H	A	C	K	S	A	W	S		C	A	L	L	U	P
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EA with ETI marketplace

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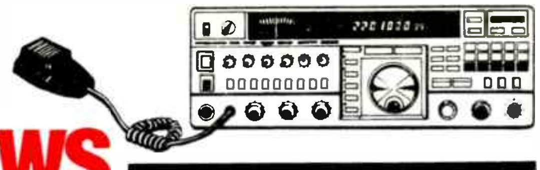
Amateur Radio News



Worrying trend in New Zealand

From Ian Andrews, ZL4MB, comes news of a worrying trend in his country, which is likely to cause a lot of complications for radio amateurs and other users of two-way radio gear — and it could easily spread to Australia as well.

Apparently the City Council in Waitakere, a western suburb of Auckland, recently announced a new by-law which is ostensibly designed 'to govern transmitters within the Council's area'.

Under the new by-law, all transmitters within the city boundaries will have to be approved by Council, and an annual licence fee paid — quite separately from, and additional to, any licences which may be held by the user from the main regulatory authority: the NZ Radio Frequency Service.

The idea behind the new by-law is supposedly to ensure that all transmitters used within the Council's area do not pose a health hazard. However no power limits are specified, and all microwave ovens and transmitters operated by all government services are exempt.

According to ZL4MB, when the NZRFS was queried about the Council's move, the reply was that it 'had no jurisdiction, as this is a health and welfare matter'.

It is expected that other city councils will follow Waitakere's lead and impose similar licensing schemes, due to pressure from consumer and environmental protection groups.

Callsign mixup — Mk2

Remember the item in our July 1991 column, about the mixup in the *1991 Amateur Call Book* regarding the callsign for *EA*"s editor Jim Rowe? Well, our faces are now red too, because Murphy's Law struck our item in exactly the same way.

We showed the callsign for Bill Roper, the WIA's general manager and secretary, as VK2ARZ — when it is of course VK3ARZ!

Shortly after the July issue was published, Bill sent our editor a good humoured little note by fax, with the message:

As usual I enjoyed reading the latest issue of your magazine. I was particularly interested to read the 'Amateur Radio News' column on page 96, and note that it is not only DoTC and the WIA who can get callsigns wrong. I trust that Max Riley VK2ARZ doesn't mind his callsign being allocated to me.

Amen to that, Bill, and our apologies to both yourself and Mr Riley for the mixup. That's what we get for being smart and trying to rub your noses in the first mixup, wouldn't you say?

'Spot checks' by DoTC

The Department of Transport and Communications is apparently planning to carry out spot checks of factories, wholesalers and retailers of radiocommunications gear, to verify that it meets the performance requirements.

A copy of Icom Australia's newsletter just to hand quotes from a recent letter sent to the firm from DoTC's Regulatory Branch:

The Department proposes to embark on a program of visiting factories, wholesalers and retailers, collecting samples of various items of radiocommunications equipment for testing against the appropriate requirements. The purpose of this letter is to advise you in advance of this action.

Where it is found that sub-standard equipment is being sold, action will be taken against the suppliers or sellers of the equipment under the provisions of Section 11 of the Radiocommunications Act 1983.

Penalties under this section are severe, with fines of up to $10,000 for individuals and $50,000 for companies convicted of supplying or possessing sub-standard equipment.

This all sounds very laudable, as a way to help prevent the sale and use of sub-standard gear. But we can't help wondering about that advance warning letter — did DoTC send letters like this out to ALL firms selling radiocomms equipment? There wouldn't be much point in sending it only to reputable firms like Icom, because *they* only sell high quality and approved gear anyway.

Yet if DoTC sent the letter out to all firms, the whole idea of carrying out spot checks would seem pretty pointless — any sellers of shonky gear would be forewarned. ■

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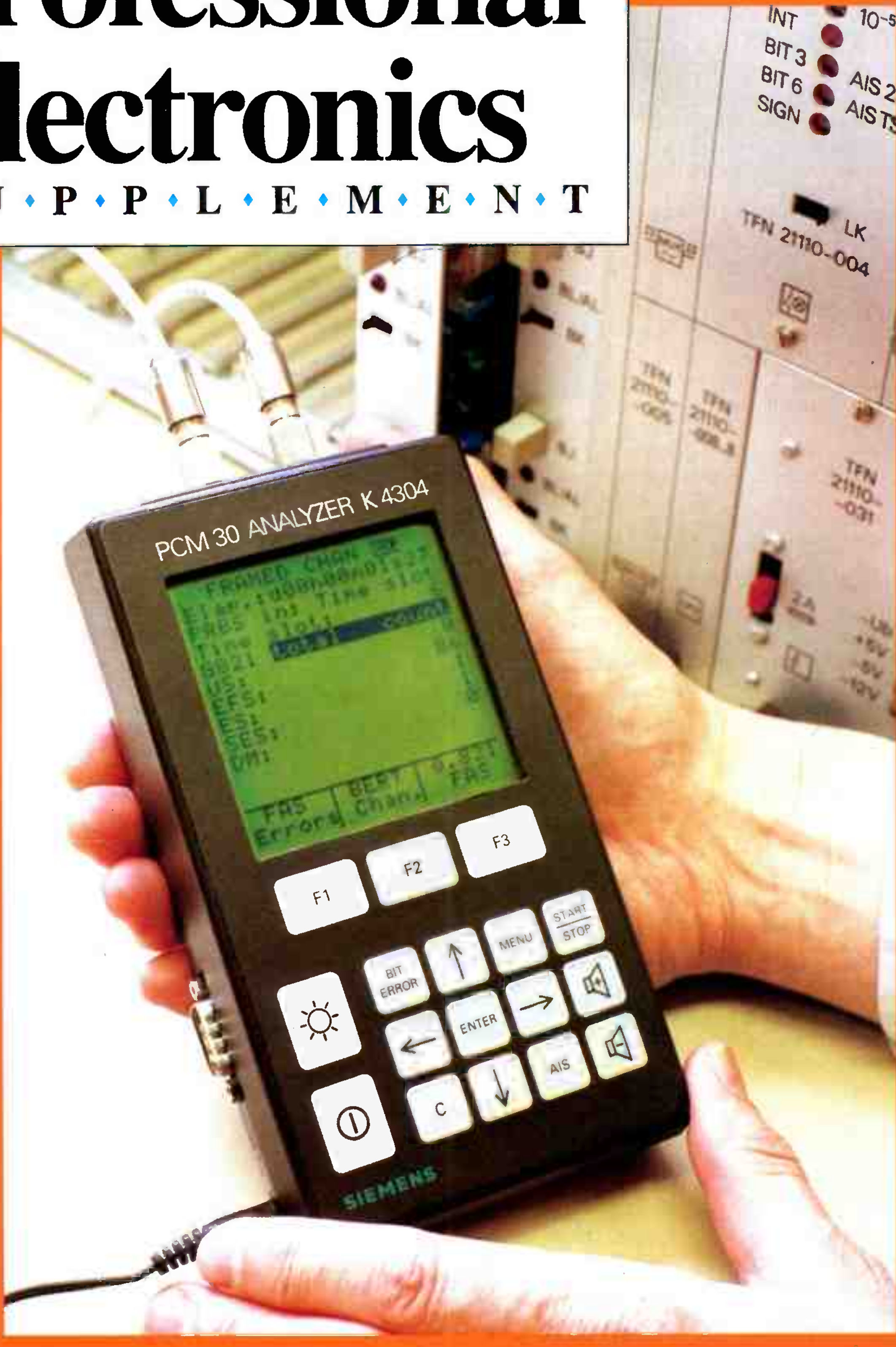


SIEMENS' NEW HANDHELD 2Mbps PCM ANALYSER

NEWS HIGHLIGHTS

COMPUTER, DATACOMM TRAINING COURSES

Technology training firm IIR Technology is offering a range of 'hands on' courses in computer and data communications technology, over the next few months in Sydney, Melbourne and Brisbane.

Included in the courses are: X.25 Networks (2-4 September, Sydney); Ethernet (9-11 September, Sydney); Token Ring (16-18 October Melbourne, 23-25 October Sydney); PC Troubleshooting I (18-18 October Sydney, 23-25 October Melbourne); TCP/IP Networks (16-18 September Melbourne, 23-25 September Brisbane); and C Programming (7-9 October, Sydney).

Further information about the courses is available from Elisabeth Warne, on Sydney (02) 959 5455.

JOINT VENTURE TO MAKE CDMA PHONES

Qualcomm Inc, San Diego-based developer of the innovative CDMA (code division multiple access) 'spread spectrum' technology, has formed a joint venture with US firm Alpine Electronics and its Tokyo-based parent Alps Electric, to manufacture, market and distribute digital cellular telephones and other wireless products based on the technology.

Qualcomm is currently engaged in the final phase of testing designed to validate CDMA digital cellular technology. The validation testing is expected to result in the ability to bring CDMA products to market by mid 1992.

Products to be produced by the joint venture include digital micro-portable phones, as well as dual-mode mobile and portable cellular phones able to use either CDMA or existing analog systems. Initial manufacturing is expected to be carried out in San Diego.

FORD & MOTOROLA FORM STRATEGIC PARTNERSHIP

A new class of microelectronic chips to control automotive engines and transmissions is expected to result from a technology partnership between Ford Motor Company and Motorola, Inc.

In a joint announcement recently, Ford's Electronics Division and Motorola's Semiconductor Products Sector said they will co-design and Motorola will supply a RISC-based (reduced instruction set computer) microcontroller for Ford's future Powertrain Electronics Controller (PTEC).

"RISC' technology will add power to control powertrain components for optimum performance, fuel efficiency and emissions levels, " said Charles Szuluk, General Manager of Ford's Automotive Components Division. "The Ford Power Electronics Controller will be more than two generations ahead of our current technology."

The device is targeted for completion by the mid-1990's. Ford plans to introduce PTEC in stages, beginning with selected North America car lines and ramping up to worldwide production of more than six million cars and trucks annually.

The design is based on Motorola's 88000 RISC microprocessor and will use the modular design methodology pioneered in its 68300 family of embedded controllers.

AEDC COURSES

The Australian Electronics Development Centre, sponsored by 10 of the country's leading electronics organisations, has provided details of its workshop courses and practical self-help programs for the remainder of this year. The programs have all been devised to meet the purpose and criteria for eligibility of the Commonwealth Government's Training Guarantee Levy.

Courses include PCB Assembly Technology (9-13 September and 19-22 November, Melbourne); Designing for Surface Mount (September 5 and October 23, Melbourne; September 24, Sydney; November 20, Brisbane); and Electronic Product Development (December 2-4, Melbourne).

Similarly the practical programs include Introductory Protel (September 5-6 and October 9-10, Melbourne; November 20- 21, Brisbane), and Advanced Protel for Productivity (October 11, Melbourne; November 22, Brisbane).

Course fees vary from $350 to $975, depending on the number of days involved. Information on all AEDC courses and programs is available by phoning (008) 339 601, or (03) 302 1422.

NEW MELBOURNE COMPUTER PLANT

The Federal Minister for Industry, Technology and Commerce, Senator John Button has officially opened a new multi-million dollar manufacturing facility for Australian-owned computer designer and manufacturer Terran Computers, in the picturesque outer-Melbourne suburb of Montmorency. Spanning across more than 10,000 square feet of floorspace, the new Terran manufacturing plant houses leading-edge surface mount equipment, board and component assembly, power supply and casing assembly plus a wide range of testing equipment.

The new manufacturing plant will initially produce up to 1500 PCs a month, including Terran 286 workstations, 386 desktop computers and the range of 486-based network file servers. According to Managing Director and co-founder of Terran Computers, Peter Nunn, the new manufacturing facility will have the capacity to produce up to 6000 computers a month.

AMF BUYING RADIO, AVIONICS FROM ROCKWELL

The Royal Australia Air Force (RAAF) has awarded a $2 million contract to Rockwell Systems Australia for the supply of a new generation of airborne HF radios for the RAAF's C-130 Hercules aircraft.

The radios are the commercial HF-9000, a variant of the ARC-217. Rockwell is to supply 31 of the sets, in addition to test equipment, installation kits and aircraft support equipment. First deliveries will be in late 1991.

Rockwell has also been awarded a $3 million subcontract by Aerospace Technologies of Australia (ASTA) to provide a complete avionics suite for 10 of the Army's Nomads, as part of the modification program for these short takeoff and landing aircraft.

The avionics systems will include Rockwell's WXR-270 weather radar systems; EFIS-84 electronic flight instrument systems; AP-107 autopilots; DME-42 distance measuring equipment; ADF-60A automatic direction finder systems; MCS-65 compass system; and AN/ARC-186 dual VHF AM/FM transceivers.

COMMITTEE TO STUDY DIGITAL BROADCASTING

The Department of Transport and Communications (DoTAC) and the broadcasting industry have set up a joint committee to co-ordinate studies into digital audio broadcasting (DAB) in Australia. DoTAC's communications laboratory is setting up a study program to evaluate DAB systems, with a view to their eventual introduction.

The 1992 World Administrative Radio Conference (WARC-92) is to consider the allocation of a frequency band for DAB, and it is expected that the first DAB services could begin as early as the mid 1990's. DAB offers the prospect of CD-quality reception, with 12 to 16 audio programmes on a single transmission and free of both the noise and interference that plagues AM, and the flutter and drop-out effects that affect FM reception in cars. It also allows mixed satellite and terrestrial transmission, and the use of relatively low power transmitters with 'boosters' operating on the same frequency to extend services into difficult areas.

ROYAL NAVY BUYS 40 MARCONI ANALYSERS

The Royal Navy has awarded a contract to Marconi Instruments to supply forty of its model 2382 10Hz - 400MHz high resolution spectrum analysers, to be used at calibration sites and at shore stations to assist in providing and maintaining high integrity Navy HF communications.

The 2382 was chosen because its specifications were well within the key requirements demanded. The Royal Navy required narrow spans with resolution bandwidths better than 5Hz, for close-in analysis for signal purity. The 2382 has a minimum resolution bandwidth of 3Hz and a guaranteed total level accuracy of +/-1dB across the entire frequency range.

The model 2382 has also found favour with the Royal New Zealand Army, the Royal New Zealand Navy, and also the Royal Australian Navy where it is a standardised item.

SATELLITE FAX FOR SHIPS

Ships at sea can now receive up-to-the-minute high-quality newspapers and weather reports by broadcast fascimile via satellite. The new service has been inaugurated by KDD, the Japanese telecommunications organisation, with Asahi Shinbun, the Japanese newspaper organisation, as KDD's first customer. It is also available to other organisations on land who wish to broadcast information in the form of facsimile messages to a number of ships or other Inmarsat-A users simultaneously.

Newspaper articles and weather reports are sent from a facsimile machine at the point of origin, via the Inmarsat satellite system, to an unlimited number of recipients who form a group. Any mobile ship earth station with the group number entered in its software can receive the message from the group's predefined originator.

Normally facsimile machines can communicate with each other only after they have 'shaken hands' and a distinctive tone obtained on the line. This procedure is a way for the machines on both ends of a transmission to check that they are calibrated for the same data rate and that the terrestrial lines are open. A modified facsimile terminal has now made it possible for facsimile messages

NEWS HIGHLIGHTS

to be broadcast via satellite to an unlimited number of multiple subscribers simultaneously. The terminal essentially 'tricks' both the originating and all of the receiving facsimile machines into 'thinking' that the necessary handshaking has occurred, by generating the tone that normally follows a successful handshake.

ELECTRONICS COURSE FOR WOMEN IN VIC

The Wantirna South campus of Victoria's Outer Eastern College of TAFE has begun a full time 20-week course called the Certificate of Occupational Studies (Electronics). This is funded through the State Training Board by the Department of Employment, Education and Training.

The course targets, amongst others, women who have been out of work for more than six months, or who are supporting parents. They may be eligible for the Formal Training Allowance through the CES or Austudy.

There are no prerequisites for the course. The women study core subjects which include communication skills, computing, preparation for interviews and problem solving.

Additionally, they involve themselves with electronics, welding and electrical wiring. They also carry out site-work such as the current task of wiring a house.

GALILEO TO MEET ASTEROID GASPRA

NASA's 2.5-ton Galileo spacecraft turned and fired its small on-board thrusters on July 2, to set its course for an encounter with the asteroid Gaspra in October 1991. The spacecraft was acting on computer commands sent to it by engineers at the Jet Propulsion Laboratory (JPL).

The maneuvre altered Galileo's velocity in space by about eight miles per hour, slowing it slightly and adjusting the flyby distance at Gaspra on October 29, 1991, to 1000 miles.

The October event will be the first flyby of an asteroid. Gaspra, about eight miles across, orbits roughly 200 million miles from the Sun, near the inner edge of the asteroid belt. Scientists believe it is a fairly typical, small, rocky main-belt asteroid.

Galileo is enroute to Jupiter, where it will go into oribit in December 1995 after sending a probe into Jupiter's atmosphere. Following an October 1989 launch, the spacecraft flew by Venus and the Earth in 1990 in gravity-assist passes to increase the spacecraft's velocity. One more Earth gravity assist is planned in December 1992 to pick up the last increment of velocity necessary to reach Jupiter.

WATCH MONITORS UV-B RADIATION

A Hong Kong designed wrist watch that doubles as a sun cancer alarm is to be marketed in Australia for next summer.

Sunwatch, the brainchild of Hong Kong based multi-national company Saitek Ltd, takes the guess work out of knowing how long to remain in the sun — with or without protection from sun screen lotions.

After information such as the wearer's skin type and the sun protection factor (SPF) of the lotion being used is programmed into the Sunwatch, it will sound an alarm when the safe time is up. If the wearer wants to stay out in the sun longer, the watch calculates what SPF should be applied to stop burning.

The Sunwatch can also tell the intensity of the sun, how much safe time is left and takes into account how much sun the wearer was exposed to the day before.

TDK SPONSORING AUDIO BOOK AWARD

Tape manufacturer TDK is sponsoring the Australian 1991 Audio Book Award. The award was established by the National Library of Australia in 1988 and is awarded annually to the producer of the most outstanding audio book.

Focusing on technical excellence rather than literary merit of the subject matter, the award encourages audio book producers to tailor audio books to those people who are unable to read.

There are over one million functionally illiterate Australians, who could rely on audio books as a reading medium.

Additionally, there are a million more potential consumers who use unabridged audio books during their leisure time.

In announcing the sponsorship, TDK's National Marketing and Sales Manager, Mr Glen Stanford said " as Australia's largest supplier of consumer audio tape it seems most fitting that TDK can help the many impaired Australians who rely on audio books as a reading medium".

NEWS BRIEFS

- ***CAT '91*** is an international conference and exhibition on computer graphics for business. It will be held at Darling Harbour, Sydney from 30th September — 2nd October. Enquiries to the Australian Computer Society (02) 283 5544.
- An Electronics and Music Expo entitled ***Switched on Living*** will be held at the Ascot Racecourse in Perth from 6th-9th September. Enquiries phone (09) 481 0722.
- ***Critec*** has appointed Tina Kark as its new branch manager in Canberra. The company is now a sub-contractor to IBM under the Department of Defence's computer acquisition Desine program.
- Greg Butler, previously NSW district sales manager for ***Canon,*** is now the national metropolitan dealer manager for Canon's colour imaging systems.
- VSI and Promark have merged to form ***VSI Promark Electronics.*** Ted Mooney is managing director, David Segal is marketing director and John Robinson is the new sales director.
- ***Amalgamated Instruments*** have moved to larger premises at unit 5/28 Leighton Place, Hornsby; phone (02) 476 2244.
- Alpha Industries of Massachusetts USA has announced that ***Electronic Development Sales*** of Lane Cove will be the exclusive Australian distribution for its microwave and millimetre wave components.
- Peter Diddams has been appointed the general manager of the systems engineering business unit of ***British Aerospace Australia.***
- ***Crusader Electronic Components*** has appointed Graham Johnson as account executive of its Melbourne office, located at 13 Royston Street, East Burwood.
- Paul Delaney, from the UK, is the new sales manager for semiconductor products at ***Siemens,*** based in Melbourne.
- Nick Fondas has moved from Texas Instruments to become ***Bailey Controls Australia's*** national marketing and sales manager.
- ***Computer Sciences of Australia*** has appointedBill Schiralli to its new position of Sydney operations manager, systems engineering division.

LOCAL FIRM'S ROLE IN SA INFORMATION UTILITY

SA Premier John Bannon's recent announcement of a high technology Information Utility for Adelaide has major significance for South Australia's Lane Telecommunications, which will work alongside one of the world's largest communications giants in the strategic planning for the project.

Lane Telecommunications of Frewville will act as planning and design consultants to the project in conjunction with NTT International (NTTI), via a joint South Australian investment company, LTH Pty Ltd, established specially for the Information Utility.

"It will be a vital part of MFP-Adelaide's communications network, and will establish South Australia as a major information centre for South East Asia," Mr Bannon said.

The Managing Director of the new investment company LTH, Mr Steve Lane, says that in terms of potential, it is the most significant business Lane Telecommunications has ever won.

"The Information Utility (IU) breaks new ground, and we are very excited to be playing a major role in its development working alongside players such as Telecom, IBM, DEC and OTC," Mr Lane said.

CALCOMP NOW IN AUSTRALIA

CalComp Inc a Lockheed company and a leading computer graphics manufacturer, has established a wholly owned subsidiary in Sydney. Located in Stanmore, the new office will work closely with CalComp's distribution channels to promote the full range of CalComp plotters, printers, digitisers and displays in addition to providing service and technical support. William P. Conlin, President of CalComp, was in Australia to launch CalComp Australia.

"In our drive t o be more aggressive in the Asia/Pacific region and promote our reputation for quality products and service, setting up direct operations was a logical and evolutionary step," Mr Conlin said. "Australia represents an outstanding opportunity for us and our valued selling partners and we felt it essential to get closer to the customer."

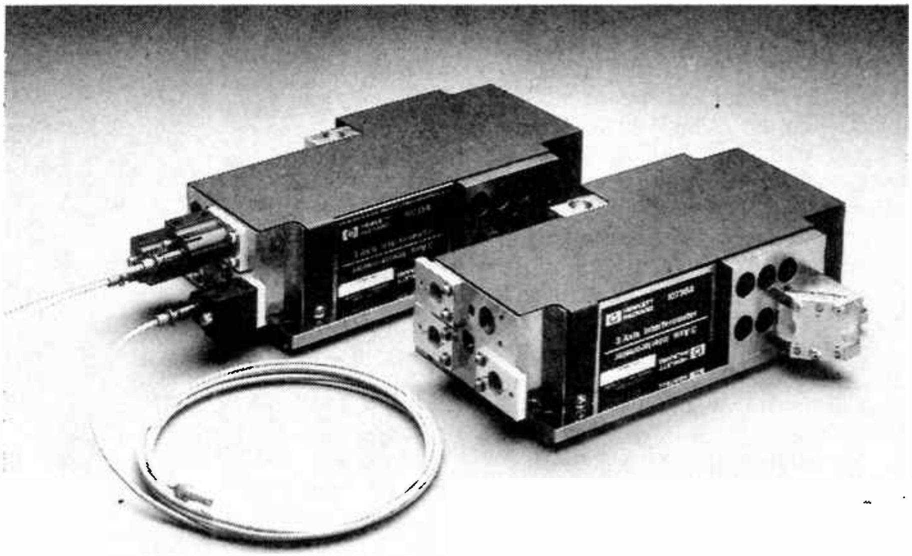
Paul Rimington has been appointed Managing Director of CalComp in Australia. Mr Rimington has been in the office equipment/computer industry for over 20 years, most recently as General Manager of OKI Electric's distributor, IPL.

2.5GBIT/S OVER SINGLE-MODE FIBRES

A system for optical telecommunication at 2.5Gbit/s — corresponding to a transmission capacity of 30,720 telephone calls — has been handed over on schedule by Siemens to the research institute of German Post Office Telekom in Berlin. Transmission over the 36km long trial route uses single mode fibres and the 'third optical windown' at 1550nm. As the basis for the development work on the Berlin V project, Siemens has chosen the new synchronous digital hierarchy (SDH).

Siemens installed the new transmission equipment for 2.5Gbit/s in the local exchange at Potsdamer Chaussee; here it was possible to use the optical cable plant that had already been installed for the Berlin IV project in 1984. The transmission route runs to the Winterfeldstrasse telecommunications centre and back.

This amounts to an overall length of about 36km between the optical transmit and receive equipment. 2.5Gbit/s systems permit repeaterless signal transmission over distances of up to 40km; using selected source diodes in the laboratory, distances of even 100km and more have been achieved at a wavelength of 1550nm.



INTERFEROMETERS FOR 0.5MICRON CHIPS

Hewlett-Packard has introduced four optical interferometers that allow microlithography systems to position silicon wafers with the accuracy needed to manufacture next generation integrated circuits (ICs).

As IC linewidths become smaller and silicon wafers become larger, microlithography system manufacturers need to maintain closer control of the multiaxis stages in their systems to reach sub-0.5micron dimensions. With the new interferometers, the multiaxis stage can be controlled in up to five degrees of motion (X, Y, yaw, pitch and roll). These multiple degrees of freedom allow overlay accuracy to be improved.

The HP10719A one axis differential interferometer and the HP10721A two-axis differential interferometer work as a pair to make column-referenced measurements of a multiaxis stage.

Together, these interferometers provide measurements for systems that require 3 to 5 degrees of freedom.

The HP10735A and HP10736A three axis interferometers offer one linear displacement measurement and two rotational displacement measurements of a multiaxis stage (yaw and pitch or roll) — a new capability in a single interferometer, HP says.

Laser positioning systems are Michelson interferometers that use the interference of light waves to make precise-distance measurements.

Like all laser interferometers, HP laser transducers are composed of three basic subsystems; the laser source, the optics and the electronics.

The laser supplies the monochromatic-light source, the optics direct the beam and generate the interference pattern, and the electronics detect and count the light and dark interference fringes, process the data and provide distance information in a useful form. ■

Solid State Update

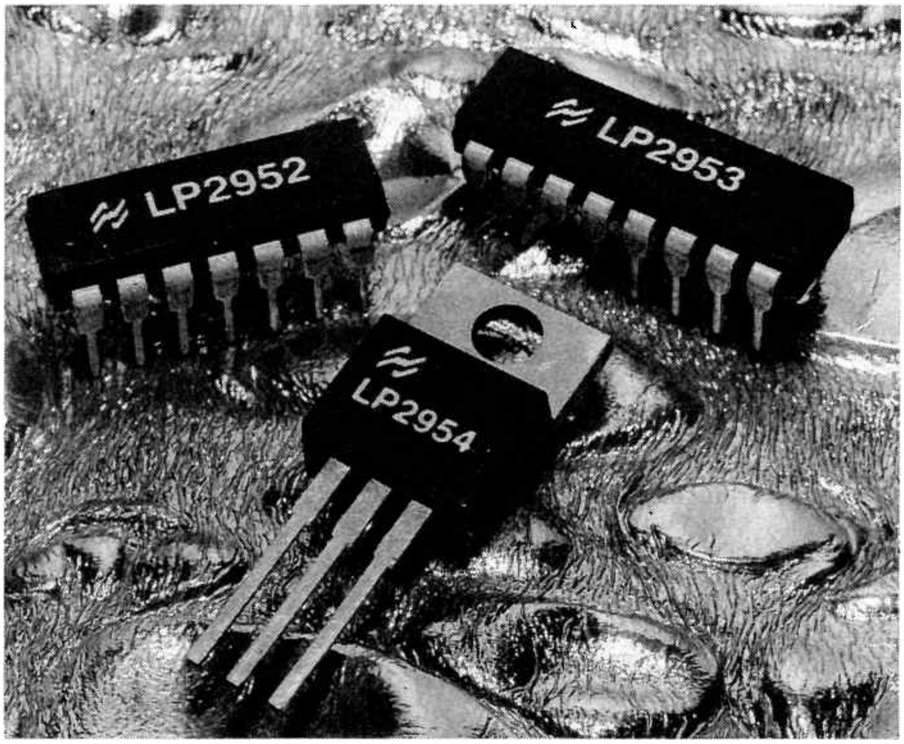
KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

'Battery extender' regulator chips

National Semiconductor has introduced a new family of micropower low-dropout (LDO) voltage regulators that are ideally suited for battery powered applications. The LP2952/3/4 are LDO voltage regulators which provide 250mA of output current, and extend the life of the battery through low dropout voltage and low quiescent current.

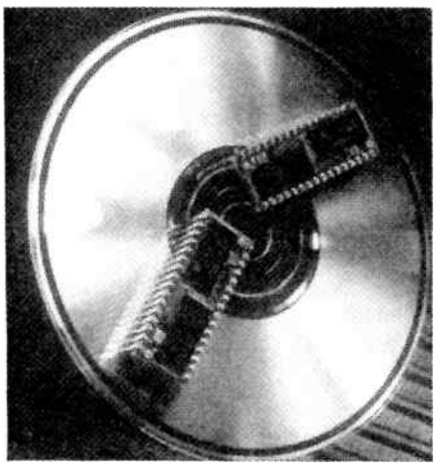
The LP2952 and LP2953 feature an adjustable output voltage of 1.23V to 29V, while the LP2954 has a fixed 5V output. With this 250mA output current and tightly regulated voltage tolerance of +/-1%, National's LDO family now serves a broad application spectrum which includes battery powered systems, mobile phones and hand-held instruments.

For more information, circle 271 on the reader services coupon, or contact National Semiconductors, 16 Business Park Drive, Monash Business Park, Nottinghill 3168; phone (03) 558 9999.



Configurable 4Mb SRAM module

Four chip-select lines, one for each of the 256K x four bit arrays, are provided on EDI's new high density 4Mb SRAM module, the EDI8M16256C. This allows the memory to be user configured to 256K x 16 bits, 512K x 8 bits or 1024K x 4 bits, according to individual requirements. The high speed SRAM module comprises 16 separate 256K x 1 devices, in leadless chip carriers which are surface mounted on a multilayered ceramic substrate. Two spare pins on the module allow for future expansion to 16M bits.



Fast access times of 35, 45, 55 and 70ns are available. All inputs and outputs are TTL compatible and the module operates from a single 5V supply.

Maximum noise immunity is provided with the incorporation of multiple earth pins. Neither clock nor refreshing circuitry are required for operation by the modules which are fully asynchronous.

For more information, circle 274 on the reader services coupon or contact KC Electronics, PO Box 307, Greenborough 3088; phone (03) 467 4666.

New 68300 microprocessor

Motorola has announced the availability of the 68330, the simplest and least expensive member of the 68300 family of integrated microprocessors.

With the 68330, existing 16-bit designs can be easily upgraded into less costly, higher performance systems that can be powered by a battery. This makes it ideal for laptop and palmtop computers, portable printers and instruments — any piece of equipment that requires 68020-class performance.

Comprising a 68020-based core processor and a complement of common glue-logic circuits, the 68330 gives designers cost effective access to 32-bit performance, as well as complete freedom to choose the optimum peripheral and custom circuits for their application.

Like all 68300 family members, the 68330 is binary software compatible with the 680x0 central and 68EC0x0 embedded control micro-processor families. This gives designers access to a broad base of real-time operating systems, languages, applications and development tools.

With a 32-bit address bus, the 68330 can directly address up to four gigabytes of memory. Additionally, the 68330 provides a 16-bit data bus and up to 16 discrete I/O lines.

It executes 2.6MIPS when clocked at 16.7MHz. Manufactured in 1um HCMOS, Motorola's low power, high performance fabrication process, the 68330 dissipates a maximum of 6300 milliwatts when active and 0.5 milliwatts in standby mode.

For more information, circle 272 on the reader services coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711.

'Virtual ground' generator

A device which simplifies use of analog integrated circuits in digital systems having only a single 5V power supply is now available from Texas Instruments. Described as a 'virtual ground generator', the device elimates the need for the resistors, capacitors, operational amplifiers and voltage references previously required to accomplish this function.

It replaces multiple components with a single three terminal device in a small package. In a dual power source system, there is an earth ground as a midpoint for termination of all signal grounds. But in a single supply environment, a designer must generate a midpoint, or virtual ground. To accomplish this engineers typically have used solutions consisting of multiple components. TI's new TLE2425 virtual ground reference eliminates the need for all of these components.

Because of its small size and low pin count, the TLE 2425 can be used for any 5V and ground application, such as telecommunications, instrumentation, industrial controls, computers and peripheral products, or automotive products. Because it eliminates the need for power-hungry resistors, it can provide an order of magnitude or greater power reduction.

For more information circle 276 on the reader services coupon, or contact Texas Instruments, 6 Talavera Road, North Ryde 2113: phone (02) 887 12122.

Low resistance MOSFET

Rated at just 10 milliohms on-resistance, Siliconix's new 30V, 60A SMP60N03-10L claims the lowest on-resistance of any power MOSFET in a TO-220 package. The record-low resistance has been accomplished by using a very high cell density and optimising the device for applications that require a 30V rating.

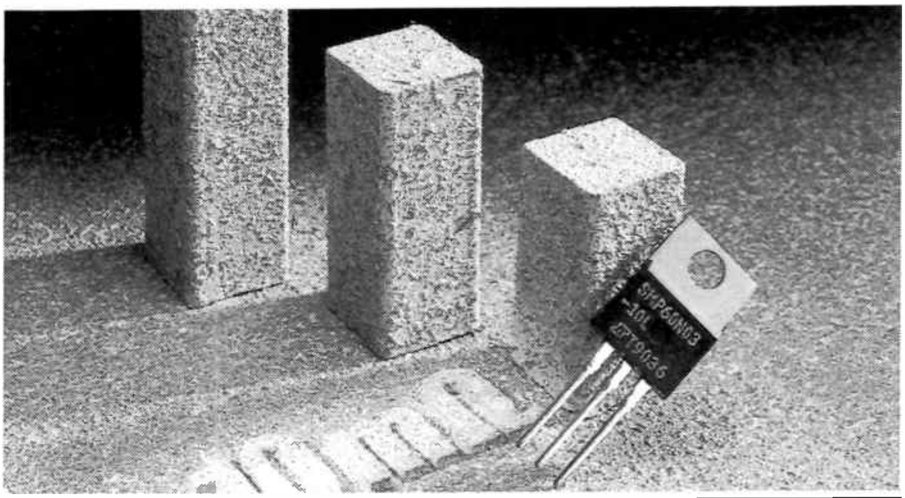
Specifically designed for power supply and power management applications in modern computers, the SMP60N03-10L provides more efficient and cooler operation. Fans can be eliminated and, in some cases, even the heatsinks can be designed out of the computer's power supply.

The SMP60N03-10L will also be beneficial to designers of motor controls in battery powered electric tools.

The chip is capable of carrying 10A continuous current, with a voltage drop of only 0.1V, and a lower voltage drop than a relay or a Schottky diode.

It is expected to replace both kinds of devices in many applications. A further advantage of the SMP60N03-10L is logic-level compatibility. The rDS (on) value approaches its minimum with a gate-to-source voltage of just 5V. This is an advantage over a relay, since the SMP60N03-10L can be controlled by a microprocessor or a logic gate.

For more information circle 275 on the reader services coupon, or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 748 4066.



Toshiba develops 'five layer' LSI chip

Researchers at Toshiba Corporation have succeeded in developing an experimental three dimensional LSI with five layers of single crystal, thin film silicon. Using an advanced electron beam and interconnecting tungsten wiring technology, the researchers formed transistors on each of the mutually insulated silicon layers and created circuits vertically connecting the elements.

Three-D LSIs are expected to surmount the limitations in packing density and operation speed of conventional semiconductor devices. Toshiba's new test chip, developed for parallel processing of image signals, integrates one million transistors on the five 9.5 x 9.5mm layers, and operates five times faster than conventional chips with equivalent function. When commercialised, the device will be suitable for super parallel processing, neural networks and real-time image processing on future prcomputers.

Synchronous 256K SRAMs

EDI has announced a range of fast 256K bit synchronous SRAMs, as a result of a second source agreement with Motorola. The devices, organised as 64K x 4 and 64K x 16, are primarily intended for first and second level cache in systems operating at up to 50MHz. Interfacing directly with popular CISC and RISC architecture devices, the synchronous memories are actually 'synchronised' by the processor clock to its internal operation.

This synchronisation method removes time wasting decoders and latches, and effectively increases performance by up to 20%, while reducing component count.

For more information, circle 280 on the reader services coupon, or contact KC Electronics, PO Box 307, Greensborough 3088; phone (03) 467 4666.

Fast high power rectifiers

Unitrode's HV Plus Series high-speed rectifiers enhance the design and performance of high voltage, high frequency switching power supplies. Featuring reverse voltage rating of 200 through 1000V, and reverse recovery times as fast as 30ns, the rectifiers improve performance in difficult applications.

For example, the rectifiers can serve as clamp diodes to protect high voltage power MOSFETs, or as output rectifiers in high-frequency converters.

Available in both industrial and high reliability/MIL-grade versions, the rectifiers have an 8pF junction capacitance and low leakage characteristics at high temperature. At 25°C, reverse leakage current ranges from 1 to 2uA for the 2A industrial units and from 0.5 to 1uA for the 2A high reliability units. Respective ratings for the two 4A units are 4 to 5uA and 2 to 4uA.

For more information, circle 273 on the readers services coupon, or contact Priority Electronics, 7/23 Melrose Street, Sandringham 3191; phone (03) 521 0266.

Track-and-hold chip runs at 30MS/s

Analog Devices' AD9100 is a fast track-and-hold (T/H) amplifier which offers true 12-bit performance at 30 million samples per second (MS/s. The AD9100 also features excellent dynamic specification: at 30MS/s, hold mode distortion is guaranteed less than -91dBfs (decibels full-scale) for frequencies up to 12MHz and -74dBfs up to 20MHz. Able to drive capacitive loads as high as 100pF, the T/H amplifier is also a good match for 8 and 10 bit flash converters operating at speeds up to 60MS/s. Applications include direct RF sampling, imaging systems, peak detection and spectral analysis.

The AD9100 uses a high speed complementary bipolar (DB) process. It integrates a closed-loop input amplifier with a switching network that substantially reduces distortion while maintaining the slew rate of traditional open-loop designs. The result is an acquisition time of 16ns to 0.01% accuracy and a tracking bandwidth of 250MHz.

For more information circle 278 on the reader services coupon or contact NSD Australia, Locked Bag 9, Box Hill 31228; phone (03) 890970. ■

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READER INFO No. 27

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Performance by design

Competitively priced US test gear:

COMMS SERVICE MONITOR, SIG GEN FROM RAMSEY

Now available in Australia, the Ramsey Electronics COM-3 Communications Service Monitor is priced well below similar units, yet offers virtually the same features — including deviation measurement and CTSS control tone generation. The company has also just released a competitively priced 1GHz synthesised signal generator, the RSG-10.

by JIM ROWE

When I came across the name Ramsey Electronics recently, it rang a faint bell in the depths of my faltering memory. Wasn't Ramsey the small New York-based firm that made pocket-sized frequency counters and other small test instruments, which were available out here around 10 years ago?

"The very same", I was assured by Stephen Brine, the sales engineer for Rohde & Schwarz Australia — which has just recently begun to represent Ramsey here. Only the company is now rather larger than it used to be, he tells me; they also make a wider range of instruments, many of which will definitely NOT fit inside a pocket — shirt, trousers, coat or otherwise. In one important respect, though, the company still has the same design philosophy that was evident in its early products: to concentrate on producing reliable, practical and competitively priced instruments for the working technician. They're happy to leave the esoteric and highly priced 'state of the art' research lab end of the test equipment market to others, and judging from their success in the last few years, this policy seems to be paying off.

Ramsey's COM-3 combines a sensitive FM/AM receiver, frequency counter, modulation/deviation meter and FM/AM signal generator in a compact portable case. Microprocessor controlled, it uses a durable membrane type front panel.

Would I like to check out a couple of the latest Ramsey instruments, asked Mr Brine? No prizes for guessing the answer to that one — we magazine editors are born stickybeaks. So it was that a week or so later, the man himself arrived carrying two instruments, each about the size of a desktop computer (less monitor and keyboard).

One turned out to be the COM-3 Communications Service Monitor, and the other Ramsey's new RSG-10 Signal Generator. And very interesting instruments they are, too.

The COM-3

The COM-3 is a *communications service monitor* — one of those 'all in one box' instruments for testing and adjustment of radio receivers, transceivers and transmitters. It combines a sensitive FM/AM receiver, frequency counter, modulation/deviation meter and FM/AM signal generator, all operating from either the AC power or an inbuilt battery supply, and fitted inside a sturdy portable case measuring 305 x 355 x 140mm and weighing about 29kg.

The COM-3 operates over the frequency range 100kHz-999.999MHz, making it suitable for servicing and checkout of a wide range of communications equipment — from HF marine and amateur radio gear, right up to UHF mobile and cellular phones operating in the 500MHz and 800-900MHz bands. This coupled with its compact form, modest weight and battery power option makes it very suitable for the field service technician.

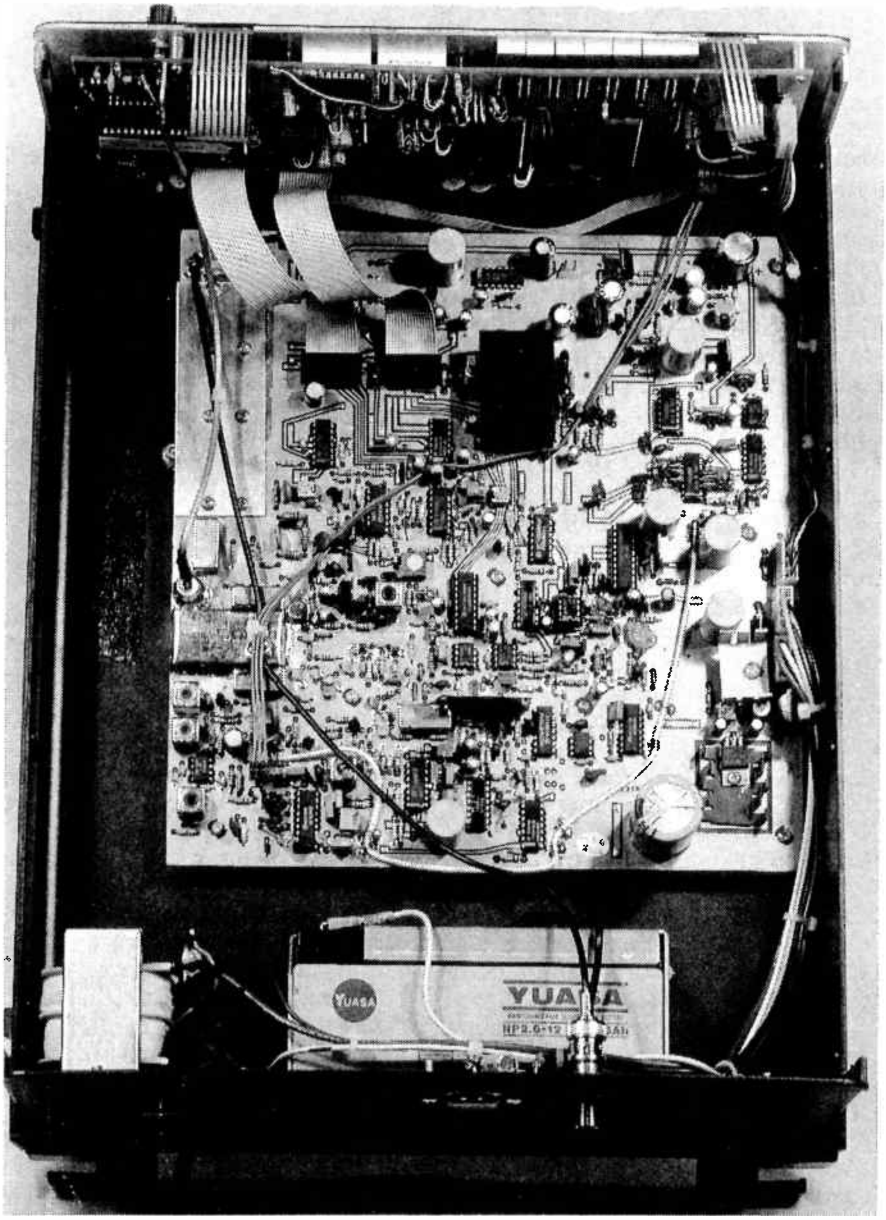
Of course there are a number of other communications service monitors around, offering similar features. However in most cases these also come with a pretty daunting price tag — generally well into the five figure region. The big point about the Ramsey COM-3 is that in its standard form it costs only $4950, plus tax if applicable. This includes telescopic antenna, internal battery and charger, 240V/50Hz power supply and user manual. At this price, the COM-3 should also appeal as a workshop instrument for many of the smaller two-radio radio servicing firms, technical colleges and perhaps also radio clubs. It may well be suitable as well for production testing in transceiver manufacturing plants, where its lower price would make it more appropriate than higher priced models.

How can Ramsey produce such a unit for around a third of the price of comparable models? Basically, by taking advantage of modern IC's and microprocessor control, and also by leaving out a few of the frills and 'over engineering' that tends to creep into the fancier models.

The COM-3 is designed to meet the known needs of technicians performing radio transceiver testing, and to meet these reliably — but without necessarily meeting the much tighter needs of R&D labs. For example the signal generator section tunes in 500Hz increments, because this is more than adequate resolution for all normal radiocomms work — many systems work on channels with no closer than 5kHz spacing.

Similarly the output attenuator is adjustable from 0.1uV to 10mV, which is narrower than a 'lab' type generator, but more than adequate for most testing of commercial 'production' equipment. Its output accuracy is also +/-2dB, again fine for normal testing, but somewhat less tight than for a true 'lab' generator.

In like fashion the RF counter has a resolution of 1kHz, over the range 10-999.999MHz. Although not as fine as a dedicated counter, this is fine for the intended application — especially



A general shot inside the COM-3, showing how virtually all of the circuitry is mounted on two printed circuit boards — the large horizontal main board, and a smaller vertical board mounted behind the front panel.

since the deviation/carrier frequency error facility has a 'narrow' range of +/-1.5kHz, capable of showing errors with a resolution of about 150Hz. This is in addition to the 'wide' range, displaying deviation and carrier error on a +/-7kHz scale. Finally, things like suppression of spurious output components and hetero-dynes are not quite as tightly controlled with the COM- 3, as they are with true 'lab quality' instruments.

But spurious outputs are more than 50dB below the carrier where it counts, for the kind of work for which the COM-3 is designed: within 10kHz of the carrier. And although there a few low-level 'birdies' from the instrument's own internal reference oscillator, these are not really likely to cause any problems in normal use.

It's by being sensible about these main performance parameters that Ramsey has been able to bring the price of the COM-3 down, well below that of other comms service monitors. The COM-3's inbuilt monitoring receiver tunes in 500Hz steps, like the sig gen. It has 5uV sensitivity between 10MHz and 999.999MHz (10dB quieting), but is useable down to about 100kHz. Audio output is rated at 2W. The frequency counter provides an audio range as well as that for carrier frequency, with a built-in multiplier giving 0.1Hz resolution

Ramsey COM-3

from 10Hz to 1kHz to allow measurement of CTSS tones, etc.

Modulation options on the sig gen section include FM with deviation adjustable from 0 to 15kHz peak, and AM with depth adjustable from 0 to 99%.

The COM-3 has a 1kHz sinewave modulation source built in, along with CTSS tones — programmable anywhere from 50Hz to 300Hz. There's also provision for external modulation, with a bandwidth of 10Hz-10kHz.

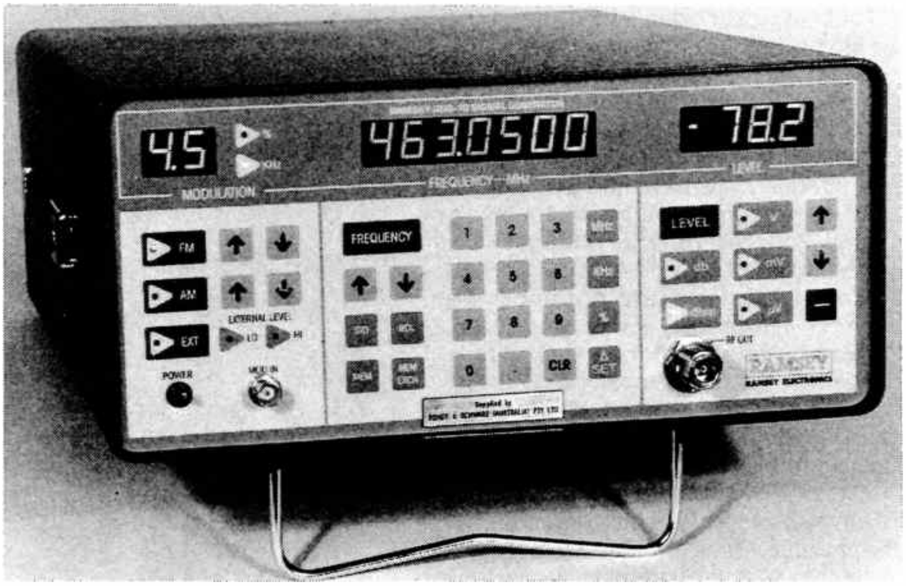
RF accuracy of the COM-3 on all ranges is determined by its internal 4MHz crystal timebase, which provides 1.0ppm over the range 0-50°C. Frequency adjustment of the receiver and/or sig gen is via a numeric keypad, which like most of the front-panel controls uses flat membrane-type buttons.

This not only keeps the cost down, but also makes the COM-3 more reliable by keeping out dust, grime and moisture. The COM-3 does not have an inbuilt RF dummy load and power meter, but one of its nice features is a protection scheme which automatically switches the front panel 'RF output' connector through to a rear panel connector, if a sensing circuit detects an RF level of greater than 500mW — caused, perhaps, by pressing the 'transmit' button on a transceiver under test.

Not only does this protect the COM-3 circuits from damage, but it also allows power measurements to be performed simply by connecting an external dummy load and power meter to the rear panel connector.

There is enough 'leak through' across the switching relay to allow the COM-3 circuits to measure carrier frequency, deviation and so on while the transmitter output is fed through to the dummy load.

Other nice features of the COM-3 include a set of memories, so that it can 'remember' 10 different front-panel setups, and recall these at the touch of a key; a pair of buttons which will shift the COM-3 up or down in frequency by a programmable offset, to allow switching between the transmit and receive frequencies used for repeater operation; another pair of buttons to allow convenient frequency stepping up or down in 5kHz steps; and an adjustable squelch control on the receiver section, as well as the volume control.



The RSG-10 signal generator is housed in a box very similar to that of the COM-3, as you can see here. Both instruments use membrane type control keys, to provide a high order of durability.

Construction of the COM-3 is fairly straightforward. The case is of the simple 'top and bottom half with ends' construction, with virtually all of the electronics on two PC boards — a large main board which mounts horizontally, and a smaller one which mounts vertically behind the front panel. There's not a great deal of internal shielding, just small shield boxes and plates over critical areas.

The internal battery and power transformer are attached to the rear of the case, as you can see from the photo.

In operation, we found the COM-3 to be very easy to use. The controls all seem to be straightforward, and it's surprising how rapidly you can check out all of the basic performance parameters of a transceiver.

We tried it out with a couple we had around, including one of the prototypes for the 2m FM Transceiver described in our January-April 1991 issues, and in each case the COM-3 made light work of obtaining the measurements.

In short, it seems to be a very practical instrument, and one that delivers a lot of performance for a very competitive price.

The RSG-10

The RSG-10 Synthesised Signal Generator is the very latest addition to Ramsey's instrument range, and is again designed to provide a high but 'sensible' order of performance, coupled with a competitive price. It has a range of from 100kHz to 999.9998MHz, with a resolution of 100Hz up to 500MHz and 200Hz above.

Frequency accuracy and stability with the standard reference oscillator is +/-5ppm (0-50°C), but optional alternative oscillators are available with either 0.5ppm or 0.1ppm if greater accuracy and or stability are needed.

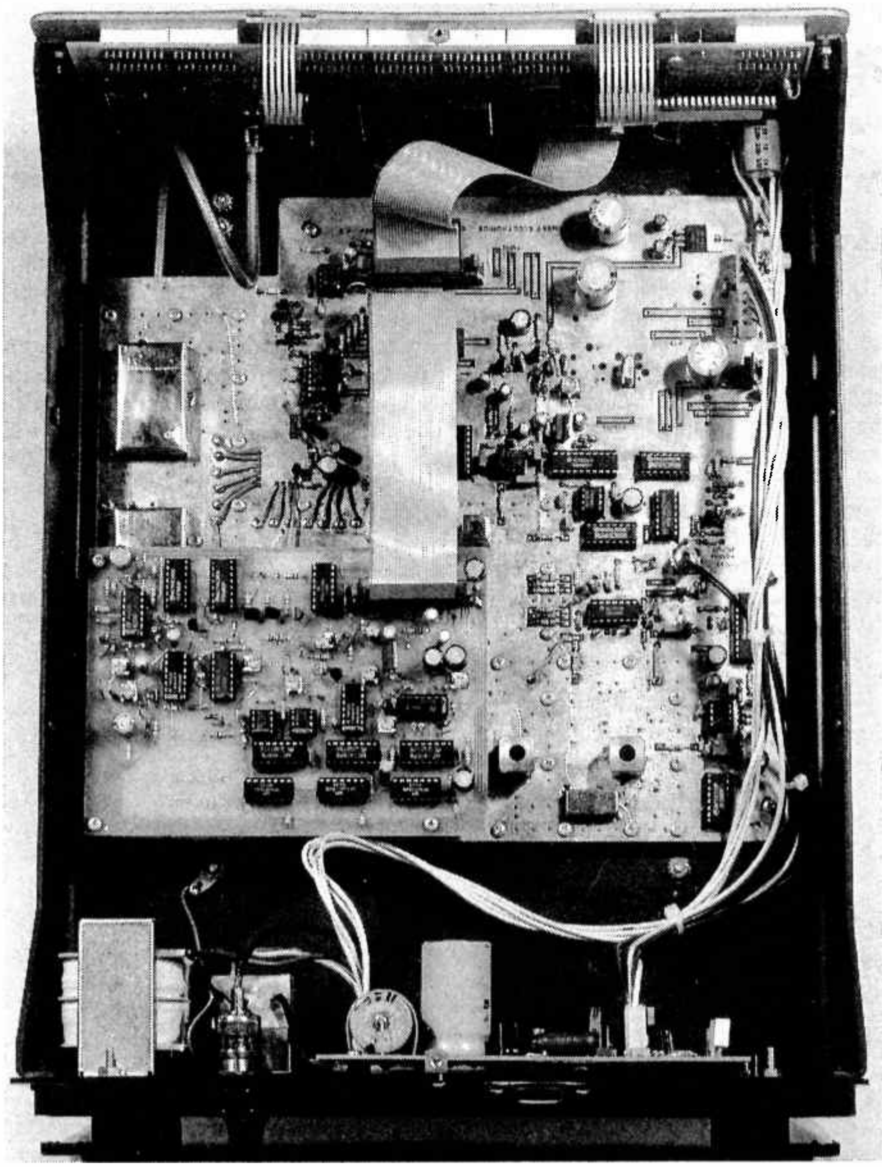
Spectral purity is quite impressive. Harmonic output is rated as -30dB below the carrier (above 3MHz), with sub-harmonics 'unmeasurable' below 500MHz and -25dB below the carrier for higher frequencies. Non-harmonic components are rated at -60dB below the carrier, at frequencies distant by greater than 10kHz.

Output level of the RSG-10 is adjustable from -127 to +10dBm into 50 ohms, in steps of 0.1dB. Absolute level accuracy is +/-2dB. A nice feature is that the output can be set and/or indicated in dBm, dBuV, dBmV, uV or mV as desired, simply by pressing the appropriate key.

Instrument leakage is quoted at 1uV into a 2-turn 25mm loop, 25mm away. The generator's output circuitry is protected against reverse power levels of up to 50W, and up to 50V DC.

The RSG-10's output can be modulated with either AM or FM independently, the AM being adjustable from 0 to 99% in 1% steps. FM is adjustable from 0-9.9kHz in 100Hz steps, or 0-99kHz in 1kHz steps, although maximum FM deviation between 125 and 250MHz is 25kHz.

An internal 1kHz modulation source is provided, along with provision for



Internally, the RSG-10 is much the same as the COM-3. The PC boards are of high quality, with careful use of shield boxes in all critical areas. The power transformer and supply circuitry are mounted on the rear of the case.

modulating with a 1V p-p external signal. External modulation bandwidth is 25Hz to 25kHz, with an input impedance of 600 ohms. Like most modern signal generators, the RSG-10 is microcomputer controlled.

Output frequency, output level and modulation level are displayed clearly on large 15mm-high seven segment LEDs, with seven digits for frequency, four for output level and two for modulation.

All functions are controlled via pushbuttons on the membrane-type front panel, with operating modes indicated via further small LEDs. An inbuilt 'beep' function provides audio feedback of control actions.

As with the COM-3, the RSG-10 has a memory facility, allowing 10 different control setup 'recipes' to be stored with a few key presses, and recalled when desired. A 'memory exchange' button allows rapid alternation between two frequently-used panel setups, a handy feature for repetitive testing of equipment in a production environment.

Most of the other functional areas are similar to the COM-3, except that here the incremental adjustment steps for both frequency and output level are user programmable. A further facility on the RSG-10 is the provision for feeding in an external 10MHz (1-5V p-p) reference signal, to replace the internal oscillator where high accuracy and/or stability is needed on occasions. If such a signal is available, say from a source locked to a caesium-beam reference, this is merely fed into a BNC connector on the rear panel — the circuitry switches over automatically. In terms of construction the RSG-10 is also similar to the COM-3, with the same kind of case and horizontal/vertical PCB system.

Here there's a little more use of compact shielding boxes for various areas on the main PCB, though, presumably to meet the rather tighter specs. The main RF sections apparently make significant use of SMT devices, although this wasn't evident from a quick look inside the case — most of the circuitry concerned is hidden inside the shield boxes.

In operation, we found the RSG-10 to be very well behaved and easy to use. It was very easy to set it for any desired output frequency, level and modulation/deviation level, and its output seemed to be very clean.

About the only facility we found ourselves missing, compared with some of the more expensive generators we've used, was an output level disable/enable switch. This is a handy facility, allowing you to 'kill' the generator's output at any time, without disturbing any of the main settings.

With the RSG-10 you can achieve an approximation of this function by having two setups, one with the normal output level and one identical, apart from having the output level set for the instrument's minimum of -127dBm. You can then toggle between the two setups using the 'MEM EXCH' key.

Still, it would be nice if Ramsey added an output enable/disable key to the instrument, to do the job more conveniently and reliably. Apart from that one niggle, though, the RSG-10 seems to us to be a well-designed unit offering a high order of performance in a competitively priced 1GHz signal generator.

The actual price is quoted at $4450, with a further $490 for the 0.5ppm timebase or $990 for the 0.1ppm timebase. A carry case is also available for $150, and an expanded 20-memory option for $40. These prices are all plus sales tax where applicable.

Further information on either the Ramsey COM-3 or RSG-10 is available by circling 202 on the reader service coupon, or by contacting Rohde & Schwarz Australia, 63 Parramatta Road, Silverwater 2141; phone (02) 748 0155. ■

NEW PRODUCTS

Dual readout, true RMS DMM

A new multimeter from DSE has a true analog readout as well as a separate digital readout. This together with its true RMS measurements from -45 to +50dBm (within the frequency range 50Hz to 2kHz) makes the Q-1700 very suitable for anyone working in telecommunications or servicing. The analog scale is mirror backed for even greater accuracy.

Features include auto polarity, audible continuity check, diode tester, overload protection and RMS measurements for AC voltage and current.

Its seven current ranges cover 20uA - 10A for both AC RMS and DC, while five voltage ranges measure 200mV - 100V (DC) and 200mV - 750V (AC) RMS. Decibel ranges are from -20dB to +40dB in 20dB stages, and six resistance ranges cover from 200 to 20M ohms.

For more information circle 246 on the reader services coupon, or contact Dick Smith Electronics, PO Box 321, North Ryde 2113; phone (02) 888 3200.

Audio service interface

Designed by Kingsley Electronics to link all the equipment usually found on the audio service bench to one control panel, the audio interface unit also measures power output to 800W per channel with internal 4V and eight ohm loads. The unit has 14 stereo signal inputs/outputs duplicated on the rear panels, so that all associated equipment leads can be hidden — leaving one lead in and one lead out from the unit being serviced. It has both comparative and selective switching.

Coupled to a millivoltmeter, it can be used to adjust record, playback and oscillator levels, with one knob and act as a high sensitivity, high output signal tracing unit.

Its three amplifier inputs are completely isolated from each other and from the attenuated oscilloscope and counter outputs. An optional adaptor allows the simultaneous connection of two interface outputs and two probes to an oscilloscope.

For more information circle 245 on the reader services coupon, or contact Kingsley Electronics, 17 Blackburn Drive, Cheltenham 3192; phone (03) 583 4020.

UV sensitive PCB films

Kalex is marketing the 4600 series Riston films, which supercede the type 3400 used in the past.

Riston films are UV sensitive films which are bonded to printed circuit board material. The laminated board is exposed to UV light through a negative of the printed circuit board tracks, and then developed, etched and drilled to produce the printed circuit board.

Commercial volume production of boards uses fully automated equipment and Riston 4600 responds favourably to such production methods, but its tolerance is such that it can be used successfully in limited scale production or for use in producing single boards. It thus finds favour with schools, small producers and government departments.

The developer used is an aqueous solution of a non-hazardous, environment friendly material. Stocks are kept in five sizes ranging from 150 x 300mm to 600 x 900mm, in both single-sided and double-sided boards.

For more information circle 242 on the reader services coupon, or contact Kalex, 40 Wallis Avenue, East Ivanhoe 3079; phone (03) 497 3422.

Surface mount testing adaptors

Although the use of modern IC packages can enable the engineer to significantly reduce the size of electronic subassemblies, it can also lead to problems during prototyping new designs and testing completed assemblies. Larger pin counts and fine lead pitches making probing a package terminal more difficult.

With pin counts often exceeding 100 and very close centre-to-centre spacing,

High quality capacitors

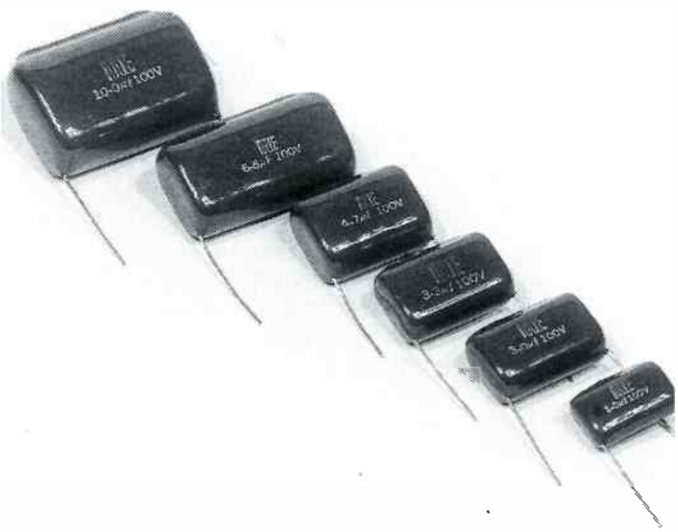
Speaker Technologies can now supply a new range of very low-loss metallised polypropylene capacitors in high values, designed especially for use in high-quality audio amplifiers and other demanding applications.

Custom made to a tight specification, the capacitors have 100V rating and are available in values from 1uF to 10uF, with a maximum tolerance of +/-5% (typically +/-1.5%).

The use of metallised polypropylene dielectric gives significantly lower losses than either polyester or polycarbonate types. Retail prices currently range from 87¢ to $6.20 each in small quantities. The company has also released a range of high quality bipolar (non-polarised) axial leaded electrolytic capacitors for loudspeaker crossover networks and similar applications, with a rating of 100V — significantly higher than others available in Australia.

These capacitors are available in values from 1uF to 100uF, and also have a relatively tight tolerance range: +/-10%. Retail prices currently range from 44¢ to $3.17 in small quantities. Data sheets are available for both types of component. Allow $5 per order additional to cover freight, packing and insurance. Discounts are available for bulk purchases and trade enquiries are welcome.

For further details circle 250 on the reader service coupon or contact Speaker Technologies, PO Box 50, Dyers Crossing 2429; phone (065) 50 2254.



hooking up test equipment probes at the chip pins can be a real headache, and possibly dangerous.

Emulation Technology offer a range of prototyping adaptors, socket converters, debugging accessories and debugging tools that will accommodate LCC, PLCC and PQFP (both EIAJ and JEDEC type) device packages with pin counts ranging from 20 to 160.

One such product is the 386SX test clip PQFP package with 100 pins spaced on 0.025" centres. The clip consists of a small PC board, on the underside of which is a clip which covers a 386SX already soldered onto a PCB. A set of pins, spaced at 0.10" centres, is located around the perimeter of the top of the unit's PC board, thus making it easy to attach test leads.

For more information circle 243 on the reader services coupon, or contact PP Component Sales, PO Box 580, Bayswater 3153; phone (03) 764 5199.

Low profile transformers

Sydney company Robert Ford & Co manufactures a wide range of Telectran power and audio transformers. Power transformers range from 1VA to 35kVA and, where applicable, may be designed to Australian Standard 3108. Included in the range is a low profile transformer, constructed on frame UJ66, which has a maximum rating of 100VA. Mountings include chassis mounting with brackets, flat chassis mounting with extended stack clamping screws and PCB mounting. Different versions give various outputs: 18V (2x9) supply 5A in series or 2.5A in parallel; 24V (2x12) with 4A or 2A; and 30V (2x15) with 3A or 1.5A.

For more information circle 249 on the reader service coupon or contact Robert Ford & Co, 4 Tepko Road, Terrey Hills 2084; phone (02) 450 2644.

PCB circuit breakers

Heinemann has developed a patented card-mounted socket that allows circuit protectors to be plugged into or removed from PC boards in seconds. It permits snap-in mounting of Heinemann Series JAcircuit protectors with current ratings from 20mA to 30A.

Mounting circuit breakers on printed circuit boards not only protects the circuit, but also provides a visual indication of whether any of the boards in a system contain a fault. However circuit breakers are not normally hard-wired onto PC boards, due to the possibility of residues remaining inside the breaker from flux used in wave soldering and detergents used during card-cleaning procedures. The use of the socket overcomes this problem. The narrow profile circuit breakers, measuring 19 x 51 x 25mm, permit close board spacing, while the position of the reset handles easily identify any faulty board.

For more information circle 241 on the reader services coupon, or contact Heinemann Electric, PO Box 241, Springvale 3171; phone (03) 560 3522.

Component fault finder

Huntron Instruments has released the Switcher 640, which when used with a Huntron Tracker 2000, automatically locates faults in devices with up to 64 pins. The Tracker 2000 isolates faults and failing components by displaying their analog 'signatures'. The Switcher 640 automates this process by comparing the analog signatures of a suspect component with a known good component, and reporting any differences.

Designed to speed up the PCB and multi-pin device troubleshooting process, the Switcher 640 works in one of three ways: it can scan through all of a device's signatures at a user-selected rate, allowing the technician to rely on experience to determine if a signature is suspect; it can automatically scan both a good and a suspect component, comparing the signatures of each pin and stopping on differences; or it can scan and compare all component pins and then take the technician to the worst failure first.

For more information circle 251 on the reader services coupon or contact Nilsen Instruments, PO Box 930, Carlton South 30531; phone (03) 347 9166.

Energy computer

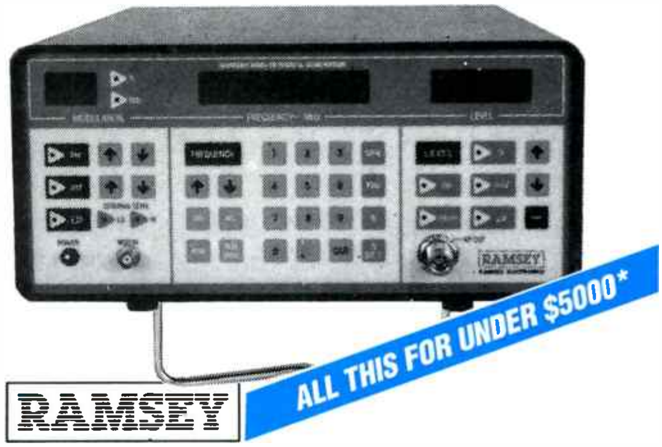
A mini version of the award winning Energy Saving Computer has been released for small to medium sized companies. It is designed for companies which use as little as 5 to 10 kilowatts of air conditioning ro 2 to 5 killowatts of refrigeration.

The product's 'big brother' won the Federal Government's National Energy Management Award in 1985, and has been used successfully in more than 4000 installations worldwide. The EC1 Jr. was developed for smaller applications, but still works on the same principle of reducing the running time of heating, air conditioning or refrigeration systems without changing the desired set conditions. With this economy, the intelligent microcomputer device reduces energy costs by 15 to 30% and requires virtually no maintenance. Retailing around $995 (per single system), plus installation costs, it is claimed to repay its cost within two years.

For more information circle 253 on the reader services coupon, or contact the Energy Saving Computer Company, 9 Donegal Rd, Killarney Heights, 2087; phone (02) 975 3820. ■

Ramsey Electronics Inc is a U.S. manufacturer of quality, economically priced electronic equipment. Their cost effective instruments incorporate all the "most-used" features of competitive instruments and leave off the extras. The result – hard working instruments that don't break the budget!

RSG-10 Synthesised Signal Generator



- ***Full frequency coverage 100kHz to 999.9998MHz***
- ***Calibrated AM and FM modulation***
- ***Delta Set Increment Key for fast parameter variations***
- ***Ten non-volatile programmable memories using EEPROM technology***
- ***Automatic memory exchange for switching between two set-ups***
- ***Extensive SMD in RF section for improved reliability***
- ***High stability – 5ppm (0.1ppm optional ovens)***
- ***Automatic timebase locking to external source***
- ***Reverse Power Protection***

READER INFO No. 30

Specification

Frequency Coverage:	100kHz to 999.9998MHz
Resolution:	100Hz (<500MHz), 200Hz (>500MHz)
Accuracy:	±5ppm standard ±0.5ppm and ±0.1ppm optional
Spectral Purity:	-30dBc
Subharmonics:	-25dBc (>500MHz), None (<500MHz)
Non-Harmonics:	-60dBc
Frequency Modulation:	0-9.9kHz in 0.1kHz steps
Amplitude Modulation:	0-99% in 1% steps
Output:	50Ω
Level Range:	-127 to +10dBm 0.1dB resolution
External Modulation :	600Ω, 1Vp-p
Memory :	Up to 10 complete front panel set-ups may be stored
Controls:	Fully sealed membrane switch panel

** Prices subject to Sales Tax if applicable*

ROHDE & SCHWARZ

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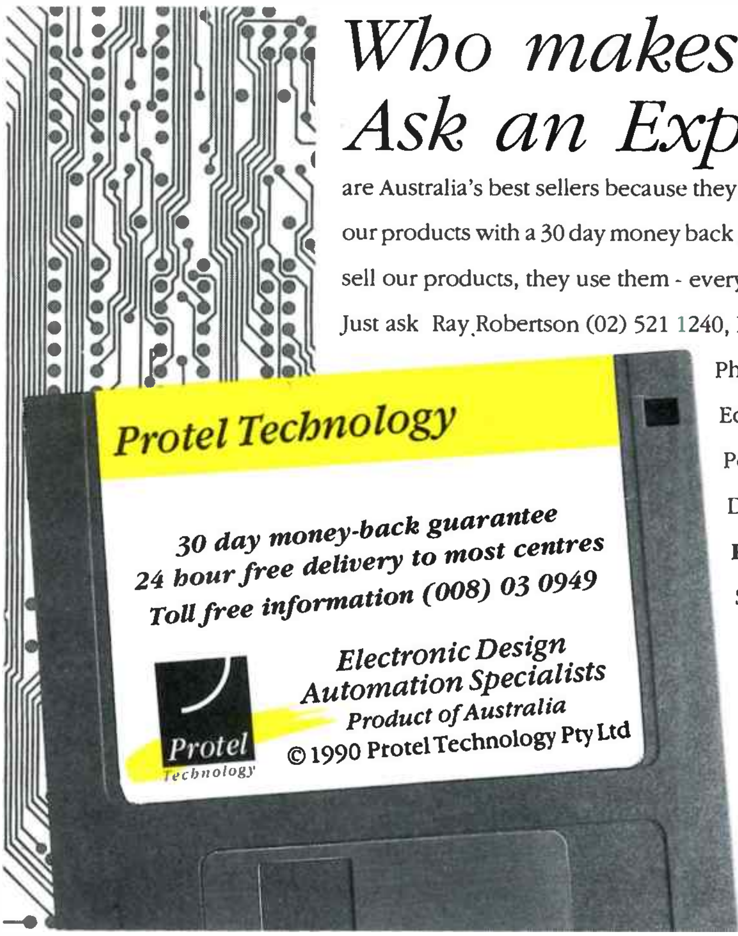

Just ask Ray Robertson (02) 521 1240, Igsaan Jamie (02) 790 0580, Chris Krulic (03) 366 5318, Phil Muraca (03) 521 2869, Martin Gregory (03) 562 1277, Ed Neil (08) 45 4986, Doug Brown (08) 371 1022, Peter Borg (09) 356 1997, Rob Berkavicius (09) 445 3153, David Warren (002) 71 8120, Alistair Henderson (07) 369 5900.

Protel Autotrax™ – fully automated PCB design system with SMD support, auto place, autorouter for only $1595 (Mac® version $1995); **Protel Easytrax™** – low cost PCB layout package, including pad-to-pad autorouting for only $395 (Mac version $495). Both systems feature metric/imperial grids, Gerber, PostScript and N/C drill support.

PC version requires XT/AT/386/486 compatible with 640K RAM; DOS 2.0 or later.
Macintosh version requires Mac Plus, SE or II, hard disk drive recommended.
Mac and Macintosh are registered trademarks of Apple Computer, Inc.
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READER INFO No. 31

Australian-made PCB design software:

Protel enhances Autotrax, Easytrax

Tasmanian company Protel Technology has recently added new features and facilities to both of its very popular PCB CAD packages for personal computers: the 'professional' package *Autotrax*, and its lower-priced and more basic sibling *Easytrax*. Both packages are now also available in versions to run on the Apple Macintosh, as well as IBM-compatible machines.

by JIM ROWE

Nowadays, I guess most people involved in designing PC boards would be at least aware of Australian firm Protel Technology and its well-proven CAD packages *Autotrax* and *Easytrax*, for IBM-compatible PCs. Like the company's circuit drawing package *Protel Schematic*, they're widely used, not only throughout Australia but around the world. And this popularity is well deserved, as all three packages are both powerful and easy to use — as well as offering particularly good value for money.

Regular *EA* readers will recall that we published a review of *Autotrax* in the September 1989 issue, written by Peter Phillips and Mark Cheeseman; a review of *Easytrax* in the December 1989 issue, written by Tom Moffat; and a review of *Protel Schematic* in the August 1990 issue, written by myself. Not only that, but here in the *EA* office we've been using Version 1.1 of *Autotrax* for some time now, to design PC boards for our construction projects, and more recently we've had a chance to use *Easytrax* as well. We've found that both packages allow us to produce clean and elegant board designs quickly — and also to modify them with equal efficiency, when this is needed.

Since I reviewed it, *Protel Schematic* has also been finding use for drawing some of our smaller schematics, as the more astute readers will have noticed. This too is an easy to use and efficient package, although its more limited output resolution makes it a little less suitable for publishing work.

On the whole, then, I guess you could say that we're reasonably experienced users of the Protel packages. Perhaps we're also rather biased in their favour, but the fact is that the packages *are* quite friendly and easy to use, the PCB design programs in particular produce high quality output, and they are very reasonably priced. All of which contributes to user enthusiasm and satisfaction.

Of course the fact that they're also 'made in Australia' inevitably adds to their appeal, as far as we're concerned. It's especially nice to be able to endorse locally developed products — they aren't that thick on the ground, nowadays!

But enough of this preamble. The real reason for this present write-up is that the good people down at Protel, never content to rest on their laurels, are constantly striving to improve their

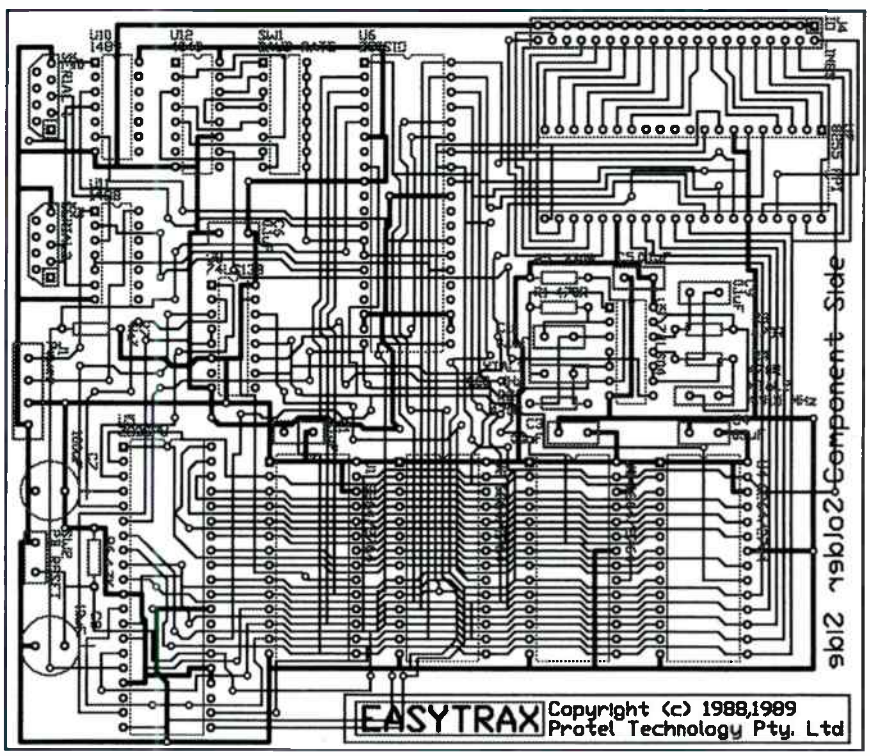
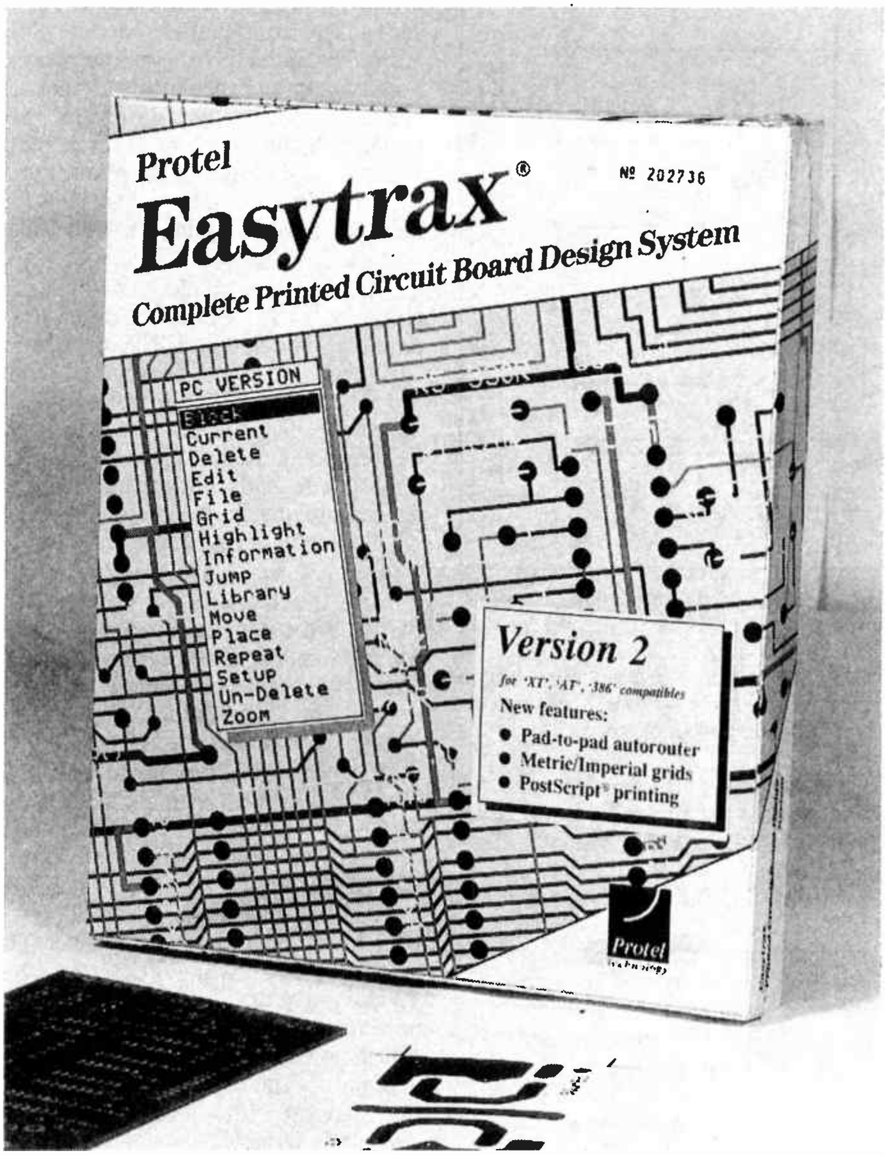


Fig.1: A printout of the checkplot for the 'Demo' board file provided with Easytrax, reproduced here at 75% of actual size. Using the 300dpi PostScript printer/driver it took a total of 164 seconds before printer start-up. By comparison, printing the same file with the HPGL driver took 380 seconds.



products. Late last year they released enhanced versions of both *Autotrax* and *Easytrax*, and very kindly sent us up samples of the latest versions to try out. Now that we've had a chance to do so, here's a report on the new features.

By the way, I've just learned that there are actually now *two* versions of *Autotrax* — the 'standard' version, and the Extended version.

The main difference between the two is that the standard version provides automatic component loading from a netlist, but only pad-to-pad auto routing and 'rats nest rubberbanding' as a visual guide for manual routing. It's now only the Extended version that offers full auto placing and multi-pass autorouting facilities.

Apart from this difference, the two new versions of *Autotrax* are apparently the same. Both versions share such functions as user definable track widths, pad sizes and spacing rules; global editing; and support for surface-mount devices.

So in terms of capabilities, the new 'standard' *Autotrax* now slots about halfway between the Extended version and *Easytrax* — making it a good choice for those who need a little more than the facilities of *Easytrax*, but can't quite justify the cost of the full *Autotrax Extended*.

Autotrax V1.5

The new enhanced versions of *Autotrax* boast many new features. General enhancements to the complete package include re-written video drivers, for improved performance with EGA, VGA and 'Super VGA' graphics adaptors; a *GRAPHSET* utility, to allow changing the video driver more conveniently after initial installation; and a utility called *2NET*, which translates EDIF (*OrCAD*), *SCHEMA* and *PADS-PCB* netlist files into the format used by *Autotrax*. A further utility called *PCBTODXF* is apparently under development, to allow conversion of *Autotrax*'s .PCB files into *AutoCAD*'s .DXF format.

Traxedit, the main PCB editing part of the package, now provides the option of either imperial or metric grids; the ability to place curved tracks; an option to use a 'polygon' grid of tracks for external fills, instead of solid fill; dynamic 'rats nest rubberbanding' or net highlighting when you're manually routing from a loaded netlist, to allow you to see progress more easily; and many improvements to the Extended version's autorouter. These include the ability to select via-to-pad separation; selectable smoothing passes, including replacement of 90° corners with arcs; and the ability to place up to a specified number of short 45° 'wave' segments, to allow passing obstacles without changing the search/path axis.

Needless to say, the matching PCB plotting program *Traxplot* has also been provided with a number of new features. These include automatic generation of a .TOL file, to specify drill sizes for an Excellon NC drilling machine; the ability to specify a disk directory/path for the plotter or printer driver; selectable enlargement of holes in intermediate power and groundplane layers, to clear pins; the ability to 'flip' any layer around its Y axis during printing, to get mirror images (often more convenient for making film negs); drivers for Epson 'LQ' and compatible 24-pin printers, and for QMS laser printers (HP Laserjet emulation only); an additional plotter driver, to suit Roland 1000 series plotters; and automatic naming of print output files to match the .PCB input file.

But perhaps the most welcome addition of all is that *Traxplot* will now produce output in *PostScript* graphics description language, to drive laser printers and phototypesetters. Version 1.56 will produce output in 300, 400, 600 and 1200dpi resolution to suit laser printers, with a choice of either A4, A3, B5, US letter and US legal paper sizes for 300dpi, A4 or A3 for 1200dpi and A4 only for 400 and 600dpi. For Linotronic setters 1270dpi resolution drivers are available for either A4 or A3 formats.

Easytrax V2.06

The latest version of Protel's very popular 'economy' PCB design package *Easytrax* has also been considerably improved. It now comes in a snazzy presentation box with four-colour printing, and even more importantly boasts a well-written and very nicely presented user manual of 156 pages.

Happily, many of the enhancements to *Autotrax* have now been added to *Easytrax* as well. For example it uses the same improved video drivers, while the editing program *Easyedit* now offers a choice of metric or imperial grids, like its bigger brother.

Similarly *Easyplot* now offers the driver for Roland 1000 series plotters, improved disk path handling, the automatic naming of output files and the same very welcome set of 11 different PostScript printer/setter output drivers.

In addition to these goodies, *Easyedit* now also provides the 'pad to pad' autorouting feature, previously available only with *Autoedit*. This lets you nominate two specific pads to be connected by a track, and have the program automatically work out an appropriate path — or at least, one that meets its inbuilt spacing/geometry rules.

Another new addition to *Easyplot* is the ability to produce Gerber photoplotter output files and Excellon NC drilling files, like its larger brother.

And finally, *Easytrax* now comes with an expanded library of some 100-odd standard 'through hole' components, which can be modified and/or added to if desired. It also comes with an additional utility called *EASYAUTO*, which can convert the .PCB files produced by *Easyedit* into the similar but different .PCB file format used by *Traxedit* (but not vice-versa, for some reason).

Mac versions

Protel has also released versions of both *Autotrax* and *Easytrax* to run on the Apple Macintosh. We haven't been able to play with these as yet (mainly because we don't have easy access to a Mac), but we're assured that they provide virtually the same features as the PC versions.

What we found

Frankly, the new feature that we like most of all about both *Autotrax 1.5* and *Easytrax 2.06* is the PostScript print drivers. These provide a very significant speedup in the time to print out PCB layer artwork, compared with HPGL printing, with no discernable penalty in terms of resolution.

Over the last few months, we've had the opportunity to try out the new 300dpi PostScript driver in particular, and compare printing times with the corresponding HPGL driver using the same laser printer — our TI MicroLaser, which has both H-P Laserjet and PostScript emulations inbuilt. There's no doubt that the PostScript driver gives much faster results on the average, although the speedup factor varies according to the complexity of your board.

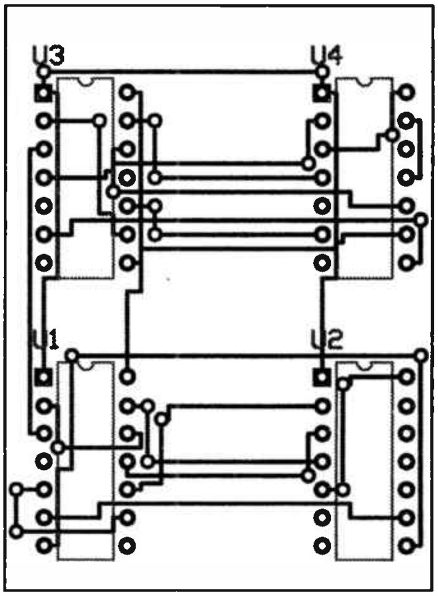


Fig.2: The checkplot for a small 'dummy' PCB file, reproduced here at around 150% of actual size. Using the 300dpi PostScript driver, this took a mere 18 seconds — nine times faster than with the HPGL driver.

To give you a more specific handle on this, just before I sat down to write this story I tried printing out the 'checkplot' versions of two different but fairly representative files, using *Easyplot* running on the 20MHz 386SX machine in my office. The two files were the 'Demo' board pattern that Protel supplies with *Easytrax*, with around 13 ICs and assorted connectors and passive components (a small, but fairly complex two-layer board), and a very simple 'sample board' with just four 14-pin DIP packages and about a dozen interconnections. They're shown in Figs.1 and 2.

Incidentally the PC used has about 1.5MB of EMS 'expanded' memory, while the TI Microlaser is fitted with 2.5MB of internal memory.

So the combination is fairly speedy, but representative of the kind of hardware that many serious users would tend to be using nowadays. What I found was that using the 300dpi HPGL printer driver, the checkplot of the Demo board took 380 seconds before *Easyplot* sounded its 'beep' to signify that the last of the print file had been sent to the printer, and the latter's mechanism sprang into life to print it out. Using the 300dpi PostScript driver, only 34 seconds elapsed before the beep occurred — although the printer's PostScript interpreter then took a further 130 seconds to crunch the script and produce the bit-map image for printing. But the total time before printing was still only 164 seconds — less than half the time needed to print the same image resolution using the HPGL driver.

With the much smaller 'sample board' file, the difference was even more dramatic. The 300dpi HPGL driver took 152 seconds total before printing, while the 300dpi PostScript driver took only 18 seconds — of which preparation and delivery of the file to the printer took only four seconds, with the printer's interpreter taking the remaining 14. Overall, a speedup of over nine times!

From our use of the new driver over the last few months, my impression is that with the patterns for typical 'small project' boards, the speedup is around four or five times. Certainly it's been enough for us to have swung over to PostScript printing completely.

Of course it's possible to get faster HPGL printing with either *Traxplot* or *Easyplot*, by using the lower resolution drivers. For example printing a checkplot of the 'Demo' board file at 150dpi takes only 96 seconds, or about 1/4 of the time for 300dpi, as you'd expect (1/4 as many pixels), while dropping back to 100dpi is even faster at 51 seconds. Both packages also provide a 75dpi HPGL driver, which is about four times faster again than the 150dpi driver; but the resolution at 75dpi is really quite poor, and barely useable.

If you have a printer that will only accept HPGL, the 100dpi or 150dpi drivers are probably the best compromise betw een speed and resolution. But if your printer can handle PostScript, there's no need to accept any compromise. With Protel's beaut new PS drivers, you can often have 300dpi resolution in less time than 150dpi with the HPGL driver!

Of the other new features that have been added to *Autotrax*, we really like the improved video drivers, which seem faster and allow improved results with VGA type monitors; the curved track placement; the ability to specify a disk path for *Traxplot*; and the polygon fill option. We don't have an NC drilling machine, so the new ability to generate .TOL files hasn't had much impact on us. Similarly most of the boards we do are relatively simple, and we prefer to use manual routing rather than make use of *Traxedit*'s quite elaborate autorouting

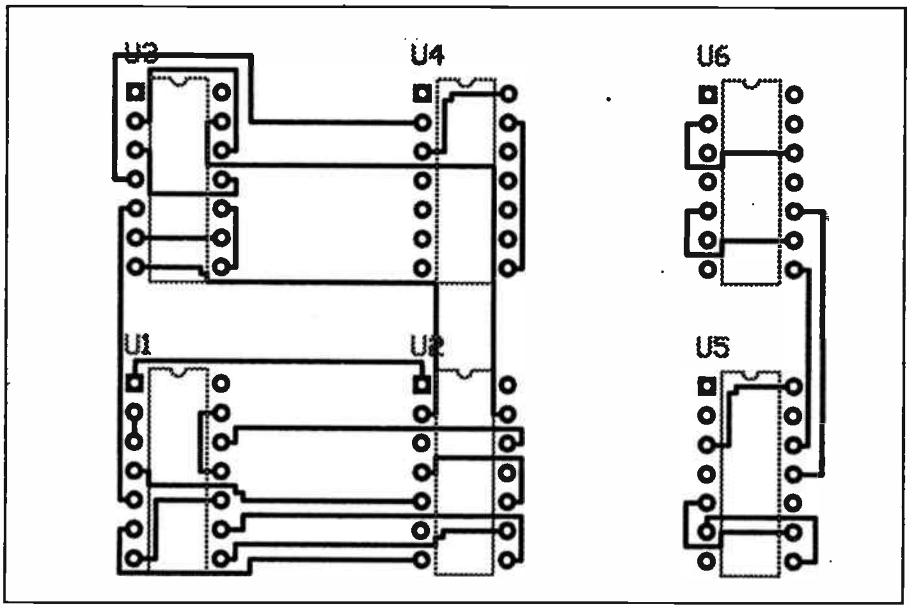


Fig.3: An example of the kind of track work produced by the pad-to-pad autorouter feature now provided in Easytrax. It has a number of puzzling idiocyncracies — including a tendency to use a long and complicated route when a short and direct one is quite feasible. Track-to-pad spacing is not adjustable by the user, and often turns out to be unacceptably close. (Reproduced here at 200%).

facilities — even with the new smoothing and wave routing enhancements.

In fact in many ways, most of the PCB work we do can be done just as well using *Easytrax*, or at most the new 'standard' version of *Autotrax*. I suspect many people would be in the same boat, especially if like us they produce relatively small and simple boards, and perhaps haven't as yet gone to surface mount designs.

Talking about *Easytrax*, its new-found ability to perform pad-to-pad autorouting did prompt us to try this feature out, rather more than we'd done previously with *Autotrax*.

And the feature is certainly quite handy, although it's rather more limited in *Easytrax* due to the lack of any provision to change many of the spacing rules (like track/pad spacing).

Somehow this seems to accentuate some of the peculiar little 'quirks' of the feature, that you notice even in the more flexible form in which it's given in *Autotrax*.

Things like its apparent inability (refusal?) to route some tracks when you're using a particular track width, even when a clear route is clearly visible — or its apparent tendency to regard the *minimum* spacing as the default or *preferred* spacing, which when coupled with its inability to push previous tracks aside, means that it will often run tracks that prevent the routing of later tracks, simply because they were placed at minimum spacing from a pad, unnecessarily. Or its choice of complex multi-via routes, when they're patently unnecessary because a simple direct route is available. These things can at times lead to quite weird track placement, which no self-respecting human board designer would even contemplate.

Some of these are illustrated in the sample of Fig.3, where all of the tracks were placed by the pad-to-pad autorouter. Often when you're using a track width that is narrow enough to fit between IC pads, it will even join a track to such a pad *between* the pads — i.e., so that there's a small 90° crank, with the join axis parallel with the IC's long axis! This can occur even when there's plenty of space to make the join in the more acceptable way, to either the inside or outside of the pad.

In our opinion, the pad-to-pad router would be somewhat better if it was *only* able to join tracks to IC pads on these inner or outer sides, and also if it allowed you to specify both a *preferred* and a *minimum* value for track-to-pad spacing. Without these further refinements, it seems to be one of those features that are 'great in theory, but in practice more trouble than they're worth'.

But this is not a major criticism, and I don't really want to give the impression that we've found either *Autotrax* or *Easytrax* wanting in any significant way. On the whole, they're both excellent and we're very impressed with them in their new enhanced versions.

With their expanded features and facilities, coupled with their already high level of user convenience and efficiency, they seem to us to represent exceptional value for money in PC-based board design packages.

At the current price of $395 for the PC version and $495 for the Mac version, *Easytrax* must surely be outstanding value for a 'basic' package. Similarly the new Standard version of *Autotrax* seems very well priced at $995 for the PC version and $1295 for the Mac, while the full *Autotrax Extended* is surely also good value for professionals at $1595 for the PC version and $1995 for the Mac.

Further information on any of these products is available from Protel's dealers and distributors in each state, or by ringing their information hotline on (008) 03 0949. Demo disks are also available for all of their products, by either ringing this number or writing to Protel Technology, Technopark, Dowsing Point, Hobart, Tasmania 7010. ■

Useful computer program:

VIDEO ALIGNMENT DISK

Want to check the colours displayed on your computer monitor, or to check its alignment and linearity? Eric Rodda's program CARD does all this for a range of monitors used with IBM and IBM-compatible computers running on MS-DOS.

There are really two parts to this collection of software. The first is a set of programs for monitor checking, while the second is a series of utilities. While these utilities were basically written to run the main CARD.BAT program, they are quite useful to add to your own personal batch file. The author's copyright allows such use.

The origin of the CARD package is the colour card which used to be held up in front of a TV camera to allow the correct setup of the TV monitors. This is a computer generated version designed to achieve the same results.

If you have a VGA monitor, there is a colourful demonstration display activated by VGACOLOR.EXE. The author's logo first appears, then disintegrates. Then colour rectangles featuring all 256 colours are randomly displayed, superimposed all over the screen. After a key press, they are lined up and drawn in colour number order, from white to black. But be patient with this demo — you must go through the whole routine before being able to escape.

The main programs in the package are CGACARD, EGACARD and VGACARD, and the easiest way to use them is to run the CARD.BAT file which allows selection from a screen menu. These programs provide the tools for correct alignment and colour of the three types of monitor.

To do this, each test pattern provides various reference features. A border frame is provided to allow correct alignment. Shifting is done using horizontal and vertical monitor controls, with rotation being corrected by adjustments to the CRT yoke.

Convergence dots allow for adjusting static convergence, while bright lines with crosses allow you to view convergence errors. Corrections to these areas require adjustment to various ring and strip magnets on the neck of the CRT etc. Then there are closely ruled grids on which you adjust the focus, and a grey scale to touch up brilliance and contrast. A circle allows a quick check for linearity and picture height.

And finally the colours themselves. CGA (mode 4) displays only four foreground colours, with much reduced resolution. EGA (mode 16) and VGA (mode 18) display 14 colour squares.

Each colour card will work on more advanced monitors, so the EGACARD works for both EGA and VGA. It would therefore tend to be the most useful. Monochrome Hercules display is also available, providing that the driver card of the computer supports it.

Two other programs CROSSHAT (crosshatch) and DOTS allow for more precise checking of convergence, picture position and size, and linearity. These programs automatically default to a suitable video mode determined by the system configuration with the simple CROSSHAT command; but any valid configurations can be asked for. Hence, CROSSHAT 4 will run the CGA mode 4. (Appendix A in the CARD.DOC file lists the various valid monitor modes.) The ERSVMODE program lets you check which modes your computer will allow to run.

Colour purity can be checked for white, red, blue and green, using PURITYW, PURITYR etc., which fill the screen with just that colour. Patches of wrong colour require degaussing, either by switching the monitor off then on, to activate its degaussing field, or by using a degaussing wand. If these methods fail, then a qualified person will need to adjust the purity magnets physically or reposition the CRT yoke deflection coils.

There are also two programs for systems without graphics, to allow correct alignment. MONOGRID works for monochrome displays, while LAPTOP replaces CARD when not all writing is displayed or the result is blotchy. Running PURITY with laptops will check whether all pixels are working. The second part of the package consists of several useful utilities.

PICKONE is a menu selection which operates off the various error level messages, DELAY provides a pause measured in seconds, CURSA gives the option of displaying or hiding the cursor, while PRESS causes the program to pause until a key is pressed. A message to this effect can be displayed or hidden.

Three routines are provided to replace the DOS 'CLS'. WIPELEFT clears the screen to the left, while WIPERITE clears to the right. CLR clears like CLS, but the cursor is then able to be positioned on a nominated line, or positioned by the program at random.

All these routines are used in the main CARD program, and suggestions for their use in other BAT files is given in the CARD.DOC file. This .DOC file gives extensive notes on the use of all the programs in the package.

The CARD package would be extremely useful for technicians working often on screen alignment. It is useful also for the minor adjustments which most of us make when fiddling with the various knobs on the back of the monitor! And the various utilities are a nice bonus. There is even an INSTALL program which makes a \CARD subdirectory and copies the contents of the floppy into it, even adding (if desired) \CARD to the path in your AUTOEXEC.BAT file.

All of the files can be called directly from DOS, including the menu program itself. This means that the utilities may be used in other DOS software. But, as mentioned earlier, the simplest way to run the various CARD programs is via the screen menu, which is activated through the CARD.BAT file.

The review copy of CARD came from Microgram Computers, 17 Barry Street, Bateau Bay NSW 2261. Copies are available from that address by direct mail order for $40. (P.M.) ■

Silicon Valley NEWSLETTER

Texas Instruments and IBM have established an 'electronic trading' system in the Pacific Rim area, linking the two organisations via an X.400 electronic mail network. The move is said to be the first step in a full electronic data interchange (EDI) link between the two companies. Shown here (l to r) are Tony Bowra of IBM, Ian Hawkins of TI, Geoff Lamb of IBM, and Stuart McNair of TI.

'Electronic bullet' zaps illegal cable boxes

Electronics has come to the aid of cable television companies, in their battle against people who use illegal converter boxes that unscramble signals of movies, sports and other paid cable TV channels.

CableVision of New York recently sent a high-power 'electronic bullet' through its cable system, instantly zapping the delicate circuitry of thousands of illegal converter boxes. Most cable customers never noticed the all-out attack because the circuits of their legitimate converter boxes were designed to withstand the impact of the high-energy signal. But boxes containing illegally installed converter chips were destroyed on impact.

The action prompted hundreds of calls to the cable company, from people using illegal boxes after their screens went blank. CableVision immediately dispatched servicemen to the homes, supposedly to replace the boxes. Instead, the illegal boxes were confiscated by the company to be used as evidence against the owner.

In all, CableVision filed civil suits against 317 alleged cable pirates who called in to complain and thus provided the company with their name and address. It is estimated that cable companies in the US lose an estimated US$3 billion in revenue due to the use of illegal converter boxes.

Cypress first to buy X-ray litho system

In a most unusual move for a company its size, San Jose-based Cypress Semiconductor has purchased the first of a new generation of X-ray based commercial lithography systems. With the machine, Cypress hopes to acceleratedevelopment of components with features of just 0.3 microns.

The US$4 million system was developed by Hampshire Instruments and uses a laser developed at the Lawrence National Laboratory in Livermore near Silicon Valley. To date, Hampshire has shipped three of the machines to research laboratories. The sale to Cypress of the System 3500 represents the first X-ray machine built for high-volume production applications.

Hampshire president Moshe Lubin said the system was developed with a US$3.2 million grant from DARPA, the Defense Advanced Research Projects Agency. Already six other companies have signed up to buy the system.

Industry observers said they were somewhat puzzled why Cypress has decided to purchase the X-ray system. Typically, only the largest chip makers purchase such expensive systems, particularly those that represent a radically different manufacturing technique. X-ray is still considered highly experimental and there is no data on long-term reliability of parts manufactured in high volume with the technology. However, many experts are convinced that X-ray represents the next generation in lithography, even though the major Japanese DRAM makers have vowed to use 0.35 micron-based optical lithography technology for their four and 16 megabit DRAM products. While 0.35 micron appears to be the absolute limit of optical lithography, X-ray has the potential of making chips with much smaller features, perhaps as small as 50 nanometers, (0.05 micron).

Chip orders evaporate in May

A sharp plunge in May chip orders from US-based manufacturers has caused a sharp drop in the closely-watched book-to-bill ratio, from 1.15 in April to just 1.04 in May, according to the latest figures released by the Semiconductor Industry Association.

According to the SIA, 3-month average orders fell nearly 7% from April to US$1.35 billion. Actual orders during May show a whopping US$300 million (19.2%) drop in May orders to only US$1.22 billion, down from the industry record of US$1.5 billion set in April. Compounding the slide in the b-t-b ratio was a 2.5% increase in average shipment. Because the SIA uses a three month average sales and orders the b-t-b was able to stay above the break-even 1.0 level, but based on actual orders and shipments, the indstry's May b-t-b ratio fell to only 0.95, compared to 1.27 in April. The sharp decline in May orders could spell problems for the industry. Traditionally, May is one of the year's best months for chip orders, traditionally followed by three months of slow sales during the June-August summer slump.

Because the summer slump may have set in early — and in dramatic fashion

— chip manufactuers may find themselves entering the summer with too small a backlog to keep their workforce busy during the next four months.

First superconductor chip claimed

Conductus of San Jose, one of the leading start-ups in commercial applications of a new generation of high-temperature superconductor materials claims to have developed the world's first superconductor-based integrated circuit. The chip, an ultra-sensitive magnetic detector, is said to be the most complex device produced to date using the new superconductor material. The chip could be used in equipment for heart disease diagnosis by detecting the faint magnetic signals of the heart beat.

Conductus said the main significance of the chip was that it shows that techniques have now been refined to the point where superconductor materials can be used to make high-speed computer chips.

IBM buys into Wang

In yet another major new computer industry alliance, IBM has forged a link with struggling Wang Laboratories. Under the terms of the deal, IBM will assume US$25 million of Wang's debt and provide an additional US$75 million in cash infusion, based on the success of Wang in selling several of IBM's product lines.

Among other things, Wang, which has not played a role in the [personal computer and workstation markets, will resell PS/2 personal computers and RS6000 workstation systems under its own brandname. In addition, the company will market IBM's AS/400 minicomputers under the IBM name.

16Mb DRAMS in production by mid '92

Although 4Mb DRAM chips have been off to a slow start compared to earlier generations, the speed at which future generations are coming to market shows no signs of letting up. IBM has said it expects production of its new 16Mb DRAM to get into gear by the middle of 1992. The company produces its DRAMs mainly for in-house use, and will achieve a substantial lead over any competitor in the use of the advanced memory chips.

The first 16Mb chips are not expected to arrive on the open market until early 1993. Beyond that, it will take computer manufacturers even longer before the new chips will have been evaluated and incorporated into new products.

IBM has historically led the industry in the production of next-generation DRAMs. But because the cost of maintaining a lead in DRAM technology is putting a strain even on IBM, the giant has been seeking joint development programs with other firms, most notably Siemens in Germany. And to recuperate some of its investment, IBM has also begun to license its DRAM technology to companies like Micron Technology, which will allow IBM to earn royalties on the sale of those chips.

Microsoft drops font battle with Adobe

Two years after embarking on an ambitious project to unseat Adobe Systems as the dominant supplier of laser printer type fonts, Microsoft has decided to give up on the controversial project it started in cooperation with Apple Computer. While it will continue to improve the typographical appearance of its own programs, it will no longer try to compete head-on with Adobe.

In September of 1989, Apple and Microsoft unveiled their plan which many feared would add to the already great confusion over various operating systems, display and printer technologies available to users today.

At the time, the move by Microsoft and Apple, which had been Adobe's closest ally so emotionally upset Adobe chairman John Warnook he nearly broke into tears during a press conference denouncing the move.

While Apple was able to complete its part of the project and incorporated the TrueType font technology in its new System 7 operating system, Microsoft apparently does not believe it will be able to move the market away from Adobe's PostScript standard. Industry observers point out that Microsoft's TrueType project may have been the first victim of the more cautious position Microsoft may be forced to adopt in the face of the on-going Federal Trade Commission investigation into the firm's alleged monopolistic-oriented business practices.

Former Apple Execs must pay $100M

In a verdict that is sending shockwaves throughout the US industry and Wall Street investment community, two former Apple top executives were ordered to pay up to US$100 million to Apple shareholders, who a Federal Jury agreed, were harmed financially by statements the two executives made in 1984 about the future prospects of their company's financial performance.

The case involves a class action suit filed in 1984 by several disgruntled Apple shareholders, who claimed the company had misled them about the quality of a disk drive Apple had launched for its ill-fated LISA computer system.

The jury found that former chairman A.C.Markkula (now vice-chairman), and former peripherals division vice president John Vennard had violated securities laws when they failed to disclose problems Apple was experiencing with the disk drive. The same jury cleared Apple Computer and company co-founder Steve Jobs of any wrongdoing in the case.

Apple said it will appeal the verdict, adding that most of the damage will be covered by the com-pany's insurance policy that protects corporate executives from shareholder lawsuits. Apple, along with Markkula and other defendants, maintained that the main reason behind the steep decline in Apple's stock value in the 1983-84 time frame was not so much due to the failure of the disk drive, but more to the raging success of the IBM PC. Almost overnight, the entire PC market shifted focus, with hundreds of existing and new companies building products for the IBM PC.

VCR case jury clears Japan Inc.

In a major victory for Japan's consumer electronics industry, an American jury has declared that Japanese VCR producers did not gang up on a tiny US VCR start-up to prevent the firm bringing its innovative product to market.

Go-Video of Arizona had filed a US $500 million anti-trust lawsuit against six Japanese and two Korean VCR makers, claiming they conspired against the company by refusing to produce the so-called VCR-2.

Since it filed that lawsuit in 1987, Go-Video has reached out-of-court settlements with four of the Japanese and one of the Korean manufa-turers. The settlements have netted Go-Video $6.8 million. Key factors in the Jury's decision according to a lawyer for Sony, one of the defendants, was that Go-Video chairman Terren Dunlap had lied to the Jap-anese producers about the company's start-up financing and the magnitude of orders he had signed up for his machine from major US retailers such as Sears. ■

Wireless links for office LANs

There are many advantages in linking office PCs and workstations together in a local area network (LAN), so that they can exchange information readily and also share expensive laser printers, plotters, scanners etc. One of the traditional hassles is the need to run cabling between each computer and peripheral on the LAN, but with a new 'wireless LAN' system now available from Melbourne firm Precision Images, this is no longer a problem.

Up until now, most computer networks have been connected by cables. Installing this kind of wiring in existing buildings can be difficult and costly, and further problems can arise when any parts of the network need to be moved.

This problem is obviated with a new network system called 'LAWN', standing for Local Area Wireless Network. The parts of a LAWN network communicate using specialised radio transceivers, so there is no need for any new wiring or cabling.

Each computer or peripheral in the network is merely fitted with a LAWN transceiver unit, allowing data to be transferred reliably and transparently over distances of up to 150m (500') inside most buildings. If a LAWN unit is placed by a window, computers and peripherals in adjoining buildings can also be linked into the network, providing they are in range. When the LAWN system was launched recently in the USA, 3000 units were sold in less than four months. Judging from the initial response in Australia, Precision Images anticipating a similar reaction here.

LAWN system transceivers use frequencies between 902 and 928MHz, in the UHF band. They provide two data channels for duplex operation, at a fixed data rate of 19,200bps and using the AX.25 'packet' protocol — the 'radio' version of X.25. Network contention protocol is carrier sense multiple access (CSMA), while the topology is multipoint to multipoint — there's no separate fileserver.

Transmitter power is 20mW into an internal omnidirectional antenna array. Interestingly, the modulation used is 'spread spectrum' technology, originally developed by the military for high reliability and security (see the feature story in *EA* March 1991, starting on page 22).

It has apparently been adapted for this application by the LAWN system's manufacturer, Information Systems Corporation of Augusta, Georgia.

If greater distances than 150m are needed between LAWN transceivers, a free-standing transceiver can be used as a repeater or 'via'. LAWN transceivers used in this way don't have to be connected to a PC or peripheral — although a transceiver that is so connected can also act as a 'via' in background mode.

LAWN networks are *self-configuring*. Each unit on a network transmits its network name code automatically, about once a minute. Computer LAWNs use these *beacons* to update their list of printer and computer LAWNs. When a new user joins the network, their user name instantly appears on the general user selection list.

LAWNs can operate on one of two channels and can be assigned a security code so that other LAWN networks nearby cannot disturb or intercept their transmissions. LAWNs microprocessor program checks the transmissions it receives to make sure they have a network's unique security code. In addition to a radio transmitter and receiver, each LAWN unit has its own dedicated Z80 microcomputer and memory. A program in the microcomputer assures that all data is exchanged without errors. If a LAWN detects a data error, it automatically tells the sending LAWN to retransmit the data.

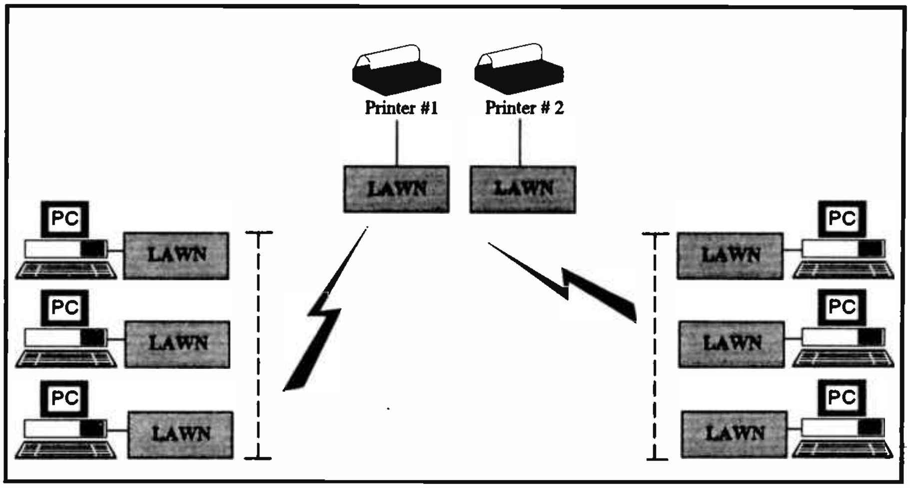
The simplest LAWN network requires two LAWN units. For example, one LAWN can be connected to a computer and another to a printer. When a printout is needed, the LAWNs take care of sending the information to the printer — just as if the printer were connected directly to a computer.

Electronic mail messages or files can be exchanged with another computer user in an office area simply by connecting a LAWN to each computer. The LAWN software includes a set of simple menus that enable mail messages to be received or sent, 'carbon copies' of messages can be received or sent, and files can be enclosed with messages — just as if a separate document was being sent with a business letter.

Different types of hardware connected to a LAWN network may need to communicate at differing speeds. These speeds can be changed within the LAWN unit. LAWNs can communicate with various devices at speeds ranging from 300bps to 19,200bps. Different LAWNs in the same network can use devices that require different speeds. For example, a LAWN connected to a printer can 'talk' to the printer at 19,200bps, while a LAWN connected to a modem is operating at the modem's slower speed of 1200bps. Note that the speed at which LAWN communicates with a computer, printer, or modem does not affect the speed of the LAWN network itself.

If a LAWN is unplugged, its built-in battery provides power to the LAWN memory to store the settings that were provided when the LAWN was installed. The memory also stores up to four double-spaced pages of mail messages that may be sent while the computer is turned off. When the computer is restarted the LAWN program retrieves the mail messages from the LAWN memory.

In addition to the program inside each LAWN unit, there are three other LAWN Programs that run on the computers connected into the network: the LAWN Features program, a memory-resident program that handles LAWN network print and mail requests, and a installation program.



The LAWN Features Program is used whenever communication between network users is needed. The program is invoked by typing the command ***lawn***, which displays the LAWN system's Main Menu. From the Main Menu messages can be sent and read, files can be sent and received and information about the status of mail messages and files can be accessed. Also, printers and modems can be selected and deselected from this program. Included in the Features Program is an easy to use text editor for writing and editing mail messages.

The Features Program also enables the storing of mail messages and files without having to exit from the program and return to the DOS operating system. Note: some LAWN functions can be controlled directly from your computer's operating system command line.

The memory-resident program, which is only used indirectly, is a Terminate and Stay Resident (TSR) program. Loaded automatically when the computer is turned on, the LAWN TSR is always running and handles the communications between applications and the computer LAWN. It intercepts print requests from application programs and send them to a printer that has been selected in the LAWN network. The printing being done on the LAWN network is 'invisible' to the user because the print commands are not changed in any way. The LAWN TSR is also responsible for sending mail messages (and any files that are enclosed with them) to other users on the LAWN network. LAWN TSR can be told to send messages or mail in either the *foreground* or the *background*. Generally messages and files are sent in the background, so that users can continue to use their computers while this traffic is sent.

Messages sent in the background are copied and stored on disk until all the recipients have received the message. The LAWN software removes the message from your disk as soon as the message is received by all of the recipients. Operating in the background, the software sends messages to a recipient's LAWN, even if their computer is turned off. If a recipient's LAWN is busy or is already full, the software waits until the recipient's LAWN is available to receive new messages, and then sends them.

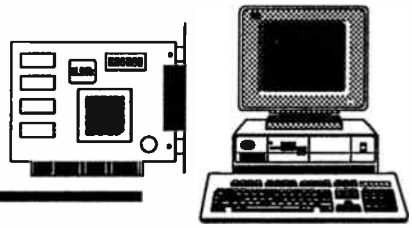
Print spooling is also possible, by sending print jobs in the background. Instead of storing jobs in a mail-box, the LAWN software stores print jobs temporarily in a printer spooler disk file. When 'print spooling' is on, the LAWN software stores printer jobs on your disk until it can send the jobs to the printer (if it is already in use or turned off). Also LAWN need not be in use to receive mail messages, they are stored in the background on disk until they are viewed.

LAWN transceiver units measure 180 x 100 x 50mm, and weighs 453 grams. Power requirements are a modest 250mA at 12V DC.

To assist users in getting started with LAWN networks, Precision Images is offering a 'LAWN Starter Kit' which comprises three LAWN transceiver units plus all necessary attachments and software, for $2000 plus tax if applicable. Individual LAWN units are available separately for $850 each, plus tax.

Further information is available by circling 201 on the reader service coupon, or by contacting Precision Images, 123 Camberwell Road, Hawthorn East 3123; phone (03) 811 9934. ■

Computer News and New Products



Laser beam printer kit

National Semiconductor has introduced a new laser beam printer design kit that allows manufacturers to slash their time-to-market by two-thirds, enabling an OEM to complete a new design in three months. Additionally, this design kit makes true PostScript performance affordable for the personal printer market. It delivers NTX levels of performance at the cost of an NT.

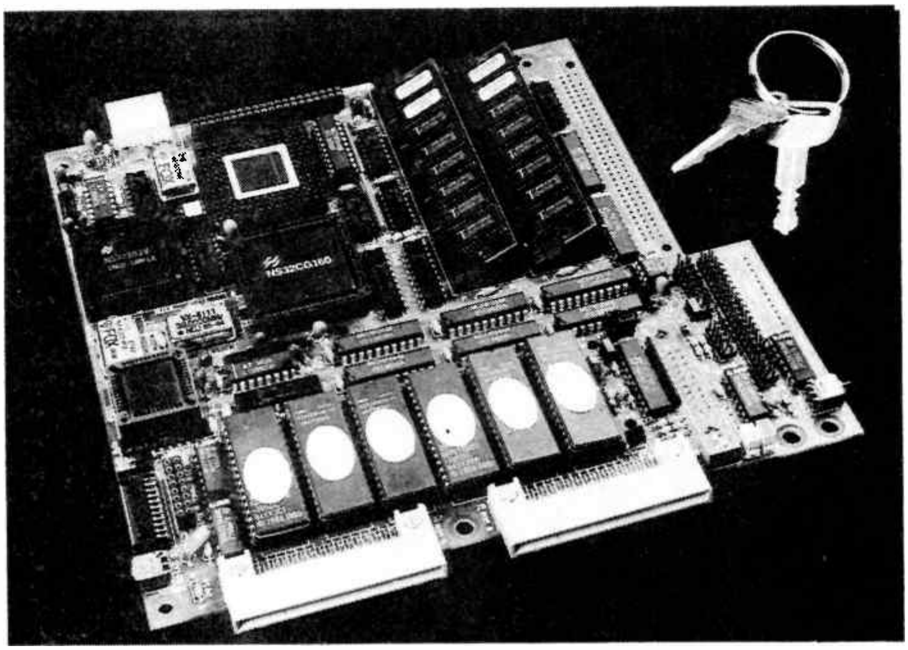
The new solution, called SWIFT, is based on National Semiconductor's NS32CG160 embedded system processor. It offers a complete, in-printer platform for evaluation, development and low-volume prototyping of laser beam printer systems in the four to eight page-per-minute range.

The SWIFT fits inside a Canon LX-based printer and hooks directly to the power supply and front panel, providing a development platform as well as a totally functional printer.

Third party vendors including Microsoft and Phoenix Technologies have already ported finished languages to SWIFT, including PCL 4, PCL 5 and PostScript compatible programs.

The SWIFT also offers font/emulation ROM expansions headers and I/O expansion connector for user-defined extensions such as SCSI, Ethernet or others and a font panel connector for local printer control.

For more information, circle 163 on the reader service coupon or contact National Semiconductor Australia, 16 Business Park Drive, Monash Business Park, Nottinghill 3168; phone (03) 558 9999.



Programmer's text editor

Procon Technology is now an authorised reseller of an Australian software package called ED.

ED is a professional programmer's text editor designed to enhance productivity by providing high power with ease of use.

ED is easy to learn because it can emulate other editors. Currently supported are: Brief, Wordstar, Norton and VI. Other emulations are being developed, or you can develop your own, using the C extension language included with ED.

ED is also language sensitive with support for C, C++, Pascal, BASIC, Assembler, Clipper, dBase and DataFlex. It even supports error tracking, which positions you at each compiler error and lets you correct it.

For more information, circle 162 on the reader services coupon, or contact Procon Technology, PO Box 655, Mount Waverley 3149; (03) 807 5660.

High speed data acquisition

Strawberry Tree's response to ultra high speed data acquisition applications is the FLASH-12 family. These boards offer a 12-bit, 1MHz throughput rate and an ultra fast front end.

At these speeds it is not possible to transfer the data directly to the computer, so onboard memory is used to buffer the incoming readings and also to set up the next reading.

This allows the FLASH-12 to perform a host of convenient features including background and data acquisition and comprehensive, digital oscilloscope-like triggering.

The FLASH-12 cards have a frequency synthesised pacer clock which allows the conversion rate to be set with 0.1%

resolution, all the way from 1MHz to one conversion per day. The pacer clock is absolutely jitter-free and has an accuracy of 0.01%.

Strawberry Tree's new high speed boards never need to be calibrated. They have an EPROM (Electronically Eraseable Programmable Read Only Memory) on the board to provide all calibration data for the card.

Every time the card is initialised, the calibration information is read from the EPROM. No time is wasted on manual calibration and the readings are always accurate.

For more information circle 161 on the reader services card, or contact APC Services, PO Box 584, Bayswater 3153; phone (03) 762 3000.

Optical disks store 600MB

Verbatim has extended its range of storage media products to include 5.25" optical disks.

These disks are of 600MB (512 bytes/sector) and 650MB (1024 bytes/sector) for both PC and mainframe workstation applications.

They are designed to fit 5.25" Sony and other IOS-standard optical disk drives.

The main advantage of optical disks is their larger capacity with lower cost per megabyte compared to other storage mediums. They are also removable, which provides flexibility and security for stored data. Like floppies, many copies can be made easily.

For more information, circle 165 on the reader service coupon or contact Verbatim; phone (03) 241 1361.

AST ships EISA 486 computers

AST Research has announced volume shipments to Australia of desktop and tower versions of 486-based 33MHz EISA computers. The machines are the desktop AST Premium 486/33E and the AST Premium 486/33TE Tower.

EISA is a high performance 32-bit I/O bus that provides complete compatibility with ISA expansion boards. Both machines feature the i486 microprocessor with 8KB memory cache and floating point hardware integrated on the chip.

RAM capacitity is 48MB, comprising 4MB of memory standard, expandable to 16MB on the CPU card, to which two additional 16MB cards can be added.

For more information, circle 166 on the reader services coupon, or contact AST Research, 5/706 Mowbray Road, Lane Cove 2066; phone (02) 418 7444.

ROM/RAM emulator

APAU Electronics has released its Australian designed and manufactured EMU++, a universal low cost standalone ROM/RAM emulator.

The product is computer independent, with both serial RS232 and parallel Centronics ports to communicate with a host computer. Ideally suited for an embedded system development, it can almost completely eliminate the step of 'burning EPROMs' from the design cycle and needs only a fraction of the time required to download the code.

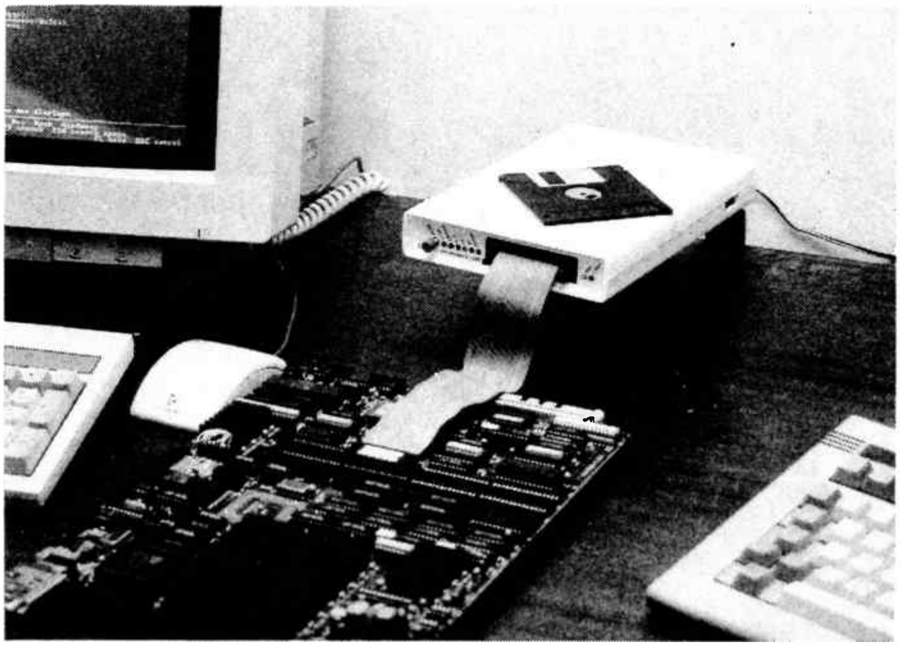
The emulator is completely transparent to the target system, and allows true execution of system software in the target system hardware environment. It can be used to emulate all popular 28, 32 and 40 pin 150ns EPROMs (a faster version is also available) from 8KB up to 512KB (4Mbits) in size.

It can emulate a single 8-bit wide EPROM, a pair of 8-bit wide EPROMs in 16-bit wide configuration, or a single 40 pin 16-bit wide EPROM.

When used in 32-bit systems a pair of EMU++ emulators is required. All of these features are completely programmable.

The EMU++ software driver supports several of the most popular download formats: Intel Hex, extended intellec-86 HEX, Motorola-S and Binary Image.

For more information circle 164 on the reader service coupon or contact APAU Electronics, 226 Bambra Road, Caulfield South 3162; phone (03) 786 6868.



Infra-red data transmission

Modular Technologies' Interlaser systems are designed for the transmission of data or video signals over comparatively short distances, between points within mutual line-of-sight, where the use of cables is impractical or inappropriate.

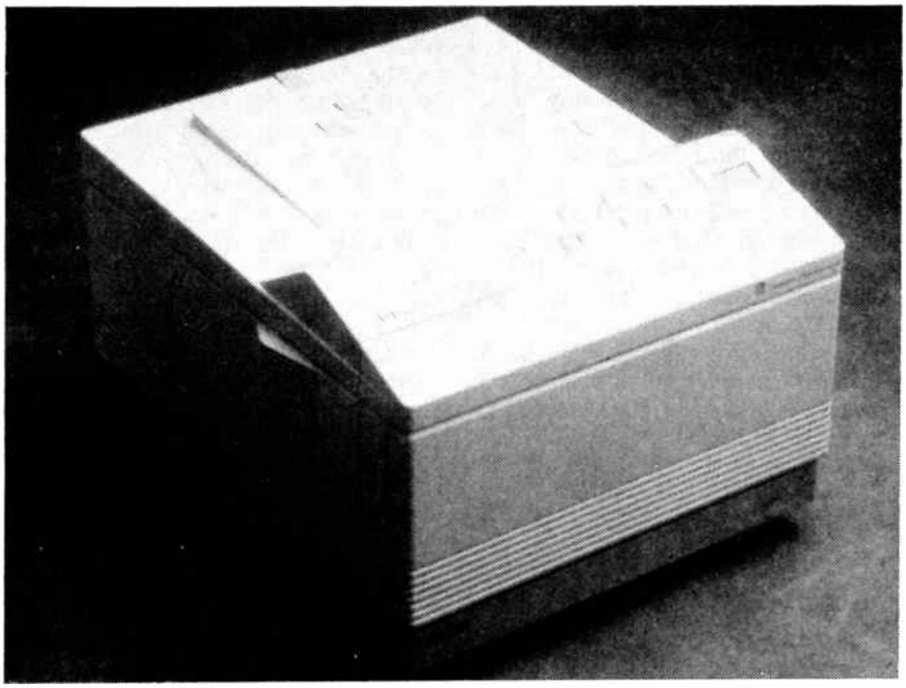
The transmission medium is a beam of infra-red light which is generated by a low power laser diode, and focused through the atmosphere to reach the distant site.

The beam is modulated by the signal to be transmitted, the information being recovered by the distant receiver. A transmitter, receiver and alignment aids are integrated into a weathertight housing.

The Interlaser can interconnect computers, data systems, or television signals, or provide up to 60 audio channels between buildings — without laying cables, seeking right of way or obtaining licences. It's transmissions are secure and are immune to electromagnetic interference.

Suitable for permanent use or temporary use when awaiting cable laying, or as an emergency backup, the Interlaser transmits colour or monochrome pictures at up to 5.5MHz, data at a speedy 2.5Mb/sec, or Ethernet signals at 10Mb/sec over distances up to one kilometre.

For more information circle 167 on the reader services coupon, or contact Meteor Communications, 13 the Highway, Mount Waverley 3149; phone (03) 807 8126.



Compact 4ppm HP laserjet

Hewlett-Packard Australia has introduced a compact four-page-per-minute (4ppm) HP LaserJet IIIP printer, featuring HP resolution enhancement technology and HP's PCL5 printer language for $2469.

The HP LaserJet IIIP printer rounds out HP's line of HP PCL5 laser printers and is compatible with the HP LaserJet III, IIID and IIISi printers. It is the company's second 4ppm laser printer.

The new printer uses the same 4ppm engine as that of the HP LaserJet HP printer.

However it features an increase in processor speed from 10MHz to 16MHz; a new parallel port that can accept data four times faster, which allows users to regain use of their PCs more quickly (the printer also includes a standard serial port); and the advanced capabilities of the HP PCL5 printer language for faster text and graphics printing.

For more information ring Hewlett Packard on (008) 033 821.

Upgraded version of 'LEAP'

Audio Teknology Inc has released an upgraded and enhanced version of its Loudspeaker Enclosure Analysis Program LEAP. Version 4.1 of the package offers many new features, and is now described as a 'complete professional electro-acoustic development system'.

New features include an extended frequency analysis range from 1Hz to 100kHz; design of both passive and active crossover networks, including conjugate matching; an 'optimiser' function for crossover network design; modelling of sealed or vented, high-pass or band-pass enclosures; large-signal and distortion analysis; the ability to model passive radiators at any port, multiple speakers and ports, and series, parallel and series/parallel wiring; a much wider range of available graphs; and high quality printout to both HPGL and PostScript laser printers. Full price of the new version is $1050.

For more details circlie 172 on the reader service coupon, or by contact Speaker Technologies, PO Box 50, Dyers Crossing 2429 or phone (065) 50 2254.

Notebook PC's with plasma displays

Toshiba has announced the introduction of four new models of the company's popular 'Dynabook' 32-bit portable computers in the Japanese market. These notebook-size computers feature battery driven gas plasma displays.

The gas plasma display is a significant advance on liquid crystal displays, as it responds to instructions faster than LCDs. It also offers a wider screen viewing angle and a higher contrast ratio

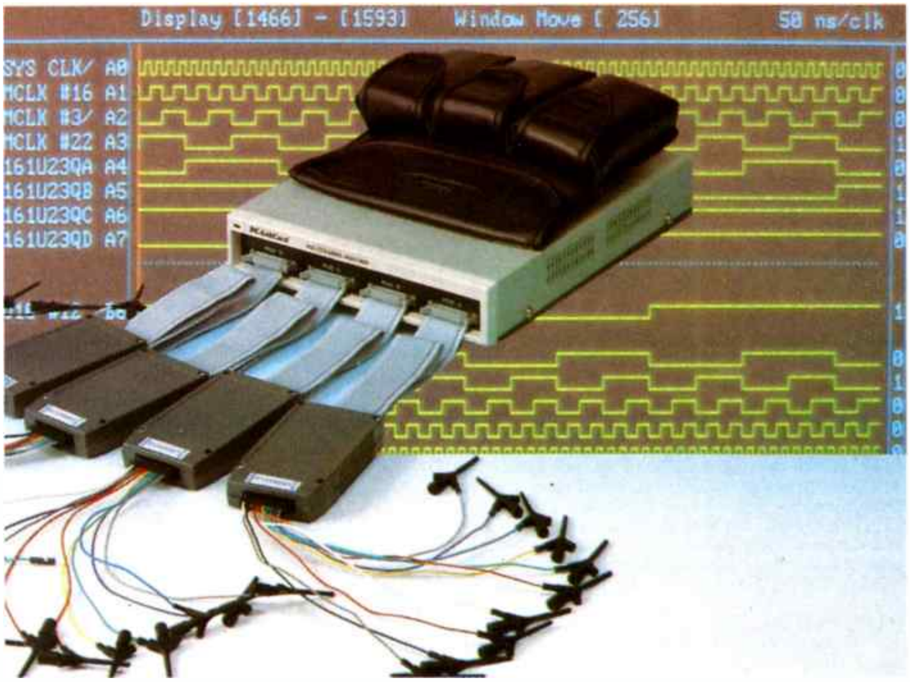
32-ch PC based logic analyser

The PCL-512 is a PC-based logic analyser that turns your PC into a 100MHz timing/state analyser with a maximum 32 channels. When it is adapted to a laptop computer, the combination becomes a portable logic analyser station.

The PCL-512 samples up to 100MHz with the internal clock at eight channels and 8K memory depth. It can also sample up to 25MHz with either internal or external clock at up to 32 channels and 2K byte memory depth each. The 500 ohm, 5pF input impedance will ensure no loading to the testing circuit. The acquired data can be displayed as a timing diagram or state format.

The PCL-512 can record data before/after trigger. It also offers over 4000 multilevel-combinational-trigger conditions and eight data qualification channels. The analyser records the data you really want and presents cursors on timing mode for precision time interval measurement. All of the above functions are provided as a cost effective test tool.

For further information circle 170 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham, 3191; phone (03) 521 0266.



(100:1) between the screen's background and text and graphics displayed on it, making it highly suitable for use with the mouse devices that are now widely used. The four new J-3100SX models are based on the 32bit i386SX (20MHz) microprocessors. All incorporate an internal floppy disk drive, with removable 20MB, 40MB or 60MB hard disk drives.

For more information contact your nearest Toshiba dealer.

Internal UPS for PCs

The ITT PowerSystems VIP Powsersave is an uninterruptible power supply (UPS) which provides an internal, cost-effective solution for the power protection needs of XT/AT, 286, 386 and 486-based personal computers operating in MS-DOS.

It installs entirely within the PC, eliminating the bulk and inconvenience of many external UPS systems.

Powersave guarantees that an information network and its valuable data remains unaffected by power disturbances. If a power interruption occurs Powersave instantaneously provides backup power, automatically saves a complete image of the PC state to disk and shuts down the entire system.Once AC power resumes, Powersave automatically restores the computer's state. The VIP Powersave UPS includes a single full-length I/O card, internal power supply, hardware and software. The internal software uses no computer memory.

For more information circle 173 on theReader Services Coupon or contact Crusader Electronic Components, 73-81 Princes Highway, St.Peters 2044; phone (02) 516 3855. ■

EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
All Electronic Components	VIC	●	●	●	●	●		
Altronics	WA	●	●	●	●	●	●	●
Dick Smith Electronics	ALL	●	●	●	●	●	●	●
Electronic Component Shop	VIC	●		●	●	●	●	
Emona Instruments	NSW						●	
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Rod Irving Electronics	VIC	●	●	●	●	●	●	●
Scientific Devices	VIC						●	
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KEY TO CODING
A. Kits and modules
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G. Reference Books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are anv errors or omissions, please let us know.

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PHOTOSTAT COPIES: When back issues are exhausted, photocopies of articles can be supplied. Price $5 per project or $10 where a project spreads over several issues.

PCB PATTERNS: High contrast, actual size transparencies for printed circuit boards and front panels are available. Price $5 for boards up to 100 square centimetres. $10 for larger boards. Please specify positive or negative.

PROJECT QUERIES: Advice on projects is limited to postal correspondence only, and to projects less than five years old. Price $5. Please note that we cannot undertake special research or advise on project modifications. Members of our technical staff are not available to discuss technical problems by telephone.

OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

PAYMENT: Must be negotiable in Australia and made payable to 'Electronics Australia'. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form). All prices include postage within Australia and New Zealand.

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Please note that we are unable to supply back issues, photocopies or PCB artwork over the counter.

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TDA1520 Complete 20Watt Hi-Fi Audio Amplifier IC

- Ideal for mains powered applications using a 44Vdc supply, but operates down to 15V. Quiescent current 54mA (typ).
- Power bandwidth from 20Hz to 20kHz giving 22W into 4Ω.
- 74dB open loop voltage gain gives 260mV input sensitivity for 16W output
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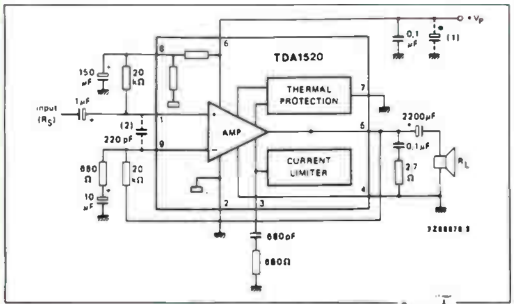
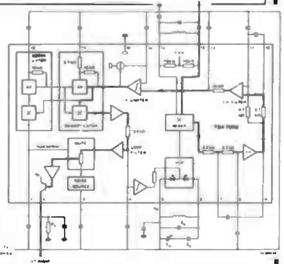


TDA7000 FM Radio Circuit

Monolithic IC for mono FM portable radios. Uses absolute minimum of external components yet has frequency-locked-loop system with 70KHz i.f. with selectivity obtained by RC filters. Oscillator is only function which needs alignment. Spurious reception is automatically muted. The IC contains RF input, Mixer, Local Oscillator, IF amplifier/limiter, Phase demodulator, Mute detector and mute switch.

ONLY $3.40



See FM Radio Intercom article in Silicon Chip Oct 89 for more details.

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Covers CD4000, 74HC00, 74HCT00 and 74C00 families. If you're quick you'll get one. We can never get enough – So Hurry **$15.00**

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- 0.5% dc accuracy **$142.80**

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Adc 200µA, 2mA, 20mA, 200mA, 2A, 20A
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Ohms 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ
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- 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

$166.80

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
Frequency 2kHz, 20kHz, 200kHz
Capacitance 2nF, 20nF, 200nF, 2µF, 20µF

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Does the things your multimeter doesn't!

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"When it comes to using Serialtest to diagnose a practical serial communications set-up, most users will find the package easy-to-drive, yet a powerful diagnostic tool..."
Rob Evans E.A. May 91

SerialTest serial data analysis on your PC

This is an MS-DOS software and cabling package which enables technicians and engineers to perform serial data comms analysis. It offers sophisticated problem solving facilities at a fraction of the cost of dedicated hardware systems. SerialTest provides a window onto RS232 lines operating either as a passive observer or actively sending data or control signals to simulate either at DTE or DCE device. Triggers can be defined based on error conditions or data to initiate or terminate monitoring sequences.

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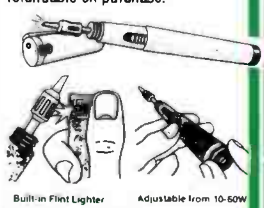
- View each byte in ASCII or EBCDIC, decoded to hex, decimal, binary or octal

- Writes captured data directly to disk to allow maximum capture buffer
- CRC checksum calculations
- Auto-configuration to any of the comms ports 1 to 4
- Time-stamping (absolute and relative) including delta time calculations
- Split line DTE over DCE display

$425 ($395 ex tax)

Send $10 for a demo disk, refundable on purchase.



PORTASOL PROFESSIONAL SOLDERING KIT

See E.A. April 88. No cords or batteries yet it gives the equivalent of a 10 to 60W iron. Up to 90 minutes continuous use from a single fill. Tip temperatures as high as 400°C can be set. The kit includes one soldering tip, a hot knife, blow torch and hot blow. Cap contains a flint lighter. Comes in a handy case (with stand for the iron) almost fits in your pocket. **$69.95**

PORTASOL STANDARD SOLDERING IRON

We've sold hundreds of 'em to servicemen and technicians. Complete and ready to use with just the iron and bit **$39.95**

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IC-R1. 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.

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