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LOUIS CHALLIS TESTS THE LATEST AUDIO CASSETTE TAPES

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HOW YOUR CAR'S ELECTRONIC ENGINE CONTROL WORKS

BUILD OUR 'KARAOKE' ADAPTOR FOR LOW COST PARTY FUN!

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Volume 53, No.11

November 1991

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

The great 1991 review of audio cassette tapes

Confused by all of those tape brands and formulations? This month Louis Challis has carried out a marathon review of 19 different kinds of cassette tape, putting them through their paces in his lab, so we could offer you some objective advice on choosing the best one for your particular needs. *(See page 10)*

Our evolving telecomms

Digital trunking, packet switching and ISDN are all part of changes under way in our telecommunication networks. Changes that will provide many new services and facilities, as Robert Owen explains. *(See page 28)*

On the cover

Rather than simply show you a straight picture of Rob Evans' new Karaoke adaptor, we asked Federal copyperson Andrianna Apostol to demonstrate the kind of fun it can provide. She succeeded rather well, don't you think?
(Picture by Kevin Ling)

Video and Audio

Features

Projects and Technical

Professional Electronics

Columns and Comments

Departments

MANAGING EDITOR
Jamieson Rowe, B.A., B.Sc., SMIREE, VK2ZLO
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CONTRIBUTORS
Neville Williams, FIREE, VK2XV
Jim Lawler, MTETIA
Arthur Cushen, MBE
Tom Moffat, VK7TM
Peter Lankshear
DRAFTING
Karen Rowlands
GRAPHICS DESIGNER
Clive Davis
PRODUCTION
Mal Burgess
ADVERTISING PRODUCTION
Anthony Macarounas
CIRCULATION MANAGER
Michael Prior
PUBLISHER
Michael Hannan
HEAD OFFICE
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INTERSTATE ADVERTISING OFFICES
Melbourne: 504 Princes Highway, Noble Park, Vic 3174. Phone: (03) 795 3666, Fax No: (03) 701 1534. Nikki Roche
Brisbane: 26 Chermside Street, Newstead, Qld 4006. Phone: (07) 854 1119, Fax No: (07) 252 3692. Bernie Summers
Adelaide: 98 Jervois Street, Torrensville, SA 5031. Phone: (08) 352 8666, Fax No: (08) 352 6033. Mike Mullins
Perth: Allen & Associates, 54 Havelock Street, West Perth, WA 6005. Phone: (09) 321 2998, Fax (09) 321 2940, Tony Allen
New Zealand: The Advertising Co-ordinator, Rugby Press, 67 View Road, Glenfield Auckland, New Zealand. Phone: (09) 443 0250, Fax No: (09) 443 0249.
United Kingdom: John Fairfax & Sons (Aust), 12 Norwich Street, London, EC4A 1BH. Phone: (71) 353 9321, Fax: (71) 583 0348
Asia: Headway Media Services Ltd, Room 2101, Causeway Bay Centre, 15-23 Sugar Street, Hong Kong. Phone: 516 8002, Fax: (862) 890 4811 Adrian Batten
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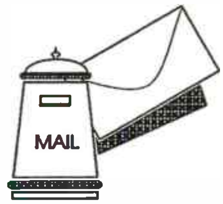
LETTERS TO THE EDITOR



Old magazines

I have some old copies of *Electronics Australia* which I would like to give away (free) to any of your readers who would find them useful.

I have to clean out a lot of stuff at home and sadly, my collection of *EA* dating through the eighties (perhaps some late seventies) must go. The wealth of information in them is too good to just dump.

My phone number is (02) 624 2634.

L.J. Anderson,
Seven Hills, NSW.

Amateur radio

Reference the editorial footnote to my letter in July *EA*. If the title Amateur Radiocommunications Service is pretentious and 'off putting' how about these: Inshore Boating Radiotelephone Service, Aeronautical Mobile Radiocommunication Service, International Maritime Mobile Radiocommunication Service and so on?

Perhaps the International Telecommunications Union will consider your suggestions for less pretentious titles.

If we use amateur society journals and periodicals and 'on air' chatter as performance indicators, radio amateurs do seem to be doing 'less and less of the original experimentation.' Radio experimentation is, however, more popular than ever and carried out with much more technical competence than previously.

The 'visible' amateurs are the majority — remember that representative organisations attract less than 50% of practising amateurs; the proportion in Australia is 41% and decreasing.

Lindsay Lawless,
Lakes Entrance, VIC.

Comment: A number of your colleagues have written in making the same point about ITU terms and definitions, Lindsay. Fair enough — but do amateurs necessarily have to use the strict ITU label to describe themselves and their activities? A little less formality may attract a few more interested youngsters!

Trunked radio comms

With reference to the 'Comms Trunking Security Risk' item in your June News Highlights, it's no wonder the spokesperson wishes to remain anonymous — the comments are unfounded and simply not true.

Motorola Australia operates the Trunking Systems at nearly all major airports in this country, with some systems co-located, with others installed remotely.

The Smartnet Trunking Systems employed have been specially designed to meet the stringent operational requirements of Emergency Services whether that be 'SWAT' teams, fire staff or simple ground crew usage around the airport.

The systems are provided with high levels of redundancy and are dramatically less susceptible to 'jamming' as compared to the older 'conventional' two-way systems.

Significantly, they do not suffer the intermodulation distortion which could be caused by the use of multiple uncoordinated Repeaters/Base Stations in the event of a major crisis.

Motorola has hundreds of such systems in operation through the world, many of which have been used (unfortunately) in real crisis scenarios.

Thanks to the massive developments in microprocessor technology, trunking is now firmly part of radio communications' future.

Martin P. Cahill,
Marketing Manager,
Motorola Communications,
Springvale, VIC

Hi-tech woes

In the July issue, Laurie Larsen and Tom Moffat presented divergent views on what is ailing Australian 'high-tech'.

While Laurie Larsen questioned the wisdom of our government, Tom Moffat argued that it is up to the individual to make a go of it, and that we shouldn't rely on government for handouts, or even direction.

I think he missed the point, that not only is the government not helping, it seems to be deliberately dismantling our local industries.

Our government is hell-bent on 'levelling the playing field' by removing tariffs, but we can only have a 'level playing field' if all our competitors also drop their policies of government intervention.

I don't know of any major 'developed' country which does not have import duties, taxes, bounties, subsidies and other schemes for supporting their indigenous industries. So it's clearly crazy for Australia to try it unilaterally.

Even if we overcame that obstacle, to compete with the Asian manufacturers, we would have to install billions of dollars of highly automated plant, cut wages to $2.50 an hour, and work 60 hours a week.

Are we prepared to accept that, just so we can buy a second colour TV to watch on our two weeks a year holidays?

Another thing the government did to destroy Australian industry was raising interest rates.

The result of this policy was that borrowing to finance research or manufacturing became nearly impossible. Who in their right mind would lend money to a manufacturer, at considerable risk, when they could put their money in the bank and get 18 or more percent with no risk?

Tom Moffatt did have an answer to this — don't get into debt. This is of course, sound advice, but unfortunately not everyone is lucky enough to have a working spouse to support them in lean times.

Suppose Tom's wife works for a company that is being hit hard by the recession, and they say to her, sorry, we can't employ you for the time being without going into debt. Would he advise them to fire his breadwinner and stay out of debt?

I may not be a financial whiz, but I can't for the left of me see why, when too many imports are sending the country broke, the appropriate action is to lower tariffs and increase interest rates.

Does it require a genius to see that this would increase imports, destroy local manufacturing, and direct all profit making into non productive paper shuffling?

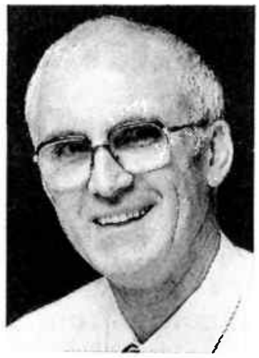
Lest it appear that I think the government is totally hopeless, I should add that there are some worthwhile initiatives, such as Export Market Development Grants and Research and Development grants which helped launch my company, Fairlight Instruments, onto the world stage 10 years ago.

Devaluation of the Australian dollar has also been helpful to Australian industry, although it needs to go lower still. The problem is that making imports more expensive is not electorally popular in the short term as it makes 'luxuries' more expensive.

But my view is that although it would not be a disaster if we had to pay more for our VCRs and washing machines, it would be a disaster if we found ourselves without a source of basic components.

Peter Vogel,
Right Hemisphere Pty Ltd,
Faulconbridge, NSW.

EDITORIAL VIEWPOINT



Australia's electronics future: Hypothetical or actual?

At this year's IREECON '91 convention, held a few weeks ago in Sydney, the Institution of Radio and Electronics Engineers held a seminar in the 'Hypothetical' format popularised by well-known barrister and TV personality Geoffrey Robertson. The moderator in this case was John Leaney, a senior lecturer in computer systems engineering at the University of Technology, and the panel consisted of leading engineers, scientists, academics, chief executives, engineering managers, a commercial banker — and surprisingly, yours truly (I'm still not sure why!).

Our topic was 'Australia, the clever country? — What if all the engineers died?', and Mr Leaney set the scene in the year 2001, when Australia had virtually closed down its design and manufacturing industry, and the few electronics engineers still employed were involved mainly in converting the power supplies of imported equipment for use by the military. It made for a lively and entertaining discussion — particularly when we went on to consider the fortunes of local engineer 'Abel Peter', who had developed a revolutionary 'biological supercomputer', and was attempting to defy the odds by manufacturing it in Australia.

The IREE and Telecom Australia (who sponsored the Hypothetical) are to be congratulated for their initiative in promoting this type of discussion, which just might play a part in ensuring that the future scenario we considered will never actually take place.

All the same, the discussion made clear a number of points which I personally found rather sobering. One of these is that engineering in general, and electronics in particular, are obviously still seen by many people as dull and boring — despite the fact that many of us working in the field *know* that it can be challenging, interesting and intensely satisfying. Obviously we electronics people need to do a much better job of selling the positive aspects of our vocation...

What also emerged is that many of today's managers and financiers really don't see much point in attempting to manufacture electronics gear in Australia. Supposedly our domestic market is too small, and it's too expensive to ship the final products overseas — to where the *real* markets are. Not only that, but since the necessary components, manufacturing plant and investment capital all have to be imported from overseas anyway, why not arrange for the manufacturing to be done offshore in the first place, and save all the hassle and expense?

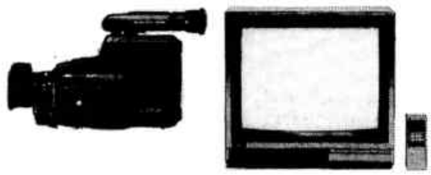
No doubt this argument sounds like hard-nosed logic to the managers and bean counters, but I couldn't help wonder where countries like Taiwan would be today, if *they* had followed this policy of defeatism.

It was also fairly clear from the discussion that many people see an engineering career of little value in itself, and largely a 'stepping stone' to management. Hence the pressure on our engineering schools, to squeeze more management training into their already overloaded engineering courses. A pretty crazy idea, surely — what are all those managers going to manage?

I could go on. There were lots of other points raised, all very relevant to the future of Australia's industry. But what do YOU think about this important subject? Write in, or fax me your opinions and suggestions. I'd like us ALL to give it the thought and discussion it deserves.

Jim Rowe

What's New in VIDEO and AUDIO



Ultra Compact Hi8 camcorder from Sony

Sony has announced the CCD-TR705 which combines the high resolution of the Hi8 video system with the ultra-compact form of the Handycam Traveller series, to create a camcorder that offers the highest quality in video recording.

When first introduced, the Sony TR series of Handycam camcorders opened up new possibilities for video recording in a compact, easy-to-use format. The CCD-TR705 is the same size as other camcorders in the TR series, and weighs just 790g (without battery). However, the new model uses the technology of the Hi8 system to give enhanced horizontal resolution and superior signal to noise ration.

The high resolution of over 400 lines offered by the Hi8 system brings precision and clarity to the recorded image. The TR705 also incorporates a CCD (charge coupled device), which in the PAL system allows detail at the remarkable level of 470,000 pixels (440,000 pixels effective).

Thanks to the newly developed 'Cats Eye' CCD, the Hi8 Traveller is also able to shoot under almost all light conditions, even with light levels as low as 2 lux (roughly equivalent to a small candle).

The improved auto focus function of the CCD-TR705 makes it possible to follow the subject around during shooting and yet remain constantly in focus. The CCD-TR705 has a wide focusing range; objects as close as 1cm from the lens right up to infinity are ocused accurately, rapidly and smoothly.

The CCD-TR705 comes with a number of special features that allow creative video recording, including an advanced 8x zoom lens.

The Digital Superimposer with scroll and reverse features allows captions or illustrations to be inserted, either while shooting or during playback, to give a professional look to video production. With the Digital Superimposer, colour can be added and there is a choice of eight colours available in the palette.

Another creative effect possible with the Hi8 Traveller is offered by its variable digital shutter. The shutter speed of up to 1/10,000 second can be selected, allowing fine detail of fast action to be captured without blur.

To go with the CCD-TR705, Sony has also developed an affordable yet surprisingly advanced home editing system. Called the 'Family Studio', the system now comprises three separate units; the XV-T335F Video Sketch Titler, the RM-E33F Video Edit Controller and the XV-A33F Video Sound Effector. Used either separately or in combination, these units offer a host of near-professional effects to add lasting excitement to any home video.

Once connected to a camcorder and video deck, the easy to use modules allow home video makers to compile custom titles, edit out unwanted scenes and add great special sound effects.

The RM-E33F Editing Controller lets users simply edit out unwanted scenes in the One-cut Edit Mode. After pressing the Tape Playback button, users can edit easily, by selecting scenes with a touch of the Start Here and Stop Here buttons. Advanced features allow both real-time and programmed editing of up to four scenes.

The XV-T33F Video Titler lets you superimpose handwritten letters and drawings when editing your home video tapes.

Other versatile features are the 115 different pre-programmed illustrations which are instantly accessible, as well as standard type fonts in two sizes and six styles. Special wipe and superimpose features are available and overall operation is as simple as drawing with a pencil and paper. The palette has 13 standard colours and 20 changing 'rainbow' colour combinations, to add even more existing visual drama.

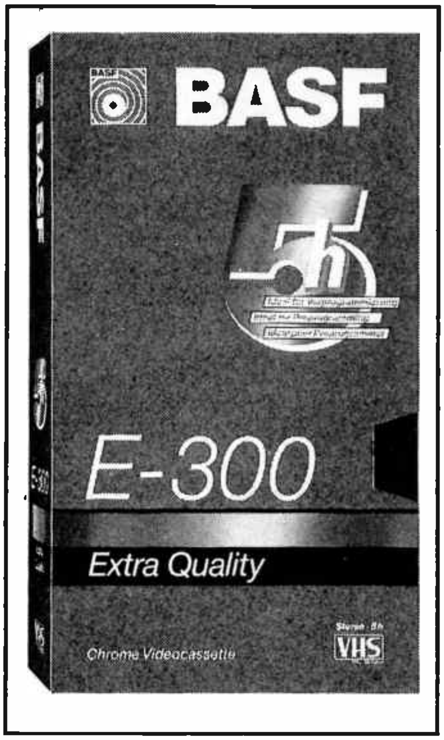
The XV-A33F Video Sound Effector allows mixing-in of prerecorded music from tapes, CDs or records and the dubbing of 'live' narration from the supplied microphone.

This unit also has 14 different sound effects, available at the touch of a button. Even more, a simulated stereo effect adds depth to monaural recordings and there is a fader for both video and audio tracks.

All three units are equipped with S-terminals for enhanced picture quality, and are designed for easy connection and use.

The CCD-TR705 camcorder is priced at around $2999, while the editing modules are priced at around $499 each.

Five hour video tapes from BASF



BASF has released its world-first 'Extra Quality' E300 five hour videotape in Australia.

At 70% longer than the popular three hour cassette, the E300 allows up to three feature length movies to be recorded on a single cassette. On VCRs equipped with Long Play mode, with E300 will record for 10 hours.

The Australian release follows extensive testing of the new length in the Austrian market, during which the E300 apparently proved itself technically and found favour with consumers. More than half the Austrian tape buyers tried the E300 and 86% of those buyers made a repeat purchase.

E300 uses a combination of special tear resistant polyester film, super-fine chromium dioxide with six billion colour particles per square millimetre, and a special back-coating to ensure smooth tape travel.

BASF has also developed special stainless steel rollers which are designed to guarantee the mechanical reliability of the cassette, a critical factor in long play cassettes.

Camcorder batteries from Eveready

Eveready Australia has expanded into the fast growing camcorder battery market, with a new range of rechargeable video camera batteries. The range, consisting of 13 models, is designed to fit most brands of camcorders and video lights and all batteries come with a one-year guarantee. According to Eveready, the new batteries offer the high quality of the Energizer brand at attractive and competitive prices.

Marketing Director for Eveready, Mr David Dalton, said that pricing was a key factor in Eveready's strategy to enter this relatively new market.

"Up until recently, the camcorder battery market has been dominated by the manufacturers' own brands. We are offering a high quality independent range suitable for most manufacturers' products," he said.

VHS-C camcorder has colour viewfinder

Panasonic's new G3 VHS-C camera follows the success of its G1 and G2 cameras, and like them, offers 8x power zoon, a minimum illumination of 3-lux, variable high speed shutter (up to 1/1,4000th sec) and digital AI auto focus.

But the newly-developed 1" colour LCD screen on the G3 also enables users to watch full colour scenes through the viewfinder during and after recording.

So now users can check the subject and the picture condition, including the titles, all in colour.

The G3's viewfind picture size is effectively doubled when the new AV widescope (supplied as standard) is attached to the EVF.

With a built-in audio amplifier and speaker, users can also hear the sound recorded with the picture during playback. The effect is similar to that of watching a small, personal TV.

Another useful feature is the built-in auto light, first introduced in the NV-G2.

Sanyo's compact CD system

Sanyo's 'Premier Collection' MCD-Z300F is a fully remote-controlled portable system with CD player and 100 watts (PMPO) power output.

It has an FM Stereo/AM digital radio, programmable CD player, twin auto-reverse tape decks with computerised recording, and a 'Bassurround' speaker system which is claimed to produce deep, smooth bass, even at low listening levels.

'Surround sound'circuitry creates a feeling of being in the centre of the sound which is produced by the large capacity detachable three way speakers. Sanyo's MCD-Z300F is available at a recommended retail price of $999 from selected electrical retailers and department stores.

VIDEO & AUDIO

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Akai 68cm CTV has stereo amp

Akai has introduced the CTK-280 68cm CTV, which boasts an inbuilt stereo audio amplifier and speakers, although its receiver section is only mono.

For full high fidelity stereo realisation the CTK-280 requires a hi-fi stereo VCR to supply the stereo signal, but its internal mono tuner and stereo amplifier will provide high fidelity mono sound without a VCR.

Since many home viewers already own a stereo VCR, Akai believes this design concept saves the viewer considerable expense as the major cost factor in a stereo CTV is the stereo tuner.

The CTK-280 also boasts Akai's FST (Flatter Squarer Technology) which enables viewers a less distorted picture and a wider viewing angle.

The CTK-280 comes complete with a 27 button infra-red remote control. It has a recommended retail price of $1399 and is covered by a twelve month warranty.

Stereo sampler for MIDI systems

Akai's S1100 stereo MIDI digital sampler is said to be the most powerful and cost effective digital sampling system available. The S1100 is able to function as a stand-alone digital audio production tool and is suited to a variety of applications in recording, broadcast, audio/visual and live performance.

The S1100 features a powerful Digital Signal Processor (DSP) to provide a wide range of sonic effects including reverberation, chorus, flanging, pitch shifting and delay, and includes an built-in SMPTE timecode reader/generator with cue list programming.

The SMPTE capability permits synchronisation of the S1100 with any timecode source, without the need for an external synchroniser.

Features of the S1100 include: 16-bit linear sampling at 44.1/22.05kHz, 16 voices, true phase locked stereo recording, a built-in SCSI port for fast storage and loading of data to an external hard disk or magneto-optical disk. AES/EBU digital output, and 2MB of standard memory expandible to 32MB.

Up to 200 samples and 100 programs may be stored within the S1100. Akai offers an extensive library of digital samples for use with the S1100 and the entire range of Akai S1000 series digital samplers.

The S1100 can also access any of the many libraries available for the S900 and S950 samplers.

Akai professional audio products are available in NSW from The P.A. People, phone (02) 642 5344. ■

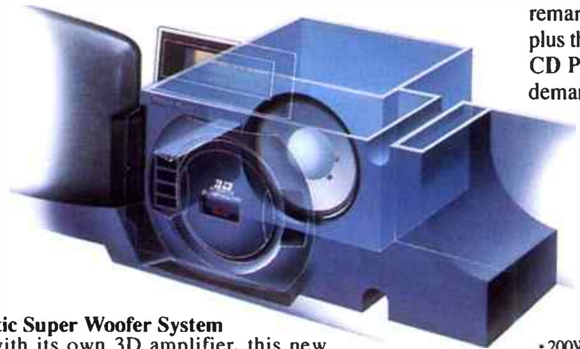
New Yamaha receivers offer 'Total Purity'

Yamaha has introduced the first two of what it says is a new line of more musical AM/FM stereo receivers. Designated RX-750, with a suggested retail price of $899, and RX-550 with a suggested retail of $699, the models employ new technology and innovative approaches to deliver a more transparent, musical, and 'pure audio' sound than the company's previous receivers at these price points.

The RX-750 delivers 80 watts per channel into 8-ohms and has a pre-main amplifier coupler, while the RX-550 delivers 60 watts and has no coupler. Both receivers incorporate Yamaha's ToP-ART circuitry. ToP-ART, which stands for 'Total Purity - Audio Reproduction Technology,' is not a single new circuit or feature, but an overall design and engineering approach to the new receivers. Very large power transformers, 2mm diameter circuit board cabling, block capacitors, film capacitors/audio electrolytic capacitors, audio anti-magnetic resistors, and cement emitter resistors are among the superior grade of components that make up new units.

The receivers also maintain a symmetrical left/right design to minimise interference. Inputs and outputs are symmetrically arranged and use short, straight signal transmission paths. Processing paths are also kept to the shortest possible lengths.

Hitachi breaks the sound barrier- Acoustic Super Woofer in a portable unit.



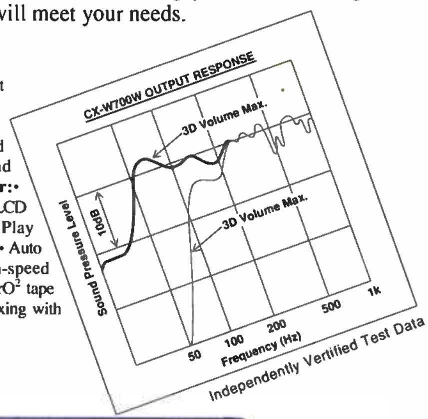
New Acoustic Super Woofer System
Equipped with its own 3D amplifier, this new system meets the performance standards needed for high-quality digital sound. And by sealing the super woofer in a rear chamber, reverse phase frequencies are prevented from interfering with low-frequency output ensuring clear, rich bass.

Hitachi CX-W700W offers sound quality equal to that of many mini-component systems in a portable unit. You get a remarkable 200W (PMPO) audio output with powerful, solid bass, plus the full benefit of CD digital sound.

CD Player: The optimum quality of digitally recorded sound demands a high level of performance from the amplifier and speakers. Hitachi CX-W700W delivers the wide frequency response needed to get the most out of CD recordings.

Home Music System: Hitachi CX-W700W is equipped with radio, twin cassette decks and a CD player. So whatever your choice in listening pleasure, this single compact unit will meet your needs.

• 200W (PMPO) audio output • New 3D Acoustic Super Woofer system • Two full-range12cm speakers • Surround sound system • Three-band graphic equalizer **CD Player:** • 32- program random memory • LCD track number display • CD Play /Rec.Synchro **Cassette Decks:** • Auto Reverse (on Tape 1) • High-speed dubbing • AutoStop & Nor/CrO^2 tape selector (on Tape 2) • Mic mixing with volume control.



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COMPACT disc DIGITAL AUDIO

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A REVIEW OF CURRENT CASSETTE TAPES

Which compact cassette tape is the best choice, for various cassette machines and kinds of audio recording? The range available can be bewildering, even from a single manufacturer. This month we asked Louis Challis to test a representative selection from the many brands and formulations currently available, and use these to come up with a few objective recommendations for the 1991 tape buyer...

Following last month's review of the new Pioneer CT-93 Cassette Deck, many of you may well have a different perspective on the capabilities and merits of compact cassette recorders — particularly as the CT-93 offers features which almost seem too good to be true.

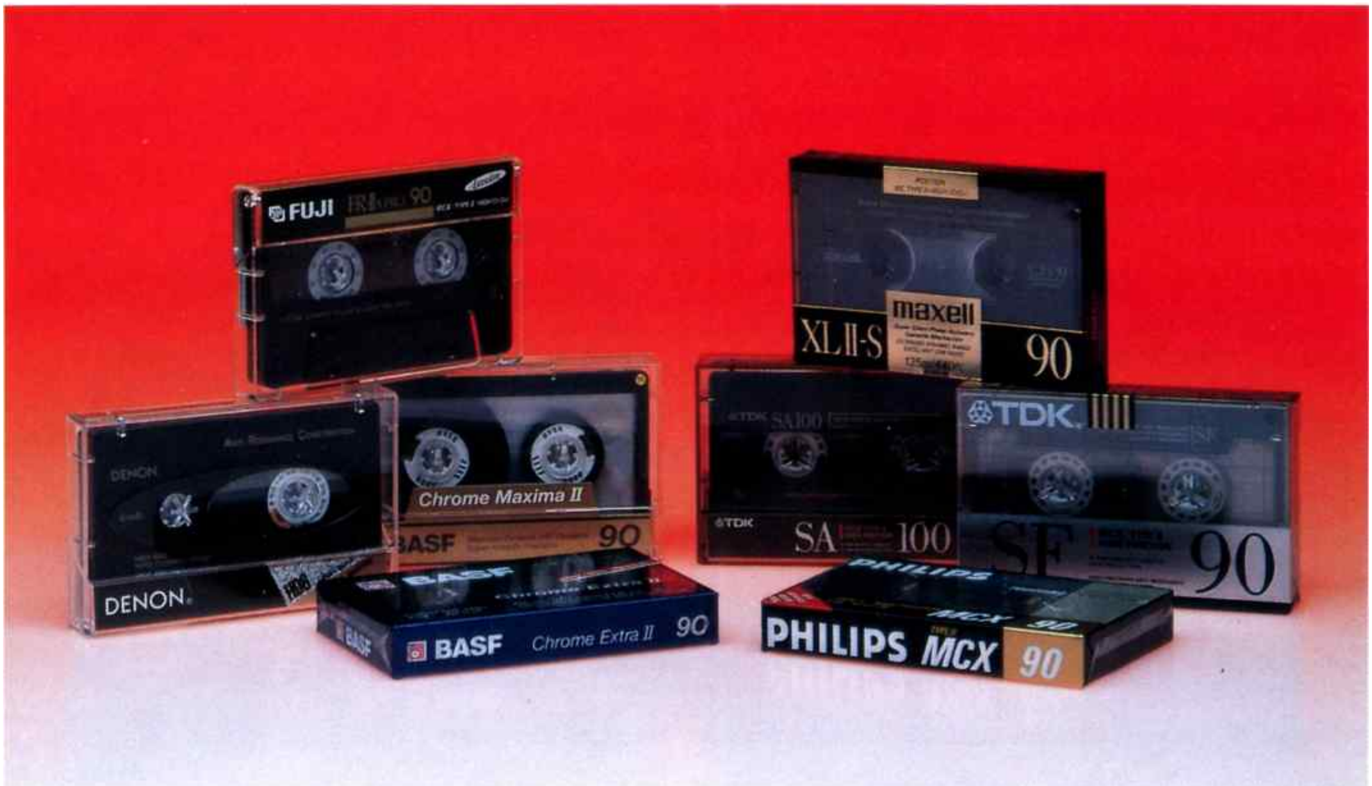
To my mind, the most exciting feature of the CT-93 is its ability to make poor recording tapes good, and good recording tapes even better. It is this optimisation characteristic which although currently an exception, I forecast will soon become the norm.

Worldwide sales of blank compact cassette tapes now constitute a truly prodigious market. Although you may not have realised it, the bulk of that market is firmly held by a small and select band of manufacturers who have devoted considerable time, effort and resources to manufacturing magnetic tape and related products.

Although nobody publishes precise figures on the value of the products sold worldwide, or even the value of those imported into Australia, I would conservatively estimate that the annual sales are somewhere in the order of $1 billion for just blank compact cassettes.

With a market as large as that, with at least 30 major brands being manufactured and at least 200 different types of formulations of tape available, intending purchasers can be forgiven for displaying some reticence, or confusion when faced with the unenviable task of selecting the best tape for your

Here are seven of the type I tapes tested. A sample of the Fuji DRI90 tape was not available when the picture was taken.



And here are all eight of the type II tapes tested.

compact cassette recorder. Now each of us has faced the vexing problem of selecting which compact cassette tape to buy in the local store — in which there are generally numerous shelves stacked with at least 10 or more different brands, from the three basic types of tape (Type I, Type II and Type IV).

In some of the larger shops there may possibly be as many as 60 or more variants from which to select.

How could you possibl know whether Brand X's more expensive tape is technically superior or offers better value for money than Brand X's cheaper tape, or whether Super X Type I tape is really all that much better than the Standard X Type I tape marketed by the same manufacturer?

This decision of course, is without even taking into account the Brand Y or Brand Z tapes, all of which you will find feature beautiful coloured, or even shiny gold and silver packaging which literally screams out to be bought in six (6) packs from the shelf below.

If you're confused by some of the 'variations on a theme' developed by some of the manufacturers, (i.e., six different variants of Type I tape marketed by TDK for example), then I must quietly acknowledge that I too am often confused.

The only difference between our respective positions is that I am able to allay my confusion by conducting laboratory tests to clarify some (but not necessarily all) of the complex issues involved, in what is fast becoming a merchandising nightmare for both the seller and the purchaser.

Table 1
Comparison of Type I Tapes

Parameter	Hitachi DL90	Philips FS-90	TEAC CDX90	TDK AR100	TDK D90	Fuji DRI90	TDK AD90	TDK ARX-90
Record/Replay Frequency response @ -10VU	10Hz-17kHz	10Hz-17.5kHz	10Hz-17.5kHz	10Hz-17kHz	10Hz-17.5kHz	10Hz-19kHz	10Hz-19kHz	10hz-20kHz
3% 3rd Harmonic Distortion Level	7.5	+8.0	+7.0	+9.0	+8.0	+8.5	+9.5	+8.0
Dynamic Range								
A-Weighted	57	58.5	54	59.5	57	59	59.5	59.5
Unweighted	51.5	52.5	49.5	53.5	52	53	53	53
Compression Level @ 10dB	9.0	9.0	8.8	9.4	9.2	9.4	9.3	9.1
High Frequency Non-Uniformity	****	*****	**	****	****	***	***	*****
Prices Quoted	$8.99 (3pack)	$3.45	$1.39	$5.95/ $6.95	$3.95/ $4.35	$2.95	$4.45/ $5.95	$6.45/ $6.95

In the type IV category, only three different formulations were submitted for testing.

When *EA's* Editor suggested that it was time we conducted a tape review again, my response was "But it's only a couple of years since we did the last one!"

Of course when I came to check my files, I was a trifle perplexed to find that that couple of years was five, and of course five years is a considerable time in an industry that is progressing as fast as the magnetic tape industry.

The Editor's first approach was that we should test just one type, and my suggestion was that we should test Type II tapes.

This is my favourite tape, because the maximum output levels (MOL) figures for this type have generally been 2dB or better on Type II tapes than on Type I.

But as soon as the tapes began arriving from the various suppliers, we rediscovered the truth of the old axiom *Men plan, but God decides.* What we ended up with was not just Type II tapes, but a mixed bag of Type I, Type II and Type IV.

This forced us to replan our approach, and in doing so we realised that the prime function of such a review was to provide the greatest possible help to *EA*'s readers — especially those who just want to load a cassette tape into their recorder.

And this is most likely to occur if we can clarify as much as possible the differences in performance that are likely to occur as a result of their cassette tape selection.

Having accepted the challenge, I sat down to ponder the critical question of how I would conduct such an evaluation. My first thoughts were that I would bypass the CT-93, and use a cassette recorder which offers either no

Table 2
Comparison of Type II Tapes

Parameter	BASF Chrome Extra II	BASF Chrome Maxima II	Denon HD8/100	Fuji FRII XPRO	Maxwell XLII-S90	Philips MCX-90	TDK SA100	TDK SF90
Record/Replay Frequency Response @ -10VU	10Hz-13kHz	10Hz-15kHz	10Hz-20kHz	10Hz-13kHz	10Hz-13kHz	10Hz-19kHz	10Hz-13kHz	10Hz-13kHz
3% 3rd Harmonic Distortion level	9.5	8.0	+5.0	+8.0	+7.0	+7.5	+8.5	+8.0
Dynamic Range A-weighted	66.5	64	56	63	61	62.5	64.0	62.5
Unweighted	55.5	55.5	50.5	54.5	52.5	54.0	55.5	54.0
Compression Level @ 10dB	9.3	9.1	8.4	8.7	8.6	9.0	8.8	8.7
High Frequency Non-Uniformity	••••	••••	•••••	••••	•••••	•••••	••••	•••
Prices Quotes	$4.45	$6.95	$9.50	$6.50	$6.50/ $7.80	$7.45	$6.95	$5.45

adjustment or minimal bias adjustment capability. I even went as far as borrowing a new NAD-6300 cassette recorder.

After viewing the results of preliminary testing with the NAD-6300, I once more changed my mind. I decided that the correct thing to do would be to acquire three IEC (International Electrotechnical Commission) reference tapes for Types I, II and IV, and to align the CT-93 so that its record/replay characteristics conform to the relevant reference tape.

This would allow evaluation of each individual type of tape relative to the internationally standardised reference.

In theory, each manufacturer of cassette recorders has aligned your particular cassette recorder with those reference tapes. In practice, each manufacturer adopts a different policy, and some of them like Nakamichi align their machines to suit their own branded tape.

Obviously, when that happens you are in a 'no-win' situation, and you then have to rely on the information provided by the manufacturer if optimum record/replay linearity looms as a significant factor in your ranked requirements.

I knew that the IEC had published *IEC Magnetic Tape Sound Recording and Reproducing Systems Document 94-5, Part 5,* and Table IV of that document which specifies the reference batch numbers for the tapes for Type I (normal gamma ferric oxide tapes) and Type II (high position, chrome or chrome equivalent tapes), which the *Standard* tells me are manufactured by BASF, and were produced in batch Nos R723 DG, and U564 W.

When I telephoned BASF Australia and TDK Australia, the response and support I received were absolutely wonderful; within days each of those companies had couriered out the primary reference samples for me to use in my evaluation.

With support like that, I had visions of completing my testing within a day or two, and having my review finished within a week.

Nothing could be further from the truth, and the task turned out to be much more complex than I would have imagined.

We suffered delays in receiving samples, we suffered an embarrassing failure in our level recorder — the 10dB potentiometer had to be replaced with a new one — and there were even problems in finding out the cost of the tapes, which I consider to be an important factor in evaluating cost-benefit ratios.

Table 3
Comparison of Type IV Tapes

Parameter	Maxwell Metal Vertex 90	TDK MA90	TDK MA-XG90
Record/Replay Frequency Response @ 0VU	10Hz-15kHz	10Hz-17kHz	10Hz-16kHz
Record/Replay Frequency Response @ -10VU	10Hz > 20kHz	10Hz > 20kHz	10Hz > 20kHz
3% 3rd Harmonic Distortion level	+10	+9	+10
Dynamic Range			
A-Weighted	62	62	63
Unweighted	55	54.5	54.5
Compression level @ 10dB	9.3	9.25	9.4
High frequency Non-uniformity	*****+	*****+	*****
Prices Quoted	$49.95	$7.96	$23.95/$24.95

The cassette tape evaluation procedure that I finally adopted was as follows:

1. For each of the three tape formulations, I separately aligned the record/replay characteristics of the Pioneer CT-93 cassette recorder with the IEC Reference Tape, and then evaluated each of the sample tapes with the bias and equalisation unchanged from that reference position.
2. The first set of parameters that I evaluated were the record/replay frequency response at four levels, which were respectively +6VU, 0VU, -10VU and -20VU. These provide primary data on the linearity of the tape, and the effects that its formulation has on the high frequency response of the tape under nominal Maximum Output Level (MOL) conditions over the range 10Hz to 1kHz at +6VU (relative to the 0VU signal) — as well as the saturation output level characteristics over the frequency range 2kHz to 20kHz, at both +6VU and at 0VU.
3. The second set of parameters that I evaluated are the saturation characteristics of the tape, for a series of ten 1dB increments from 0VU to +10VU for a 333Hz signal. This test graphically illustrates the non-linearity compression of the tape formulation. Non-linearity in the magnetic coating on the tape is also displayed.
4. The third set of parameters that I evaluated was the high frequency drop-out linearity for each of the tapes, with an input signal frequency of 6.3kHz and a signal level of -30VU. I have previously confirmed that this provides a simple and direct evaluation of tape linearity, quality of calendaring (the polishing of the tape surface), and high frequency stability of the tape.
5. The fourth set of parameters I evaluated were the one-third octave band noise thresholds of each of the tapes, as well as the unweighted and A-weighted noise figures relative to 0VU.
6. When the fourth set of data is compared with the fifth set of data, which is the 3% third harmonic distortion levels for each of the tapes at 333Hz, we have an accurate value for the *dynamic range* of the tape. This is a particularly important parameter.

So far, so good. By this stage, I had 19 tapes from some seven manufacturers, with prices ranging from $1.39 for the Teac CDX-90 Type I tape at one end of the spectrum, up to the almost unprecedented price of $49.95 for the Maxell Vertex Type IV tape.

After viewing the comparative record/replay data for the respective Type I and Type II tapes, I became very self-critical of my test procedure. Most of the Type I tapes exhibited substantially flatter and smoother responses at both +6VU and at 0VU when compared to the Type II tapes — how could this be? Being sceptical, I proceeded to re-appraise the subject tapes with two other cassette recorders — a Nakamichi Dragon, which is five

The Challis Report

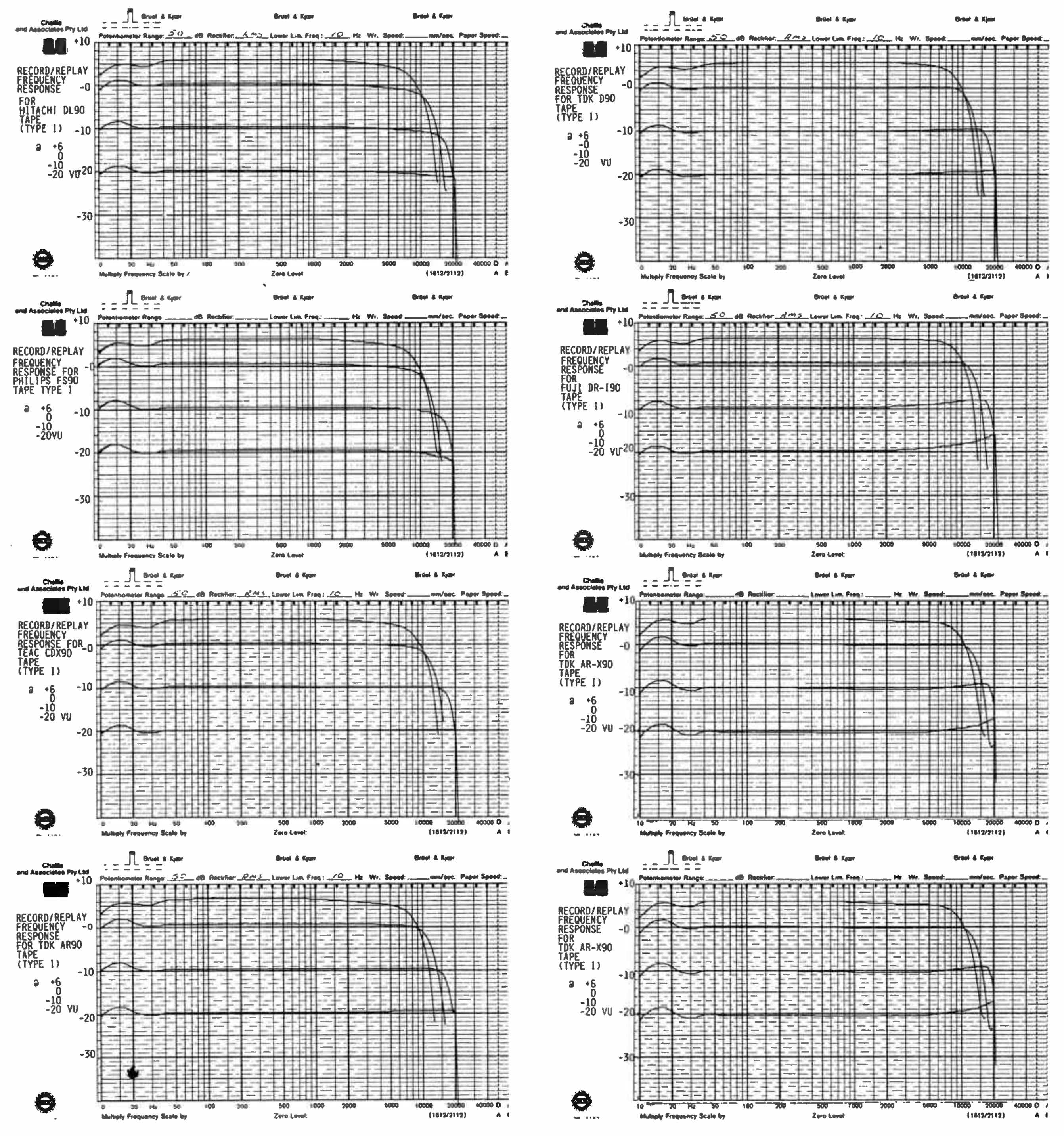
years old, and a tried and true AIWA AD6900 which is at least 10 years old. Lo and behold, the other two cassette recorders provided similar if not precisely the same results. This confirmed both the character and validity of the data provided by the Pioneer CT-93 cassette recorder.

Having satisfied myself with the procedure, and satisfied that the results were realistic, I completed the laborious task of evaluating the tapes — and then to collate and present the voluminous test data.

General results

A review of the test data highlights a number of important general issues, first of which is identified by a comparison of the record/replay frequency responses of the IEC Type I, IEC Type II and IEC Type IV reference tapes.

In the case of the Type I tape, the frequency response at 0VU, - 10VU and -20VU displays a decrease in the Saturation Output Level (SOL) for reduced input signal levels, with a -3dB point of approximately 12kHz at 0VU, 16kHz at -10VU and beyond 20kHz at -20VU.



Above are the measured record/replay response curves for the type I tapes.

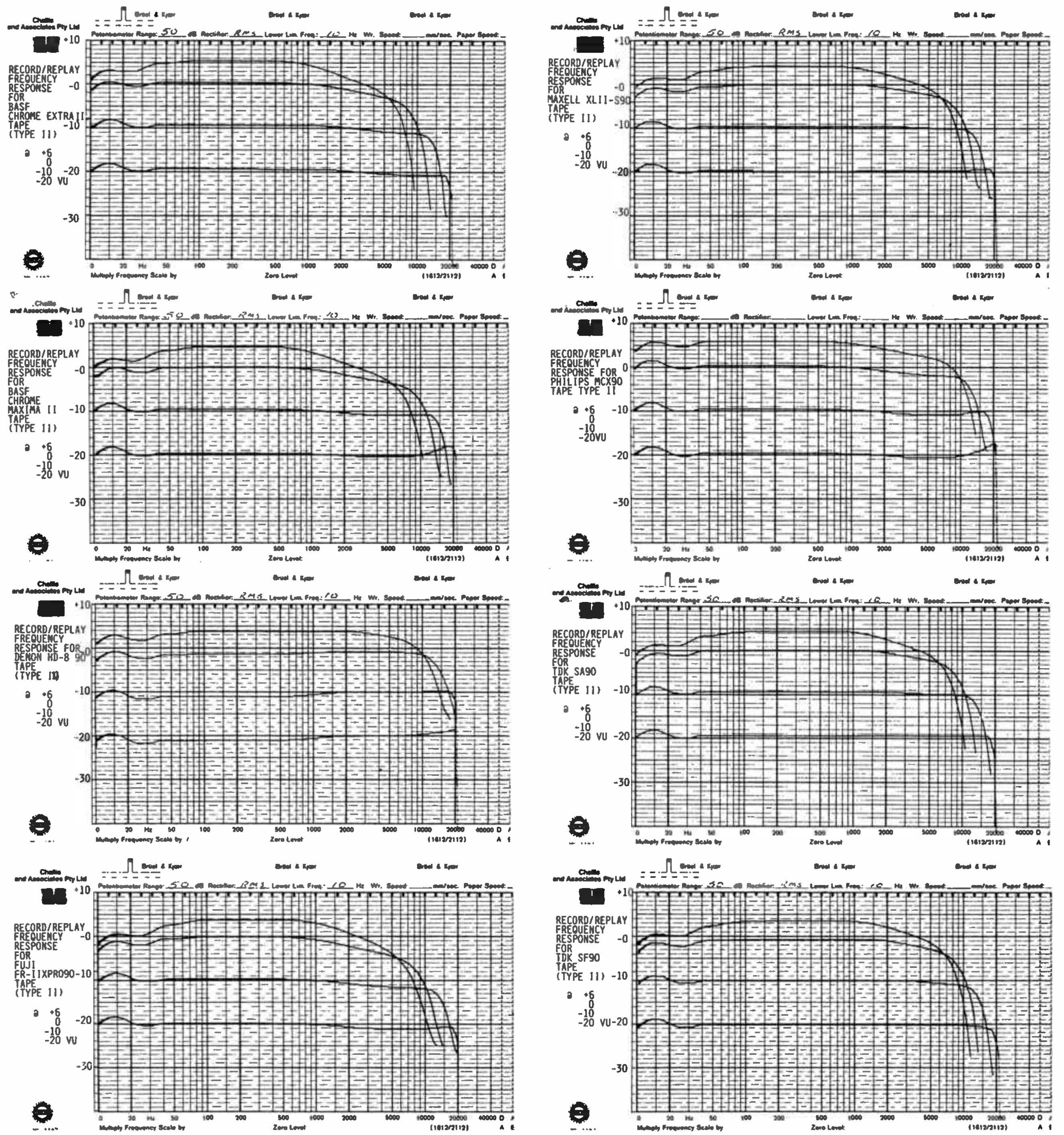
With increased signal levels of +6VU there is modest signal compression visible between 40Hz and 1.5kHz, gross compression between 10Hz and 40Hz, and readily visible and almost disturbing levels of high frequency saturation between 1.5kHz and 10kHz — with a virtual total loss of signal at frequencies beyond 10kHz.

In summary, Type I tape offers reasonable fidelity and performance for signal inputs below 0VU, and a frequency response which is likely to be acceptable below that input level range.

When the input signals rise above 0VU, the performance will be grossly prejudiced below 40Hz and above 2kHz, and is likely to be marginally acceptable with significant audible distortion between 40Hz and 2kHz.

In the case of the Type II tape, the frequency response at 0VU, -10VU and -20VU again displays a decrease in the saturation output level for reduced input signal level, with a far less acceptable level of the -3dB point of 4kHz at 0VU, 13kHz at -10VU and 19kHz at -20VU.

With increased signal levels of +6VU there is a significant signal level compression between 10Hz and 100Hz, and a far more disturbing level of high



And here are the response curves for the type II tapes.

The Challis Report

frequency saturation between 1kHz and 8kHz.

In summary, Type II tapes offer reasonable fidelity and performance for signal input levels below -6VU, and a frequency response which is only really acceptable below that range. When the input signals rise above -6VU, the frequency balance is likely to be prejudiced if there is considerable low frequency content (below 40Hz), or above 2kHz. In the case of Type IV tapes, the frequency response at +6VU and 0VU again display decreases in saturation output level for reduced input signal level, with a reasonably good -3dB point of 9kHz at +6VU, and 13kHz at 0VU.

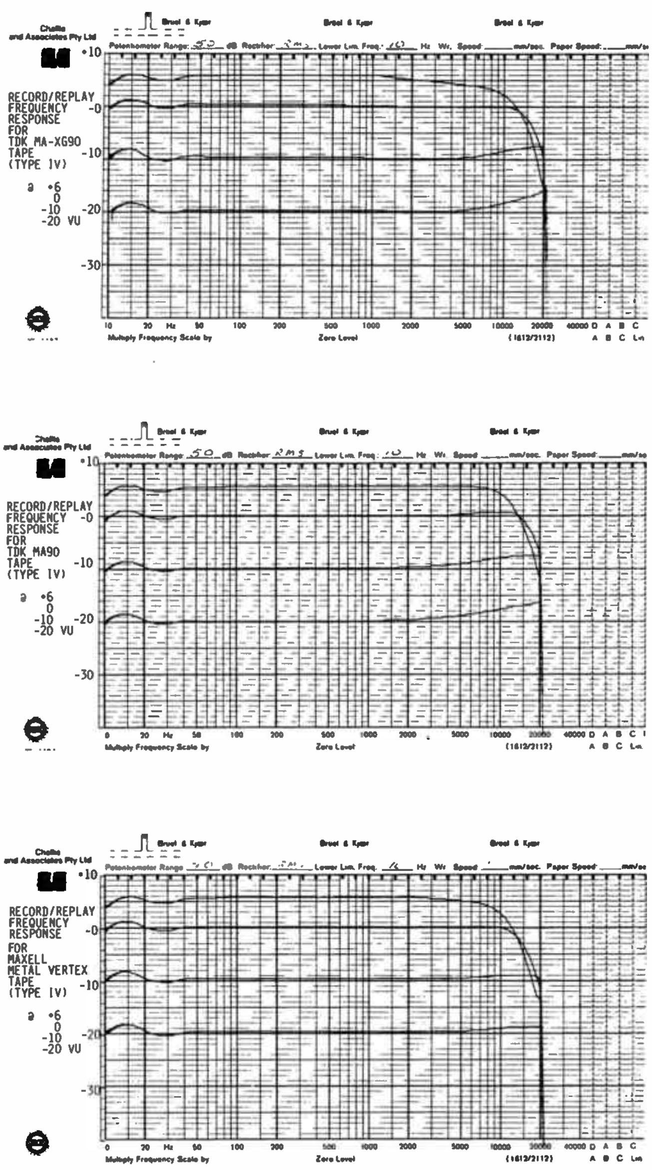
The low frequency MOL saturation below 40Hz is far less pronounced than it is for either the Type I or II tapes, and the overall performance characteristics of this formulation display its clear superiority over the other formulations. Having reviewed the frequency response characteristics of the three basic formulations, it is appropriate to compare the responses of the individual tapes within each group.

Type I tapes

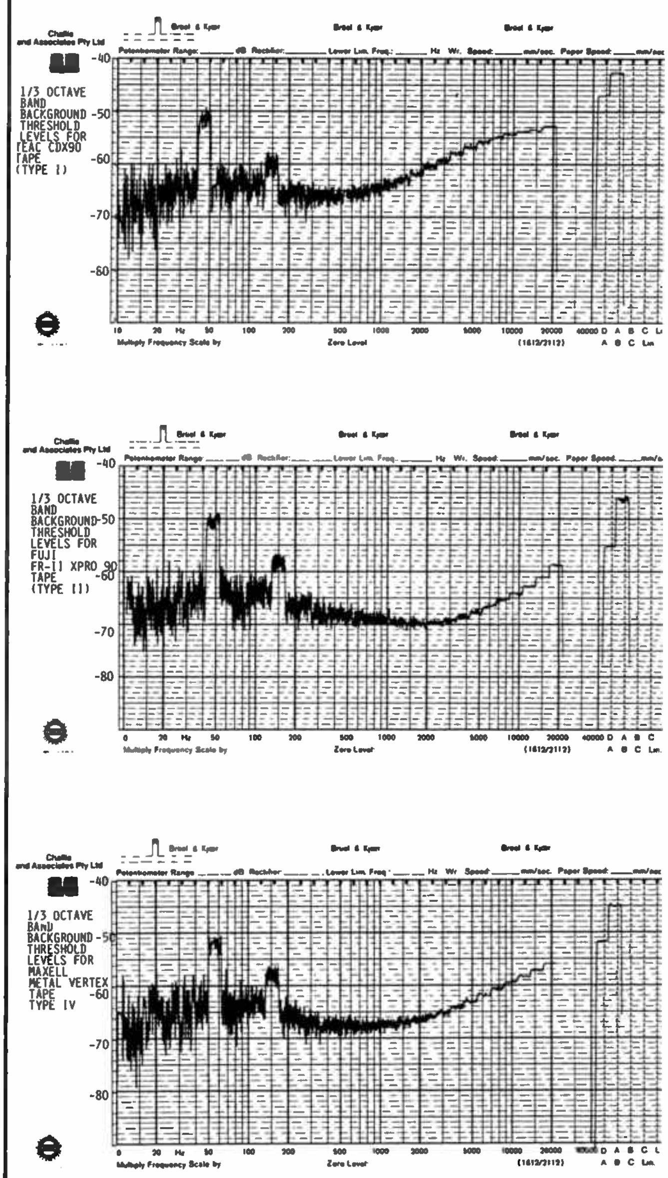
In the Type I tapes, there are two basic groups. One group consists of those whose record/replay characteristics conform to the IEC Type I reference tape, as typified by the Hitachi DL90, Philips FS-90, TEAC CDX90, TDK D90 and TDK AR90.

All of these tapes exhibit good record/replay frequency response performance, with the smoothest response being exhibited by the TDK AR90 and the TEAC CDX90. The second grouping of Type I tapes is typified by the FUJI DR-I90, the TDK AD90 and the TDK AR-X90, which either use 'Pure Linear Ferric' ultrafine particles or use a dual coating of ultrafine Avilyn particles, to provide a rising high frequency response.

This boost in high frequency response compensates for the natural

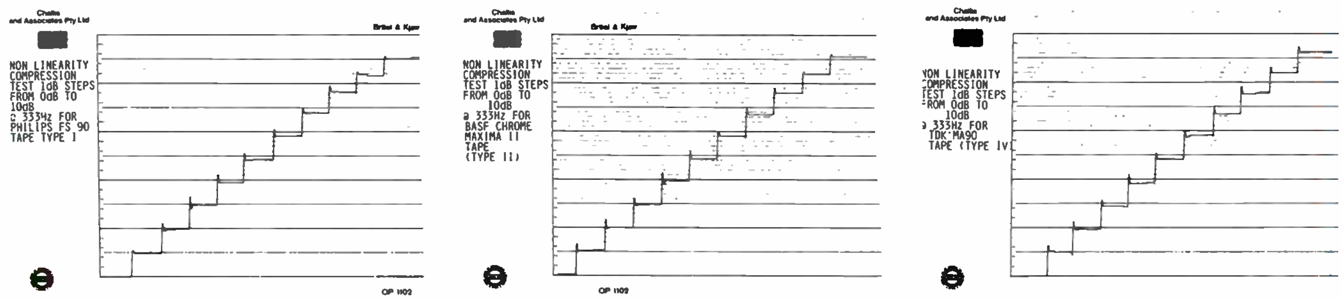


Here are the record/replay curves for the type IV tapes.



And here are representative curves for the three types of formulation, for measured background noise levels.

Here are three representative non linearity compression test results, for type I, type II and type IV tapes respectively.



droop in performance in both 0VU and -10VU, with no significant change in output in the saturation region at +6VU.

These Type I tapes offer useful extension of frequency response, with only a nominal penalty in terms of change or degradation of other parameters. Of the Type I tapes, the best *overall performance* is currently provided by the TDK AR-X90, which is marginally superior to the Philips FS-90.

But when it comes to 'dollars per decibel', the Philips FS-90 appears to offer the best value, with the TDK D90 and the Fuji DRI 90 fractionally behind the Philips tape.

Type II tapes

The Type II or 'high bias' tapes, as typified by the chrome or chrome equivalents, offer performance which is less impressive than I would have expected — particularly in terms of the saturation and related parameters.

Whilst the dynamic range of these tapes with one exception (the Denon HD8/100) is significantly better than that of the Type I tapes, the overall record/replay frequency performance at -10VU (again with the exception of the Denon HD8/100 tape) falls well short of the Type I tape bandwidth capabilities.

The Type II 3% third harmonic distortion levels are not significantly better than that offered by the Type I tapes, and when averaged out over all the tapes is marginally lower.

Notwithstanding this the noise figures of the Type II tapes are lower, so in the end all they have to offer is a superior noise figure at the expense of an inferior frequency response and saturation level at high frequency. Of the Type II tapes, the best *overall performance* currently appears to be achieved by the Philips MCX-90, primarily as a result of its extended frequency response at -10VU.

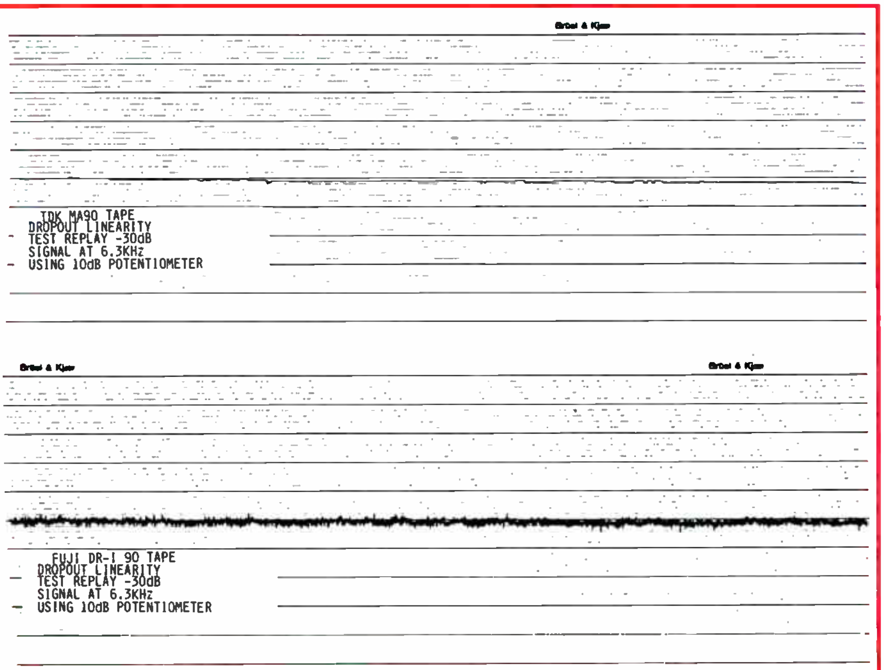
While the best value for money appears to be BASF Chrome Extra II, which offers an excellent dynamic range, high 3% distortion level, and the lowest cost in the group.

Type IV tapes

The Type IV tapes have on this occasion remarkably few entrants, and it should be noted that we initially mistook the Denon HD8-100 tape as being a metal tape, when it is in fact clearly a high bias chrome equivalent.

The best *overall performance* in the Type IV group is currently achieved by the TDK MA-XG90, although Maxell's Metal Vertex 90 is still a mighty impressive tape.

When it comes to sheer value for money, the TDK MA90 offers a price for performance that is hard to beat, and at $7.95 this tape provides a performance which I believe offers the best overall value for money of all the tapes I tested.



Two examples of the results obtained from the drop out linearity tests. Louis Challis supplied curves for all tapes, but space prevents from including these.

Summary

In the end, when I sat down to consider what I had learnt from this latest testing program, I realised that the research and development recently undertaken to improve the quality of Type I tapes has produced unparalleled results, with Type I tapes now offering first class performance for very little expenditure.

Type I and Type IV tapes have now clearly eclipsed the Type II tapes, and tapes with the performance of TDK MA90 are really worth considering, when you take into account the attributes offered for serious live or dubbed CD recordings. ■

HITACHI'S FX-7 CD MINI STEREO

The new Hitachi FX-7 Compact Disc Mini Stereo System integrates virtually all of the functions needed by most of today's music lovers, in a compact and elegant three-piece package capable of being housed on a small bookshelf. Here's a look at its functions and facilities.

by LES CARDILINI

One of the things that you notice first about Hitachi's new FX-7 mini stereo system is that it incorporates a compact disc player, of the direct top-loading type. As these are a little different from the familiar front-loading players with motorised disc trays, in terms of pro's and con's, a few words of explanation may be in order.

Most stereo enthusiasts who have handled or installed a compact disc player in a stereo system would have come across the conspicuous yellow and black label on the rear of the cabinet, drawing attention to the fact that there is a laser inside.

Although lasers tend to conjure up visions of star wars and high-tech surgery, the ones that are used in the majority of compact disc players are relatively low-power devices tucked away inside the sets — safely out of sight and harm's way, typically.

The risk of being injured by the laser in your compact disc player — if you operate the player correctly — is negligible. Nonetheless it is good practice to avoid looking directly into the lens on the pickup while the player is switched on. An invisible infrared laser beam is focused through the lens for a few seconds each time the set is powered up, and then continuously while a disc is playing.

Again, there is normally no risk to users. But service people and others who might operate the set with its covers removed, or by over-riding the interlocks, should take care when inspecting or making measurements around the pickup.

In contrast with front-loading players, where the pickup lens that focuses the laser beam onto the disc always remains hidden away inside during normal operation, with top-loading players and portables it is normally in full view of the operator when the disc compartment lid is open. Because of this additional safeguards are usually built into these models. Interlock switches or sensors that automatically disconnect the power to the laser are included, to prevent the player from working unless the lid is closed. For this reason it is unwise to operate a portable compact disc player that has, say, a broken lid.

But the user is not the only one to be considered. The pickup lens assembly and the flexible mountings in which it is delicately suspended are easily damaged if handled clumsily, and it can be a very expensive exercise to have the pickup replaced should the need arise. If the optical pickup in your player is within reach of inquisitive fingers, I strongly suggest that you resist the temptation to fiddle with it, and encourage others to do likewise.

Having the lens exposed to view also has its advantages, of course. For example a compact player into which you load the disc directly by hand is likely to have fewer mechanical parts, compared with an equivalent model that has a motorised loading tray. It is also relatively easy to check the lens regularly for dust and other foreign matter or moisture condensation, without having to dismantle the set.

In the event you do spy a bit of loose fluff near the lens, it may be removed from the pickup with a squeeze-operated blower or air-puffer similar to those used to clean cameras, before it has time to settle in and make itself at home on the lens. However, using brushes and chamois pads that may scratch — or wet cleaners that could cloud the lens if you use the wrong kind — is best left to the experts.

Having hopefully cleared the air with regard to the CD player section, let's now look at the rest of Hitachi's new FX-7.

Dubbed a 'Mini Compact Disc Stereo System' it's a three-piece system based on a a stereo amplifier rated at 25 watts per channel (measured at 1% total harmonic distortion or THD). This is coupled with an FM stereo radio tuner, with AM and three shortwave bands for international listening, and also twin cassette tape decks controlled by a single set of 'intelligent' function push-buttons.

This 'intelligence' means that while you are playing a cassette in Deck-1, for example, you could begin rewinding a tape in Deck-2. Then you can reselect Deck-1 and switch it to play in reverse. Then you can go back and fast-forward the other tape, and so on — all with the same single set of push buttons.

The twin decks can be set up for auto-reverse playing of either deck, or continuous play from both, and are supported by the Dolby B noise reduction system, and Normal/Chromium Dioxide tape selection. Dubbing may be carried out at normal or high speed.

The recording deck may also be set to work intelligently with the compact disc player, responding mutually to stops and end of tape, and inserting four-second spaces for use in decks (like that in the FX-7 itself) which have auto music search and skip features.

Automatic programming of tracks, to best match the playing time of the cassette you are using when recording from

the compact disc player, is also included. Either the standard playing times of C90, C60 and C46 (minutes) may be selected by repeatedly pressing the relevant edit pushbutton, or alternatively, non-standard playing times may be entered using the compact disc track programming keys, in the appropriate mode.

For example you could enter a playing time of, say, 52 minutes. Tracks selected for recording on the respective sides A and B of the cassette are displayed in the track program display on the front panel.

Consistent with other models of its ilk, the Hitachi FX-7 also has a digital 12-hour clock complete with Sleep and Record or Playback Timers. Program sources are prioritised for timer operation — CD, Tape 1, Tape 2 and Tune, in that order.

Accordingly, if you wish to have the tuner switch on under timer control, you simply make sure that there is no disc in the compact disc player and that cassette tapes have been removed from Tape Deck 1 and Tape Deck 2. Similarly, to operate Tape Deck 2 under timer control you unload the compact disc player and leave Tape Deck 1 empty.

Inputs to the amplifier section include the on-board tape decks, tuner and CD player. An Auxiliary input is also provided, to connect an external line level program source, and this can be switched to Phono to accommodate a turntable in the system, if desired.

Colour coded, spring-loaded terminals and cables make for easy connection of the matching, two-way bass reflex speaker enclosures to the centre unit. Headphones with impedance ratings between 8 and 100 ohms are also suitable for use with this system, according to the specifications.

Besides the regular medium wave AM, and stereo FM bands, the tuner is also equipped for shortwave (SW) radio reception, covering from 3.5MHz to 12.5MHz in 5kHz steps. A small loop AM antenna and an FM indoor wire dipole are supplied as standard accessories, while separate, spring-loaded antenna terminals are provided for each band — including the shortwave section, for which a longer, external wire antenna is recommended.

An alternative 75-ohm coaxial (coax) FM antenna connector is also available at the back of the set.

Three memories in the tuner section can store up to 12 stations on each band, including shortwave. This gives a total memory capacity of 36 stations in all. Programs may be tuned in manually using the Up/Down buttons to browse along the bands, or they may be selected from what you have already programmed into the memories.

The motorised, system volume control can be adjusted either manually at the main FX-7 control panel or via the hand held 28-key infrared remote control. The remote control is effective at distances of up to seven metres from the set, within an angle of ±30° of normal to the sensor on the front of the system.

The remote control can also be used to switch the system from Standby to Power On, and to select and adjust the various program sources: CD player, cassette decks, tuner and auxiliary or phono. Front panel slider controls are provided for Dynamic Bass, Treble and Balance.

The CD player in the FX-7 will play both regular 12cm discs and the smaller 8cm type. A disc is loaded manually for playing, and is magnetically clamped to the spindle turntable as the lid is pressed closed.

Up to 24 tracks may be programmed in any order from the remote control, and then played in that sequence. Repeat play modes are also provided.

The FX-7 system comes in a satin

black finish, with the speakers matching the main centre unit. The speakers can be separated from the main unit if desired, to achieve greater stereo separation.

The centre unit measures 360 x 260 x 293mm (W x H x D), while the speaker enclosures each measure 188 x 255 x 252mm (W x H x D), not counting the 5mm-high feet.

The tops of the enclosures are flush with the top of the main unit when the three are installed side by side on a shelf or table.

Trying it out

One way of finding out how friendly a new system is is to try and get it up and running before reading the instructions. Now that is not my considered advice to prospective system owners — quite the contrary, in fact — but I justify the approach when reviewing equipment, on the basis that we Australians collectively tend to read the instructions only when all else fails.

Besides, it is handy to be able to point to the kind of trouble you might get into if you use the bull-in-a-china-shop approach.

On that score the FX-7 created few if any problems. The components in the centre unit are already connected internally, and the speaker terminals and separate antenna terminals for the tuner are clearly identified. The ends of the speaker leads and antenna wires are already stripped and trimmed, ready to insert into the mating spring-loaded connectors.

I thought the 75-ohm socket for the FM tuner was a good idea, too, as the set can immediately share an existing outdoor TV antenna system by simply adding a two-way splitter to a spare fly-lead (not supplied).

The quality of sound from the tuner on both AM and FM stereo was fine using the indoor antennas supplied, at a location on the Mornington Peninsula in Victoria.

Due to interference from a local 30kV AC overhead power line nearby, however, I was unable to check out the shortwave bands with any success — but I have experienced similar difficulties using sensitive amateur radio receivers at the same location. The loop antenna supplied for AM reception, on the other hand, was directional enough to null-out AM interference created by a TV set operating adjacent to the system.

I had already found my way around the tuner, timer and compact disc player and also had the tape decks under control, by the time I opened the FX-7's user manual.

The rear-ported speaker enclosures with their two-way, 12cm and 5cm diameter drivers provided a lively bass, which I found could be further enhanced by carefully adjusting their position to couple the port openings to the corner of a room.

For general listening the '25 watts per channel' amplifier provided adequate volume. However, it was possible to operate the system at full volume without feeling that the neighbours might complain.

Operating the FX-7 proved to be a leisurely affair, thanks to the duplication of most of the system functions on the remote control. I expect there are many friends of Hitachi, budgeting around the price tag of the FX-7 system, who would be very happy with its performance, compact size and ease of installation and operation.

Recommended retail price of the Hitachi FX-7 Compact Disc Mini Stereo System is $999. Further information is available from Hitachi Sales Australia, 153 Keys Road, Moorabbin 3189 or phone (03) 555 8722. ■

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Applications: Thermocouples, RTDs; Thermistors; IC temperature transducers. Interfacing: Pressure transducers; Force transducers; Flowmeters; Level transducers. Application miscellany. Appendix; Bibliography; Indexes.

Synchro & Resolver Conversion
194 pages, 8½" x 11" softcover, 1980 **$15.00**

Synchros and resolvers; Scott-T, angles in digital form, logic I/O, conversion, resolvers and Inductosyns, related products, applications, synchro parameters, synchro & resolver manufacturers, harmonic distortion of the reference, speed voltages, vector-rotation algorithms, quadrature effects.

Nonlinear Circuits Handbook
540 pages, softcover, 1976 **$15.00**

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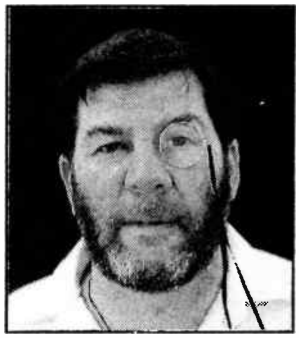
READER INFO NO. 4

Moffat's Madhouse...

by TOM MOFFAT



BANG! — what was THAT?

We see some unusual things in the electronics game. Something fails... why? That radio was working last time I used it. Now it's kaput, an unexplained failure. The computer works fine for days, even months, doing your accounts, word processing, and then one day for no good reason it drops its bundle. You haven't backed up the project you're working on, and you kiss it goodbye.

In the computer world, failures in most cases are caused by software faults. Under certain circumstances, a particular block of code executes in a disastrous way the programmer never thought of. This is called a 'bug'. But there is a lot of software which has been around for years (like the WordStar work processor), which has proved its reliability over millions of hours of use. But suddenly, it goes boom. Why?

One explanation about computers is that some random memory cell may become the unwilling target of a cosmic ray which releases energy into the cell, changing its state. There are cosmic rays raining down on us all the time — not in worrying quantities, but they're there. In fact there is a special observatory not far from my home, operated by the University of Tasmania, to study cosmic rays. Cosmic rays are also studied extensively in Antarctica.

So it's well known how often cosmic rays strike earth, and how powerful they are. If a particularly energetic cosmic ray ploughs into a memory chip on your computer and changes a bit from an 0 to a 1, then that computer is probably going to have an unexpected, and very temporary, failure. Just enough to send your data into oblivion. This isn't pie-in-the-sky stuff, as I remember an article in *Scientific American* or somewhere discussed the matter in detail, and worked out the odds of a particular computer receiving a cosmic ray strike. It wasn't an unusual occurrence.

Another hazard to computers or any electronic device is an electromagnetic pulse, or 'EMP'. Fear about EMP is usually connected with fear of nuclear war; a nuclear detonation produces a gigantic instantaneous magnetic field, as well as heat and light. The field can induce enormous voltages into electronic equipment, either via antennas or directly into metal cases housing the equipment. Much military radio gear still uses valves, because they can withstand momentary high voltage overloads that would destroy transistors.

EMP is also produced by lightning, either the traditional strike- to-the-ground variety, or some of the weird and wonderful varieties such as sheet and ball lightning. Ball lightning is thought by some to be imaginary, but I can tell you from personal experience that it's not. What follows is a story which I give you my word is absolutely genuine.

When I was a kid, about 14 years old, I actually sat there and watched ball lightning come into my house. At least I think it was ball lightning.

We lived on a military base in New Mexico in the USA. The base houses had windows with heavy steel frames set into pre-cast concrete walls. Portions of the windows opened and closed on vertical hinges like a door, driven by a crank and screw arrangement. When the window was closed there was a clamp that reached out of the frame and securely gripped the moving part, to provide a weatherproof seal against the desert dust-storms.

We had a television set in the dining room, adjoining the living room but isolated enough to prevent the telly bugging my parents too much. When I wanted to watch it, I simply had to grab a big wing-back chair in the living room and swing it around to face into the dining room. With my feet up on a dining room chair, I was then in position for a long night of sitcoms and soapies. And my parents could read or talk in peace.

The television antenna was mounted on the chimney with one of those metal strap arrangements, and the lead-in was the old-fashioned 300-ohm twinlead. This came down to the dining room window, where it was fed though the bottom of the opening part. The window had then been cranked closed and secured with the clamp, thoroughly squashing the twinlead where it came through. It also meant the weather seal at that point was no longer airtight. The twinlead then continued on, drooping along for three metres or so, and then it rose up to the antenna terminals on the back of the telly.

One night there was a violent desert thunderstorm — the sky almost continuously flashing with lightning, and thunder rumbling and grumbling. But no lightning bolts seemed to be hitting nearby; there was always a decent delay between the brightest flashes and the booms. Then, all of a sudden, there came a kind of fizzing sound from the window. And as I watched, this ball of blue-white light came into the house along the television twin-lead.

The ball of light was moving at a leisurely pace, taking at least 10 seconds to cover the distance between the window and the television. As it entered it didn't go through the glass; it had to squeeze through the crack where the lead-in came through the window frame. It was if you took a balloon and forced it through a crack; it flattened right out, went through, and then expanded again once inside. This was accompanied by a 'floop' sound.

As the ball of light moved along the twinlead from the window to the TV set, it made a frying noise, just like you'd expect such a thing to make. And, surprisingly enough, there was no sensation of heat from it at all. It just seemed like a cold light. When the ball of light finally got to the television, there was 'zap' sound, and the thing disappeared. End of show, for the telly as well.

Investigation the next day revealed that the only damage to the TV set was to the little balun inside, which coupled the twinlead to the unbalanced input of the tuner. The tiny wire it was wound with was burnt out, and that's all. No other charring inside the set, nothing. And once the balun was replaced, the set worked fine.

I consider myself very fortunate to witness such an event. As it occurred I just sat there speechless, so my parents missed out. In fact I'm not sure they really believed me. I wasn't the least bit afraid of it, just fascinated, and for 10 seconds or so I was able to study a phenomenon that raises a lot of questions. For instance...

Why wasn't it hot, and why didn't it do more damage? I get the feeling the light ball was just a small quantity of energy, sort of bound up into itself by its own magnetic field. I could have damaged the TV balun just as much by discharging a 100uF 500-volt electrolytic capacitor into it. So that's the order of energy involved, certainly not lightning-sized. The colour, a cold blue-white, was exactly the same as the auroras we see nowadays in southern Tasmania. I suspect the auroras and the light-ball may be made of the same stuff.

Why did it have to squeeze through the crack under the window, why couldn't it just move through the glass? I suspect the reason for this is that the thing was based on ionized air, so it had to have some communication from one air molecule to the next, via the crack in the window frame.

Why didn't it just short itself out when it hit the steel window frame? I couldn't even hazard a guess at that one.

It seemed like the ball reached some stable state of equilibrium once it had attached itself to an electric conductor running right through its middle. There have been reports of similar but larger balls of light latching onto overhead power transmission lines. This sounds like exactly the same thing, but coming into somebody's house? Blimey!

Over the years there have been reports of glowing globes of light in the sky. These are usually served up as UFO reports, but they are pretty common in New Mexico, and most people living there, including me, have seen them. My observation is that they are exactly the same colour as the one that came into the house, although possibly bigger. There's no real way of telling their size, because you can't judge how far away they are. My suspicion is that they are once again 'energy balls' that would be quite happy to attach themselves to the first power line they encountered.

I know this sounds like science fiction, but let me reiterate that the above report is absolutely fair dinkum. The phenomenon has been taken seriously enough that a research institution I once worked for decided to manufacture 'plasmas' in the lab. They chose a truly brute-force method, constructing an enormous bank of oil-filled capacitors that could be charged up slowly and then discharged all at once, to form a giant spark that would hopefully have enough energy to totally enclose and entrap itself.

The capacitors filled a whole room, and as I remember they constituted several Farads with several thousand volts across them. During initial tests the scientists let the thing off without warning, and it sounded as if someone had fired a cannon in the room.

I was part of a team constructing a wind tunnel on the other side of the lab, installing empty beer cans as a baffle to reduce air turbulence (I won't relate how the beer cans became empty). The first time the plasma experiment was fired tools, men, and beer cans went flying every which way. After that we always got fair warning.

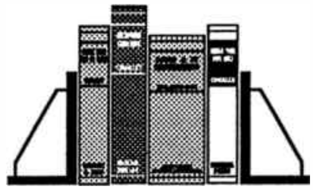
I believe the plasma experiment produced some measurable results; there was some indication that the thing was trying to be self-sustaining. But the 'plasma' they produced was bright yellow, hot, and extremely noisy, a far cry from the gentle blue ball that came into my home.

Ah — funny stuff, lightning. Another incident, completely opposite from the blue ball of light, occurred a few years ago on Christmas morning, right here is Tasmania. It was a brilliant, warm, sunny day, and we were out in the driveway playing with some of the toys the kids had been given. All of a sudden there was an ear-shattering bang in the sky directly above. It sounded like a lightning strike, but there was no visible flash, and as well it wasn't raining, not even a cloud in the sky. And it certainly wasn't a sonic boom, it didn't sound like that at all.

Later, at a neighborhood Christmas party, the big bang was the talk of the town. Interestingly, everyone got the impression that the explosion had happened directly over *them*, even though they were several kilometres apart when it occurred. And those who were indoors said it made the telephone bells tinkle — a sure sign of a lightning strike. The next day I found that my VHF scanning receiver had gone deaf, its front end zapped via a large voltage pulse from the antenna.

Where did this discharge in the sky come from? Was it lightning, or something else? Usually such things come from potential differences between clouds, or between clouds and the ground. But there wasn't a cloud in sight. Very mysterious. Maybe it was some kind of sheet lightning, the stuff you see far off in the distance on hot summer evenings. Whatever it was, it came equipped with one mighty dose of EMP. And it taught me a valuable lesson — always disconnect the antennas when radios are not being used. ■

NEW BOOKS



High power amplifiers

HIGH POWER AUDIO AMPLIFIER CONSTRUCTION, by R.A. Penfold. Published by Bernard Babani, 1991. Soft cover, 180 x 110mm, 86 pages. ISBN 0-85934-222-0. Recommended retail price $13.00.

This book gives the theory, plus practical circuits, for constructing power amplifiers in the 50 - 400W RMS range.

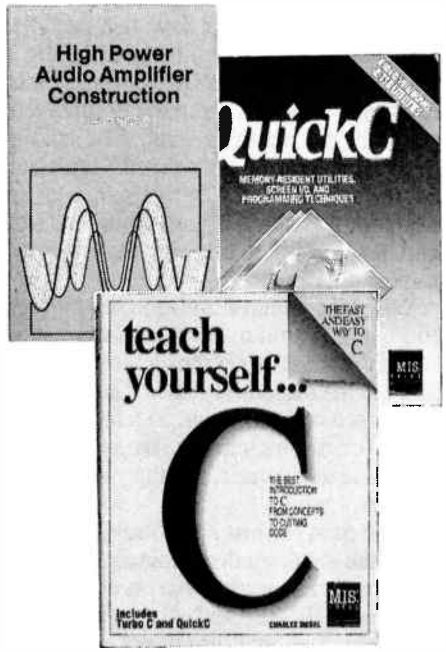
Chapter 1 deals with the particular problems associated with high power amplifier design, such as safety and the increasing voltage supply needed. The use of bridge output circuits is explained, to get around the latter problem.

Chapter 2 compares the use of bipolar and MOSFET transistors, especially when used in the class B configuration. Crossover distortion, thermal runaway and parallel operation are all discussed.

Chapter 3 gives actual circuits to build. The first circuit is a 50W class B MOSFET design. All constructional details are given. A second design includes op-amp techniques, which allow the construction of non-inverting and inverting stages to drive a bridge circuit with out-of-phase signals. The final design uses bipolar transistors, with amplified diode biasing to control thermal runaway.

The book is very easy to read and explains the background theory very well, illustrating the main points with basic circuit diagrams. Once the basic principles are explained, it then gives practical circuits to build. So whether you just want to understand how high power amplifiers work, or intend to build one, you should find it very useful.

The review copy came from the *Electronics Australia* Book Shop, PO Box 199, Alexandria 2015. It is available by mail order from this address for $13.00, plus $1.50 for post and packaging. (P.M.)



Programming in C

TEACH YOURSELF C, by Charles Siegel. Published by MIS Press, 1989. Soft cover, 235 x 180, 357 pages. ISBN 0-943518-99-7. Recommended retail price $47.95.

QUICK C, by Al Stevens. Published by MIS Press, 1988. Soft cover, 235 x 185mm, 318 pages. ISBN 0-943518-80-6. Recommended retail price $55.00.

These two book from MIS Press are aimed at very different audiences. The first is for beginners in programming, while the second assumes that you know the C language well and also understand DOS and its functions.

'Teach Yourself C' sets out to guide beginners through the C language without confusing them. It adopts the approach that you don't have to understand the whole language before you can use any of it, and that the abbreviations of the C commands — while very useful for an experienced programmer — are not necessary when first starting.

The examples throughout the book assume that you know how to load, run and use your C compiler. For those who don't know this, you are referred to Appendices A and B, which show you how to use Borland's 'Turbo C' and Microsoft's 'Quick C' respectively. Both appendices explain very clearly all the necessary steps to follow.

As you work your way through the various chapters of the book, you progress from simple concepts to more complex ones. The early chapters cover basic concepts like 'Talking with the user', 'Controlling program flow', 'Numbers and arrays' and 'Working with words'. A listing is given for the game, 'Tic-Tac-Toe'. This really is an illustration of how to program using arrays.

A second listing for 'The Little Black Book' (an address book program) shows how to program for 'words'. Such a program needs to load and save from your disk, so the concept of 'pointers' (the variables that 'point' to addresses in memory) is introduced. But errors when using pointers can be dangerous, so there is a strong warning about the possibility of corrupting your hard disk, and of the need for backing up your files.

The final chapter covers more complex concepts like variables, storage types, formatted I/O, control flow, numeric functions and operators.

As a beginner to C, I found this book very easy to follow and understand. No assumptions are made, and all concepts are clearly illustrated with short programs. I especially liked the two major listings which both summarise the ideas and illustrate complete C programs.

The second book, 'Quick C', is far more technical and does not pretend to teach you how to program in C. Its aim is to show how to write C language memory-resident programs which manage video windows. This volume (No.2) is for the QuickC compiler — volume 1 does the same task for 'Turbo C'.

Chapters 1-4 cover 'Interactive software', 'The C language', 'QuickC' and 'General purpose functions'. Chapters 5-10 deal with the concept and uses of 'windows'. Chapters 11 and 12 deal with TSRs (Terminate and Stay Resident programs). The listing for a simple on-screen clock is given, illustrating how to actually install such a resident program.

If you wish to write C programs dealing with screen windows, using the QuickC compiler, then this book clearly shows you how to do it. It covers its specific aim in great detail. But it assumes that you probably are already a C programmer and merely wish to master the QuickC compiler.

The review copies for both books on C came from Woodslane, 2/315 Barrenjoey Road, Newport 2106. They are available at most bookshops. (P.M.) ■

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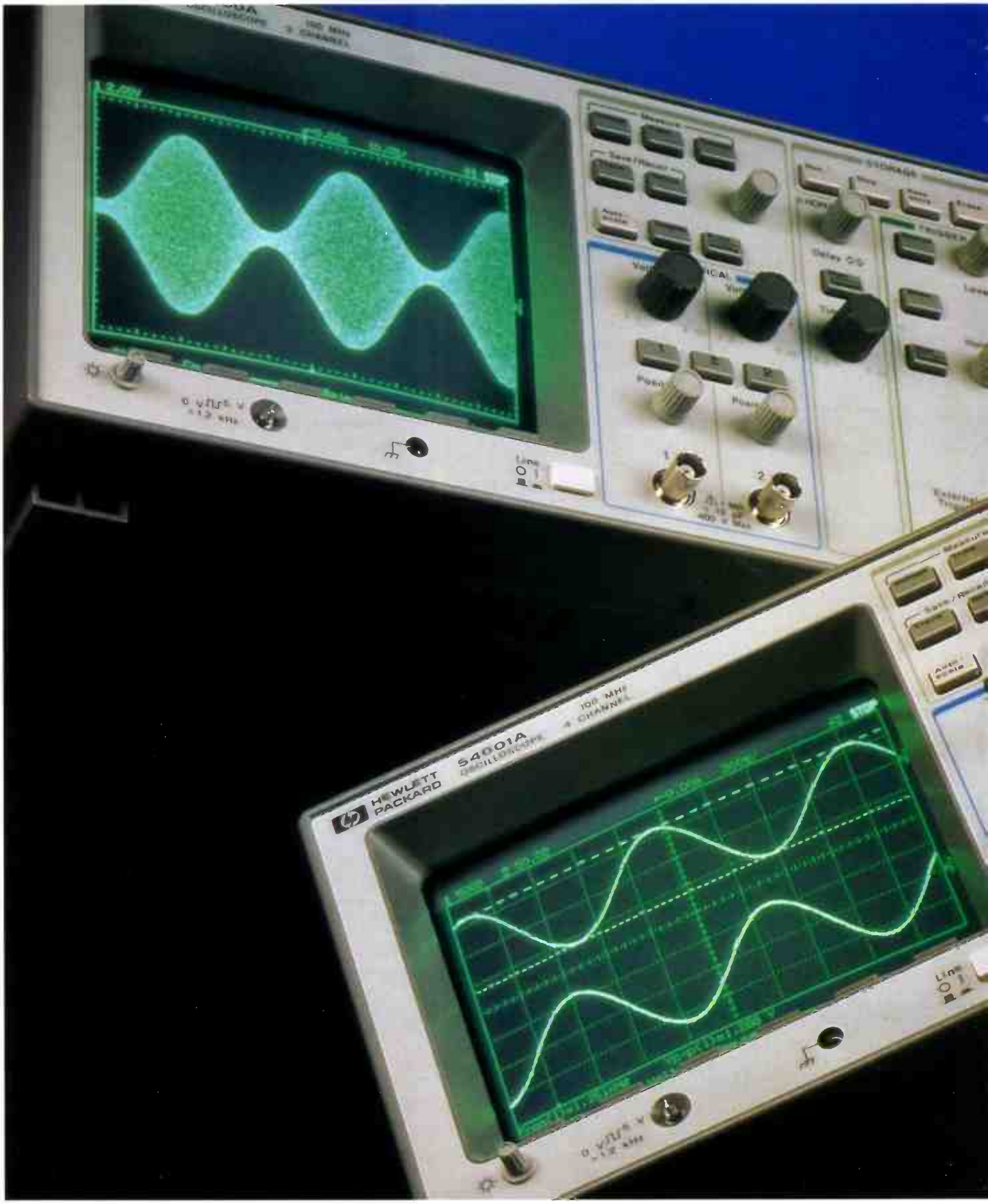

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HEWLETT PACKARD

Our evolving network of communications - 1

The telecommunications network in both Australia and the world is changing rapidly, but since most of the new technology introduced into the network is invisible to the user, this upgrading has largely gone unnoticed by the general public. This is the first of a short series of articles that discuss some of the new technologies that are being introduced, and show how they will give subscribers a range of previously unheard of services.

by ROBERT OWEN

There is one part of the modernisation of telecommunications that is receiving a lot of public attention, and that is the *Integrated Services Digital Network*, or ISDN. Although the ISDN is an entirely new way of setting up calls and handling voice and data, it is only a small part of a much larger upgrading of the technologies associated with telecommunications.

Before we can discuss the way that the telephone network will change over the next decade, we first need to understand two techniques that are already in use: these two techniques are the digital network and packet switching.

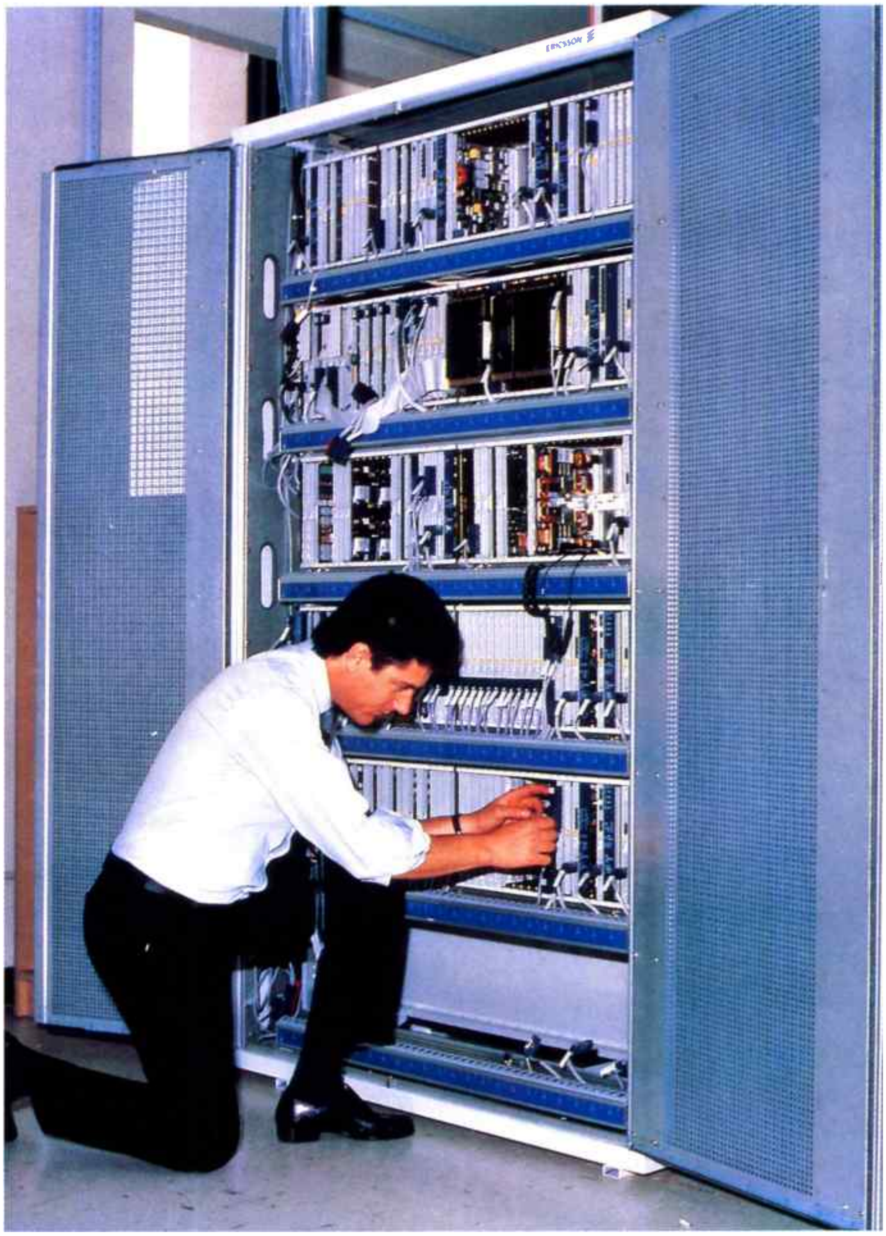
The digital network

Voice is essentially an analog signal. The mouthpiece of the telephone set, when spoken into, converts the changes in air pressure due to speech into an analog electrical signal. Although this principle is easy to implement and costs very little, the resulting use of a dedicated pair of wires to transmit an analog signal is very inefficient.

What happens in the digital network is that the analog voice signal is converted to digital form, by sampling the waveform 8000 times each second and then assigning a value to each sample. The voltage levels of the samples are represented as binary numbers, and transmitted as a sequence of 0's and 1's.

At the receiving end, the binary numbers are re-converted into the original analog voice waveform. This transmission method is called *Pulse Code Modulation*, or PCM for short (see Figs.1A and 1B).

The digital network goes even further than this, in order to use copper or fibre-optic cable to transmit signals efficiently. In its simplest form, 32 simultaneous voice channels are sequentially interleaved, or *multiplexed* onto one circuit.



Modern telephone exchanges such as this AXE made by L.M. Ericsson can handle many of the new services described in this article.

When 32 channels are multiplexed together the resulting circuit is called a 'PCM30 trunk'.

With this method of transmission, each voice connection is still sampled 8000 times each second and each voice sample represented as an 8-bit binary number. But the transmission of the signal is fast enough that between the times that an 8-bit sample of a single voice channel can be transmitted, 31 similar 8-bit samples of other voice channels can also be transmitted.

This allows 32 simultaneous telephone calls to be conveyed along the same cable. In practice though, only 30 of the 32 channels are used for speech — the remaining two channels being used for control and timing signals, hence the name PCM30.

If each speech sample consists of eight bits, and a voice channel is sampled 8000 times each second, then the digital bandwidth of a single voice channel is 8000 x 8 = 64,000 bits/second (bps). This 64,000bps bandwidth is the fundamental building block of the digital network.

We have seen how an analog voice channel is digitised to enable the signal to be transmitted efficiently. If we want the telephone network to transmit *computer data*, traditionally, most people have used modems. The modem converts the digital signals from the computer into an audible sound pattern for transmission

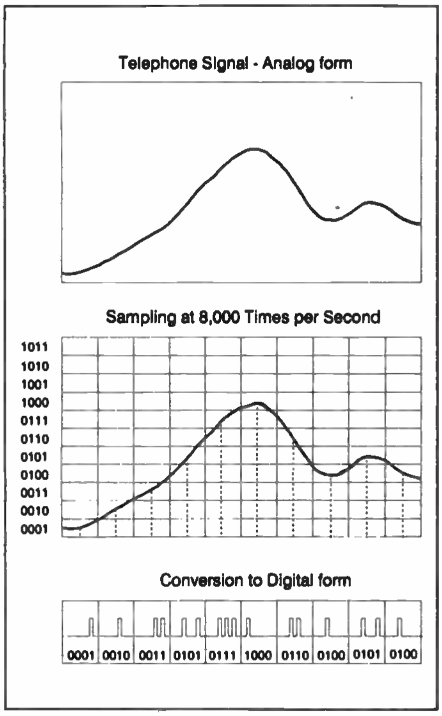


Fig.1a: The digital network converts analog voice signals into digital form by 8-bit sampling 8000 times per second. The principle is illustrated here using 4-bit sampling for clarity.

Calling Line Identification (CLI) is one of the new facilities offered by modern display phones such as this model from L.M. Ericsson.

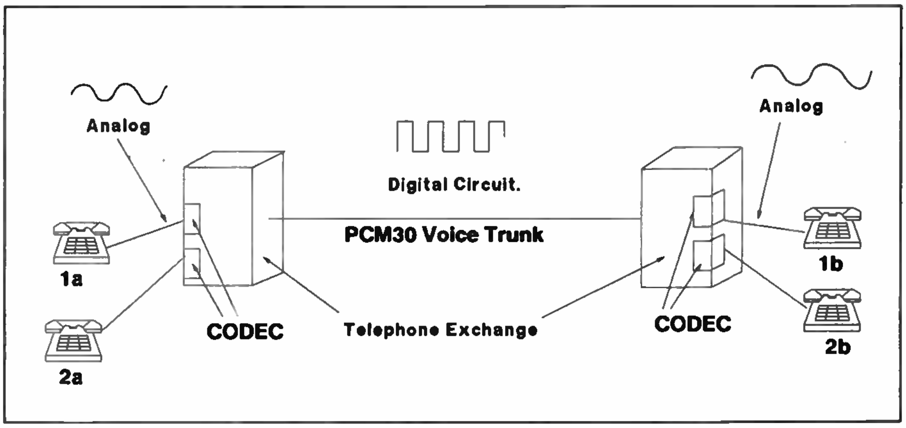


Fig.1b: At the telephone exchange CODECs are used to conver the analog voice signals into and out of digital form. Thirty separate calls are multiplexed onto one PCM30 trunk for transmission. Each channel has a bandwidth of 64kbps.

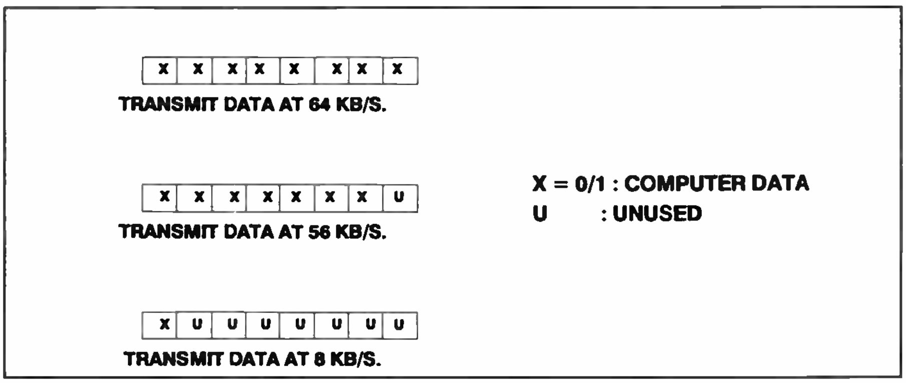


Fig.2: How 8-bit PCM digital words are used to transmit computer data. If all bits are used the data can be transmitted at 64kbps; using smaller numbers of bits can give data rates down to 8Kbps.

through the network. This method, however, is inefficient as only speeds up to 2400bps can be transmitted.

A much better way is to incorporate the data to be sent directly into the 8-bit pattern used to transmit speech. If all eight bits were used, 64,000 bits of data could be transmitted per second.

If seven bits were used and the eighth bit left blank, then 56,000bps could be transmitted. If only one bit were used and seven bits left blank, then 8000bps could be transmitted.

To perform this, new equipment needs to be installed at the subscriber's premises to handle the 8-bit pattern, as the 8-bit format itself is usually generated at the telephone exchange (see Fig.2). This is the principle behind Telecom's Digital Data Service.

Packet switching

We have just shown how the digital telephone network can transmit data, in a constant stream at rates up to 64,000bps (64kbps). Apart from the bulk down loading of large computer files, to dedicate a complete 64kbps channel to data transfer is not usually the most efficient method of making use of the network.

Consider an operator sitting at a terminal and interactively entering data. The operator enters data, sends it to the computer for processing, and then waits a few minutes for the response. Once the response has been received, several minutes may pass while the operator studies the data and decides what to do next.

All this waiting means that a dedicated channel between the terminal and the computer is used for, perhaps, only 5% of the time. A more efficient method of making use of the network for data transmission needs to be used, and in the late 1970's *packet switching* was widely introduced.

What packet switching does is to split up a long sequence of data into smaller segments, and to bundle each segment into a 'packet' for transmission.

These packets are then transmitted through a Public Packet Switched Network (PPSN), which is separate from the public switched telecommunications network (PSTN), although the packet switched network is often accessed through the switched telephone network. The Public Packet Switched Network in Australia is called Austpac.

Typically, a packet will contain a maximum amount of data that can be transmitted at once. With X.25, a commonly used packet switching protocol, this upper maximum is specified by the user as being between 16 and 4096 bytes, with each byte containing eight bits of data. Of course, there is no minimum amount of data that a packet can contain.

If no packet size is specified by the user, then X.25 defaults to a packet size of 128 bytes. It is this packet size that we will use in this article. If more than 128 bytes of data are to be transmitted, then the data will be split up into smaller amounts and transmitted in separate packets. It is the responsibility of the packet network to ensure that the packets are delivered in the correct sequence. In order to do this, each packet transmitted contains a sequence number; every time a new packet is transmitted, the sequence number is incremented and the new number included with the packet.

If a sequence number is to be transmitted with each packet, there needs to be an agreed-upon format for packets and their associated control information. A simple packet format, similar to X.25, is shown in Fig.3.

The packet in Fig.3 is made up of six fields. The first field is a START flag, used to signify the beginning of the packet; next comes the ADDRESS to which the packet is to be sent; then comes a CONTROL field, which includes the sequence number of the packet. These three fields are together called the packet HEADER. After this comes the INFOR-

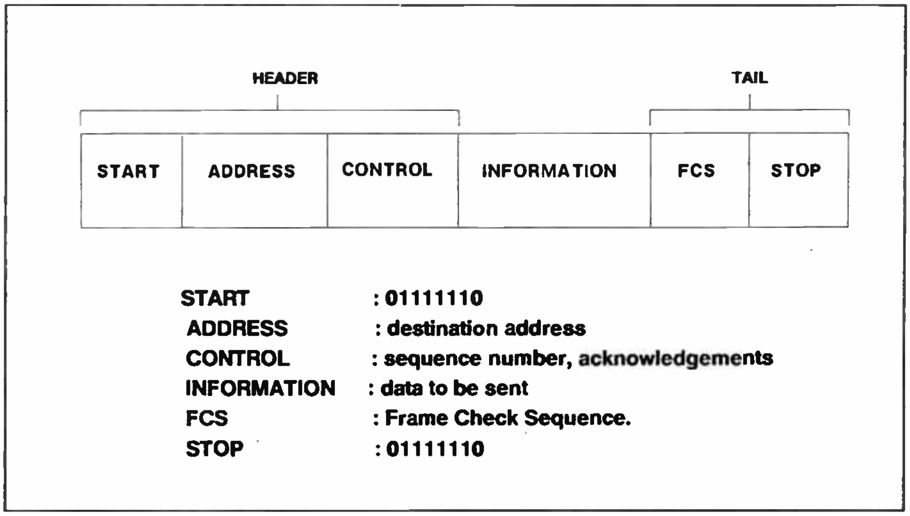


Fig.3: The kind of data format used in packet switching systems, of which X.25 is the most commonly used protocol. The information being transmitted in each packet is preceded by an identification 'header' and followed by a 'tail' as shown.

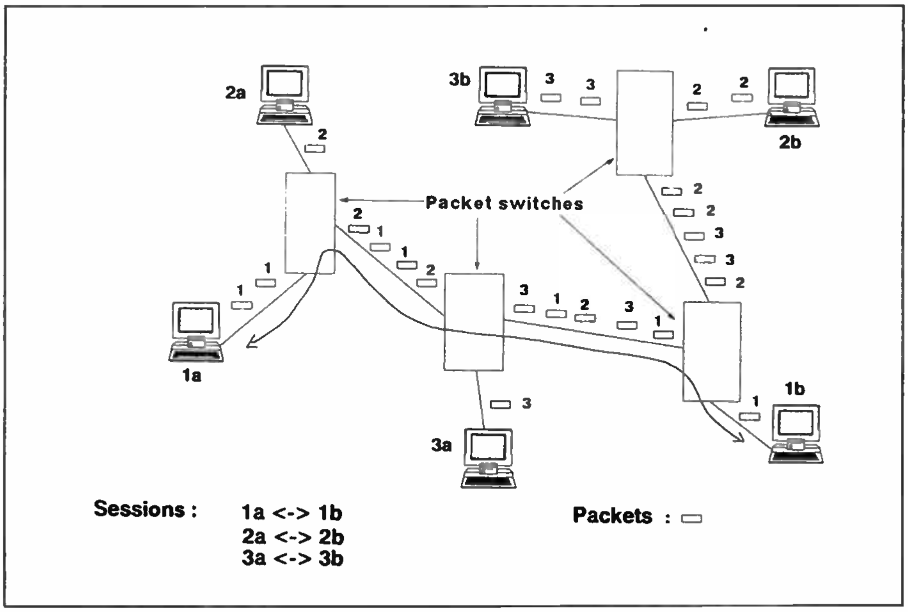


Fig.4: In packet switching, the data passes between the two ends of a link (for example, 1a and 1b) as a series of individual packets. The packets of data for other links can share the same paths, increasing system efficiency.

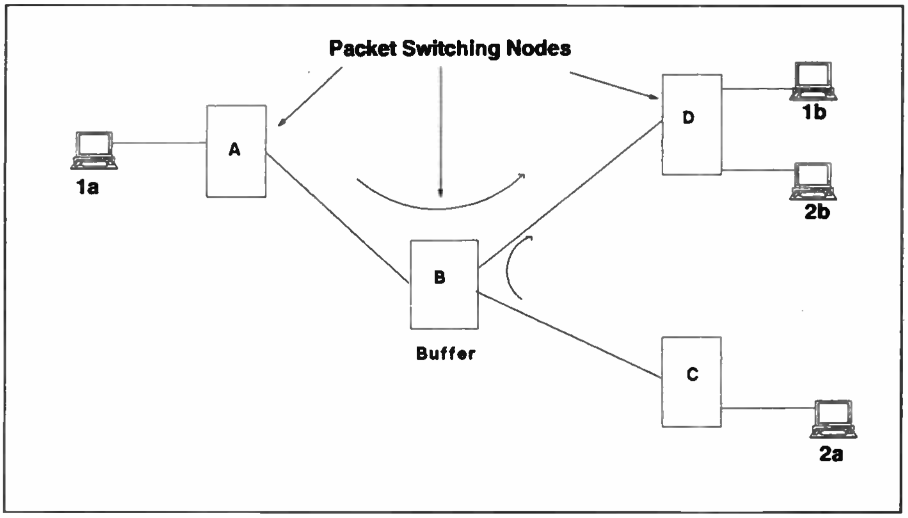


Fig.5: As well as directing the various packets of data to their respective destinations, each packet switching node can 'buffer' or store packets if a data path is overloaded, and resend them when the traffic drops.

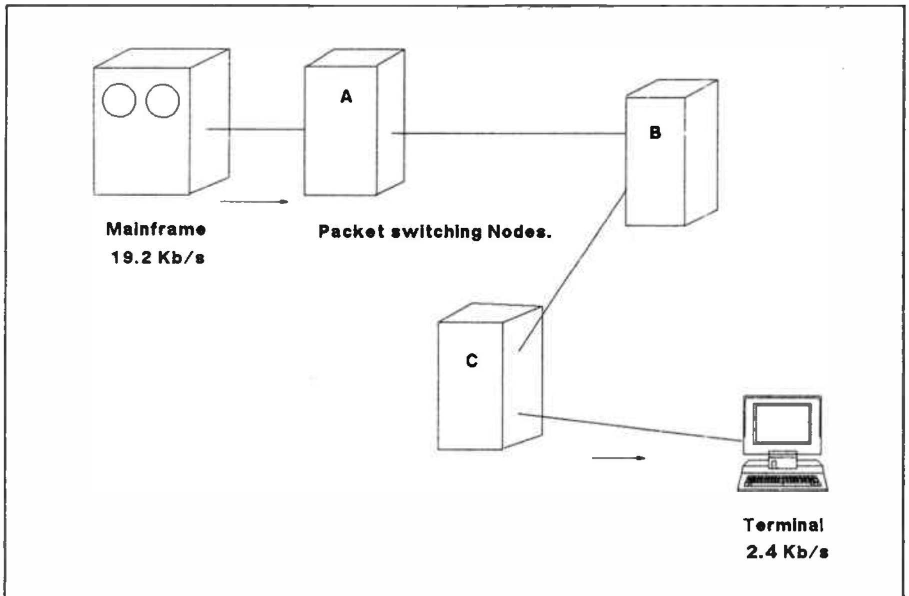


Fig.6: The buffering capability of packet switching nodes also allows communication between equipment operating at different data rates. Here a terminal operating at 2.4kbps is communicating with a mainframe running at 19.2kbps.

MATION field, which contains the data to be transmitted. The data to be transmitted can be of any length up to 128 bytes. Once the packet has been received at its destination, the FRAME CHECK SEQUENCE is used to ensure that the packet was not corrupted during transmission. If the packet was corrupted, the receiver can request the sender to retransmit the packet, using the sequence number to identify the corrupted packet.

Finally comes the STOP pattern, used to mark the end of a packet. Because each individual packet may only contain up to 128 bytes of data, a single packet switched call may involve sending several thousand packets of data.

Because each packet contains an ADDRESS, which provides to the packet switches or *nodes* through which the packet is to pass sufficient information to route the packet, and because a terminal may only use a communications channel for perhaps 5% of the time, the possibility arises of interleaving packets from different sources onto the same transmission channel without confusing the communications equipment, as shown in Fig 4.

The order of interleaving of packets is quite arbitrary, and depends only on the amount of data being sent. This is quite different from a PCM30 trunk, where the next occurrence of a particular channel will be exactly 32 channels later, whether or not any data or speech is actually being transmitted.

So long as the amount of data to be transmitted by all the terminals does not exceed the total data carrying capacity of the communications channel, packet switching works effectively. In the case where, momentarily, the communications channel becomes overloaded with packets, buffering of packets is performed to slow the rate of transmission; this usually alleviates the congestion.

The extra circuitry needed to multiplex the packets, de-multiplex them at the far end and perform buffering is more than offset by the increased usage of expensive data circuits. This is shown in Fig.5.

One of the big advantages of using packet switching is *rate adaption*. Because packets can be buffered at the nodes in the network, the speed at which packets are transmitted may be different to the speeds at which they are received.

For instance, a mainframe computer may transmit data at 9.6kbps, but the PC that receives the data may only be able to receive data at 2.4kbps. This rate adaption, shown in Fig.6, is performed by the nodes in the network and is transparent to the user.

Now that we have discussed two techniques that are widely used in telecommunications, we are in a position to look at the changes that are taking place in the network. This will be discussed in the second of these articles.

(To be continued) ■

The Author

Robert Owen is currently a Product Manager with the telecommunications company L.M. Ericsson Pty Ltd, with responsibility for the introduction of new products into the public switched telephone network.

His work includes co-ordinating the design activities at the various Ericsson design centres worldwide.

Mr Owen has B.Sc and M.Sc degrees in Communications Systems from the University of Birmingham, in the UK.

Prior to joining Ericsson he worked in the USA for a firm specialising in military communication systems, and in Canada for Northern Telecom — where he had responsibility for the field trials of new business and telecommunications products.

Automotive engine control - 1

Look under the bonnet of most modern motor cars, and you'll find a surprising number of electronic sensors and actuators. Inside under the dash, there's likely to be a microcomputer — which uses those sensors and actuators to control the operation of the engine. The result is more power, greater reliability and less pollution than with older mechanical engine control. Here's the first of a short series of articles explaining how the new engine control systems work.

by TONY MERCER

My wife's car came to a spluttering halt just the other day, and investigations revealed that one of the carburettors had died. Being an 'Olde English' vehicle, it used the SU brand of carby. Reliving my sports car youth, I gleefully took the faulty unit apart and determined the cause. Next it was off to the friendly spare parts place for some components.

I was shattered to learn that no one knew what I was talking about. "Carburettors? SU's? what form of ancient history is this? Gee I haven't seen one of those for years."

My reply was "If carbies are not used now, what is?"

"Electronic fuel injection, mate!", came the reply.

"Electronic fuel injection! What's that?"

A quick technical update, and I realised how far I had fallen behind. Ye gods! Off to some reading and fact finding.

This article, and those that follow, is the result of an electronics trained person's sojourn into the realms of modern automotive electronics.

These days, electronic fuel injection is one part of a control system called 'Engine Management'. The other part is electronic ignition control, sometimes called electronic spark timing.

In pre-fuel injection days, the engine's fuel requirements were accommodated with a carburettor. This worked on Bernoulli's venturi principle, where a flow of air over a port caused a partial vacuum to occur in the port and fluid from the port was drawn out into the air stream (see Fig.1).

The greater the flow of air, the greater the vacuum and the greater the flow of fluid. The same principle as that used in the hand operated fly spray, or garden pesticide sprays.

As the engine's requirement for an air flow/fuel mix increased, this rather cunning device sort of automatically compensated for it. When I say 'sort of automatically compensated for it' there are, in the real world of carburettors, many compromises needed to overcome cold starting, high speed, high load, idling, different fuel viscosities, etc.

Fig.2 shows how the explosive mix of air and petrol vapour is drawn into a cylinder, compressed, ignited, allowed to expand and pushes the piston away from the combustion area.

Finally the spent gas is exhausted into the atmosphere (called the Otto four cycle operation of an internal combustion engine, named after the gentleman who invented it.)

The other system needed is the means by which the ignition spark is made to happen. The system, named after a Mr Kettering who developed it, uses a transformer which has a primary to secondary turns ratio of some 1:100.

If you look at Fig.3 you can see that the circuit has a switch, called 'the points', that interrupts the current flowing through the primary each time the engine needs a spark.

The collapsing magnetic field in the primary winding causes a large voltage (around 20,000 volts) to ionize the space between the spark plug electrodes.

The capacitor across the points serves two functions. It minimises the spark developed across the points, preventing premature failure; and it also causes a smaller, lengthened spark plug voltage to be produced because of the resonance effect of a coil and a capacitor in combination.

You may wonder how a transformer of 1:100 turns ratio with 12 volts on the primary produces 20,000 on the secondary. The secret is in the rate of magnetic field collapse, which causes some 200 volts to appear on the primary for the instant that the magnetic field is collapsing.

The spark is distributed to each spark plug of a multicylinder engine from a single coil by a distributor. The timing for this spark is arranged by having a cam open the points at the appropriate moment (Fig.4). This cam timing is synchronised to the engine crankshaft and the piston position.

This system is essentially the same for later model motor cars except that a transistor interrupts the current flow, on receipt of a pulse from an electromagnetic pick-up — instead of mechanical points (Fig.5).

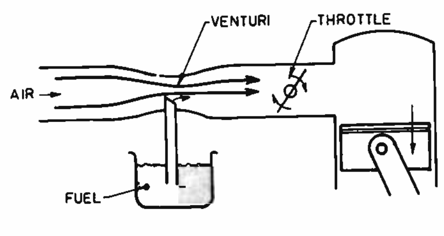


Fig.1

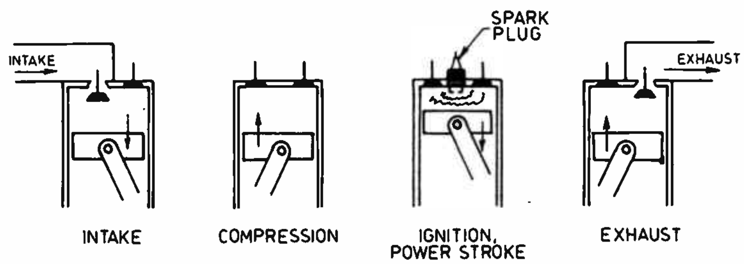


Fig.2

In order to vary this timing to suit engine speeds (we need to have the ignition occur at the optimum piston position; because the rate of fuel burn is reasonably constant, regardless of engine speed, we need to have it occur earlier in the cycle for higher speeds than we do for lower speeds), a set of centrifugal weights advances the timing.

When there is not much fuel required, for instance when in throttle over-run or idling, there is again a need for an advance in ignition timing. The individual molecules of fuel are further apart for a leaner mixture than for a richer mixture; thus the fire has to be started earlier.

This is achieved by a *vacuum advance mechanism* on the distributor. This works on the principle of there being a larger vacuum created in the intake manifold, with lighter engine loads and small throttle openings.

Again, as with the carburettor, there are all sorts of compromises needed to handle the full range of engine operating parameters. Such things need to be considered as the reduction in spark energy, to do with the coil not having enough time to charge up at high engine speeds, or when the vehicle is being started and the battery is supplying all its energy to the starter motor, etc.

This was all well and good in the days when no one concerned themselves too much about how much fuel cost (the oil producers had not at this stage made the first of their continual raids on our wallets) and how much pollution was let into the atmosphere.

At this stage the government enters the scene, and decides that what is needed is a set of rules governing such things as allowable amounts of pollution and fuel economy. A government regulation, ARD27A promulgated in July 1976, forced automotive companies to begin to address these issues.

In order to obtain maximum fuel economy consistent with acceptable levels of performance, we need an air/fuel ratio of 14.7:1. This needs to be varied to 12:1 for acceleration or high load conditions, and to 16:1 for cruise or overrun.

It was realised at this time that the old carburettor and conventional ignition system would not be adequate for this requirement, principally because of its inability to self tune and adapt itself to a variety of different situations.

The carburettor and ignition system may function adequately at one point in time, giving all the requisite performance, but at another be hopelessly inadequate. It may go out of tune through wear and tear.

The engine's operating parameters may alter, spark plugs wear and fail, air filters become blocked, engine compression start to fall and become unequal in each cylinder of a multicylinder car, etc.

The timing of the spark for good combustion is difficult to achieve using the conventional system. Points become dirty, burnt and pitted and the initial timing and engine performance deteriorates. The mechanical advance

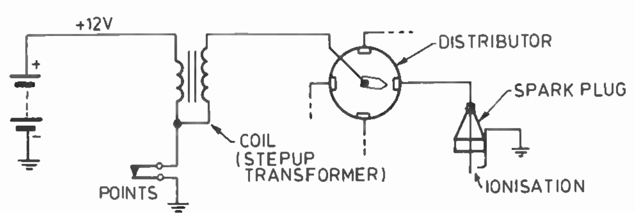


Fig.3

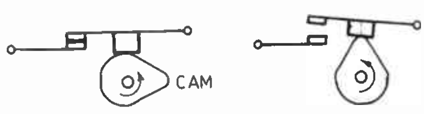


Fig.4

Engine control

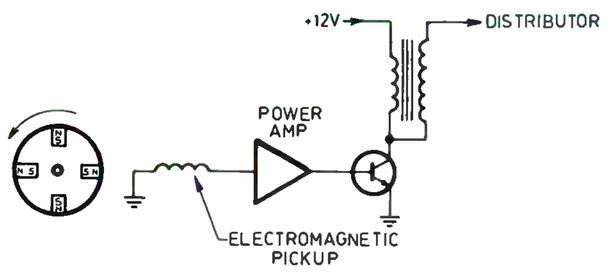


Fig.5

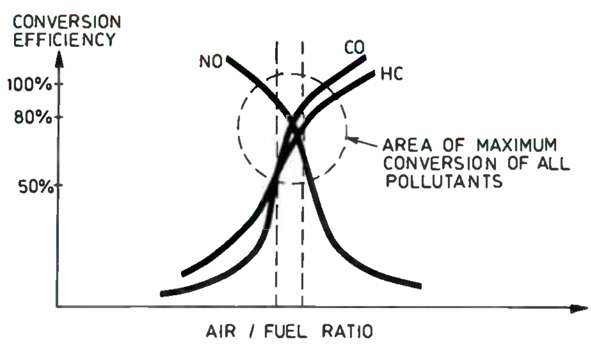


Fig.6

mechanisms were a compromise and prone to failure.

'Breakerless' systems using an inductive pickup for spark timing were an improvement, but still suffered given that the timing advance mechanisms were still the same as that used in the points system.

What is needed for constant performance and fuel economy is a system that is both *pro-active* and *reactive.*

Pro-active means that we predict what is going to happen and try and implement the changes beforehand (a bit like using insulated pliers for working on dangerous electrical equipment, *before* being belted), while reactive means making changes after the event (like, after you have received a belt). In the pro-active stage, a controller determines how much fuel and spark delay is needed for a given situation, and adjusts the fuel delivery and spark timing accordingly.

In the reactive stage the controller measures the exhaust gas for a certain level of oxygen. If it finds the exhaust gas does not have enough oxygen, the air/fuel ratio is too rich; if it has too much oxygen the air/fuel ratio is too lean. Once this has been determined the mixture is altered to correct it.

Another reactive sensor is the 'knock sensor' that senses whether or not the engine is 'pinging', or pre-igniting. This means that the ignition is occurring before it should, and the timing needs to be backed off.

In point of fact, one of the problems in the timing scheme described earlier is that it needs to take account of variations in individual cylinder characteristics. Because of slight differences in cylinder combustion area, inlet and output port

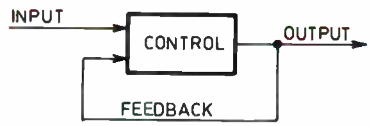


Fig.7

shapes etc., the timing specifications were a worst case compromise resulting in less than optimum engine timing.

It may be that five out of six cylinders could have their timing advanced, but this would cause pre-ignition in the sixth. Consequently all have to have their timing retarded.

For the same reason the carburettor specifications were less than optimum, in order to avoid too lean a mixture.

You may ask 'what is wrong with a lean mixture?' Apart from likely engine damage, it tends to increase one of the engine pollutants and reduces engine power.

A certain point can be reached with a mixture that is too lean, where a sort of se mi-misfire can occur: the flame is started but does not continue. This results in unburnt gasses being let into the atmosphere, a power loss and an actual *increase* in fuel consumption.

Finally there is a device called a *catalytic converter*, that further cleans the exhaust. In point of fact the correct operation of this converter requires that the three main components of the exhaust pollutants — unburnt hydrocarbons, carbon monoxide and nitrous oxides — be kept at a certain ratio and this is a further objective of the control system, along with good fuel economy. Fig.6 gives you an idea of the air/fuel ratio needed for good conversion efficiency.

A system that includes an oxygen sensor and a catalytic converter is called a *closed loop* system and examples of the theory of closed loop can be seen in such things as water heaters and toilet cisterns; any form of process control where inputs are measured and presented to a controller, decisions made as a result of these inputs and outputs applied to some actuators that effect the control.

The output is examined for ap-

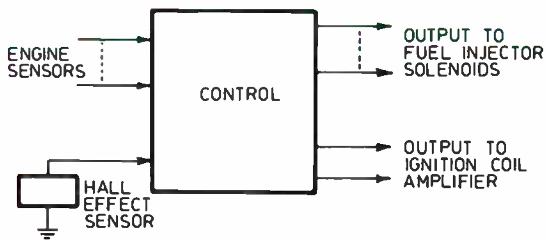


Fig.8

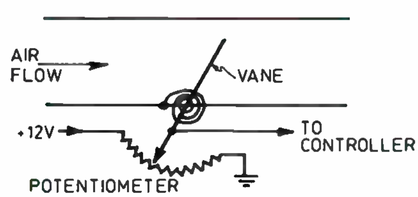


Fig.9

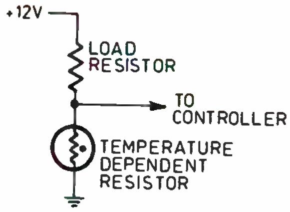


Fig.10

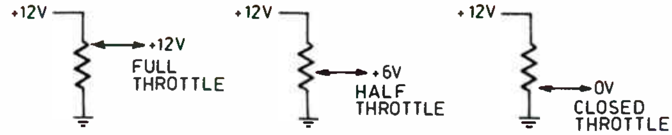


Fig.11

propriateness and some feedback is presented to the input, in order to fine tune the system (Fig.7).

There was an attempt to make a sort of electronically controlled carburettor, where the air/fuel ration could be controlled by an electronic box of tricks that varied the jet size, but these were not particularly effective.

Instead of the fuel ratio being controlled by a short length of tube, one end in fuel and the other exposed to the air flow and with the ratio being controlled by mechanical means, an electronic fuel injection system uses a controller to read various input sensors, such as air atmospheric pressure and temperature, air flow rate, engine temperature, engine speed and position etc., and determine how much fuel needs to be supplied to the engine. The fuel injection results when a solenoid-controlled valve opens and lets fuel at a controlled pressure into the intake manifold. The duration of this turn-on time controls the amount of fuel, and this time is usually in the fractions of milliseconds.

In order to determine how long to open the fuel solenoids, the controller needs to know what the mass of the air is in the cylinders. Once this is known a calculation is made so that an air/fuel ratio of 14.7:1 is aimed at.

The controller measures air mass using one of two methods:

1. The speed density mode:
In this mode the controller knows the engine capacity and can mea-sure how fast the engine is turning. It measures the air temperature and barometric air pressure (in order to work out its density), and also the manifold atmospheric pressure and throttle position.
The controller knows the volumetric efficiency of the intake system — i.e., the ratio of the theoretical amount of air possible, divided into the actual air achieved, considering all the restrictions on the air flow when all the sensory input is taken into account. Using all this data it can compute the mass of the air in the cylinders.

2. An air flow sensor:
In this mode it measures the flow of air directly using an air flow sensor — either a movable flap or a hot wire (more about these strange devices later), combined with some of the aforementioned sensors to arrive at the air mass. Using the same sensory information the controller also determines optimum spark timing.

The distributor is now minus all of its original timing advance mechanisms, and consists of a Hall effect pickup (used as a sensor by the controller to indicate crankshaft rotational position and speed) and an amplifier used in conjunction with a coil to provide the spark. (Fig.8)

The controller, which naturally is a microcomputer specifically designed for this task, has in its memory (apart from the program) a list of data appropriate for the engine specifications, operational environment, etc.

The program combines this data with its sensory inputs to determine this air/fuel ratio and spark timing.

Once this has been done, the injectors opened and a spark made to occur, the oxygen quantity in the exhaust is measured and fine tuning made to the data. In this manner the controller can continually fine tune the engine, keeping it at its optimum performance setting.

The controller can also log any failures that have occurred or sensors that appear to be out of limits. For instance if it reads that the engine is at freezing point but the air temperature is at 25°C, it would have good grounds to suspect that something was wrong.

Those sensors

So what are these sensors? They fall into what I call two categories: *direct* and *indirect*, depending on what sort of further processing the controller needs to do in order to obtain the sensed information.

The direct type use variable resistors — either potentiometers, whose sliding contact is tied to a movable mechanism (throttle position, air flow sensor flap etc. (Fig.9) — or a variable resistor whose resistance varies as a consequence of temperature, pressure, etc. (Fig.10)

This class of sensor provides an analog of some physical quantity (position, temperature, pressure, etc.), usually a voltage corresponding to the quantity, to the controller. An example should give you an idea of how this works. If a potentiometer has 12 volts across it and the slider is connected to the throttle, full throttle might be represented to the controller with 12V, a closed throttle with 0V and half throttle with 6V (Fig.11).

This class of sensor is a direct one in that the output can be used directly by the controller. The problem with them is that they are sensitive to dirt ingress, wear after a while, do not operate all that quickly and have difficulty measuring small changes.

Faster acting sensors that are more reliable are the variable capacitor and variable inductance.

If you recall from basic theory, the formulae for calculating the capacitance of a parallel two-plate capacitor is:

$C = (D \times A)/d$,

where A is the area of the plates, d is the distance between them, and D is the dielectric constant of the material between them. With a variable capacitor either the two plates are made to move closer together or further apart, the plate area is made to vary or the dielectric (material) between them is made to vary (Fig.12).

A fuel level sensor (Fig.13) using the latter principle, where petrol level alters the dielectric of a capacitor, was tried for a while but proved unreliable due to impurities in the fuel.

This class of sensor is called indirect because the controller can't calculate the capacitance directly. Rather the variable

Continued on page 99

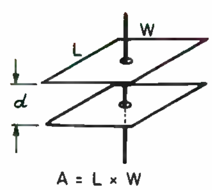


Fig.12

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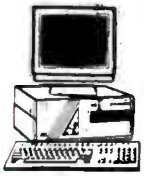

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1M VGA CARD...........$100
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85M HD add $150
126M HD add...........$290
200m HD add..........$700
EXTRA RAM
1 MEG add............ $90
2 MEG add............ $180

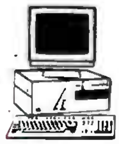
RITRON 386SX-27

80386SX-20 CPU
1 MEG RAM EXP TO 4 MEG
27Mhz LANDMARK SPEED TEST
1.2M JAPANESE F.F.D. 512K VGA CARD
85M HARD DISK DRIVE, 18ms ACCESS
101 EXTENDED "CLICK" KEYBOARD
MINI CASE & 200W POWER SUPPLY
SUPA VGA COLOUR MONITOR (1024 x 768 Resolution)
SERIAL PARALLEL GAMES PORTS
3 YEAR "AUSTRALIAN" PARTS & LABOUR WARRANTY
DOS 5.00 IBM* COMPATIBLE
SPREADSHEET, WORDPROCESSOR & DATABASE
SOFTWARE INCLUDED.
• SHAREWARE SOFTWARE

ASSEMBLED & TESTED IN AUSTRALIA.

$1,799 TAX INC.
$1,595 TAX EX

RITRON EXECUTIVE 386-57



80386-33 CPU 128K CACHE ON BOARD MEMORY
1 MEG RAM EXP TO 16 MEG
57Mhz LANDMARK SPEED TEST
85 MEG HARD DISK 18ms ACCESS TIME
1.2M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
SERIAL PARALLEL GAMES PORTS
SUPA VGA COLOUR MONITOR (1024 x 768 Resolution)
MINI CASE & 200W POWER SUPPLY
512K VGA CARD (256 COLOURS)
DOS 5.00 IBM* COMPATIBLE
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SPEADSHEET, WORDPROCESSOR & DATABASE
SOFTWARE INCLUDED.
*SHAREWARE SOFTWARE

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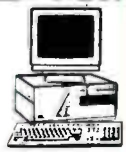
$2,195 TAX INC.
$1,965 TAX EX

RITRON EXECUTIVE 386-57



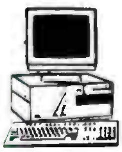
80386-40 CPU 128K CACHE ON BOARD MEMORY
1 MEG RAM EXP TO 16 MEG
57Mhz LANDMARK SPEED TEST
126 MEG HARD DISK 12ms ACCESS TIME
1.2M JAPANESE BRAND F.D.D DOS 5.00
101 EXTENDED "CLICK" KEYBOARD
SERIAL, PARALLEL, GAMES PORTS 512K VGA CARD
SUPA VGA COLOUR MONITOR (1024 x 768 Resolution)
MINI CASE & 200W POWER SUPPLY
3 YEAR "AUSTRALIAN" PARTS & LABOUR WARRANTY
SPEADSHEET, WORDPROCESSOR & DATABASE
SOFTWARE INCLUDED. *SHAREWARE SOFTWARE

ASSEMBLED & TESTED IN AUSTRALIA.

$2,395 TAX INC.
$2,150 TAX EX.

WITH 200 MEG DRIVE
$2,995 TAX INC.
$2,750 TAX EX.

RITRON EXECUTIVE 486-75



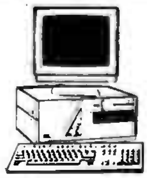
80486SX-20 CPU 64K CACHE ON BOARD MEMORY
1 MEG RAM EXP TO 32 MEG
75Mhz LANDMARK SPEED TEST
85 MEG HARD DISK 18ms ACCESS TIME
1.2M JAPANESE BRAND F.D.D DOS 5.00
101 EXTENDED "CLICK" KEYBOARD
SERIAL, PARALLEL, GAMES PORTS, 1MEG VGA CARD
SUPA VGA COLOUR MONITOR (1024 x 768 Resolution)
MINI CASE & 200W POWER SUPPLY
3 YEAR "AUSTRALIAN" PARTS & LABOUR WARRANTY
SPEADSHEET, WORDPROCESSOR & DATABASE
SOFTWARE INCLUDED. *SHAREWARE SOFTWARE

ASSEMBLED & TESTED IN AUSTRALIA.

$2,695 TAX INC.
$2,495 TAX EX.

WITH 200 MEG DRIVE
$3,295 TAX INC.
$2,995 TAX EX.

RITRON EXECUTIVE 486-115



80486-25 CPU
ON BOARD CACHE. 1 MEG OF RAM
115Mhz LANDMARK SPEED TEST
85 MEG HARD DISK 12ms ACCESS TIME
1.2M JAPANESE BRAND F.D.D
3.5" 1.44M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
SERIAL, PARALLEL, GAMES PORTS
1 MEG VGA CARD DOS 5.0 IBM* COMPATIBLE
VGA COLOUR MONITOR (1024 x 768 Resolution)
MINI CASE & 200W POWER SUPPLY
3 YEAR "AUSTRALIAN" PARTS & LABOUR WARRANTY
SPREADSHEET, WOROPROCESSOR & DATABASE SOFTWARE.

$2,995 TAX INC.
$2,695 TAX EX.

WITH 200 MEG DRIVE
$3,595 TAX INC
$3,195 TAX EX

RITRON EXECUTIVE 486-157

80486-33 CPU ON BOARD CACHE. 4 MEG OF RAM
157Mhz LANDMARK SPEED TEST
200 MEG HARD DISK 12ms ACCESS TIME
1.2M JAPANESE BRAND F.D.D
3.5" 1.44M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
SERIAL, PARALLEL, GAMES PORTS
1 MEG VGA CARD DOS 5.0 IBM* COMPATIBLE
VGA COLOUR MONITOR (1024 x 768 Resolution)
TOWER CASE & 220W POWER SUPPLY
3 YEAR "AUSTRALIAN" PARTS & LABOUR WARRANTY
SPEADSHEET, WORDPRCESSOR & DATABASE SOFTWARE.

ASSEMBLED & TESTED IN AUSTRALIA.

IDEAL CAD MACHINE!

$4,395 TAX INC.
$3,955 TAX EX.

ROD IRVING ELECTRONICS Est. 1977.

MAIL ORDER HOTLINE: 008 33 57 57. (ORDERS ONLY) ENQUIRES: (03) 543 7877
HEAD OFFICE: 56 RENVER RD, CLAYTON. PH: (03) 543 2166. FAX (03) 543 2648
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NORTHCOTE 425 HIGH ST. NORTHCOTE, PH. 489 8866. FAX: 489 8131.
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PHONE: (03) 870 1800 FAX: (03) 879 3927

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$50 - $99.99..$6.00
$100 - $199...$7.00
$200 - $500...FREE
$500 PLUS...FREE

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

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P.O BOX 620, CLAYTON, VICTORIA. 3168.

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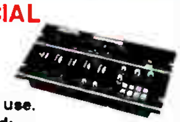
ROD IRVING ELECTRONICS MAILORDER HOTLINE: 008 33 5757

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

FIVE CHANNEL SPECIAL EFFECTS MIXER

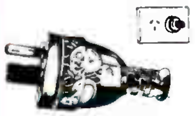


A consol or freestanding mixer with 8 inbuilt special effects.
Designed for both DJ and studio use.
The following inputs are provided:
2 x turntables • 4 x line inputs • 2 x low impendance microphones.
Eight special effects: siren, telephone, machine gun, bombing, shooting, ambulance, thunder, laser.
Other features: bass & treble control, Headphone Cue monitoring,
CH1 to CH2 cross fader, mic talkover switch, master volume level control and left & right LED VU meters.
A12013..$299.00

VIDEOCAM / VCR AUDIO MIXER

A professional audio mixer designed for the serious home video movie maker through to the home video camera user. Background music and effects can be faded in and out to existing video tape sound tracks. Ideal for weddings, family, sporting and other recordings.
• Input for a video camera, VCR, CD, tape, tuner, auxillary and turntable.
• Mic panpots • Mic faders • Turntable faders • VU meters • Mono/stereo switches • CD/Tape fader & more.
A12004..$169.00

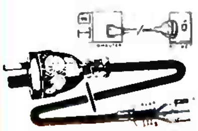
SURGE/SPIKE SAFETY PLUG



Stand alone 3 pin plug

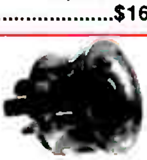
Plugs into socket adjacent to the equipment that you want to protect. All outlets on a power board can be protected by inserting the Triangle Surge/Spike Plug into any of the free outlets. Green safety neon glows when power is on.
Approval No. V88029
Total energy rating: 225 Joules (10/1000us)
Protection 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



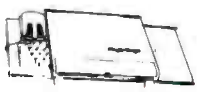
Plugs directly into your equipment and replaces your existing cord-set. Clear moulded plugs at both ends with green safety neons that glow when power is on.
Approval Numbers V88029, V900297, V85006.
Total Energy Rating: 225 Joules (10/1000us)
Protection level: 275V Nominal, 475V Peak.
Response Time: Better than 10 nanoseconds. Automatic reset.
X10080................$39.50

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

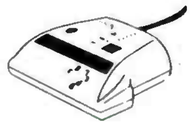
QS-129N/F SPACEAGE CONTROL NINTENDO & MULTISYSTEM COMPATIBLE (7 OR 9 PIN)
C14214..........$39.95

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

GENISCAN GS-4500 with FREE OCR software.

RESOLUTION: 100-400 dots per inch switch selectable.
• Grey Level: 3 x 32 grey scales and one letter mode.
• Scanning Width: single scan, maximum 105mm, multiscan up to 300mm
X19935...........$299

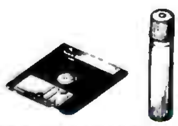


GENI SCAN COLOUR SCANNER

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.................$6.95
• 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

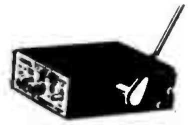
COMPUTER CLEANING KIT

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 mechanisims.
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

COMPACT DISC CASES

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

CHECK OUT THIS MONTHS MOTHERBOARD SPECIALS

286-12/16......... $159
286-16/21......... $179
386SX-20/27..... $395
386-33 with 128K CACHE... $895
486SX-20......... $1395
486-33............ $1995

MAIL ORDER HOTLINE
008 335757

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ROD IRVING ELECTRONICS - No.1 FOR COMPONENTS

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	$3.95	$3.75	$3.00

BNC SOLDERLESS TWIST ON PLUG

	1-9	10-99	100+
P10531	$3.50	$3.25	$3.00

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.

W12670 - CIC6 6 con.

1-9M	10M+	100M+
$1.30M	$1.10M	$1.00M

W12672 - CIC9 9 con.

1-9 M	10M+	100M+
$1.60M	$1.50M	$1.20M

W12674 - CIC12 12 con.

1-9M	10M+	100M+
$2.50M	$2.20M	$1.90M

W12676 - CIC16 16 con.

1-9M	10M+	100M+
$3.50M	$3.20M	$2.50M

W12678 - CIC25 25 con.

1-9M	10M+	100M+
$3.90M	$3.40M	$3.00M

LEDS

QUALITY 3mm LEDS

	1-9	10-99	100+
Z10140(R)	$0.15	$0.12	$0.10
Z10141(G)..	$0.20	$0.18	$0.15
Z10143(Y)..	$0.20	$0.18	$0.15
Z10145(O)..	$0.20	$0.18	$0.15

QUALITY 5mm LEDS

Z10150(R).	$0.15	$0.12	$0.10
Z10151(G).	$0.25	$0.20	$0.18
Z10152(Y)..	$0.25	$0.20	$0.18

FLASHING LEDS

RED 5mm	1-9	10+
Z10159	$1.10	$1.00

RECTANGULAR LEDS

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

IC SOCKETS

LOW PROFILE IC SOCKETS

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

	1-9	10+	100+
P10550 8 pin	15¢	12¢	10¢
P10560 14pin	20¢	18¢	15¢
P10565 16pin	20¢	18¢	16¢
P10567 18pin	30¢	25¢	22¢
P10568 20pin	35¢	30¢	25¢
P10569 22pin	35¢	30¢	26¢
P10570 24pin	35¢	30¢	26¢
P10572 28pin	45¢	35¢	30¢
P10575 40pin	45¢	40¢	35¢

WIRE WRAP IC SOCKETS

These quality 3 level wire wrap sockets are tin plated phosphor bronze.

P10579 8pin	$1.50	$1.40
P10580 14pin	$1.85	$1.70
P10585 16pin	$1.95	$1.80
P10587 18pin	$1.95	$1.80
P10590 20pin	$2.95	$2.75
P10592 22pin	$2.95	$2.70
P10594 24pin	$3.95	$3.50
P10596 28pin	$3.95	$3.50
P10598 40pin	$4.95	$4.50

ELECTRET MIC INSERTS

With pins for easy board insertion. C10170

1-9	10-99	100+
$1.20	$1.00	$0.90

ULTRASONIC TRANDUCERS

Designed to transmit at 40kHz (L 19990) & recieve at 40kHz (L19991) withup to 20V I/P on the transmitter. These units can't be heard so are ideal for TV remote controls, water level dectectors, burglar alarms, motion dectectors & information carriers as they can be either pulsed or used in a continuous wave mode.

Transmitter	1-9	10+
L19990.......	$2.95	$1.95
Receiver		
L19991.......	$2.95	$1.95

IDC PLUGS & SOCKETS

WOW ! FROM $1.00

D TYPE IDC PLUGS

	1-9	10+	100+
- DE9P 9pin plug			
P12166	$1.50	$1.20	$1.00
- DA15P 15pin plug			
P12168	$1.50	$1.20	$1.00
- DB25P 25 pin plug			
P12170	$4.50	$3.95	$3.50

D TYPE IDC SOCKETS

	1-9	10+	100+
- DE9S 9 pin socket			
P12167	$1.50	$1.20	$1.00
- DA15S 15 pin socket			
P12169	$1.50	$1.20	$1.00
- DB25S 15 pin socket			
P12171	$4.50	$3.95	$3.50

IDC CENTRONICS 36 WAY PLUG & SOCKET

	1-9	10+	100+
- Plug P12200	$3.95	$3.00	$2.95
- Socket P12201	$3.95	$3.00	$2.95

VOLTAGE REGULATORS BARGAINS

Description	1-9	10+
7805UC	$0.50	$0.45
7812UC	$0.50	$0.45
7815UC	$0.50	$0.45
7905UC	$0.60	$0.55
7912UC	$0.60	$0.55
7915UC	$0.60	$0.55
78L05	$0.40	$0.30
78L12	$0.40	$0.30
LM324	$1.00	$0.90
555	$0.40	$0.38
741	$0.50	$0.45

CHECK OUT THIS MONTHS GAME SPECIAL!

SPACE QUEST IV

ARWSOME DUDE! only $65.00

THIS MONTHS TOP TEN GAME SPECIALS!

THEIR FINEST HOUR	$59.95
SEARCH FOR THE KING	$59.95
LINKS CHALLENGE GOLF	$59.95
ELVIRA	$69.95
JET SET PACK	$59.95
KINGS QUEST FIVE	$69.95
SECRET OF MONKEY ISLAND	$59.95
HEART OF CHINA	$69.95
RED BARON	$69.95
TEST DRIVE II	$69.95

DB25 CONNECTORS

DB25 CONNECTOR SPECIALS

		1-9	10+
P10880	DE9P	$1.00	$0.80
P10885	DE9S	$1.00	$0.70
P10891	DA15S	$1.00	$0.70
P10892	DA15C	$1.00	$0.90
P10895	DA15S	$1.00	$0.80
P10902	DB25C	$1.00	$0.80
P10904	DB25P	$1.00	$0.80
P10905	DB25S	$1.00	$0.80

ECONOMY TRANSFORMER

	1-9	10+
2155 240V 6-15V 1A		
M12155	$8.95	$7.95
2156 240V 6-15V A2		
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When I Think Back...

by Neville Williams

Vintage radio receiver design — 5
4/5-valve superhets: the same only different!

Of the tens of thousands of receivers which found their way into Australian homes during the 'golden age' of radio, by far the greatest number were locally produced 4/5-valve, 465kHz superhets — virtually all of them variations on a common theme. How and why the designs so evolved forms the subject of this present article.

As indicated in the September issue, a generation of 'new look' Australian-made superheterodyne receivers, designed around screen-grid valves and a 175kHz IF channel, demonstrated just how practical such receivers could be. They were easy to use, and had enough gain and selectivity to perform well in isolated or otherwise difficult areas. No less to the point, they had sufficient range of control to be equally at home in congested urban situations with multiple high-level signals.

Not unduly difficult to produce, they appealed strongly to Australia's fledgling radio manufacturing industry — the more so because of the emergence of a more manageable patents situation.

Their success raised the question as to whether the basic 5/6-valve superhet configuration (September issue, Fig.4) could be simplified to create a more cost-effective product, which would hopefully still be adequate for families in average, non-critical reception areas.

One possible option was mentioned in the September issue, namely omission of the RF amplifier stage and relying on the use of a tuned preselector coil to offset the potential loss of front-end selectivity. As an economy measure, however, preselector tuning fell short of requirements, although it did find occasional application in later years for other reasons.

If the RF stage and its related components were to be eliminated completely, the alternative design option was to select a still higher intermediate frequency, thereby further isolating potential image responses from the wanted signals. (Refer to the September article).

On this premise, one American design adopted in Australia — Philco if I remember rightly — settled for a modest increase in the IF to around 250kHz. I recollect the figure mainly because of occasional reminders to contemporary servicemen that such a receiver existed. I cannot recall ever coming across one of them myself — but who knows what might turn up, these days, in vintage form?

Standard IF

In planning economy receivers, all other Australian manufacturers that I am aware of settled for what emerged as a new international design standard — 465kHz, or thereabouts.

On the assumption that the oscillator would be tuned 465kHz above the wanted signal, the image problem area would be centred 465kHz above that again — 930kHz away — and hopefully sufficiently remote from the wanted signal to be dealt with by the sole tuned antenna (aerial) coil. Fairly obviously, the higher this coil's intrinsic 'Q' or design merit, the greater would be the image attenuation.

In practice, some manufacturers specified that the intermediate frequency of their receivers be offset, during alignment, from the nominal 465kHz. In suggesting a preferred figure between about 450 and 480kHz, their idea was to dodge incidental heterodyne whistles that had been identified by their regional dealers — affecting, for example, stations transmitting around 930 or 1395kHz, which are direct harmonics of 465kHz.

To quote a case in point, I note from the Historical Radio Society of Australia's *Newsletter No.35* that Tasma specified for their model 180 (1933) an unusually low figure of 445kHz.

These days, the most commonly nominated IF for AM radio receivers is 455kHz — a frequency which is recognised internationally and kept free of deliberate transmissions as a basic precaution against stray interference.

In terms of actual circuitry, an essentially serviceable 4/5-valve 465kHz superhet could be devised from Fig.4 in the September issue, by lifting out the complete RF stage and feeding the tuned antenna circuit directly to the grid of the 24A/57 autodyne frequency changer.

A different oscillator coil and padder would be required for a 465kHz version, along with appropriate IF transformers. The designer might also juggle things a bit (as per the September issue) to get by with an 80mA power transformer. But otherwise, the circuit and layout could — and often did — remain basically similar from one model to the next in a particular manufacturer's range.

Basic 4/5V superhet

Fig.1, herewith, can be regarded as equally representative of Australian 455kHz superhets manufactured during the early 1930's. While broadly similar to the larger circuit, it does incorporate certain deliberate variations to illustrate other, but nevertheless typical, design approaches.

Following it through, the signal from the antenna input circuit feeds directly to the grid of the autodyne frequency changer. Most early 465kHz superhets used solenoid coils similar to those illustrated in Fig.3 of the Sep-

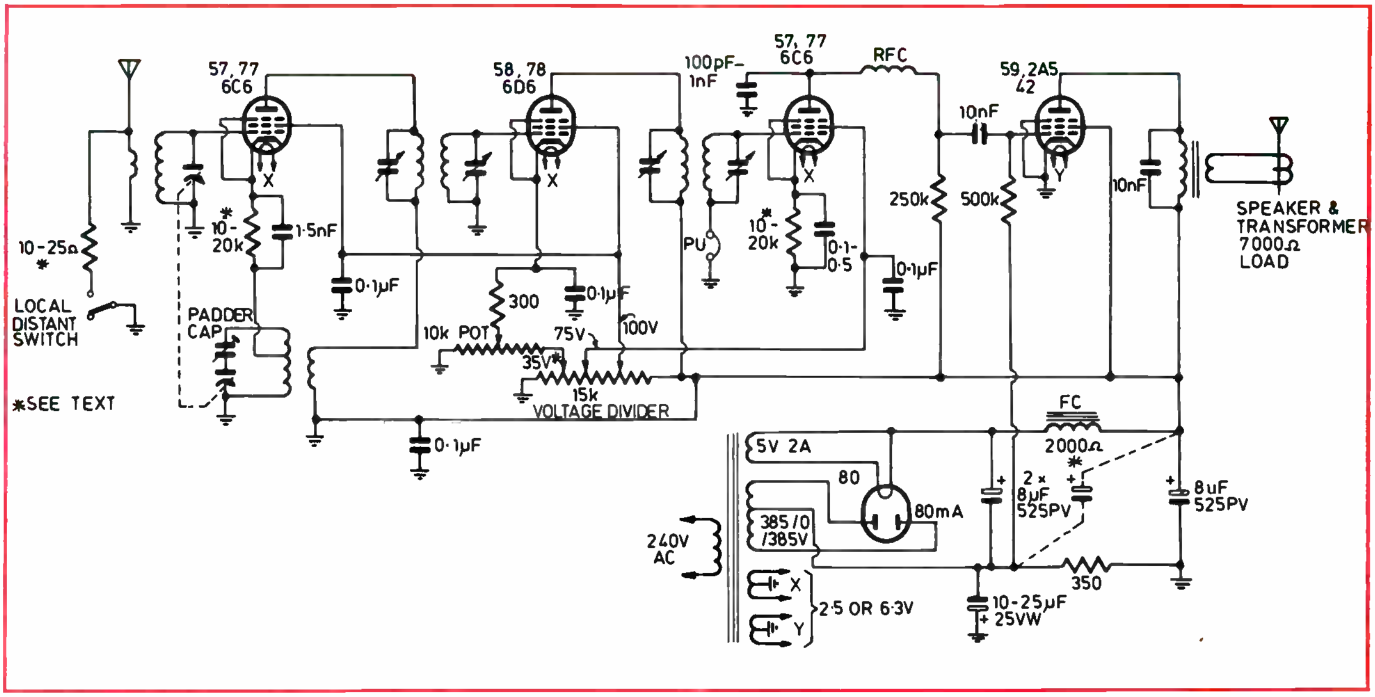

Fig.1: A basic circuit for a typical 4/5 valve 465kHz superhet receiver from the early 1930's. Various options are shown and discussed in the text.

tember article, with designers avoiding unduly small formers, small cans and small wire gauges to retain a reasonable 'Q'. In due course, new techniques emerged which made it possible to produce much smaller coils with improved Q-factors. These will be discussed in a future article.

The majority of 4/5-valve superhets produced around 1933/34 were designed around the then new 50-series valves with 2.5V heaters, with the type 57 sharp-cut off pentode being the obvious choice for the autodyne frequency changer. But not for long ...

Within a couple of years, valve manufacturers and stockists began to promote 6.3V versions of the '50' series — mainly because, over and above conventional mains receivers, they were more suitable for use in car radios, vibrator-powered farm receivers and American style AC/DC models.

Being new, they were also trendy and, at the next available model change, most Australian manufacturers switched over to them — a prime example of a concerted response to a common market stimulus!

In the changeover, the 57 was displaced by the 77 and/or the 6C6 — valves that were virtually identical to the 57 except for the heater rating: 6.3V/0.3A instead of 2.5V/1.0A. The 57, along with others in the range, were demoted in short order in the valve catalogs to 'replacement' types.

It should also be mentioned here that, because valves of that era had only limited inbuilt shielding — if any — it was routine practice, as a precaution against stray coupling between adjacent stages, to fit earthed metallic shield cans around the RF amplifier, frequency changer, IF amplifier and detector valves. Rarely indicated in manufacturers' circuit diagrams, this would apply, as a matter of course, to the first three valves in Fig.1.

The autodyne stage is essentially similar to that in the 5/6-valve circuit but, as then indicated, variations were not uncommon in both the overall configuration and in the choice of components.

Values for the cathode resistor typically ranged from 3k to over 10k and for the associated bypass from 1nF to 10nF. Those shown in Fig.1 happen to be the components that I soldered into countless receivers manufactured by Reliance Radio.

With hindsight, the values were not critical and I doubt that combinations within the suggested range would have made any noticeable difference to the performance.

Gain control

The IF amplifier stage is also essentially similar to the 175kHz version, except that the most likely valve options have been updated to 58, 78 or 6D6 — which were again virtually identical except for the heater rating. One vital factor needs to be considered, however.

Elimination of the RF stage left the IF amplifier as the only one in which the bias can be varied to provide gain control. Application of external variable bias to the autodyne frequency changer might, indeed, have had some effect on its conversion gain — but at some point, the extra bias would inevitably have interrupted the self-oscillation, rendering the receiver abruptly inoperative!

To ensure effective gain control in urban situations, it proved necessary to attenuate the input signal by shunting the antenna terminal to earth in some way. Accordingly, many early model 4/5-valve superhets were fitted with local/distant switches, as shown in Fig.1 (see also the August 1991 instalment).

The shunt resistor was typically a so-called 'non-inductive' type in the range 10-25 ohms, but it was up to designers to select a type and value of resistor which would ensure adequate attenuation relative to the primary winding of their particular antenna coil.

The voltage applied to the gain control via the voltage divider was typically about 35V, but this was again a matter of judgment. With too small a voltage, the gain control might not be sufficiently effective in some areas, even with the antenna switch in the 'local' position. With too large a voltage, unskilled listeners, forgetting all about the local/distant switch, might set the IF stage to near cut off — achieving low volume for sure, but at a very high level of distortion.

An alternative approach, obviating the need for a separate switch, is illustrated in Fig.2. The potentiometer was so wired that turning it anti-clockwise progressively reduced the gain of the IF stage, while simultaneously placing a shunt across the primary of the antenna coil.

Taken from the previously mentioned Tasma 180 receiver, the component valves shown in Fig.2 presumably ensured the right order of control voltage, with the relatively low value potentiometer providing a reasonably tapered shunting action at the low-volume setting.

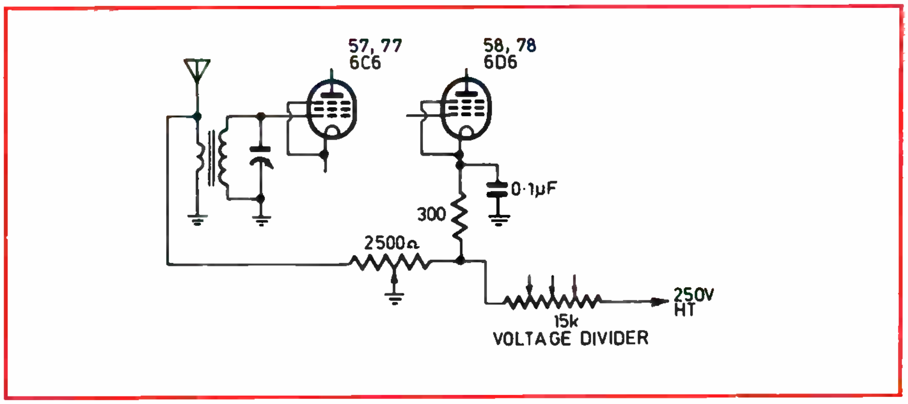

Fig.2: A method of eliminating the local/distant switch, by so arranging the gain control that it shorts the antenna to earth in the fully anti-clockwise setting.

Voltages critical

In restoring a receiver conforming to the latter circuit, the same values should be retained if at all possible. A higher value voltage divider would lower the available control voltage; a higher value potentiometer would increase it.

Either way, the substitute component(s) may need to be shunted with a fixed resistor to restore something like the original control characteristic.

Some manufacturers seemed to prefer a configuration more like that shown in Fig.3, possibly because it offered some flexibility in component values and in the exact level of control bias.

In setting it up, it was — and still would be — essential to keep in mind how the circuit is supposed to work, with the potentiometer beginning to shunt the antenna just before the IF amplifier reaches plate current cut off and consequent distortion.

If I seem to be labouring this point, it is because I can still remember the resounding complaints of installers who had to remove, up-end and readjust receivers that had passed muster in the factory but ran into overload problems in suburbs adjacent to high-power transmitters.

At best, it was a matter of readjusting the voltage divider clip; at worst the problem was caused by a potentiometer which failed to achieve a suitably low resistance at the full-off setting.

And, speaking of such matters, it is also worth stressing that, unlike modern audio volume controls, the rotating arm or centre connection in most of the old-type wirewound potentiometers made direct metal-to-metal contact with the mounting bush and locknuts. This didn't matter in circuits like Figs.2 and 3, where the rotating arm was supposed to be earthed, anyway.

In Fig.1, however, the potentiometer shaft had to be insulated from the chassis — a fiddly job that involved a miniscule tubular sleeve and two larger outer washers, punched from fibre or bakelised cloth.

In those days, pot washers were standard bench oddments; these days, they should be neither overlooked nor mislaid!

Detector circuit

For the anode-bend detector — another 57, 77 or 6C6 — the component values are again not particularly critical. The cathode resistor has to be large enough, for example, to ensure that the valve operates at near anode current cutoff; anything in the range 10k-20k should serve the purpose.

Whether an individual designer specified 10k, 15k or 20k was probably as much a matter of custom as of deliberation.

The associated bypass needs to be effective for both the intermediate and audio frequencies and, while 0.5uF would have been somewhat more functional at the bass end, most manufacturers settled for the less expensive, smaller and easier-to-mount 0.1uF.

Cheaper, smaller, down-rated components intended for less demanding applications like this were a rarity in those days. Similar remarks apply to the screen bypass, which usually ended up at 0.1uF, even though a case could have been made for 0.25 or 0.5uF. It was unlikely that prospective purchasers would have noticed the difference, anyway.

In the detector anode circuit, the inclusion of an RF choke was a routine carry-over from the past — even though, in my callow youth, I recall one designer suggesting that, for all the good it did, it could well have been replaced by a 10k carbon resistor.

It is sufficient to say that RF chokes in broadcast receivers have traditionally been inexpensive and rather nondescript devices, with (usually) a honeycomb winding or windings comprising as many turns as looked about right!

Suppression of the IF component from the detector output circuit depended mainly on the bypass capacitor, which was most commonly a 100pF unit — sufficient to bypass the IF signal without unduly attenuating the higher audio frequencies. In fact, some designers deliberately opted for values up to about 1nF, on the basis that reduced high frequency response and a more 'mellow' tone might be a good thing!

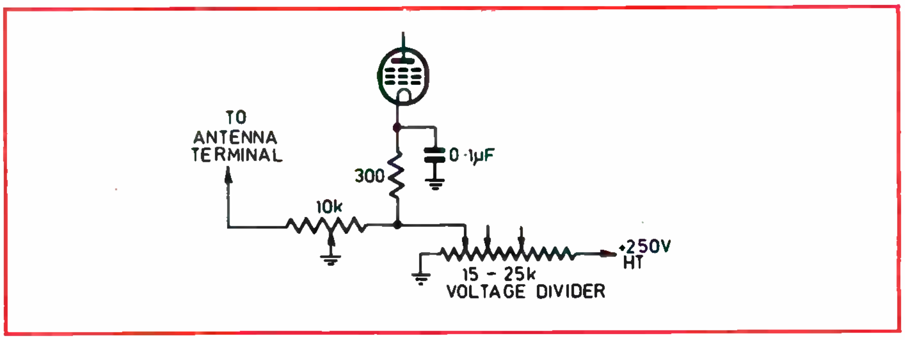

Fig.3: When fed from a tapping on the voltage divider, the clip needs to be set to a position which will ensure logical operation of the control, as explained in the text.

Output stage

Moving on to the output stage, the first choice was the 59, an impressive valve for the period, housed in a large, domed bulb and with a 'medium' — as distinct from small — ST-16 7- pin base.

With an indirectly heated cathode, it also broke new ground with ratings for operation as a single power pentode (3W output), a single power triode (1.25W), or as a push-pull class B triode stage offering an impressive 20 watts.

Unfortunately, while the 59 was less prone to the grid current problems that plagued the earlier 47, it was also less rugged physically than it should have been, developing more than its fair share of microphonic effects and internal shorts.

The 2A5 which succeeded it in fairly short order, and its 6.3V equivalent the 42, specified in Fig.1, were more compact and reliable and adopted by all local manufacturers at the first orportunity.

Valve type notwithstanding, the grid return resistor needed to be higher in value than the detector output load (250k) but not so high as to allow the output valve grid to drift significantly in a positive direction.

With some output valves, the upper limit had to be further restricted if they were operating with 'fixed' bias — signifying a bias that was totally independent of the valve's own cathode current.

Given these constraints, 500k was widely accepted as the logical choice. In fact, when reconditioning old receivers, it is a good idea to disconnect one end of this resistor and check it to ensure that it has not drifted high with the passing years. These days, the obvious replacement would be 470k.

To ensure full bass response with a 500k grid resistor, the associated coupling capacitor should really be 50nF; but most designers at the time settled for 10nF. The reason, very simply, was that paper dielectric capacitors of the era were prone to leakage (with age), which allowed some of of the positive voltage at the detector anode to reach the output valve grid.

The result could be a reduction in the effective bias and increased current through the valve, with the possibility of overheating and reduced valve life.

Designers' reasoning at the time was that a 50nF coupling capacitor could be expected to exhibit five times the leakage of a 10nF unit, and the difference in extreme bass response did not warrant the added risk.

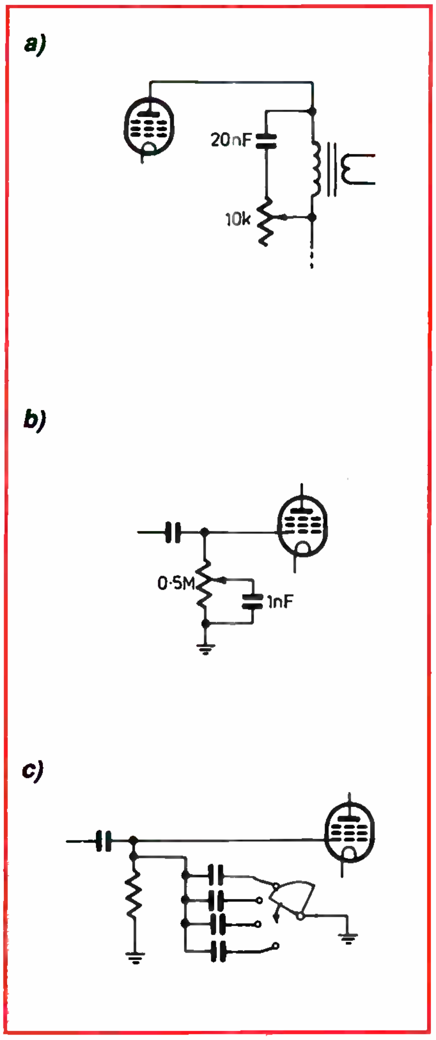

Fig.4: Three typical methods of providing a top-cut tone control in the early 1930's.

Bias method

And that brings us to the so-called 'back-bias' system for the output valve, which was fairly commonly used throughout the valve era. It has been included in Fig.1 as an alternative to the conventional cathode bias depicted in the earlier circuit.

Instead of the centre-tap of the transformer high tension winding being earthed directly, it was returned to chassis through a wirewound resistor of a few hundred ohms, rated to carry the full high-tension current drain.

The resulting voltage drop across it created a negative potential at the transformer CT, which could serve as a negative bias when applied to the lower end of the output valve grid resistor.

Note that, with this arrangement, the negative side of the first filter capacitor must return to the HT centre-tap, rather than the chassis.

This is necessary to prevent the raw 100Hz pulses from the rectifier flowing through the bias resistor and generating a large ripple voltage across it — which would be fed to the output valve grid, producing an audible buzz or hum.

In the days of fluid filled can-type electrolytics, special jumbo-size fibre washers were required to insulate the first capacitor from the chassis.

Old-timers will remember that, when fitting or replacing such electros, it was all too easy to crush the raised centering section of the main washer, allowing the threaded base of the can assembly to short against the chassis.

The final filter capacitor connects between the DC supply line and chassis, with a low voltage electrolytic bridging the bias resistor, positive to earth as per the circuit.

In receivers using an extra filter capacitor to minimise hum, it was commonly connected as shown dotted.

While the back-bias system was used in quite a few 1930's style receivers, the reasons for preferring it to conventional cathode bias were at best tenuous:

- An assumption that output valves operated to better advantage with 'fixed' rather than cathode bias. In class AB and class B push-pull, such may have been the case; but in ordinary single-ended class A stages there was no significant difference between the two methods. With the average cathode current remaining constant in class A, with or without signal, cathode bias was stable or 'fixed' anyway.
- In the negative line, the back-bias resistor could conceivably have offered additional decoupling between the first and final filter capacitors, thereby supplementing the filtering effect. I'd need to be convinced that this was a significant factor.
- With cathode bias, the HT supply line had to be set to about 265V, if the output valve was to operate at an effective 250V plus bias. With back-bias, the HT supply line could be maintained at 250V.

This last point warrants brief comment. In an era when valves and other components were prone to premature failure, the suppliers, when challenged, were likely to claim as excessive a supply voltage greater than 250V — ostensibly the 'natural' voltage limit for the 20 and 50-series valves.

It was an excuse rather than a reason for component failure, but some designers found it easier to anticipate the objection by opting for back-bias.

Treble response

But back to the circuit. As mentioned in an earlier article (August 1991), pentode output valves had a very high output impedance which resulted in a rising treble response when operating into a reactive load such as a conventional loudspeaker. To correct the resulting rather strident tone, most designers in the early 1930's included a capacitor in the audio chain intended deliberately to attenuate the higher audio frequencies.

One option employed in the Tasma receiver, referred to earlier, was to use a larger than normal bypass on the anode of the detector. Instead of the usual 100pF RF bypass, they used a 1nF, which is large enough to round off the treble response as well. In practice, the capacitor ended up anywhere in the range 100pF - 1nF, depending on the intentions of the designer.

An alternative or supplementary measure was to wire an audio bypass to the anode of the output valve, larger in value by reason of the lower nett impedance of the output circuit. The most common value to give a moderately 'mellow' tone was 10nF, as shown in Fig.1.

Early practice was to wire the capacitor directly between the anode of the output valve and chassis, but this proved to be unwise. Even at zero volume, the capacitor was subjected to a DC voltage of around 250V. At high output levels, the superimposed audio signal could boost this to peaks of double that figure, with a very real risk of breakdown.

This, in turn, would cause a short-circuit current through the output transformer primary, and a heavy load on the rectifier — until either it or the output transformer failed. In the meantime, removal of voltage from the output valve anode would divert electron flow to the output valve screen grid, raising its structure to a bright red heat, with the risk of warping and/or the release of occluded gas. It could all add up to an expensive repair, if the receiver was not switched off promptly after the initial failure.

If you come across a vintage receiver wired this way, the capacitor should be re-connected between anode and B+, as shown. It will be just as effective in limiting treble response, but will reduce the stress on the capacitor and obviate the secondary consequences in the event of a breakdown. If the old capacitor is suspect, replace it with a good quality type rated to at least 400V.

Top-cut controls

Also mentioned in the August issue was the fact that top-cut (treble) tone controls became a common feature in post-1930 receivers — one idea being to place a potentiometer, typically 10k, in series with the abovementioned treble-cut potentiometer. By selecting a higher than normal capacitance (e.g., 20nF), rotation of the potentiometer would vary the tonal balance from 'bright' to 'mellow'.

Convenient though it may have been, grounding the arm of the potentiometer would have increased the risk of capacitor breakdown, as mentioned. Returning the arm to B-plus as in Fig.4(a) reduced the stress on the capacitor, but called for the use of a self-insulated pot or the provision of insulated washers; this, plus the unpleasant prospect of an exposed control spindle connected internally to the HT line.

Faced with a 'Hobson's choice', many designers opted for a tone control in the grid circuit of the output valve, with or without additional fixed compensation across the output transformer primary.

In the arrangement shown in Fig.4(b), a 500k potentiometer served as the grid resistor, with a capacitor of around 1nF bridging between the moving contact and either (usually the earthy) end. As the moving contact approached the opposite end, the treble response would be progressively reduced.

Convention was to wire the pot so that clockwise rotation increased the treble response and, to ensure a subjectively smooth gradation between the two extremes, designers might specify a linear pot or one with something other than the conventional C-taper used for volume controls.

In a notable example of sideways thinking, one local company came up with a novel form of tone control, which was adopted for a time by some manufacturers. Styled like an ordinary potentiometer, it contained a sequence of interleaved metal shims and mica separators, forming a half-dozen-odd mica capacitors, stacked one upon the other. As the shaft was rotated, a semicircular vane bridged flexible extensions from the metal shims, progressively increasing or decreasing the effective capacitance as suggested by Fig.4(c).

As I recall, only one version of the control was released, with a nett capacitance to suit the rela-

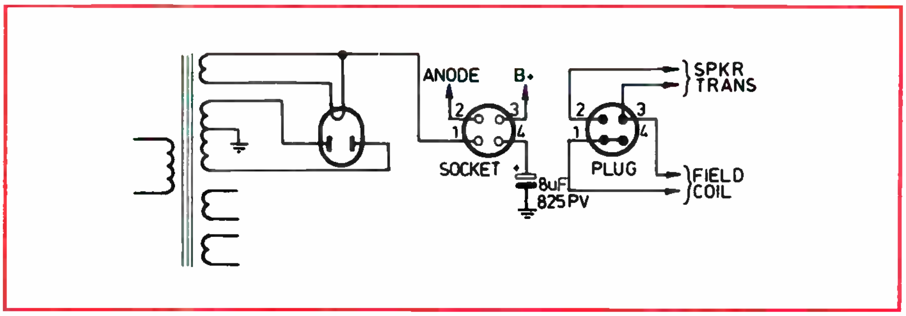

Fig.5: Wiring a loudspeaker socket and plug as shown above could protect the first filter capacitor from damage in the event of a receiver being switched on without the loudspeaker being plugged in.

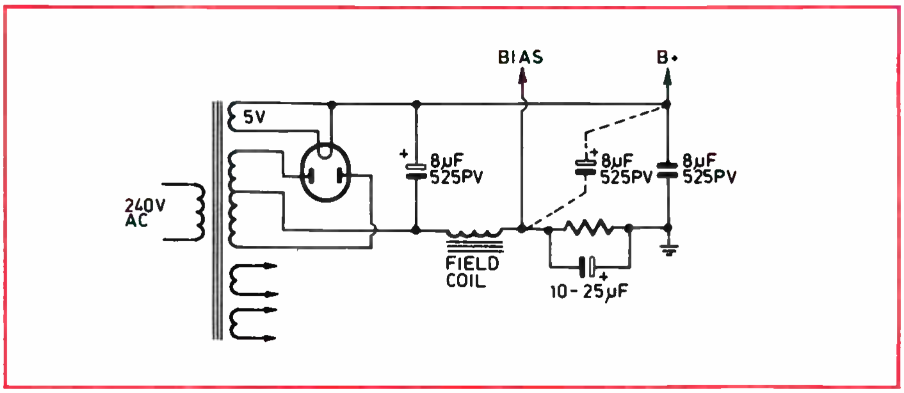

Fig.6: For reasons best known to themselves, some designers included the loudspeaker field winding, as well as the back-bias resistor in the negative supply lead. It placed about -200V on the exposed shell of the first can type electrolytic!

tively high impedance of an output valve grid circuit.

Loudspeaker connections

In 4/5-valve receivers of the period, the output transformer was almost invariably mounted on the loudspeaker, with four leads running back to the receiver — two each for the transformer and the field coil.

Having in mind that one end of each was commonly connected to the B-plus line in the receiver, as per Fig.1, a three-way cable would have been sufficient in many cases.

Common practice was to use either a 4-pin or 5-pin valve socket and matching plug for the loudspeaker connection; but while some brands happened to use a similar pattern of connections, there was certainly no industry standard.

A routine fitment on a serviceman's bench in those days was a 'universal test speaker', with provision to simulate various values of load and field coil and a patch-cord system to set up the appropriate connections.

One of the things one learned, in the old days, was never to switch on a chassis without a suitably wired loudspeaker being plugged in.

With no field coil in circuit, the first filter capacitor could be subjected to 550-odd peak volts, with a high risk of electrical breakdown or, worse still, being blown apart by internal vapour pressure — a nerve-shattering and messy event!

Curiously, one very simple precaution was available, which most manufacturers seemed to ignore: by wiring the loudspeaker socket — 4-pin or 5-pin — so that the input filter capacitor was in circuit only when a matching loudspeaker plug was in place.

Purely as a guide to what to look for, Fig.5 shows how a plug and socket could conceivably be wired to protect the first filter capacitor.

Note that the first capacitor is wired only to pin 4 of the loudspeaker socket. A link in the plug, when inserted, bridges it across to pin 1 and thence to the rectifier filament and one side of the field coil. Pin 3 provides a return path for the field and also a connection to the B+ line in the receiver, while pin 2 provides the connection for the output valve anode.

A 5-pin socket and plug, similarly wired, would leave one pin spare, which could conceivably provide an earth link between the chassis and the loudspeaker frame — a link that is neither essential nor common.

The power supply

Apart from the use of back-bias, the configuration of the power supply in Fig.1 is straightforward. It shows two 6.3V heater windings, but it was not uncommon to make do with one suitably heavy winding as an economy measure.

In terms of HT current drain, the 59 would draw a nominal 44mA in class A pentode service.

As a detector with a 500k load, the 57 would not draw more than 0.5mA of anode current. The current drawn by the IF amplifier stage would depend on the gain control setting, but a median figure would be 5 milliamps. At a guess, the over-biased autodyne converter would draw about the same.

Allowing 20mA at most for the voltage divider network, the likely drain comes to around 75mA, which was comfortably within the capacity of an 80mA power transformer. To provide the requisite - 18 bias for the 59 output pentode, the back-bias resistor would need to be around 240 ohms — in those days 250 ohms.

To provide the requisite voltage drop, the field coil works out at around 1800 ohms — available in those days 'on order', but with 2000 ohms as the nearest off-the-shelf value.

Substituting the alternative valve types suggested for the RF and IF sections would make no difference whatever to the current drain. In the output stage, there was a slight difference between the 59 and the 6-pin 2A5/42 but, in practice, circuit values nominated for the 59 would have been near enough for the later types.

One variation of the above power supply configuration, which collectors may well encounter, borders on the curious. As shown in Fig.6, it places the field coil in series with the negative rather then the positive supply line.

When I first came across the arrangement, I recall asking the production engineer why it was used. His only response was to assert that it worked fine — didn't it? Perhaps so, but I was offered no reason to believe that it was any better than the conventional hook-up.

One painfully obvious fact was that the first can-type electrolytic, standing boldly erect above the chassis, ran about 200V negative with respect to all the other exposed metalwork — which could hardly have escaped the notice of factory workers required to handle live chasses.

Chasses that 'bite'!

Indeed, one such operator pointed out that factory 'clowns' sometimes switched a receiver on for few seconds with the loudspeaker unplugged — therefore with no field coil in circuit. As a result, the first electro would be charged to the full peak voltage, with -500V or so on the exposed can. A loud yell and/or expletive was a sure sign that the charge had lingered for long enough to greet the next person to handle the chassis!

Finally, on the subject of chasses with a 'bite', it is appropriate to mention one practice in early mains receivers that was decidedly questionable.

In the early 1930's, domestic mains wiring was comparatively primitive, particularly in regard to appliance earthing arrangements and anti-interference measures. Many homes had only one or, at most, two regulation power points and it was common practice to plug appliances and/or receivers into maverick European or American 2-pin sockets — or, worse still, into light sockets with the aid of 2-way bayonet adaptors.

Fed by indoor aerials in the immediate electrostatic field of the mains wiring, the receivers often suffered more than their fair share of electrical 'snap, crackle and pop'. To make matters worse, the signal strength from metropolitan radio stations was well below what it is today.

In an attempt to attenuate noise interference, many designers adopted the practice of connecting capacitors — usually 10nF tubular types — between each side of the 240V primary winding and chassis.

Whether it was all that effective in the average case is a matter of debate, but it certainly provided an unpleasant 'tingle' to anyone who touched a chassis or an aerial wire that was not earthed in the DC sense. The 'tingle' was due to the natural reactance of the capacitor — 318,000 ohms at 50Hz.

More to the point, breakdown of the capacitor could turn the receiver, the aerial — and/or phono pickup — into a potential 240V death trap.

Granted, manufacturers normally used high quality imported capacitors for the purpose, and I never heard of any actual fatalities. But if you come across a chassis with bypasses on the primary winding of the power transformer, my advice is to remove them once and for all. They're not neccessary, these days, and we can do without the 'tingle' — or most certainly the full 240 volts!

(To be continued) ■

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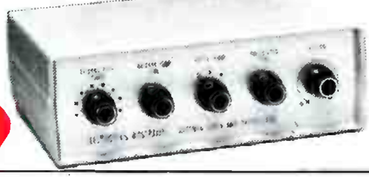

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EA NOV '91

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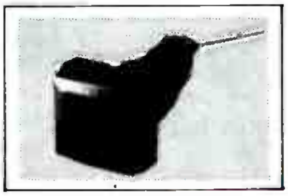

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FORUM

Conducted by Jim Rowe

A reader takes us to task on safety aspects of our projects

Yes, your memory is correct: I *was* going to bring us back to the topic of FM stereo decoder operation this month. But a second letter has arrived from a reader in the Northern Territory, raising quite serious questions about electrical safety in connection with some of our published project designs. Because the safety of our readers is obviously an extremely important subject, I feel duty bound to defer the matter of decoder operation a little while longer...

My apologies to the many readers who have responded to the column on FM stereo decoders, and sent in a lot of very interesting information. I'm aware that you've already had to wait quite a while for this topic to be tackled again, while we gnawed away at things like the relative merits of competing satellite TV transmission systems.

You *will* get your day again soon, folks, I promise; but I think you'll agree that electrical safety is even more important. Especially if it's the safety of *EA*'s own readers, and there's a suggestion that we ourselves may be putting them at risk.

The reader who has raised this topic is Mr Ian McGrath, who lives in Moulden, NT. His first letter on the topic actually arrived many months ago, when we were somewhat caught up in earlier topics; so while I realised that the points he had raised were important, I was forced to defer dealing with them for a while.

In fact I had planned to deal with this topic in the September column, as I noted in my parting comments for August. Then came the very long and obviously grieved letter from Mr Walters, in response to his critics — which seemed to justify a further deferral.

In the meantime, though — and actually triggered by my comment in the August column, Ian McGrath has written again. And his second letter is even more critical of our projects than the first, so it's now evident that I must push all other topics back and give this one a decent airing without further delay.

Needless to say, the last thing I want to be accused of is lack of concern for the safety of our readers and project builders. I can live with being regarded as ignorant, lacking in perception and unimaginative — but not that. So this month, we'd better allow Mr McGrath to explain why he's so unhappy with some of our project designs...

Just by way of preamble, though, I should note that Mr McGrath's first letter was primarily in response to our discussion at the beginning of the year about ELCD's, or RCD's as many people prefer to call them. He was also commenting on the way the term 'double insulated' has become rather misused — or perhaps more strictly, used to describe equipment which is essentially lacking an earth wire by deliberate action of the designer/manufacturer, for reasons other than safety.

I'm not proposing to quote from this part of his letter, because I believe most of the points he makes have been made in earlier columns, by one person or another. In any case, they're not quite relevant to the present topic. It was only in the last section of this first letter that he made the comments that initially attracted my full attention and concern. Here's what he wrote:

One unrelated point that I would like to make, though still related to earthing, has to do with earthing methods used in mains-connected construction projects such as the regulated power supply described in the January 1991 issue. On page 72, when describing the connection of the earthing cable the text states 'Connect the earth lead to a lug held by one of the transformer's mounting screws.' I have noticed that this method of earthing is generally recommended in your construction projects. This is not a good practice, and indeed is forbidden under rule 5.4.4.6(d) of AS3000-1986 (page 194). This is not a constructional bolt. It is a bolt used to fix equipment in position.

I believe the philosophy behind the ruling stems from the fact that in a large piece of equipment with many screw-mounted components an earth could be inadvertently left disconnected if a part was replaced or removed, where one of its mounting screws was used for the earth. Indeed, as it is usually necessary for electricians to work on live equipment the most likely time for an electrical accident to happen is during maintenance — the very time that the earth is most needed. Whether it's a big or a little box, the rule still applies.

The accepted method of earthing uses a bolt mounted in such a way that it will remain tightly in place even if the earth is removed during maintenance. The reason being that if a piece of equipment, such as a burglar alarm for example, is mounted on a wall, the head of the bolt is not accessible as it is jammed against the wall — making it impossible to properly retighten the earth lug. I would suggest that in future projects the earth be connected as follows:

The earth bolt is first mounted on the box, fixed tightly with a nut and spring washer. Then follows a flat washer, earth lug, flat washer, spring washer and then the nut (nice 'n' tight). These should all be either galvanised, cadmium plated or non-ferrous.

It doesn't hurt to make the earth tail about twice as long as the other tails as well, so that if the lead gets a hard jerk, the earth will be the last wire to part from its moorings — thus allowing the circuit breaker to blow if the active touches the case, rather than the jerk holding onto it.

The extra hole and nuts, bolt and washers is a cheap and simple expedient in the interests of safety, particularly in a magazine such as yours which is widely read and draws many home constructors who are unfamiliar with wiring regula-

tions and the hazards of improper procedures.

My many thanks for the best electronics magazine in the world.

Well, as you can see Mr McGrath was making a fairly serious criticism of our earthing practices for construction projects in general, and that for Peter Phillips' little January 1991 bench supply in particular. In fact the criticism is so serious that I'm a little puzzled how he was still able to call us 'the best electronics magazine in the world', at the end of the letter.

He's right!

I can't really argue with the point he makes, though. It does look as if our habit of fitting the earth lug under one of the power transformer mounting screws is strictly wrong, at least according to AS3000-1986. And I agree that in many cases it would be a relatively simple matter to fit a separate dedicated bolt for the earthing lug, using the procedure he describes.

All I can really offer in our defence, with examples such as the one he quotes of Peter's little supply, is that from a practical point of view it often seems — superficially at least — to make very little difference. With small items of electronic equipment such as this kind of power supply, it would often be very unlikely that anyone would need to undo the power transformer mounting bolts as part of any normal 'maintenance'.

As one of the largest, if not *the* largest component inside most projects, the transformer is likely to be one of the *last* items you'd normally expect to have to move. In most cases, almost every other component can be tested, removed or replaced without even disturbing the transformer at all. So from a practical point of view, it's almost a *de facto* part of the case, and as a result its mounting screws are almost honorary 'constructional bolts'.

I certainly think this would be the case with Peter's supply, for example, where there was tons of space inside the metal case to test or remove and replace everything else, without any need to disturb the transformer. Peter *had* also left the earth wire considerably longer than the active and neutral leads, by the way, and we normally do this with most of our projects — although we perhaps haven't placed enough stress on this in our text descriptions.

As to Mr McGrath's reference to the fact that all of the hardware used for the earthing lug attachment should be either zinc- or cadmium-plated steel, or non ferrous, I'm sure he's right there too. The only problem nowadays tends to be that often the only kind of machine screws, nuts and washers that are available are cheap and nasty steel items, many of which seem to have never been even fleetingly passed through a plating bath!

Certainly cadmium- and nickel-plated items *are* available sometimes, and when you're lucky perhaps even brass too — either plain or plated (wonder of wonders!). But none of these simple basic items is as reliably available as they used to be. I've found this out myself the hard way, and nowadays I snap up the good quality items fast, whenever I see them...

More effort needed

None of these comments is meant to suggest that Ian McGrath is wrong in the points he makes, though. Strictly speaking he's quite right, and undoubtedly we need to put greater effort into adhering more closely to the letter of the law.

But I'm interrupting him, in a sense, because as I said earlier he has just recently written a second letter on the same subject. In fact his second letter is devoted specifically to the subject of safety aspects of our projects, and is somewhat more critical than the first. So let me put on my hair shirt back on, and we'll allow him to continue:

I am writing this urgent appendage to my last letter in view of the fact that you have indicated in the August issue Forum that you will be taking up the matter of electrical safety, in the next issue. In anticipation of the possibility that you may refer to my letter, I felt that I should write to add some further points about earthing methods as used in your projects, particularly after reading the articles on the two mains-powered projects featured in the August issue.

Firstly, may I begin by stating the (apparently) obvious. An earthing wire or connection does absolutely nothing until breakdown situation occurs.

Of course I'm speaking purely from a safety point of view in saying that. I say 'apparently' because this fact tends to be missed in practice. When a project is first assembled everything is neat, connections are tight, and — provided your stringent instructions are followed — quite safe AT THE TIME OF CONSTRUCTION.

But to assume that an earthing system is working OK while an appliance is operating, just because it is tight and providing good electrical continuity, is a false premise — because in fact, while the appliance is working OK, the earthing system is dormant. In fact the earthing of the vast majority of electrical systems is never used, because they don't experience electrical breakdown.

The earth is there only for the rare occasions when an electrical breakdown occurs. However when a system starts to break down, a very different set of circumstances begins to take over — and it is how the earthing behaves under these different circumstances that govern whether it will do its job or not.

The benchtop supply featured on page 72 of the July issue illustrates this perfectly. In this project the transformer is bolted down to the plastic case with an earth lug under one of the bolts. This lug becomes the main earth point, and the heatsink and ground terminal are both solder connected to this lug along with the incoming earth.

Now at the time of construction and provided the power supply never gives trouble, this will work beautifully. But WHOOPS! I used the word 'work' there, forgetting that the earth doesn't DO any work (apart from the return path for the ground terminal), unless the power supply breaks down.

But what happens if the appliance DOES break down? The only part of the project that can become dangerous initially is the transformer. Say a diode or something goes short-circuit, and causes the transformer to start overheating.

As we all know, a transformer can become very hot indeed under these circumstances, and become dangerous when insulation breakdown occurs. Long before the insulation breaks down, however, the plastic case (where it is in contact with the transformer) will have softened to the point where the mounting bolts will have melted into the case — loosening the earth connection. The high resistance now present at the earthing point at this stage becomes in itself a hazard, as when the transformer insulation breaks down, making the iron core live, the current flowing through the high earth resistance may not be sufficient to blow the circuit breaker on the switchboard. The extra heat generated at this point, together with the sparking from the loose connection, mixed up with vapours from melting PVC makes a perfect environment for a fire to start.

If no one is present when all of this occurs, which is likely in such a situation if a project under test is being allowed to 'soak', the final result may be disaster.

Let's look at another scenario, this time allowing Murphy a look in. All of the above happens, to the point where the iron core becomes live. But the extra heat generated, instead of causing a fire, melts the solder on the earth lug. Murphy only allows the main earth wire to come adrift — leaving the other earth earth wires still, if somewhat tenuously, attached to the earth lug.

If the primary winding of the transformer has finally broken down, which is likely, the transformer core is left live. The neutral is disconnected so, as there is no current flowing, the whole device now cools down — leaving the transformer core, the heatsink and the ground terminal all at 240V potential. Need I say more?

In my earlier letter, I mentioned the fact that earthing an appliance or anything using a mounting screw is not only a bad idea, but is against the wiring rules. To use a screw that goes through plastic, or for that matter anything non-metallic, for an earth is not only illegal, it's DOWNRIGHT THOUGHTLESS! (My inclination is to use stronger language than this, but I am impelled to make allowance for the ignorance in these matters of your contributors and staff.)

I strongly suggest that you appoint at least one member of your staff to become thoroughly familiar with ALL safety standards, and have him check every project for electrical safety and compliance with regulations, before it is made available to the public. You have a very commendable practice of stressing care and safety in your projects, but all of this is lost if you fall short in this area yourselves. The vast majority of your readers will closely follow the guidelines you give, so you must make sure you are giving the correct advice.

A far better approach in this situation would be to mount the transformer on a metal plate, with a separate earth screw fixed as I outlined in my last letter, and then fix the plate to the bottom of the box with separate screws again. This would then constitute the main earth point for the project.

Might I say that I have been looking for a neat little power supply like this, and so I intend to build up a beefed-up version as per your suggested modifications — but I will be earthing it as I have outlined above.

Another approach would be to use the heatsink for the main earth point — but once again modified, as the earth screw is going through the plastic rear panel and is also one of the mounting screws for the heatsink. This should be fixed up anyway, for the same reasons mentioned as before.

A simple way to do this would be to drill a larger hole in the plastic than in the heatsink, and then the nut fixing the earth screw in place would bring the base for the earth connection proud of the plastic rear panel. A SEPARATE hole to the mounting hole should be drilled in the mounting flange of the transformer, and the earth lug fixed to this — BUT NOT THROUGH THE PLASTIC CASE.

As well as this, it is a good idea in these circumstances of several earth paths to connect them all to one lug, so that if an earth screw is undone the earth continuity is not broken. However a crimped connection is often better than a soldered one, especially in areas where heating can take place (as with a transformer). Incidentally, the SAA rules also state that the wires going into terminals or crimps should not be soldered first — as like plastic, solder will flow under pressure and loosen connections (Rule 3.11).

Moving now to the other mains-powered project for August, the triac output driver module, I was happy to see that the earthing method described was as I suggested in my last letter. But looking at the photo on page 86, it looks very much like the earth lug is fixed on top of the plastic cable clamp. Again the presence of plastic (and this time very soft plastic) *has destroyed the integrity of the earthing system.*

Is there any reason why a screw intended for use as an earth point should be used for anything else? Screws are cheap items. In situations like this the heads are hidden under the case, out of sight, so aesthetics obviously aren't the problem.

Once again let's look at the situation from somewhere down the track, when the earth is needed to protect the owner — but it has become loose due to the weakening of the plastic under pressure. Or if the unit gets knocked off the bench and is caught by the lead, wrenching the clamp askew. How tight will it leave the earth connection?

I'm sorry if I'm starting to sound a bit fanatical. I don't live with a fixation about good earthing principles. But I feel that since I am sounding off about it, I may as well get it all off my chest; and that hopefully, what I say will be of benefit and may even be lifesaving to yourselves and your readers.

Having said that, may I now carry on with one or two more suggestions that I believe would be good practices to follow in the safety aspects of project building?

Again using the abovementioned triac driver project as an example, where the mains lead comes into the box it follows a virtual straight line into the cable clamp; and then the active and neutral wires go straight into the terminal strip. This unit is quite light, so a hard pull on the three-core flex may not pull it out of the clamp. But if it was a larger unit with a fairly hefty transformer in it, a fall off a bench and being caught by the flex (which is very likely to happen — better to wreck a length of flex than a $130 black anodised case) would likely leave you standing there, with a perfect length of three-core flex in your hand and a $130 black anodised case buried in your foot.

If something like this was to happen, of course no matter how the flex is terminated it would be a good idea to open up the box and check that everything is OK — even if all looks fine on the outside.

A more robust termination would be achieved if the cable was made to follow a more tortuous route, before it got to the terminal strip. For example in the triac output driver module, the cable could be made to execute a sharp turn towards the PCB, being clamped in that position with the tails being given just a little extra length before being terminated — of course leaving the earth wire longer still, as described. Cordgrip grommets (of the correct size, of course) are even better than the rubber grommet and clamp method, provided the right size hole is used, and they are still quite cheap.

On the subject of terminal strip, some have a little 'apron' of plastic under the termination holes, to provide a bit more isolation between the termination and the metal case. This is a good idea in case a strand of wire goes astray. If this kind of strip is not available, a small square of insulating material about 6mm larger all round than the terminal block in area, and held under it, provides a nice bit of insurance against accidental short circuits.

I guess I could go on further about safety practices in project construction, but I thought I would confine these comments to the scope of the two articles mentioned. My main aim is to try to circumvent what I believe could be a very dangerous situation, associated particularly with the bench power supply. But secondarily I hope to have inspired thoughtful consideration of potential safety hazards in yourself, your staff and contributors — and also to your readers, when it comes to putting mains-powered projects together. I guess the catchcry could be 'You can't be too careful'. →

FORUM

Phew! After reading that carefully worded and clearly expressed criticism, I think you'll agree that Ian McGrath has indeed achieved his stated aims. In fact I believe he's to be highly commended, for drawing renewed attention to the whole matter and raising in all of us a heightened awareness of these important safety aspects.

I know those of us responsible for the projects to which he refers are currently looking rather embarassed, at having such searching attention drawn to our shortcomings!

Again — he's right

The fact is that as with the criticism expressed in his first letter, all of the main points he makes are essentially unanswerable. He's simply right, and the bottom line is that we very clearly have to lift our game when it comes to the safety aspects of our projects.

As for the specific projects concerned, I know Rob Evans is planning to publish a 'Notes and Errata' item to recommend changes to the Simple Bench Supply, to improve the safety aspects in the light of Mr McGrath's criticisms. I'm planning to do the same myself, with regard to the Triac Output Driver unit.

I guess our red faces will gradually fade, too. Hopefully the increased safety awareness that Ian McGrath has triggered will linger rather longer, though!

To round things off, though, I would like to make a few minor comments about some of the points Mr McGrath makes in his second letter.

The first is that while I do like his idea of a separate and correctly earthed mounting plate under the power transformer, for projects in plastic cases, I'm not sure how the firms who produce kits for our projects would react. Generally they seem to think that we already make the projects too elaborate and expensive, and I suspect they'd see such a plate as 'gilding the lily'. I have a feeling that they'd prefer Mr McGrath's idea of drilling a separate hole in the transformer mounting flange, to allow its frame and core to be earthed via a separate screw, nuts and washers. So perhaps that approach will turn out to be the most practical one in most cases.

Mr McGrath's comment about 'cordgrip' grommets suggests that he thinks the reason we don't often use them is cost. This isn't so, though. The real reason is that if these grommets are to grip the cable properly, they must be fitted into a special oblong hole — whose size and exact shape are both quite critical. If the hole isn't right, the grommet simply won't grip properly.

Cutting such a hole is easy enough for a large manufacturer, who can justify the cost of a special punch and die set. But our projects are intended for home constructors and those in small companies, who will generally not have access to the tools to make such holes easily and accurately. So that's the real reason we've tended to ignore them, and use old-fashioned rubber grommets and separate cable clamps.

Mind you, we've more or less decided to get around this whole messy problem of cable entry and reliable clamping, with a much more elegant solution which was recently suggested — quite independently — by Mr Ken Laird, of Melbourne kit manufacturer and PCB materials supplier Kalex.

Elegant alternative

Ken Laird's suggestion is to swing over to the IEC system of having one of those European-standard captive three-pin plugs mounted on the rear panel, mating with the corresponding socket on the equipment end of the cable. The panel-mounting plugs and matching mains cables are now readily available, and are of course being used more and more on all sorts of appliances — from humble toasters and electric kettles all the way through to digital storage scopes and other esoteric test gear. Not to mention just about all of the latest personal computers, of course. They're fairly inexpensive, too.

The use of the IEC cable and captive plug system should get around most of Mr McGrath's criticism about poor cable clamping, and has the added advantage that if there's a strain on the mains cord, it simply detaches as a whole from the equipment without any risk of wires breaking in the wrong order. About the only thing it doesn't let you do is rescue a piece of falling equipment by grabbing the cord — but then, you can't have everything!

Use a plug pack?

I should perhaps also note here that a recognised and accepted way to get around many of these safety problems is to use one of those ubiquitous 'plug pack' power supplies. These keep all of the 240V wiring out of the equipment altogether — at least when everything is working correctly.

Whether or not they can be relied upon to do so under breakdown conditions is probably again a moot point, as Ian McGrath would no doubt wish to point out. Equipment run from a plug-pack is generally regarded and classified as 'double insulated', by default, and is generally not provided with a safety earth. So perhaps they don't provide as much protection as we tend to think...

Now a final comment, about Mr McGrath's suggestion that we appoint at least one staff member to become our expert on safety standards and procedures.

In principle this sounds great, although I suspect Mr McGrath has a rather inflated view of the size of our in-house technical staff; nowadays, this amounts to Rob Evans, Peter Murtagh and myself! We all sit within a couple of metres of each other, and all tend to get involved in each others' projects. So in a sense, our group is too small to need a formally appointed safety expert; in any case our knowledge is essentially pooled, in an informal fashion.

I'm sure that following Mr McGrath's criticisms, we will all be much more conscious of safety considerations, and will hopefully be able to ensure that each of our projects meets the correct level. But when it comes to all of us, or even one of us, becoming 'thoroughly familiar with all safety standards', I see a problem.

Not so easy...

In the past, it has proved surprisingly difficult for us (a) to find out exactly which standards did in fact apply to our projects; and (b) to get a copy of them. This has always required a special trip to the Standards Australia offices, and the expenditure of quite a deal of time — along with a not-insignificant amount of money, quite often.

The situation may have changed, but for a long while the relevant standards didn't seem to be available in response to telephone enquiries — only to orders mailed with a cheque, or purchased over the counter. All of which makes things rather difficult for small, impecunious technical magazines with a tiny and overworked technical staff!

Still, none of my comments should be interpreted as detracting from the important safety criticisms that Ian McGrath has made. All of his main points are undeniably true, and in the future we will have to watch the safety aspects of our projects with much greater alacrity and self-discipline.

Thanks, Ian, for your salutory kick in the rear — we deserved it, and I trust we'll be the better for it.

Next month, I'll try to bring us back to the rather safer subject of FM stereo decoding. I hope you'll join me. ■

Basic Electronics — Part 13

Power Amplifiers

In this part we put all the theory to work and present a power amplifier module you can build and use. On the way we describe how a power amplifier works, and how the various stages we've already described connect together.

by PETER PHILLIPS

'Learning by doing' is often the best way of understanding how something works, providing the task is not too complicated. This chapter is about power amplifiers, and we describe a basic but useful power amplifier module that you can build as a means of learning.

The circuit uses commonly available parts, and has all the usual sections of a complete amplifier. A printed circuit board design is included, although it is possible to use strip board (Vero board) or even matrix board to construct the amplifier. So it's time to 'get your hands dirty', and put all that theory into practice.

An overview

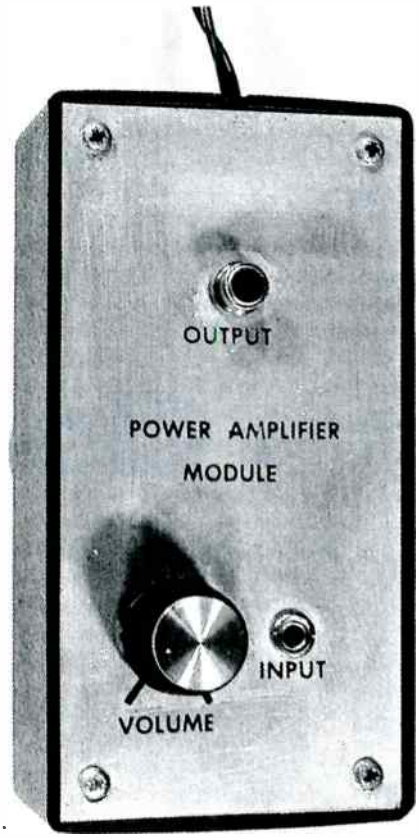
The block diagram of the amplifier we're describing is shown in Fig.1, in which the amplifier section contains a FET and a transistor. This section provides most of the *voltage* gain, and the driver stage is a *buffer* between the amplifier section and the output stage.

This block diagram is typical of most audio amplifiers, although the circuit diagram would be different, and probably more complex.

A 12V DC plug pack is used as the power supply in this case, giving a maximum power output of around 1.5W. It is possible to increase the output power by using a higher DC voltage, as we'll describe later on.

The whole amplifier has a voltage gain of 60, and requires an input signal of around 190mV p-p (peak to peak) to obtain full power output. The input resistance is 1M, which is high enough for most applications.

The amplifier (or two if you want stereo) can be used with a Walkman type radio/cassette unit, or it could form part of an intercom system. Another use is as a general purpose test amplifier, or as a signal tracer. Although the power



output is small by today's standards, it is enough to give a good sound from a typical eight ohm speaker.

Quite a bit of the circuit has already been described in Parts 11 and 12; the section we have yet to explain is the power output stage, along with a few techniques used to couple everything together. So although it seems to be starting at the end of the circuit, we'll describe the output section first and give some background theory on power amplifier stages in general.

Power amplifiers

A power output stage usually has to drive a low impedance load, such as a loudspeaker. The power comes from the power supply, and the output signal appearing across the load should ideally be a replica of the input signal. In other words, the output stage takes power from a DC supply and converts it to an AC signal that can drive a load, as depicted by Fig.2. There are various methods of doing this, all with their relative advantages and disadvantages.

It may seem simple enough in theory, but in practice the perfect output stage has yet to be invented. There are two basic problems that plague power amplifier design — efficiency and distortion.

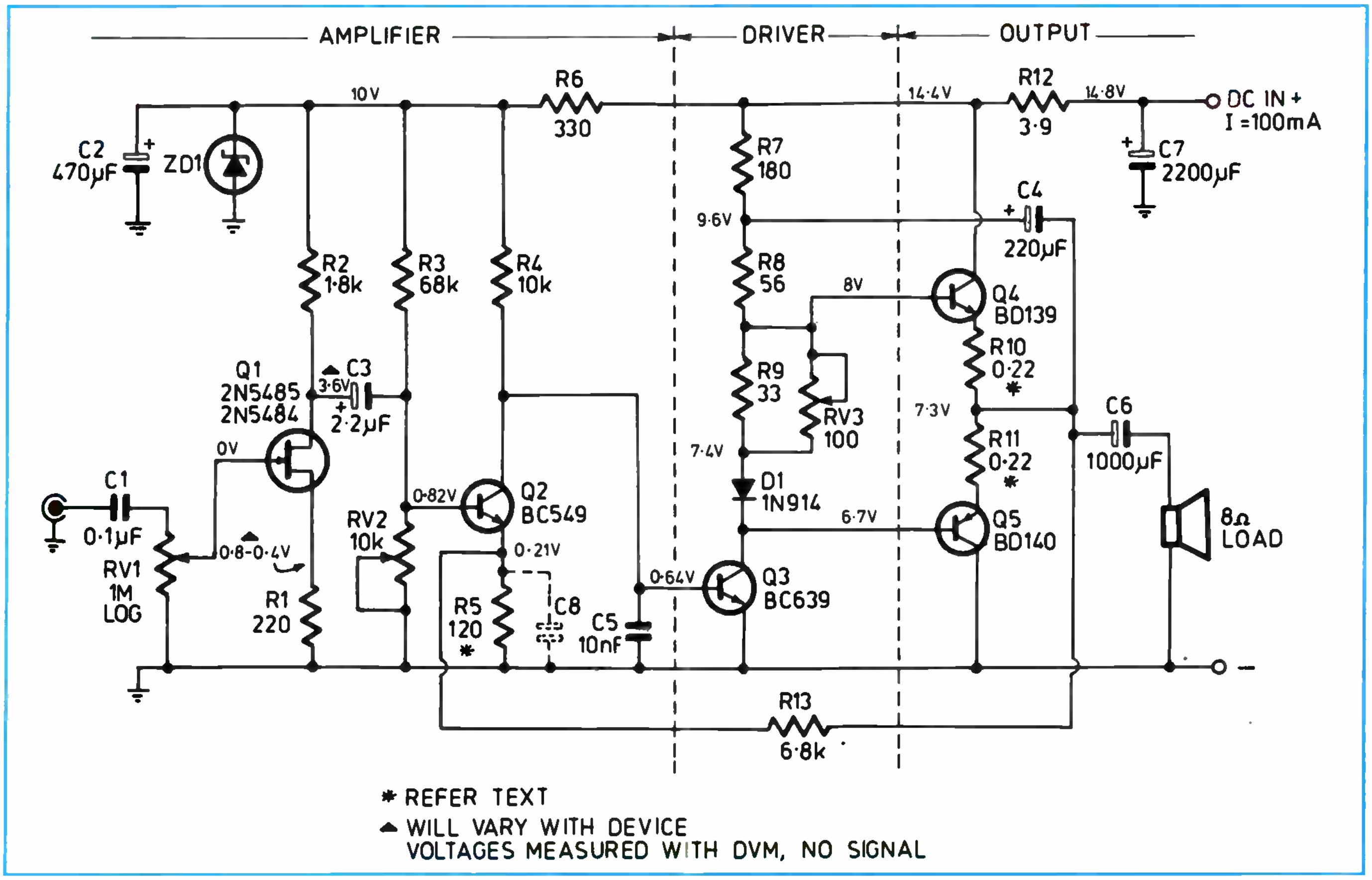
Efficiency is a measure of how much input power is required to produce the rated output power, and equals output power divided by input power. The input power is the DC voltage multiplied by the DC current taken by the circuit. The output power equals the square of the output RMS AC voltage divided by the resistance of the load.

Let's say a power amplifier has an efficiency of 25%. If the output power is 25W, the DC input power will be 100W. So where's the other 75 watts of power go?

You guessed it — into heat! Heat which needs to be dissipated by the output transistors. A characteristic of all power amplifiers is heat dissipation, and most power amplifiers have 'heatsinks' for the output transistors to help them get rid of it.

Distortion is a measure of how much the output signal differs from the input signal, and distortion measurement requires relatively sophisticated equipment. The problem is, an amplifier with a high efficiency will generally have more distortion than an amplifier with a lower efficiency.

There are two basic types of power amplifiers, referred to as class A and class B, although most amplifiers operate somewhere between these two



The circuit diagram for the amplifier includes the DC voltages you can expect when the recommended plug pack is used as the power supply. The components shown doted are optional, as explained in the text.

classes, giving an operation known as class AB. But first a look at class A...

Class A

A class A output stage can have one or more transistors, and the simplest circuit is shown in Fig.3. You will probably recognise this circuit as that of a common emitter amplifier, and the only difference will be the value of the components. This amplifier has a maximum efficiency of 6.25%, which makes it rather impractical for most uses.

The efficiency can be improved to 25% if the load is connected in place of the collector resistor Rc. However, the DC collector current will now flow through the load — causing other problems, particularly for a loudspeaker.

To isolate the load from the DC supply, a transformer can be used, with the primary of the transformer connected between the collector and the power supply and the load connected across the secondary winding. This type of amplifier has a theoretical maximum efficiency of 50%. Transformer coupling was almost universal for valve amplifier circuits and was used for quite a few early low power transistor amplifiers as well. The main feature of a class A amplifier is that current flows through the output device (transistor, valve, FET) at all times.

That is, the current in the device never falls to zero. In fact, this is the definition of class A operation, in which the active device (or devices if two or more are used) conduct for the entire cycle of the input signal. Because a complete AC cycle occupies 360 electrical degrees, the output device(s) in a class A amplifier therefore also conduct for 360°.

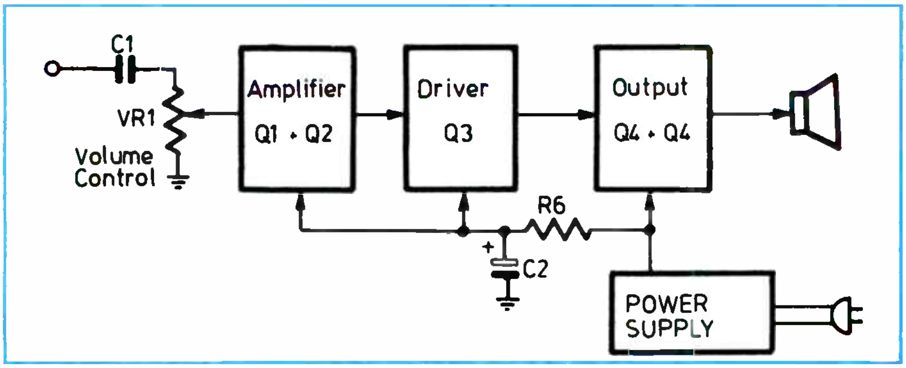


Fig.1: The block diagram of the project is typical of most power amplifiers, in which a voltage amplifier connects to the output stage via a driver stage.

Class B

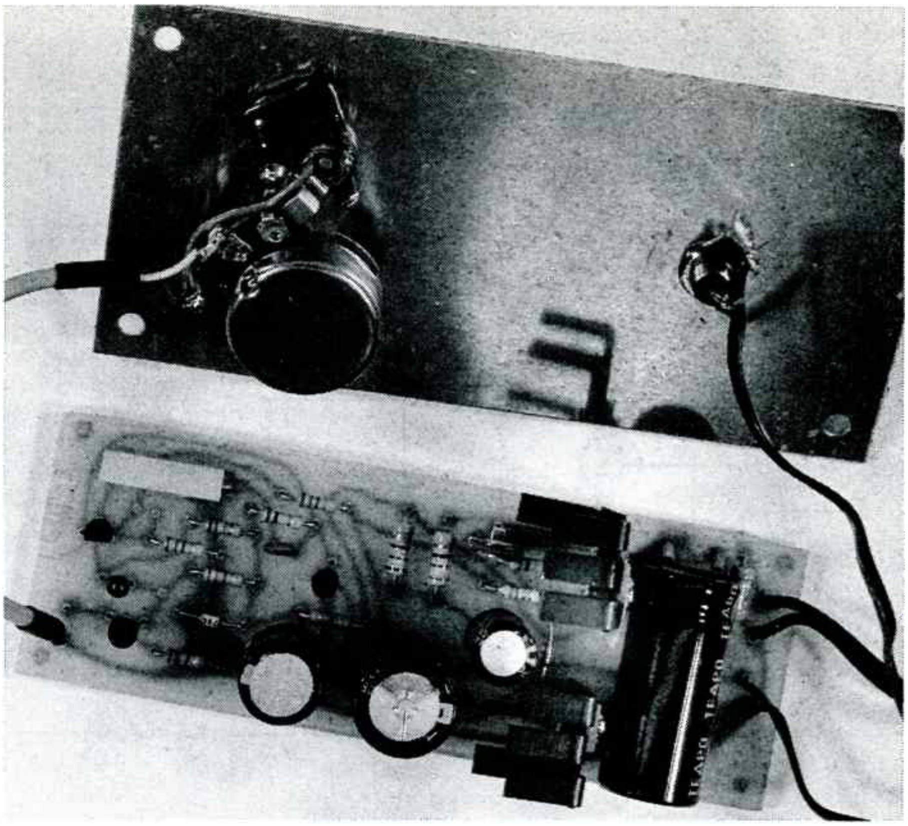
At the other end of the efficiency spectrum is the class B power amplifier. This circuit requires at least two active devices in the output section, with each device conducting for exactly *half* (or 180°) of the input signal.

The basic circuit is shown in Fig.4. This circuit has a dual polarity power supply, giving a DC voltage of zero across the load when the input signal is zero. It is also possible to use a single rail power supply as in the circuit for our project, given shortly.

In the circuit of Fig.4, transistor Q1 will conduct when the input signal is greater than 0.6V. At this time Q2 will be turned off, and the output signal will be produced by Q1 alone. When the input signal swings in the negative direction, Q2 will conduct (for a voltage more negative than -0.6V) and the output signal will now be produced by Q2.

That is, Q1 conducts for the positive half of the input signal and Q2 for the negative half. However, what about that part of the input signal for voltages between +0.6V and -0.6V? Obviously here the transistors are *both* off, and the output signal will therefore have this part missing — giving distortion known as *crossover* distortion. This is shown in Fig.5.

The maximum efficiency of a class B amplifier is 78.5%, but the price is relatively high distortion. The answer to the problem is a circuit where the output devices conduct for more than 180°, but less than 360°. This class of operation is referred to as class AB, as it is neither class A or class B, but somewhere in between.



This shot shows how the prototype was assembled. The PCB fits inside a jiffy box, and the lid supports the input/output sockets as well as the volume control. Use an RCA socket for the output and a 2.5mm earphone socket for the input.

Class AB

So that the output transistors can conduct even when the input signal is around 0V, a special biasing circuit is required. This circuit needs to supply 0.6V of forward bias to each transistor and the basic circuit is shown in Fig.6. This circuit has a single rail power supply, and the required DC voltages shown are for a rail voltage of 20V.

In this circuit, the DC voltage at the emitters of the transistors is 10V, or half the 20V rail voltage. If a dual polarity power supply was used, the emitter voltage of both transistors would be zero as in Fig.4. This way, the output signal can swing equally in either direction. For a single-rail supply as shown in Fig.6, the DC voltage is isolated from the load by capacitor C. The voltage at the base of Q1 needs to be 10.6V (0.6V higher than the emitter) and the base voltage of Q2 to be 9.4V (10V - 0.6V). The voltage difference between the bases is therefore 1.2V, obtained by connecting two diodes in series between the base terminals. Notice also that the two biasing resistors have the same value.

The result is that a small DC current flows in the transistors when there is no input signal, and once the 0.6V threshold is reached in either direction only one transistor will be conducting. The value of this quiescent current is important, as it determines the efficiency and the distortion of the amplifier — if the current is too low the distortion rises, while if it is too high the efficiency falls and the transistors will dissipate too much heat.

The input signal can be applied to the base of either transistor, as the diodes

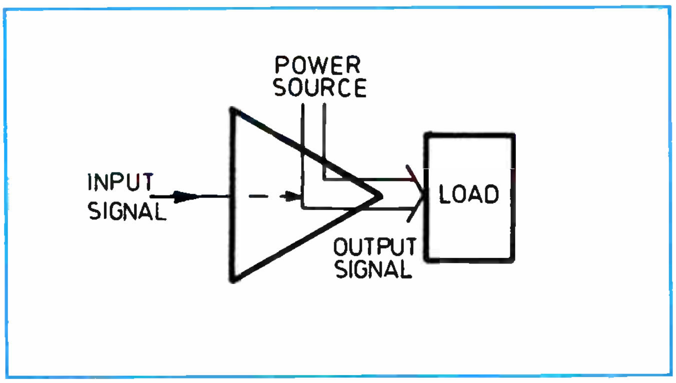


Fig.2: This diagram shows the general form of a power amplifier, in which the DC power supply provides power to a load via the output stage.

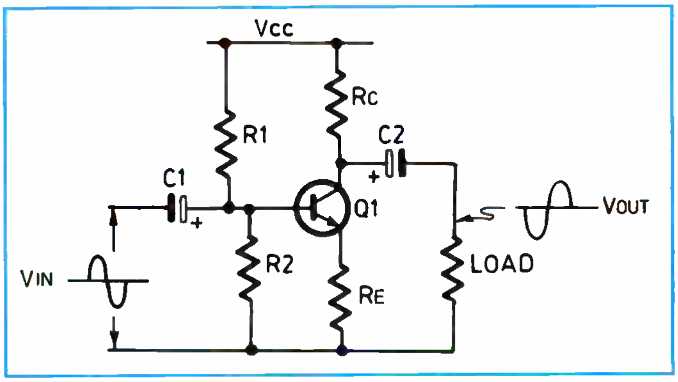


Fig.3: A common emitter amplifier is a form of class A amplifier, although its efficiency is very low, at less than 6.25%.

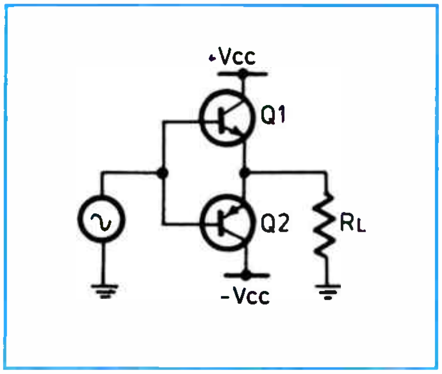


Fig.4: A class B output stage needs at least two transistors, one to handle the positive half cycle and another for the negative half cycle.

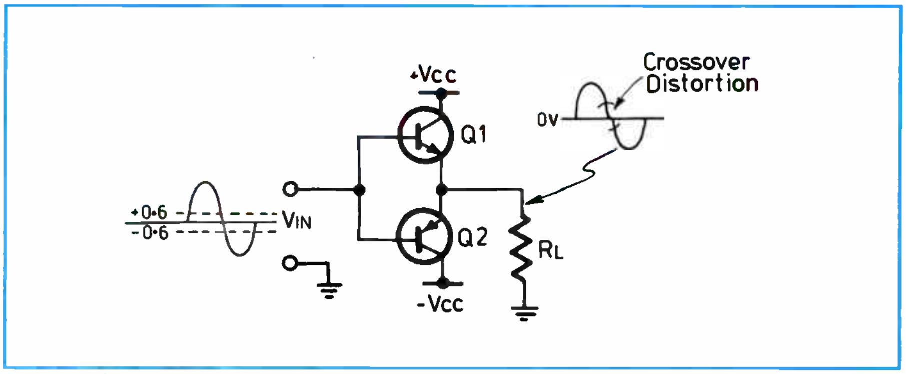


Fig.5: Although efficient, the class B power amplifier has a high degree of distortion, known ad 'crossover' distortion. This occurs when the transistors are switching from one half cycle to the other.

are effectively a short circuit to an AC signal due to the DC current flowing through them. It is also possible to use a resistor to establish the 1.2V DC voltage drop, although temperature stability is not as good. As we've explained before, the voltage across a PN junction drops with an increase in temperature, and if the bias voltage is held at a constant value, the transistors will conduct more collector current when the temperature rises. This then heats the transistors even more, and unless steps are taken to avoid it, the whole output stage can self destruct.

This effect is referred to as *thermal runaway*, and the idea of using diodes is to ensure that the bias applied to the transistors automatically falls with temperature, to prevent it from occurring. Commercial designs often include extra circuitry to maintain the stability of the circuit.

Where diodes are used as in Fig.6, the best method is to attach the diodes to the same heatsink as the transistors. This way the voltage developed across the diodes follows the base-emitter voltage of the transistors.

The maximum theoretical power output of any power amplifier depends on the value of the total supply voltage, because this limits the output voltage swing. For a class AB or similar simple output stage it can be calculated by converting this voltage to an RMS value, then using the equation $Vrms^2/R$. A simpler equation is power output (maximum) = $Vcc^2/8RL$.

For example, a 12V car radio with simple class AB output stage and a 4-ohm speaker has a theoretical maximum output power of $12^2/(8 \times 4)$, or 144/32 which equals 4.5W. So now that we've explained the concepts behind a power output stage, we can examine the circuit of our project in detail.

The project

This time we'll start at the front end of the circuit, and work through. The input signal is coupled to the volume control (VR1) via capacitor C1. The value of VR1 is specified as 1M and because the gate terminal of FET Q1 can be regarded as an open circuit, the input impedance of the circuit equals the value of VR1.

Like all audio volume controls, VR1 needs to have a *logarithmic* taper (usually denoted as type C), to give an apparent linear relationship between rotation of the control and volume level. This is necessary because human hearing follows a logarithmic response, in which a change in output power by a factor of 10 is heard as a change by a factor of two.

The FET amplifier stage was described in Part 12 and is used here to give a high input impedance. The next

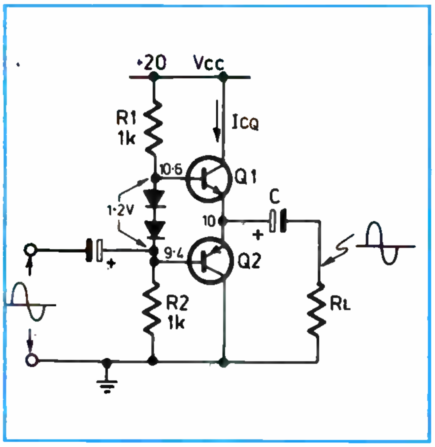


Fig.6: The class AB amplifier has forward bias applied to the transistors, to keep them both conducting while they switch from one to the other. The effect is reduced efficiency, but less distortion.

stage is the common emitter amplifier of Q2. This section has also been described before, but you may be wondering why the lower bias resistor (VR2) is adjustable.

If you examine the circuit, you'll see that apart from the coupling capacitor C2 between Q1 and Q2, all stages are directly coupled. This means that the DC voltages for Q3, Q4 and Q5 are all determined by the collector voltage at Q2. The important voltage is that at the emitters of Q4 and Q5, and VR2 is used to adjust this to half the supply voltage.

To stabilise this voltage (and others in the circuit), *negative feedback* from the output to the emitter of Q2 is provided by R13. If capacitor C8 (shown dotted) is *not* included, the feedback will be for both DC and AC voltages, but it will be for DC only if C8 is added. We'll have more to say about C8 later, but first to the DC feedback.

If the voltage at the emitters of Q4 and Q5 rises, perhaps due to a temperature change, the voltage at the emitter of Q2 will also increase by way of R13. This will cause Q2 to conduct less current, making the DC voltage at its collector increase. As a result, Q3 will conduct more current and its collector voltage will drop.

This then reduces the voltage at the base of Q4 and Q5 and therefore the voltage at their emitters. See how the feedback corrected the change?

The driver stage

The driver transistor is Q3, and the collector load for this transistor is the base circuitry associated with Q4 and Q5. In effect, Q3 is connected as a common emitter amplifier and the output signal developed across Q3 is applied to the base of Q4 via D1 and the parallel combination of R9 and VR3.

The base of Q5 connects directly to

the collector of Q3. The driver stage therefore needs to drive a relatively low resistance load, and a transistor capable of handling a degree of power is required.

The output stage

The output transistors are Q4 and Q5, connected as a *complementary symmetry* class AB output stage. In this configuration an NPN and a PNP transistor (complementary) with equal current gains are required (symmetrical).

Thus, the DC current gains of both Q4 and Q5 should ideally be matched by measurement. If you consider each transistor singly, you can see that they are both connected as a common collector amplifier, giving a *voltage* gain of only unity. However, the circuit will have considerable *power* gain.

The DC biasing circuit for Q4 and Q5 has one diode and two parallel-connected resistors, of which VR3 is used to adjust the quiescent collector current of Q4 and Q5 and therefore the class of operation. You will notice that resistors R10 and R11 are shown with asterisks, indicating they can be replaced with wire links. These resistors will reduce the available output power, but they do help stabilise the DC conditions of the circuit.

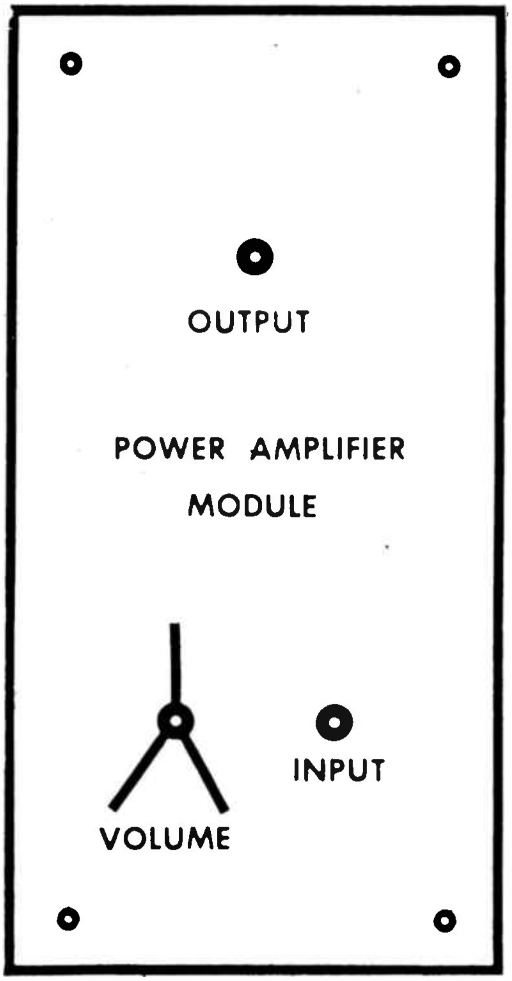
Most commercial amplifier circuits include emitter resistors to help minimise the likelihood of thermal runaway, and usually have a value ranging from fractions of an ohm to one ohm. The last part of the output stage concerns capacitor C4, which is known as a *bootstrapping* capacitor.

Bootstrapping

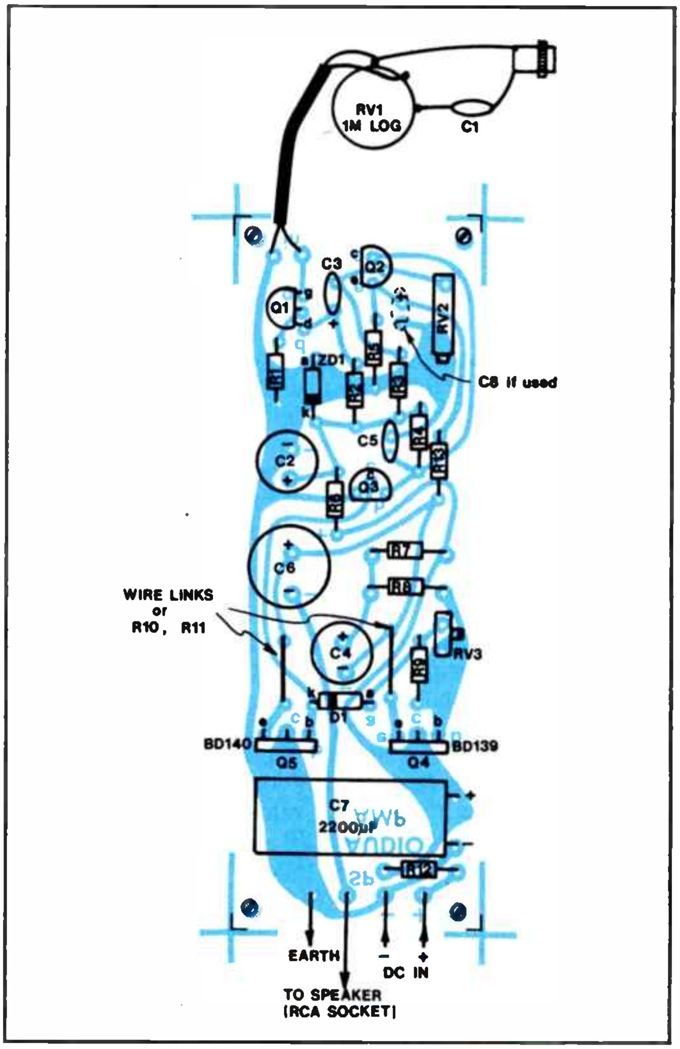
Bootstrapping is a general term used in electronics to mean a condition where the circuit 'helps itself' to operate. In this case, bootstrapping is included to allow a higher output voltage swing. If C4 was not included, biasing resistors R7 and R8 would be combined to a single resistor as in the basic circuit of Fig.6. Ideally, the output signal should be able to swing from 0V to the value of the supply voltage. However due to the 0.6V forward bias required across the base-emitter junctions of the output transistors and because of other losses, this cannot occur.

For the positive half cycle, if the output is to reach the supply voltage, the voltage at the base of Q4 must be at least 0.6V higher than the supply voltage. Similarly, an output of 0V can only be obtained if the base voltage of Q5 falls to -0.6V.

By adding a bootstrapping capacitor, the output voltage swing is effectively added to the DC bias voltages. Thus, for the positive half cycle, the positive



This front panel design will fit the suggested jiffy box. Take a photocopy of the design, spray it with plastic lacquer and glue it to the lid of the box with spray-on contact glue.



The layout diagram for the amplifier. The metallised surface of Q4 and Q5 faces the centre of the board and heatsinks should be fitted to these transistors.

change adds to the bias voltage at Q4, causing it to conduct more current and produce a higher output voltage.

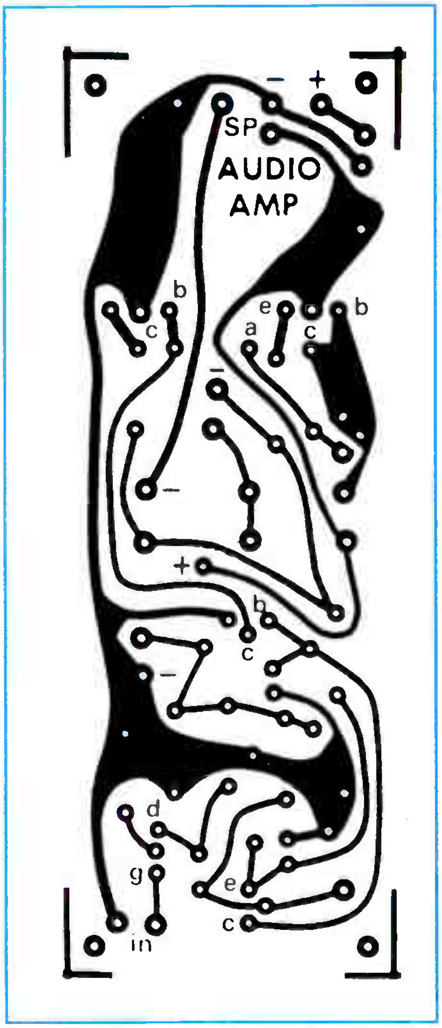
Similarly, on the negative half cycle, the negative going swing reduces the quiescent bias voltage, helping Q5 turn on harder and produce a lower output voltage. Therefore the circuit helps itself operate more effectively.

The power supply

An important aspect of amplifier design is power supply *decoupling*. When the output stage is producing full output power, the supply voltage will be delivering substantial peak currents.

Under these conditions, it is possible that some of the audio signal will appear on the supply line. To prevent this signal from affecting the operation of the rest of the circuit, it must be eliminated from that part of the supply feeding the amplifier section.

In the project, the amplifier section is supplied via R6, with C2 and ZD1 used to maintain the amplifier's supply voltage at a smooth and constant 10V. These components are the power supply *decoupling* components, and a common fault in an amplifier is for the decoupling capacitor (C2 in the project) to become open circuit. The effect is instability and strange effects on the sound output.



The PCB pattern is reproduced for those who can make their own.

Construction

As already mentioned, you can build this circuit on strip board (Vero board), but the easiest way is to use a PCB. Start by fitting the low profile components such as the resistors and the wire links. Use the layout diagram and the photo of the unit to determine where the components are placed.

The diodes, electrolytic capacitors and transistors must be mounted with the correct polarity. The bar on the diodes is the cathode end and the capacitors will have their polarity marked. The output transistors (Q4 and Q5) have a metallised surface on one side, which should face towards the centre of the board. A heatsink is required for both transistors, and either a small (20mm square) piece of aluminium or a commercial heatsink can be used. The heatsink on Q4 should be insulated from the transistor with a piece of mylar or similar material, as this transistor (and therefore the heatsink) connects directly to the power supply.

Before fitting the two PCB mount potentiometers, adjust VR2 to its maximum value and set VR3 to its minimum value. Connect the volume control to the PCB using a 100mm length of shielded lead.

Once everything is fitted, check your construction to confirm there are no solder blobs between tracks and that all components are correctly placed.

Getting it going

Before applying power to the circuit, connect an eight ohm load (resistor or loudspeaker) to the output and connect capacitor C1 between the input terminal and the volume control. Set the volume control to minimum and then apply power, either from the plug pack or an external 15V DC supply.

Confirm that both output transistors are cool when touched. If not, try adjusting VR3, as perhaps it was incorrectly adjusted in the first place.

The correct setting for VR3 should give a quiescent collector current through Q4 and Q5 of around 100mA. An easy way to measure this is to connect a voltmeter across R12 and to adjust VR3 for a voltage drop of around 0.4V across R12. Now measure the DC voltage at the emitters of the output transistors, and adjust VR2 to give a voltage around half the supply voltage.

With the recommended plug pack, this will be approximately 7.3V.

If all is well so far, turn up the volume and touch the input lead. You should hear hum from the loudspeaker, confirming that the amplifier is operational.

If not, you will need to fault find the circuit. Look first for components

Continued on page 103

PARTS LIST

Resistors

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

R1	220
R2	1.8k
R3	68k
R4	10k
R5	120
R6	330
R7	180 1/2W
R8	56 1/2W
R9	33 ohms
R10,11	0.22 ohm (optional: fit wire links if not used)*
R12	3.9 ohms 1/2W
R13	6.8k

Variable resistors

VR1	1M logarithmic panel mount
VR2	10k, 10-turn trimpot
VR3	100 ohm trimpot, vertical mount

Capacitors

All 25V electrolytic unless otherwise stated:

C1	0.1uF polyester, 100V
C2	470uF 16VW electrolytic
C3	2.2uF tantalum
C4	220uF 16VW electrolytic
C5	10nF ceramic or polyester
C6	1000uF 16VW electrolytic
C7	2200uF 16VW electrolytic
C8	47uF 6VW electrolytic*

Semiconductors

D1	1N914 (or equivalent) signal diode
Q1	FET type 2N5484 or 2N5458
Q2	BC549 (or equivalent) NPN transistor
Q3	BC639 NPN transistor
Q4	BD139 NPN power transistor
Q5	BD140 PNP power transistor (should be Beta matched to Q4)
ZD1	10V, 400mW zener diode (1N961 or BZX79)

Miscellaneous

PCB 45mm x 123mm coded AUDIO AMP; medium sized zippy box; 12V, 300mA DC plug-pack; panel mount RCA socket; 3.5mm panel mount phono socket; knob to suit volume control; hook-up wire, 100mm length of shielded lead, small heatsinks.

* see text

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Cat CS-2471/72
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$379 save $70

SA-100
2 Way kit, 70 Watts RMS
Spks/cabs normally $699
Cat CS-2460/62
Birthday price
$599 save $100

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Spks/cabs normally $999
Cat CS-2471/72
Birthday price
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$39.50 save $10

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$79.50 save $10

12" 200W RMS
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Cat CG-2381
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15" 150W RMS
Cat price $129
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This midrange has a clear polypropylene cone. It has a square black freame and is a totally sealed unit.

Impedane	8 ohm
Resonant freq	600Hz
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Power handling system	100 watts RMS
SPL	95dB

Catalogue price $24.95
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$14.95 save $10

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We've made a scoop purchase of quality brand Teapo electrolytic capacitors. They are in three styles - RC - Can package with solder lugs and chassis mounting brackets, HS/RP - PC mount with an extra lead for stability. LY - PC pin type. All these capacitors are way below what you would normally expect to pay, so grab some while they last.

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RG Can Type

Cat	Valve	Price
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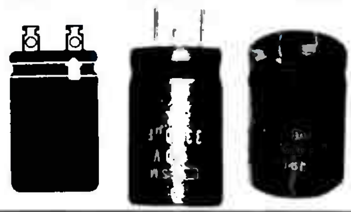
RU6741	100uf 350V	3.95
RU6742	1000uf 35V	3.50
RU6743	1000uf 63V	4.50
RU6744	1000uf 100V	5.50
RU6745	2200uf 25V	2.95
RU6746	2200uf 35V	3.95
RU6747	2200uf 63V	4.75
RU6748	2200uf 100V	5.95
RU6749	3300uf 63V	4.95
RU6750	4700uf 25V	3.75
RU6751	4700uf 100V	8.95
RU6752	6800uf 16V	3.50
RU6753	6800uf 63V	5.95
RU6754	10,000uf 16V	5.95
RU6755	10,000uf 25V	7.95
RU6756	10,000uf 35V	8.95

RP/HS PC mount type

RU6760	1000uf 35V	3.25
RU6761	1000uf 63V	4.25
RU6762	1000uf 100V	5.25
RU6763	2200uf 25V	2.75
RU6764	4700uf 25V	3.50
RU6765	10,000uf 16V	5.25

LY PC pin type

RU6770	1000uf 63V	4.25
RU6771	2200uf 35V	3.75
RU6772	3300uf 35V	3.95
RU6773	3300uf 63V	4.50
RU6774	6800uf 63V	5.50



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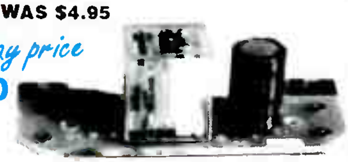
Birthday price
$2.00



ULTRASONICS FOR CAR ALARMS

Don't miss this. Don't pay $79 to add ultrasonics to your car alarm. We've got quality 3 wire units for only $39.95. With this in your car you'll have protection against illegal entry, movement, as well as broken windows. Cal LA-8960

WAS $39.95 *Birthday price* **$25** save $14.95

3.75 DIGIT DMM

- 7000 count
- 39 range
- Inductance
- Capacitance
- Frequency
- Temperature
- Peak hold
- Logic

Cat QM-1475
CATALOGUE PRICE $169
Birthday price
$149 save $20

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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.

Now less than half price

Cat CW-2117

ONLY $49.95 a pair

1988 Cat price $119.95

240 VOLT MOTOR BARGAIN

Top quality US made 240V 50Hz 1300rpm motor which was used to power a cylindrical blower fan for an air conditioning system. Taiwan made motors sell for around $40 - US made motors would cost $60 or more plus tax. We have a limited quantity. Dimensions 85 dia, 100 height including mounting bolts and drive shaft.

Cat. MM-5050

Was $24.95

Birthday price **$14.95** save $10

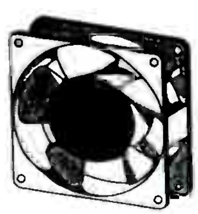
FAN BARGAIN

Another scoop bargain. This time its quality Sunon brand 80mm (31/2") 115V AC fans. Yes, they are 115V, not 240V, but use two 115V units connected in series on 240V. And you can buy two of these for less than one 240V unit and get double the exhaust volume.

Details -
Brand: Sunon
Model: SF 11580A
Voltage: 115V AC 50/60Hz
Current: 0.13 amp
Size: 80 x 80 x 38mm
Impedance protected
Cat YX-2520

$10 EACH

UNDER HALF PRICE



SPIROMATIC INDOOR ANTENNA

For prime reception areas, sits on top of your TV. Popular spiral design, 300 ohm cable supplied.

Birthday price **$5.00** save $4.95

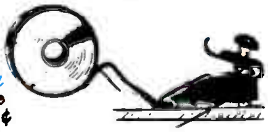
Burglar alarm tape blocks

To suit window tape LA-5050. Self adhesive.

Cat LA-5060

Catalogue price $1.25

Birthday price **.50¢** save .75¢



LAMINATOR

Price breakthrough! Below $100!

Up until now, if you wanted to purchase a laminating machine to laminate business cards it would cost you upwards of $400.

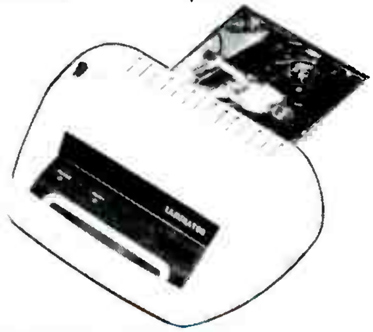
Jaycar is proud to announce the arrival of our own direct imported laminator that will not only do business card sized cards but photographs as well. And the price is below $100! It 's so simple to use, you can protect and preserve your favourite photos (up to 4" x 6") (100 x 150mm) specimens, business cards, recipes, membership cards etc. Operates on 240V AC. Will heat up in 2-3 minutes. Call into any store for a demo.

Cat XL-2500

Only $99.95

Laminating cards available

BUSINESS CARD SIZE	PHOTO SIZE
95 x 57mm, pkt 100	166 x 112mm, pkt 24
Cat XL-2504	Cat XL-2505
$19.95	**$12.95**



MOTOR SIREN

This 12 volt motor driven siren really lets out a blast! In fact, it's almost deafening, it's very small compared to most sirens measuring only 82(H) x 80(L) x 74(D)mm.

Limited quantity.

Cat LA-5252

Was $24.95

Birthday price **$19.95** save $5

VHS VIDEO TAPE CASE

Ideal for making short tapes or repairing damaged ones. (No tape, just case.)

Cat AR-1435

Was $3.95

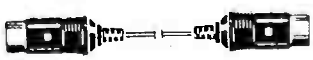
Birthday price **$2**

Reverse 5 pin DIN lead

Made for video. Pins are reversed, length 1.5 metres.

Cat AV-6525 **Arista price $5.95**

Birthday price **.50¢**



Professional cable cutter

SAVE OVER 60%

Another surplus stock buy which will save you heaps. This time it's a cable cutter. They are designed to cut copper and aluminium cable up to 38 sq mm. They will slice through cable with the greatest of ease and strip as well. Length 215mm (8½"). Every toolbox needs one. Trade price $21.89 plus tax.

Cat TH-1823

Jaycar price $9.95

JAYCAR - NO 1 FOR NEW KITS

PC VOLTMETER KIT

Ref Silicon Chip Oct '91

Construct a talking voltmeter with an on-screen display! This simple project mates with the PC voice recorder kit (SC Aug 91, Cat KC5099 $32.95) and plugs directly into the printer port of your PC. Kit includes PCB, box, panel label, D25 plug, cable, multimeter leads and all specified components. Software disc available from author.

Cat KC5100 **$42.95**

STEAMSOUND MKII FOR MODEL TRAINS

Ref: Silicon Chip Oct 91

Brand new design uses our new mini AS3002 Speaker and the mini Philips resistors. Includes PCB and all components except Ra & Rb.

Cat KC-5101 **$19.95**

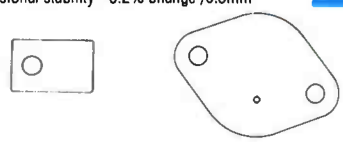
Transistor washers that don't require silicon grease

Silicon impregnated rubber washers

At last you can stop using messy silicon grease. These washers are made from silicon rubber and are effective as mica and grease. Avoid mica washers that crack, avoid run off, speed production assembly time. Three sizes available including the new TO3P size as well as TO3 and TO220. Physical properties:

Colour - grey Tensile strength - 40kg/cm²
Elongation - 80%Dielectric breakdown voltage - 4000/0.3mm
Co-efficient of thermal conductance - 2.4 x 10^{-3}
Flammability class - 94V-0/0.3mm
Dimensional stability - 0.2% change /0.3mm

NEW



Type	Pack qty	Price	Cat
TO3	20	$6.95	HP-1150
TO3	100	$23.95	HP-1151
TO220	20	$2.50	HP-1155
TO220	100	$8.95	HP-1156
TO3-P	20	$4.50	HP-1160
TO3-P	100	$14.95	HP-1161

(Size 25 x 20mm)

BUSHES

Now available, separate bags of bushes to suit the new silicon impregnated rubber washers and mica washers

TO220	Pkt 100	**$8.95**	Cat HP-1166
TO3	Pkt 100	**$9.95**	Cat HP-1168

D Size NiCad

1.2Ah current

Cat SB-2460

Normally $6.95

NOW $5

AA Size NiCad

450mAh

Cat SB-2452

Normally $3.50ea

NOW 4 for $10

240V NE2 NEON

A 90V neon pre-wired with resistor for 240V. Wire length 90mm. Resistor is covered with heatshrink tubing.

Cal SL-2691

Normally .75¢

Birthday price **10 for $2**

UNBELIEVABLE CAR ALARM BARGAINS

In the last few months we have brought you some amazing car alarm bargains. These included the Vandalert remote V40 and the V80 with backup battery for $169. The way these alarms sold out within about 2 weeks showed us that car alarms would be part of our product range provided the price is right. With this criteria in mind we went shopping for quality car alarms. We simply could not believe what we found. Hi quality car alarms and central locking units with more features than the Vandalerts for about the same money as the surplus purchased Vandalerts.

REMOTE CONTROL CAR ALARM

This system is supplied with 2 transmitters and each transmitter has two buttons on them - blue one for alarm on/off and a red one for panic. Hit the red one anytime and the alarm will sound immediately. Also these transmitters have a feature that we have only seen on very expensive systems. They have a sliding cover which covers the buttons so the alarm can't accidentally be activated by a key or coin in your pocket touching the buttons. If you have used a remote control car alarm before you will understand how easily this can happen and how annoying it is. The receiver and alarm electronics are housed in a black box.

FEATURES OF THE ALARM • Visual arming/disarming signal - alarm on: flash once, alarm off: flash twice • Audible arming/disarming signal - alarm on: sound once, alarm off: sound twice • Starter disable: A separate starter disable relay is supplied which will stop the engine from starting when the alarm is on • Emergency panic: As mentioned earlier, press the red button and alarm will sound instantly • Instant triggering: Siren will sound immediately when triggered • Door, bonnet and boot instant triggering • Ignition key switch triggering when alarm is on the engine cannot be started by the ignition key • Alarm triggered indication: Siren sounds and lights flash simultaneously when alarm is triggered • Ignition key on protection: Alarm cannot be switched on/of when ignition is on • Manual override system: Alarm can be switched off manually if radio key is lost • Improper seal warning: If a door is not closed when alarm is switched on, siren will sound immediately • Direct line output: Build in negative output for connection of alarm sensor, ultrasonics etc • Interior light delay circuit: Will accommodate cars with delays on their interior lights • Dashboard light: Supplied with a yellow LED to visually show that an alarm is fitted • Choice of sirens available: Alarm is sold without a siren and there is a choice of normal siren, or back up battery siren for greater security • Can be used to operate central door locking that is already installed with negative output (our LR8830 4 door kit) • Supplied with installation instructions.

WHAT YOU GET • 1 black box electronic module with all the above features • 2 transmitter key fobs • 1 ignition cut out relay

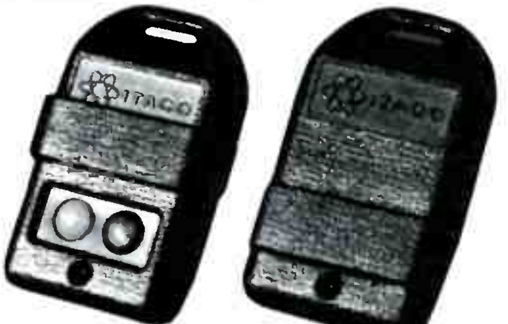
Cat LA-8900

ALL THIS FOR ONLY $129.50

SIREN OPTIONS: You will require one of the following:

Normal siren horn Cat LA-8908 **$19.95**

Backup battery siren horn Cat LA-8910 **$49.95**



Pictured: Remote controls

REMOTE CONTROL CAR ALARM WITH DRIVERS DOOR CENTRAL LOCKING

This system uses the same electronic black box as the alarm above (LA8900) with the addition of a central door lock actuator for drivers door and relay to suit. So when alarm is switched on drivers door is locked, and when alarm is switched off, drivers door is unlocked.

WHAT YOU GET • 1 black box electronic module • 2 transmitter key fobs • 1 ignition out relay • 1 drivers door central door lock actuator • 1 relay for central lock • 1 wiring harness

Cat LA8902

$179.50

SIREN OPTIONS: You will require one of the following:

Normal siren horn Cat LA-8908 **$19.95**

Backup battery siren horn Cat LA-8910 **$49.95**

REMOTE CONTROL CAR ALARM WITH 4 DOOR CENTRAL LOCKING

Again this system uses the same black box and has all the same features of the previous models but with the addition of central locking for 4 doors. So when the alarm is switched on all 4 doors are locked and when alarm is off all 4 doors are unlocked.

WHAT YOU GET • 1 black box electronic module • 2 transmitter key fobs • 1 ignition cut out relay • 4 central door locking actuators • 1 relay for central lock • 1 wiring harness.

Cat LA-8905

All this for only $269.50

SIREN OPTIONS: You will require one of the following:

Normal siren horn Cat LA-8908 **$19.95**

Backup battery siren horn Cat LA-8910 **$49.95**

4 DOOR CENTRAL LOCKING

A new addition to our range of central door locking products. you could say that this is an economy set, because it cannot be wireless controlled and there is only one master control which is for the drivers door. The front seat passenger door is a slave as is the rear door units. Supplied with relay, wiring harness and all hardware.

Cat LR-8850

SAVE OVER $50 OVER OTHER SYSTEM

$119.50

Pictured Romote control car alarm with 4 door central locking. Cat LA-8905

AC MILLIVOLTMETER

See catalogue for full specifications.

Cat QT-2320

Catalogue price $225

Birthday price

$175 save $50

PC mount transformer bargain

Save a fortune on normal prices.

240Vprimary - 3V secondary @ 725mA. Cat MF-1020

Was $3.95

Birthday price **$2**

NEW KIT

KARAOKE BOX

Refer EA Nov '91

With this kit you can remove the lead vocal from almost any recording and replace it with your own via a standard microphone (not supplied) Replaces the vocal canceller kit. Kit includes PCB, box, front panel and all specified components.

Cat KA-1738 **$27.95**

ECONOMY DIGITAL MULTIMETER

- 3.5 digit display
- Battery check
- Diode check
- Compact size

See catalogue for full details

Cat QM-1430

Normally $34.95

Birthday price

$30

save $4.95

TOWERS MICROPROCESSOR SELECTOR BOOK

Lists specifications of over 7000 microprocessor chips including MPU's, CPU's and support devices ROM's, RAM's, PROM's, clocks, VARTS and I/O's.
Cat BM-4564 **Was $19.95**

Birthday price
$8.50 save $11.45

Quality video/audio RF modulator

VHF unit switchable to Aust Ch 3 or 4. The audio is placed at the correct subcarrier frequency and output frequency is stable with good strong signal. Full specs supplied.
Cat LM-3848

Cat price $22.95
Birthday price
$17.95 save $5

Jaycar 5mHz CRO

See catalogue for full details
Cat QC-1910
Catalogue price $399
Birthday price
$349 save $50

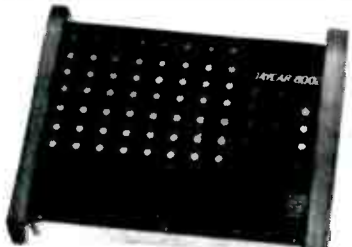
Studio 1/2 octave Eq kit

See catalogue for full details.
Cat KC-5055
Cat price $349
Birthday price
$299 save $50

BUY 10 LESS 10%

JAYCAR MIXER KIT SELLOUT

Don't miss this amazing runout sale of ALL our stock of 8, 12 and 16 channel mixers. This includes complete kits and separate modules. See 1991 catalogue pages 6 and 7.
20% OFF ALL MIXERS AND MIXER PARTS



6 Sector Programmable Alarm Panel Bargain

See last months ads or call into any store
Cal LA-5180
Save about $200 ONLY
$199.50

12 Sector Programmable Alarm Panel Bargain

Supplied with two alpha numeric remote keypads.
Cat LA-5185
Below wholesale **$599**

UHF ANTENNA PRICES SLASHED

We were sick and tired of paying too much for antennas. We have found our own supplier and can now reduce the prices by up to 45%. But don't worry, the new ones are imported but so were the ones they replaced. New everyday low prices. Wholesale enquiries: phone (02) 747-2022.

43 Element

Specs - Gain: 13dB, Channels: 21-69, Frequ: 470-862mHz, Boom: 20mm square, Overall length: 1234mm, Finish: elements and boom anodised.
Cat LT-3181
Was $89.50
NOW ONLY $49.50 SAVE 45%

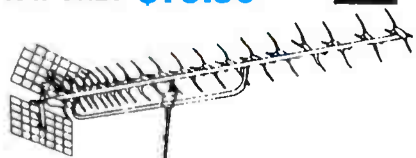
2 PIN MAINS LEADS SPECIAL

Don't miss this bargain. Top quality DMA brand 2 pin moulded mains leads. The cable is grey round with blueand brown inner cable. 240V, 7.5A, SAA approved. Length 2.75mt.

1 - 9	**$1.50**
10 - 99	**$1.35**
100+	**$1.00**

91 Element

Specs - Gain: 15-19dB, Channels: 21-69, Frequency: 470-862mHz, Boom: 20mm square, Overal length 2214mm, Finish: elements and boom anodised.
Cat LT-3182
Was $139
NOW ONLY $79.50 SAVE 43%



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DOUBLE SIDED FIBREGLASS BOARD

365 x 210mm
Cat HP-9520
Cat price $14.95
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$5.00 save $9.95

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THE SERVICEMAN

Tales of two VCRs — each with illogical faults

The three stories I have for you this month all concern two examples of a single model of video recorder: the Mitsubishi machine marketed here as the AWA AV-11. These have generally been very reliable, and I had not seen all that many in my workshop. However these two machines arrived within a few days of each other, and each presented as much trouble as I have ever had with a VCR!

The first of these stories is incomplete, in that although the machine is working again, the fault has not been repaired and in fact may never be properly restored. It seems to be totally unique, but if any reader knows the answer, both Mitsubishi and I would be very pleased to hear of it.

It began this way. The owner was quite perplexed and couldn't really explain what her problem was. All she could tell me was that occasionally she could not get the machine to switch on.

To me, when I began to examine it, the most obvious symptom was that the clock was not running. It could be set, and the counter would work, but the clock would not advance. It seems the owner hadn't noticed that it had been 12 o'clock for the last few weeks!

There seemed to be no doubt that the trouble lay somewhere on the timer board, since every other function worked perfectly (so long as the 'power up' function had not gone on strike).

Without going too deeply into the logic of the clock/timer board, I could only surmise that the lack of 'power up' was caused by a lack of clock signals. I assume that the board was going into a sort of self-induced 'Timer Record' mode and was waiting for the clock to tell it that it was time to start.

The timer board carries very few components, although it is a rather complicated arrangement. Most of the board functions are carried out by the timer microprocessor, an M558858-615P. There are a few mechanical switches, a few transistor switches, and a multi-segment fluorescent display. All in all, not a lot of parts to be checked in the hunt for the fault.

The micro has three main functions. It drives the clock display, using a crystal oscillator as a signal source. It also contains a power switch, for use in the Timer Record mode. And finally it drives the tape counter when switched to the Counter mode.

I removed the board from the machine and set about checking every resistor, capacitor, switch and transistor that I could get at. Need I say that I found nothing wrong with any of them? Similarly, I checked all the supply voltages and found them to be all present and correct.

This left only the microprocessor and the display as the likely sources of trouble. As far as I could tell, the display was a purely passive device, driven by the micro. I could imagine some segments not working, but not the 'No clock, no timer, but counter OK' situation I that found before me.

Which left the microprocessor under the strongest suspicion. I found all the voltages around the chip to be approximately correct. And the crystal oscillator was running at what seemed to be a reasonable frequency and amplitude.

It seemed that there was to be nothing for it but to change the microprocessor chip itself. So I ordered one from Mitsubishi. As a matter of interest, this machine has two M558858 chips, one in the timer and the other on the system control board. The timer chip carries the suffix -615P.

The chip eventually arrived and I wasted no time in fitting it to the board, then replacing the board in the machine.

I expected the job to be all but finished when I switched on and the clock came up with its normal 'Power-up' display, flashing alternately 'EE:EE' and '*', at about one second intervals.

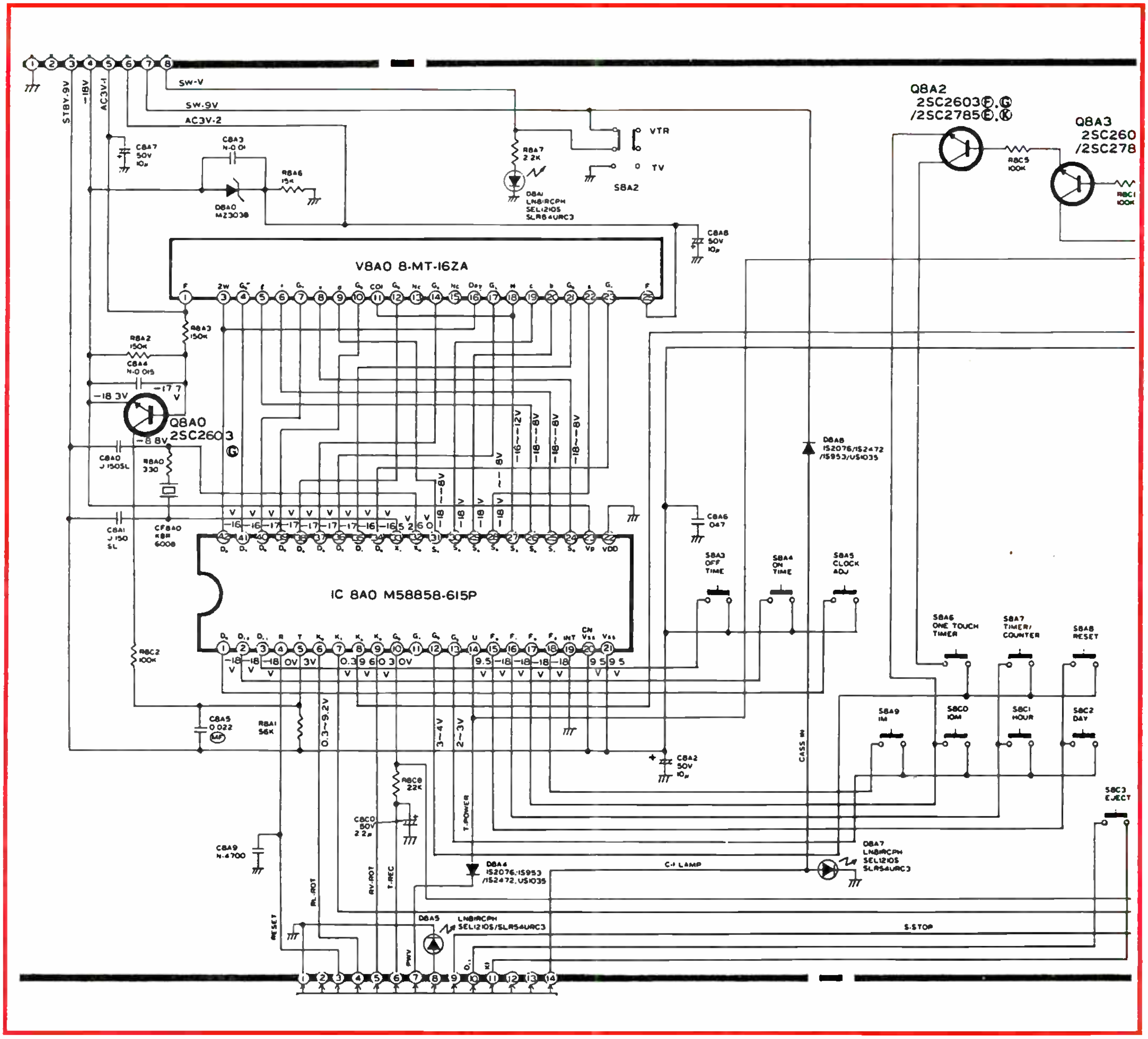
With the front cover off, I was unable to identify the clock setting switches, so I replaced the board and then the front panel.

This enabled me to set the clock to the correct time, and I proceeded to clean the tape path, test all the functions and reassemble the machine ready for the owner to collect.

But it was not to be. Five minutes after I had finished the job, I noticed that the clock had not advanced beyond the time I'd set earlier. Which meant that either the fault was still present, or else the new microprocessor was faulty.

This was confirmed when next I switched the power on, and found the display was no longer flashing. It had been OK when first switched on, but now it wasn't. So it had to be the micro.

I was right back to square one. It seemed to me that the cause of the problem was some fault off the board that



The timer and display circuitry of the Mitsubishi VCR, based on an M58858-615P microcomputer. In the first story related by our Serviceman this month, a machine stubbornly refused to turn on reliably — even when the microcomputer chip was replaced with a known good one. Finally, a temporary fix was achieved by linking pins 8 and 14...

could kill the micro. But I couldn't imagine what it could be. I could understand careless handling doing damage, but once the chip was installed and working that cause was hardly credible.

The really frustrating thing about the problem was that the machine was otherwise quite OK and if I could only bypass the micro, to get the standby voltage into the power supply, it could be used normally.

The service manual wasn't very helpful on this matter. All that I could determine was that the 9V standby rail went into the micro on pin 8. I had to work backwards from the power supply, along the power supply control rail marked OPW, to find that it originated at pin 14 on the micro. I wondered what would happen if I linked pins 8 and 14, and this was no sooner said than done. The machine came to life and played a tape as well as it had ever done. I could even switch the display to Counter and have that function work perfectly.

At about this time I had reason to call the Mitsubishi service department, and I took the opportunity to ask them if they had ever heard of the problem. They had had display problems, and they had heard of microprocessor problems, but never anything that fitted the symptoms that described this case. I thanked them, and promised to let them know if I ever came across the real cause of the trouble.

By this time the owner was rather anxious to have the machine back at home. When I explained the problem, she was not overly worried.

It seems that she has only rarely needed the timer function and could quite easily live without it. Neither did she need the display as a clock, so there seemed to be no great need to continue to hunt for the real cause of the trouble.

The machine was eventually collected and I heard nothing more of it for about three months.

Then I met the owner in the street and she confessed that she had quite forgotten that the machine was still bearing a fault.

She had not wanted the timer since it failed, and hadn't noticed that the clock was not running.

Some time later I acquired a good timer board from another source and called my customer to ask if she would like to have it fitted to her machine. She would, and in due course the new board was fitted and worked perfectly in every respect.

So the fault was definitely on the old board, and probably not in the microprocessor. But what it might be, I simply couldn't imagine. Can you?

VCR number two

The second machine came in with the simple explanation that "It won't record". I was assured that it would play back pre-recorded tapes without trouble, but anything that it tried to record would play back as a jumbled mess.

I queried the owner as to whether the machine recorded anything, or nothing at all. I also wanted to know if it would record the sound. He replied that the sound was OK, but the picture was rolling, losing colour, going dark then light — in short, quite unwatchable.

I forgot to ask him what the TV picture was like on the video channel, but as things turned out, the question would have been superfluous.

When I set the machine up in the 'E to E' mode, I could see just what he meant. The E to E picture was just as he had described the recorded picture, with the added symptom of an occasional reversal of contrast to a negative image.

If I had had my brain in gear, I would have solved this problem in short order. But then there wouldn't have been any story here, and our less experienced readers would not have learned anything...

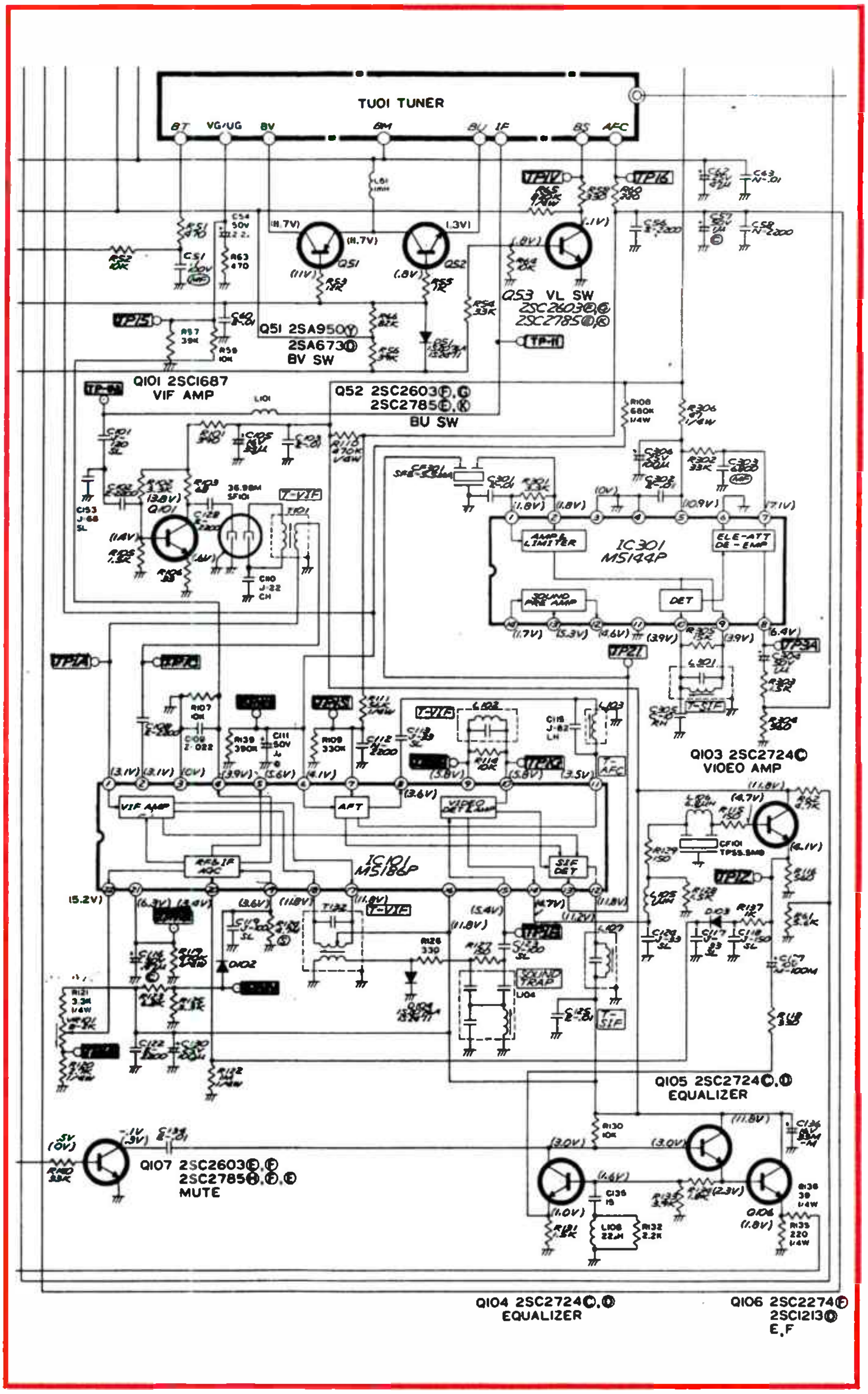
I began my investigations by connecting my pattern generator to the machine and tuning the colour bars. This is always a good move with unstable pictures, because it removes any possibility of interaction between the sync pulses and the video information.

Then I used my oscilloscope to look at the video coming out of the 'video out' socket. This showed exactly why the picture was so horrible.

The waveform was hardly ever still. It was jumping up and down so vigorously that even the special TV sync separator in the CRO couldn't lock the trace. Sometimes the trace expanded to double its normal height and this was accompanied by a negative image on the monitor screen. Then at other times it shrank to half its normal height, and cut off half the sync pulses into the bargain. There were any number of possibilities for this trouble, and I didn't quite know where to start.

I pulled out the service manual and looked for the tuner/IF diagrams. At first it didn't look all that complicated; but then I tried to trace out the route taken by the various video signals, to get some idea of where the trouble might be coming from.

The video IF emerges from the tuner at the top of the diagram. It then passes



Here's most of the tuner, IF and detector circuitry of the Mitsubishi VCR, on the front end signal board. After testing and replacing almost every conceivable component in this section, the second machine's problem turned out to have a surprising solution.

down between the band switching transistors and across to Q101, the first video IF amplifier.

From there it passes through a surface acoustic wave (SAW) filter S101, through T101 and into the main IF amplifier and processing chip IC101 at pins 1 and 2.

Fortunately, the diagram gives a block diagram for the interior functions of the IF chip. Without this information, the rest of the diagram would make very little sense, at least so far as signal tracing is concerned.

Inside the chip the IF signal is amplified and AGC controlled, before passing out, at pins 17 and 18, to an impedance converter and sound trap. It re-enters the chip at pin 15 and goes straight to the video detector.

From the video detector, the signal emerges at pin 14 and passes via a ceramic filter CF101, to the video amplifier Q103. From here the signal divides, one part going back into the AGC circuits inside the chip at pin 20.

The other route taken by the video signal goes into a network of three transistors Q104, Q105 and Q106, which are labelled 'Equaliser'. The equalised signal leaves the network at the emitter of Q106 and passes out to the rest of the circuitry on the left of the diagram.

The sound IF and AFC detectors are also incorporated in IC101. Incidentally, the latter function is variously labelled AFC or AFT in different parts of the circuit.

So, once I had mapped out the signals, I was ready to begin seeking a cause of the fault. I began by looking at the tuner output with my modified TV test set.

With video IF from the VCR tuner fed into the IF strip in the television, I found a perfect picture; no sign of rolling or inversion.

Fault of the Month

AWA Thorn ML chassis CTV

SYMPTOM: Dark band down the left-hand side of picture. It looked very much like a ghost of the horizontal blanking bar. A secondary symptom was a slight kink in the band, and any other vertical lines in the picture.

CURE: C905, a 33uF 450V electrolytic capacitor, was open circuit. This is one of two main filter caps that smooth the output of the bridge rectifier. With C905 open circuit, the switch-mode power supply that followed was unable to eliminate the ripple at its input.

This information is supplied by courtesy of the Tasmanian Branch of The Electronics Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

Next, I took IF from the test set and injected it into the VCR at the base of Q101. This resulted in pictures just as bad as the machine's own tuner and placed the problem firmly in the recorder's IF strip.

At this point I had a sudden recollection. The next component in this circuit was the SAW filter and I had seen similar troubles in TV's when this filter has broken down.

On those occasions, I had been able to prove the point by bypassing the filter with a small capacitor. But this time I wasn't going to be so lucky. The bypass cap made very little difference and I had to go on to look for the fault elsewhere.

I injected the IF into the chip at pin 1 and still had the problem. There was absolutely no difference in the picture, whether the source of IF was the VCR tuner or the television tuner. At this point I was thinking that I had run out of things to try with the IF.

Then I realised that there was another access point, on pin 15 of IC101, leading to the video detector. Any signal injected here would lack the benefit of earlier IF amplification, but it could give some indication of what was going on.

And indeed it did. Feeding signal straight into the detector produced a clean, stable picture — lacking only some of the contrast that more gain would have given it. More to the point, it proved that the fault was somewhere between the video IF amplifier and the input to the video detector.

By now I strongly suspected the IF chip itself. It was an M5186P, and I didn't have a replacement in stock. But I did have an old AWA ATV4 VCR which used the same chip and still had a good one on board.

I wasted no time in changing them over, but all to no avail. The fault was still there, and just as bad as ever.

Now I knew quite a few things that were *not* faulty, but I was still no nearer finding the one that was.

Over the next hour or two, I went over the board with the proverbial fine-toothed comb.

I measured all the resistors, and replaced any that gave ambiguous readings. I checked all the coils and transformers for continuity, and all capacitors for short circuits. I found nothing amiss.

Then I got to work on the electrolytics. There were quite a few of them on the board, and many were low value components for which I have developed a deep mistrust.

Doing a proper job on electros involves removing them from the board and checking for both capacity and leakage.

In this case everything came up roses. Not a fault anywhere — that I could pin down. It began to look as though the fault had to be in one of the ceramic filters, either the SAW filter after the first IF amplifier, or the 5.5MHz filter after the video detector.

Bypassing these did nothing to improve the picture, but I had come to the point where I had nothing else to blame. Because I had no replacements for these filters and would have to order them from Mitsubishi, I put the machine aside to await their arrival.

Then late one night, I had a flash of inspiration. It came to me quite suddenly that I knew what the fault was, even if I didn't know exactly what was causing it.

I had seen this sort of problem in TV sets, going right back to the early days of black and white. It is caused by a failure of the AGC circuit, and the consequential variation of the signal reaching the video detector.

Depending on the nature of the fault, it can clip the sync pulses from the video signal, causing rolling and instability. Or it can allow exceptionally large signals to reach the detector, causing overload and picture reversal with similar vertical hold problems.

In fact, I have had customers complaining about lack of vertical hold, without ever noticing that the picture has gone negative!

In this case, I was facing a more unusual job — because this picture was exhibiting spasms of both types of AGC failure. I wasn't sure if I had one or several problems before me.

First thing next morning, I tried running the machine with a 'battery box' patched across the RF AGC line. A battery box comprises a 9-volt battery wired across a 10k potentiometer, with leads terminating in crocodile clips going from the negative and slider terminals.

Unfortunately I was unable to get at the IF AGC, because it was generated and applied to the IF amp inside the chip. The block diagram showed five pins connected to the AGC section of the chip, but applying my battery box to each of them in turn produced no result worth speaking of. Certainly, it did not cure the fault.

By this time, I had spent many hours on the machine and it owed me more than I would ever be able to charge. So I put it aside while I cleared some other work, and in the hope that a new inspiration might come again late one night.

A week or two later I was yarning with some colleagues about work in general when I mentioned the VCR with the AGC problem. One of these friends said, without even looking up, "Change the electros!"

I told him that I had already had them out and checked for both capacity and leakage, but he kept on repeating "...change the electros!"

We pulled out his copy of the manual and he stood there looking at it for two or three minutes. Then he put his finger on C116, a 0.47uF 50V unit from pin 21 of IC101 to ground. "That's it! Change that!" he announced.

And that's the end of the story. I put a new 0.47uF electro into the circuit, and the picture came up perfect. It's been perfect ever since.

Again I tested the faulty capacitor every which way, and it measured perfect. I even tried cobbling the cap into a small time constant circuit and driving it with a 1MHz square wave from a signal generator. Even this worked exactly as theory would have predicted. Yet the cap would not work in the AGC circuit.

I have always mistrusted low-value electros and this incident serves only to harden that mistrust. I will have to change my habits and learn to discard every such cap that ever gives rise to suspicion.

Hidden fault

The third fault in this series involved the machine just discussed. In fact, the owner didn't know the fault was there, and it may never have shown up if the machine had not cooled off while it was being brought into the workshop.

The fault took the form of a continuously rotating takeup spool. It started as soon as power was applied, and continued for a quarter of an hour or more, until it was thoroughly warmed up.

After that, I didn't see the fault again that day, but it returned next morning when I restored power to the workshop.

The fault didn't seem to cause any trouble with the deck's mechanical functions. The spool stopped rotating when a cassette was inserted, and seemed to drive the takeup reel without any trouble.

I put this problem aside initially, while I tackled the AGC headache related above. In the meanwhile, I looked up a list of service tips for this model that was published some years ago. And here I found the cause and the cure.

In common with many other Mitsubishi models, both VCR and TV, this chassis has many components glued in with a brownish coloured rubber cement. This is apparently applied in the factory, to hold components in place before they are soldered in.

Unfortunately, the cement Mitsubishi chose to use deteriorates after a few years and becomes hard and conductive. Many transistors that appear to be short circuited only have a layer of this material between their base and collector.

That was the case here. The takeup reel drive transistor, Q5C1, a 2SD1273, and its heatsink had a liberal dose of this cement and exhibited as near to a short circuit as doesn't matter.

I unsoldered it and then pulled it off the board for a closer examination. With the cement cleaned away from the pins, the transistor showed no sign of leakage and was quite OK to go back into service. Getting the cement off the board itself was another story.

It had spread over a number of small components, diodes, resistors, etc., and then gone hard. I started to chip it off the board, but soon realised that this would have taken weeks. I needed something to soften the cement. I suspect that this cement is a form of synthetic rubber. Fortunately it seems to respond to natural rubber solvents.

I keep a small can of white spirit, also known as Shellite, on hand for just such a problem as this.

A small brush dipped in the spirit can be used to dampen the cement wherever it can be reached. Very hard cement may need two or three applications, but it will eventually work well enough to allow most of the cement to be lifted off. Sometimes the cement clings so tenaciously on, and under, small components that the board must be literally flooded with spirit to effect any removal. I have occasionally had to use a big brush and lots of spirit to flush away the last of the cement.

This treatment should be carried out out-of-doors and naturally, cigarettes and matches MUST be kept well away. After treatment the board can be left to dry off in the sun before being replaced and tested.

In this case the treatment seemed to be completely satisfactory, and next day there was no sign of rotating reels. I certainly had plenty of time to confirm this fix, before the AGC fault was cured. I just wish the first fault had been as easy to track down as the second!

That's all for this month. Next time I hope to have a collection of contributor's items for you. ■

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.

Computer interface

This interface was born out of the need to operate 26 switches and monitor 24 LEDs, and also allow for future expansion. Its advantages are: it is capable of reading an integer in a few microseconds; I/O is software controlled; and it is made of cheap, readily available parts.

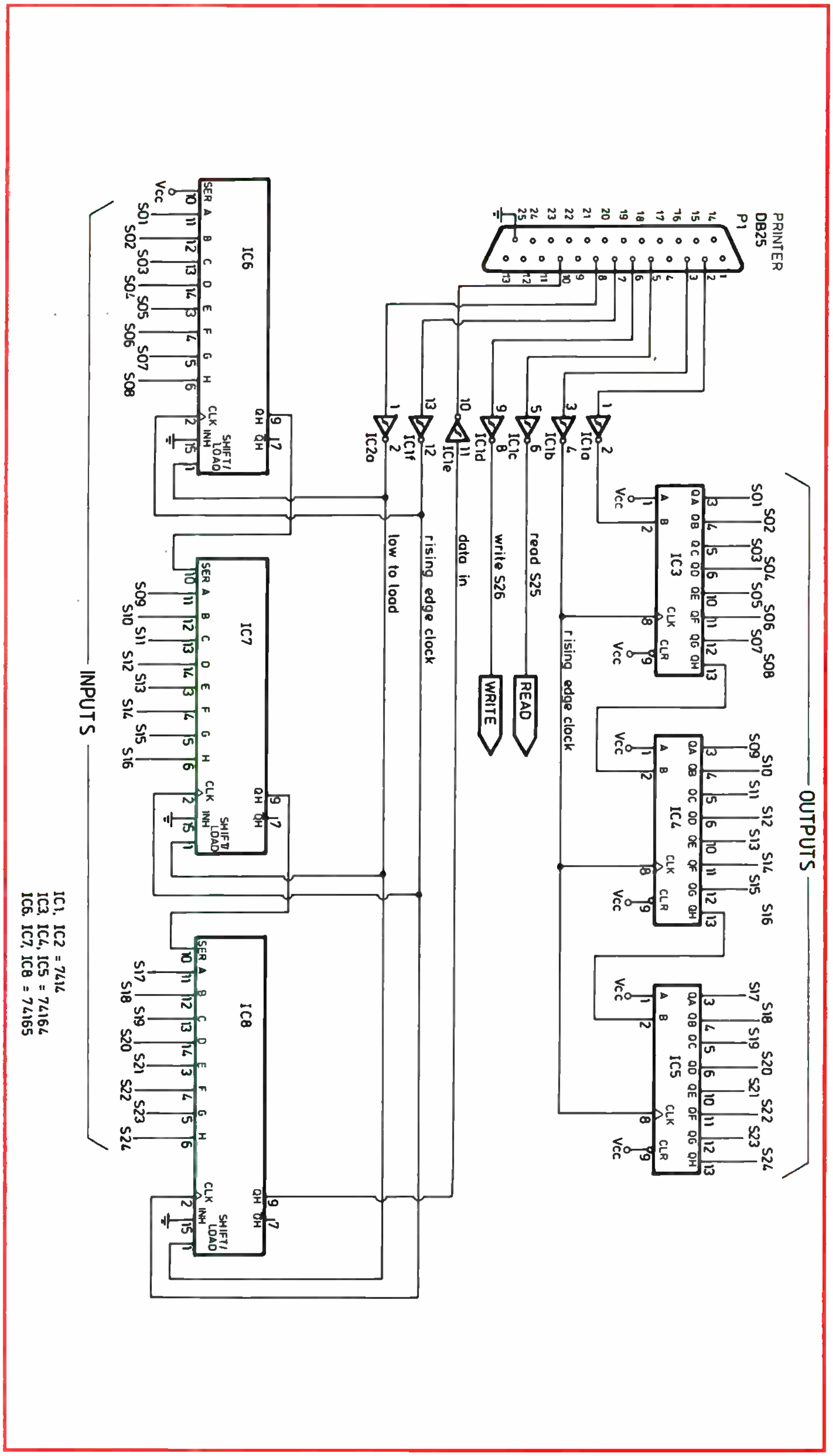
The interface uses the parallel printer port as a number of serial ports, giving several ready made lines into and out of the computer. (The author has provided a Turbo C program to serially input and output a character and integer, one shifted left and the other right. Photocopies of the listing are available from the reader services division of *EA* for the usual $5 fee.)

Output of data occurs on pin 2 of the DB25 socket P1. After inversion in IC1a, it goes to the serial input pin 2 of IC3. P1-pin 3 next outputs a falling edge clock pulse, which IC1b transmits to IC3-IC5 as a rising edge. This shifts the data along the serial-in, parallel-out shift registers. Three interconnected registers are shown — this number can be reduced or expanded to suit different requirements.

For the reverse procedure, to input data into the computer, it must first be loaded into the parallel-in, serial-out chips, IC6-IC8. P1-pin 8 sends a high pulse which is inverted by IC2a to produce a low input to the shift/load, pin 1, of these chips. This latches the parallel data into internal flipflops in the 74165s so that any change on the parallel-in lines will have no effect until the next negative load pulse.

The data is then read into the computer via P1-pin 10, after inversion in IC1e. P1-pin 7 provides a series of low pulses, inverted by IC1f, to clock pin 2 of IC6-IC8 to shift the data into the computer. When outputting data from the computer, if the 75164s have to be cleared before use, P1-pin 4 could be connected to the CLR pin 9 of IC3-IC6. Similarly, any other unused pins on P1 (e.g. pins 5 and 6) can be used to directly control different I/O devices.

Greg Smith,
Mitcham, Vic $40



Quiz game

Here is a circuit for a quiz game buzzer suitable for large groups of people, like sunday school, kids clubs and camps. Like all similar circuits, the first contestant to press his or her pushbutton latches on their light, locks out the other contestants and sounds the buzzer for a short time. The compere pushes a button to reset the game for the next question.

The circuit is built around a 4044 quad R-S flipflop chip.

Assume contestant 1 is the first to press their button. PB1, connected to pin 15 of IC1a, goes low and sets the flipflop. This sends pin 1 high, which acts through D1 to make the pushbutton bus high — locking out the other contestants. Pin 1 going high also turns on lamp 1. The lamp is controlled by a silicon controlled rectifier which allows the use of high wattage lamps (up to 36W), making the display very easy to see. Cheap 18W 12V trailer lamps can be used without heatsinking the SCRs.

The lamps are powered by unfiltered DC current since the current through the SCRs must fall to zero to allow them to turn off. If filtered DC was used, once a lamp was triggered it would stay on until the supply was interrupted.

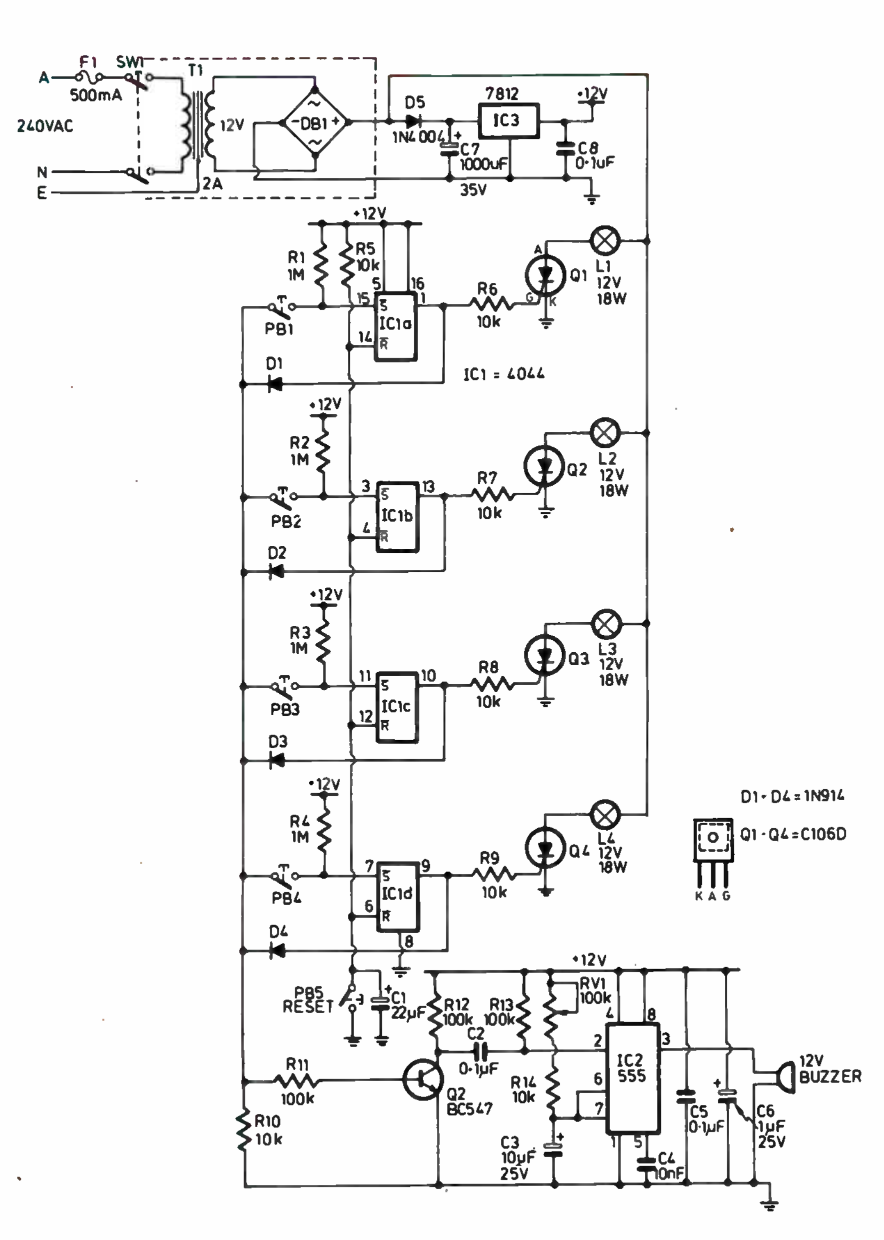
The pushbutton bus going high also sounds the buzzer. When Q2 turns on, it triggers IC2 with a negative pulse to send its output pin 3 high. The 555 is used in a monostable mode, with RV1 able to adjust the length of the output pulse. This allows the buzzer to sound for roughly 0.5 — 5s.

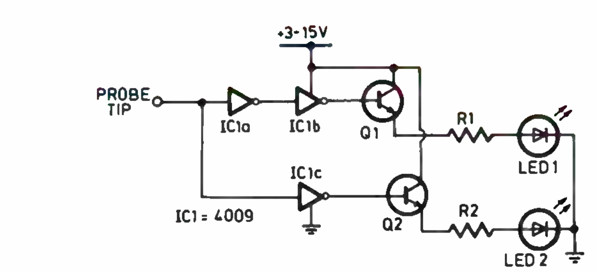
Pressing the compere's reset button PB5 provides a negative pulse which resets all the flipflops, and so turns off the winner's lamp and allows the next game to proceed.

The capacitor C1 across the pushbutton ensures that all flipflops are reset at power up, to prevent any lamps coming on.

IC3 provides a suitable 12V supply for the ICs in the circuit. To save expense, the dashed section of the power supply may be replaced by a commercial battery charger with a 1.5A continuous rating, assuming you already have such a unit.

David Pickering,
Bundaberg, Qld **$40**





Poor man's logic probe

The power for this probe is derived from the circuit being tested, which should be in the range 3-15V. The circuit draws about 60mA.

The signal passes through the probe tip into both 4009 inverters. The lower inverter, IC1c, inverts the signal, and drives the 'Lo' LED indicator.

Sufficient current is provided by IC1c turning on transistor Q2. The upper pair, IC1a and IC1b, function in a similar way, with IC1b turning on Q1, but the pair buffer the signal without inverting it, in order to drive the 'Hi' LED.

Paul Fitzgerald,
Te Aroha, NZ **$30**

ANTENNA TUNER AND RF PREAMP

Here's a low cost, easy to build unit which can really improve the performance of many elderly shortwave receivers, and give them a new lease of life. It combines an antenna tuner with an RF preamp and preselector — giving the ability to improve both sensitivity and selectivity, at the same time.

by JIM ROWE

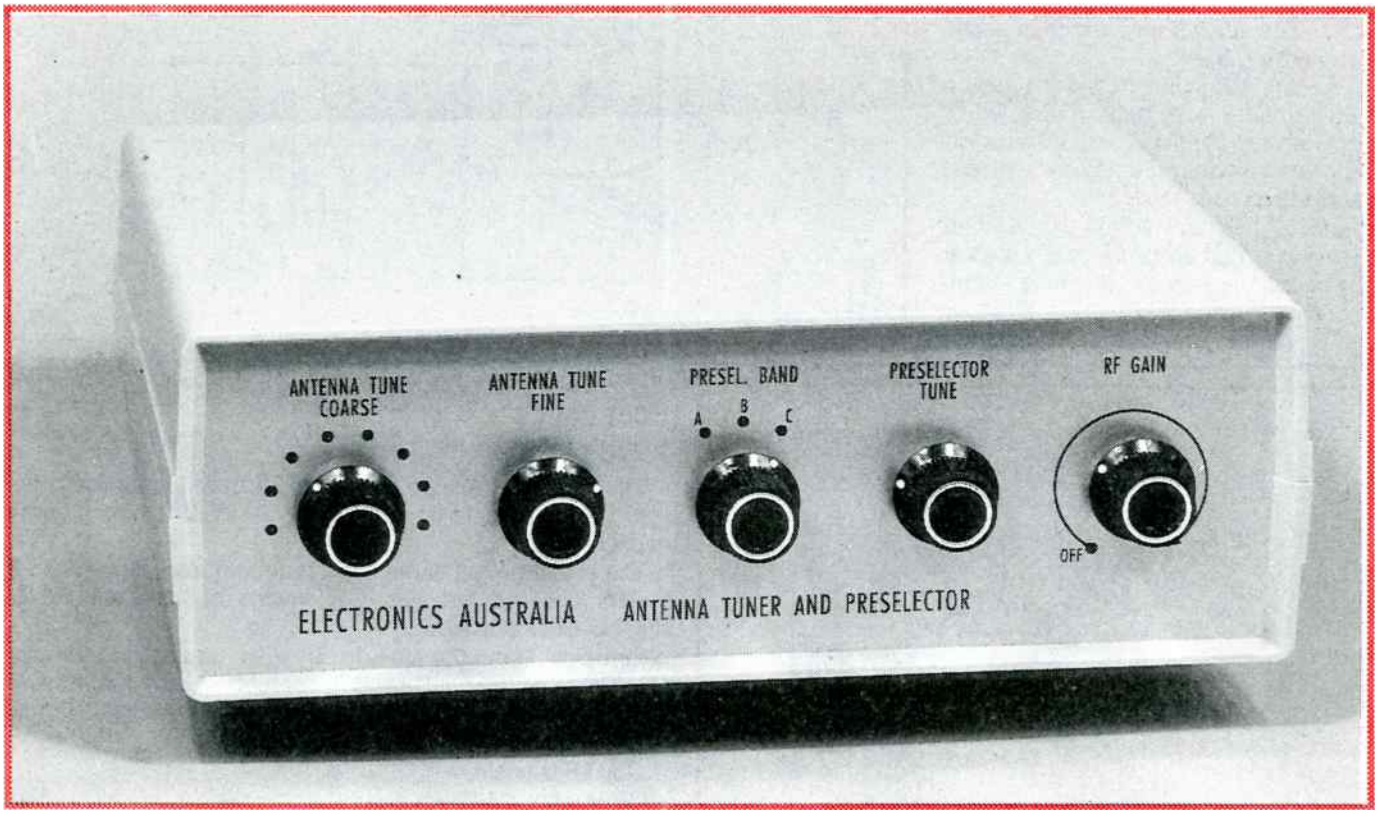
Nowadays most of us live in fairly crowded urban and suburban situations, where it isn't easy to set up an elaborate antenna system for shortwave listening.

As a result many people have to settle for a few metres of wire, either run around a window frame indoors, or perhaps out to a nearby post or tree at best. The results with such a modest antenna system can be fairly disappointing, even with a sensitive modern receiver.

Even going to the trouble of setting up a larger antenna may not achieve a great deal of improvement. There are many sources of noise and interference in our modern society, and a larger antenna may well cause these to 'swamp' the receiver front end. This can cause all kinds of problems, unless your antenna can be tuned to at least a broad resonance at the frequencies you're interested in — to reject a large proportion of the unwanted signals and interference.

For satisfying reception, then, you often need an antenna tuner. Quite often a further improvement can be obtained by adding a preselector or 'tuned filter' stage as well, to provide further help to the receiver's front end in rejecting unwanted 'rubbish'. And finally, with older receivers in particular, it can be desirable to provide some additional RF gain — if only to compensate for the shortcomings of a modest antenna system.

The unit described here has been designed to provide all of these facilities, in a compact and low-cost



form. It's easy to build too, with virtually all of the parts readily available through normal stockists.

Housed in a standard medium-sized plastic case and with most components on a PC board to simplify construction, it provides a simple antenna tuner capable of resonating most typical small- to medium-sized high impedance 'length of wire' antennas, over the frequency range from 500kHz to 30MHz. This makes it suitable for improving broadcast-band performance as well, by the way, which may make it of interest to country listeners.

Along with the antenna tuner, the unit also includes a tuned RF preamp stage, which provides both gain and preselection over the same frequency range as the tuner. The preamp has three tuning bands, and provides a maximum gain which varies typically between about 35dB at 500kHz and 17dB at 30MHz — very worthwhile in boosting the performance of older receivers.

At the same time the preamp has adjustable gain, so that the level provided can be set for optimum reception without producing overload. In fact when the control is turned to the minimum position, the unit actually *attenuates* the incoming signals rather than boosting them — allowing a very wide range of adjustment.

The complete unit is powered from an external 12V DC source, which can either be batteries or a low-cost 'plug pack' power supply. The power drain is very low — less than 10mA.

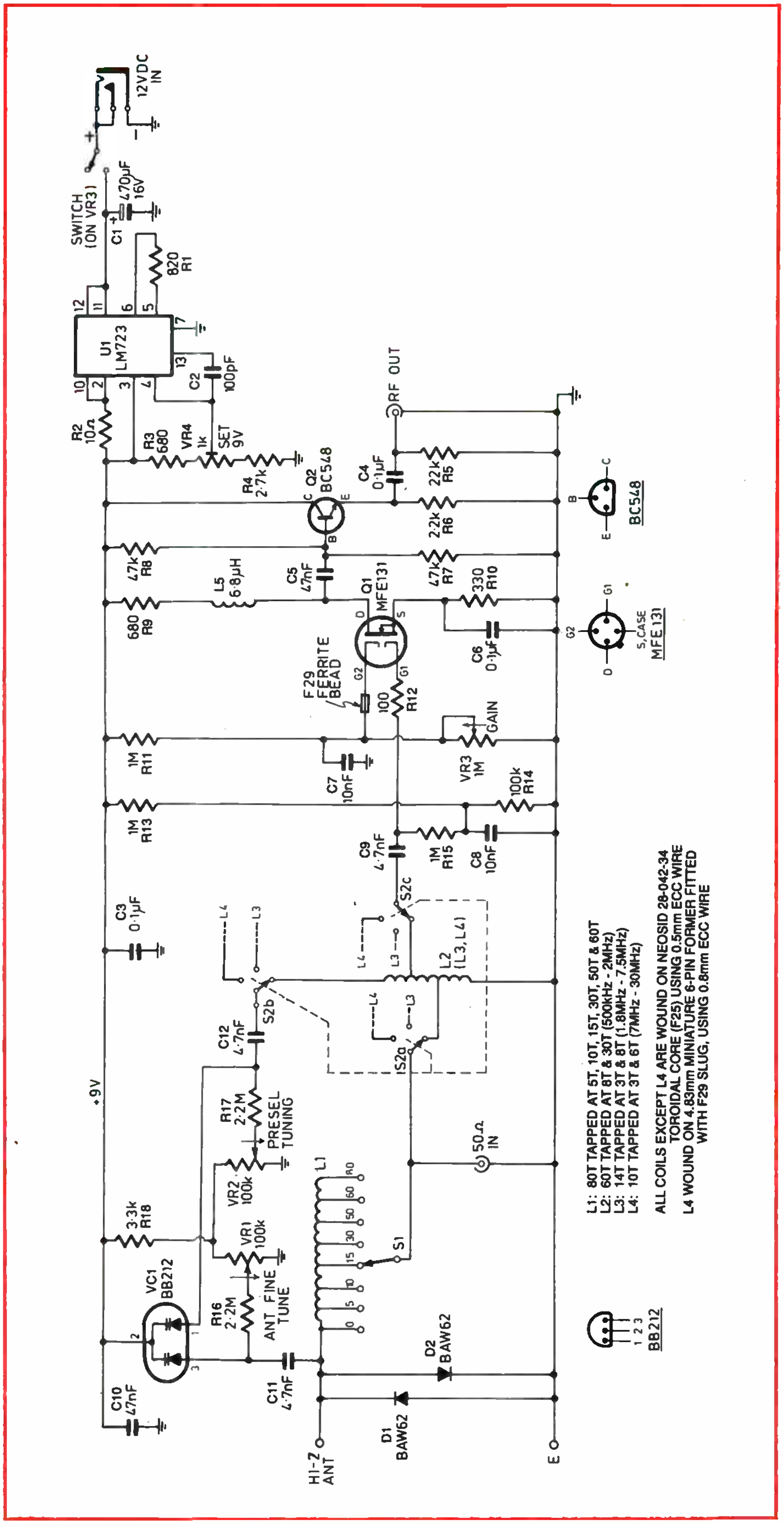
Incidentally, the unit can also be used as an 'active indoor antenna', simply by fitting it with a small telescopic whip antenna. Provision has actually been made for this on the printed circuit board, although low-cost telescopic whips don't appear to be readily available at present.

Circuit description

As you can see from the schematic, there isn't a great deal of circuitry involved. Inductor L1 is the antenna 'coarse' tuning coil, with adjustable taps and selector switch S1 to allow it to cope with a wide frequency range and variety of antennas.

Like two of the inductors in the preamp/preselector section, L1 is wound on a Neosid 29-042-34 toroidal ferrite (F29) core, using 0.5mm enamelled copper wire.

Fine control of antenna tuning is performed by one half of VC1, a BB212 dual varicap diode, with its necessary reverse bias voltage adjusted by pot VR1. The other half of the BB212 is



As you can see from the schematic, the circuit of our new antenna tuner/RF preamp is quite straightforward. Note that the small arrows on VR1, VR2 and VR3 indicate clockwise rotation.

used for the preamp/preselector fine tuning, adjusted by VR2.

Fine tuning of both sections would be somewhat simpler if conventional air-dielectric tuning capacitors were still readily available, but they're not. Still, the diodes inside a BB212 have a wide capacitance range (typically 20-550pF), and are smoothly adjustable using a bias range of 8V-0.5V.

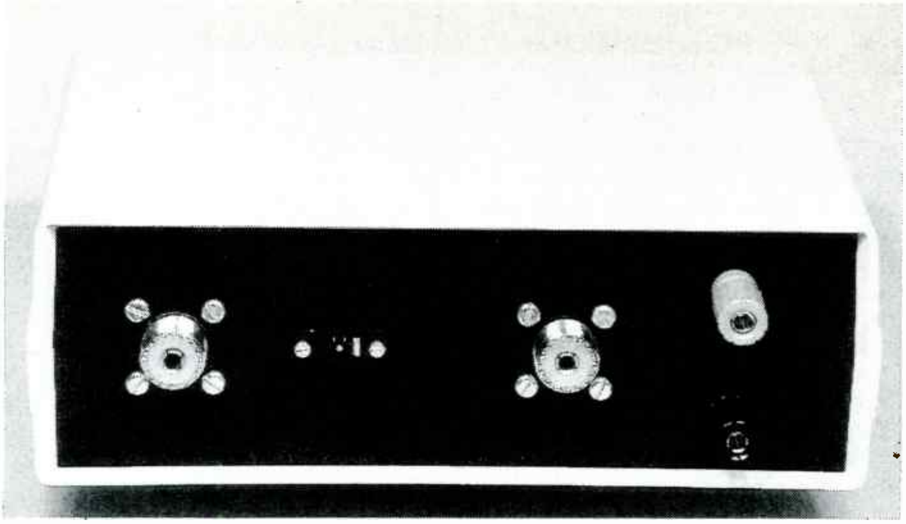
The only real complication with varicap tuning is that the bias voltage must be tightly regulated, to ensure that the tuning is stable. Since the present circuit is intended to be operated from relatively unstable supplies such as batteries or a low-cost plug pack, an LM723 regulator chip (U1) is used to establish a stable and well filtered +9V supply line. The LM723 is cheap and readily available, and needs only a few peripheral components to do the job. Preset pot VR4 is used to set the supply rail to 9V.

At the output of the antenna tuner section, a 50-ohm input is provided. This allows direct input to the preamp/preselector from a resonant 50-ohm antenna, if desired.

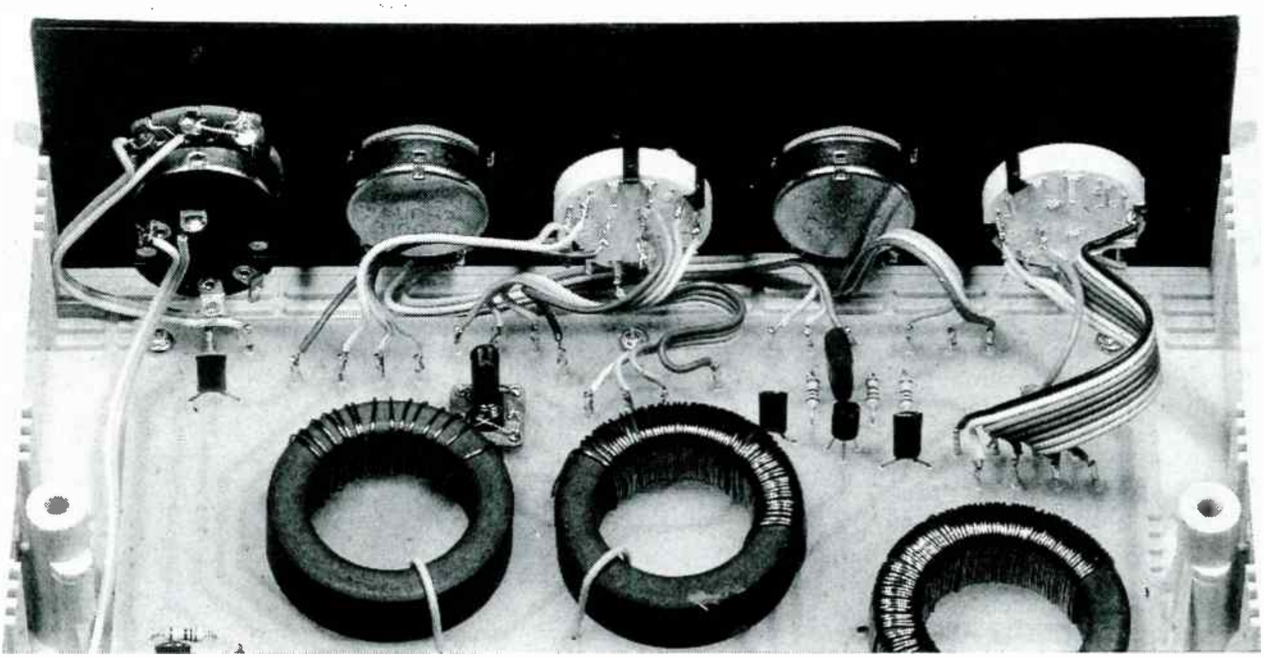
The preselector tuned circuit uses three switched coils L2, L3 and L4, selected by band switch S2. Each coil has two taps — one at a fairly low point to match the nominally 50-ohm input from the antenna tuner section, selected by S2a, and the other (selected by S2c) somewhat higher to suit the high impedance input of the RF preamp section. The varicap tuning connects to the top of each coil, via S2b.

L2 tunes from 500kHz to 2MHz, while L3 tunes from 1.8MHz to 7.5MHz and L4 from 7MHz to 30MHz. The first two of these are wound on Neosid 28-042-34 ferrite toroids, like L1, while L4 is wound on a 4.83mm miniature coil former, provided with an F29 ferrite slug.

The RF preamp section of the circuit uses two readily available transistors: an MFE131 dual-gate MOSFET (Q1), and a BC548 NPN bipolar (Q2). The MFE131 provides the gain, while the BC548 matches its relatively high impedance output to the low impedance (nominally 50 ohms) of a typical



The rear of the unit is not terribly exciting, to be sure, but it's quite functional. From right to left the connectors are high impedance antenna input, 50-ohm input, 12V DC input and RF output.



A view inside the unit, showing the controls behind the front panel and the wiring between them and the PC board. Note that the PC board visible in this picture is slightly different from the final design.

shortwave receiver input. Despite its simple configuration, this preamp circuit gives good results. In fact I was able to optimise its operation quite conveniently using Intusoft's *IsSPICE* analog circuit simulator, during my recent reviews of this and other simulator packages.

The final design needed only a minor adjustment to the value of L5, the peaking choke in the MFE131's drain load (from 4.7uH to 6.8uH), to match the simulated performance. The DC conditions of the MFE131 stage are arranged to be as tolerant as possible of device parameter spread, so that almost any device should give good results without any component changes.

This is done by the choice of source resistor R10, to give negative current feedback, coupled with a small forward bias applied to G1 via the voltage divider formed from resistors R13 and R14, across the 9V supply.

The gain of the stage is adjusted by pot VR3, which varies the G2 bias voltage between zero and +4.5V. Maximum gain is achieved at around +4.3V for most devices, while the MFE131 is throttled right back and virtually becomes a signal attenuator when the G2 voltage is reduced below about +1V.

VR3 is actually a switch pot, with the switch wired in series with the +12V DC input so that it can be used for on-off switching when a battery is used.

The 100-ohm resistor R12 in series with the MFE131's G1 lead, and the F29 ferrite bead fitted to its G2 lead are both parasitic stoppers, to ensure that the device gives stable amplification.

Probably the only other components which need a mention here are the two BAW62 diodes D1 and D2, connected across the antenna tuner input terminals. These are to protect the circuitry against damage from minor corona discharges, and perhaps also very high-level signals from passing or nearby transceivers.

Note that the diodes will *not* provide protection against damage from lightning strikes, or larger corona discharge during electrical storms. The best protection against these 'serious' sources of damage is to disconnect any outside antenna, during such a storm.

Construction

As noted earlier, the complete unit is housed in a readily available plastic case measuring 200 x 160 x 67mm. With the exception of the control pots and switches, and the various input and output connectors, all remaining components are mounted on a PC board measuring 167 x 114mm and coded 91rfb10.

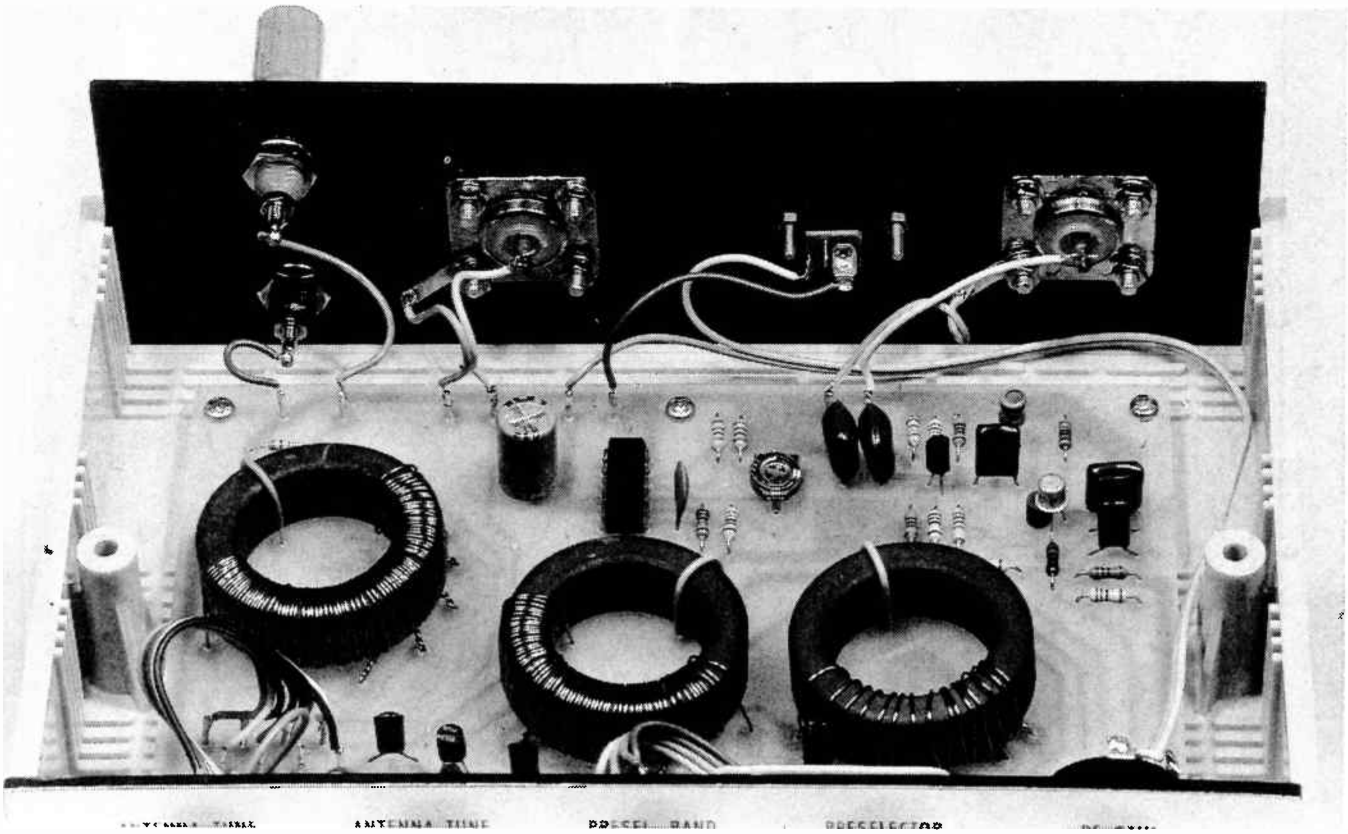
The control pots and switches are all mounted on the case front panel, and wired to the PCB via short lengths of hookup wire, while the connectors all mount on the rear panel and are wired to the board in the same way.

The position and orientation of virtually all of the parts should be clear from the PCB overlay diagram and the various photographs. Hopefully the connections between the PCB and the controls and connectors should also be quite clear, especially since the overlay diagram is provided with detailed legends.

Note that the PCB has been arranged to accept either a horizontal- or vertical-mount miniature preset pot for VR4, to make things easier if one type or the other should become unavailable.

I recommend that you fit PCB pins to the board at all places where wires are used to connect it to either the front-panel controls or the rear-panel connectors. This makes it easy to connect everything up, after the complete PCB assembly is finished and mounted inside the bottom half of the case.

Fitting the PCB pins should in fact be the first step in assembly of the PCB, after you have checked it for any imperfections in etching. After pushing each pin through its hole from the component



And here's a view looking in the opposite direction, showing the rear panel connectors and the wiring from them to the PC board. Also visible are most of the components on the rear half of the board.

Antenna tuner

side, solder it carefully to the surounding copper pad.

As usual the next step is to fit the lower-profile components, such as the resistors and diodes. Then follow the capacitors, taking care with the polarity of electrolytic C1.

Next you can add the regulator chip U1, varicap diode VC1 and the two transistors Q1 and Q2. Note that Q1 has an F29 ferrite bead (DSE cat. number L-1433 or similar) slipped over its G2 lead before mounting on the board, and hence mounts above the board by the length of the bead — 5mm.

Don't mount it any higher than this, however; push it down so that its body is hard against the top of the bead. Q2 and VC1 can also be mounted about 5mm above the board, while U1 mounts right down on the board.

Preset pot VR4 can now be mounted, with its pins pushed as far into the board as possible before soldering. Also RF choke L5 can be added as well, with its body again about 4-5mm above the board.

At this stage your board assembly will be complete apart from the coils, and the next step is to wind these. The easiest is L4, which winds on one of the miniature 4.83mm formers which mates with a 6-pin base (DSE cat. no. L-1010 and L-1015, or similar).

As you can see from the schematic, this has a total of only 10 turns, with the T1 tap and 3T and the T2 tap at 6T. The pins on the former used for the four connections are shown in the PCB overlay diagram (viewed from above).

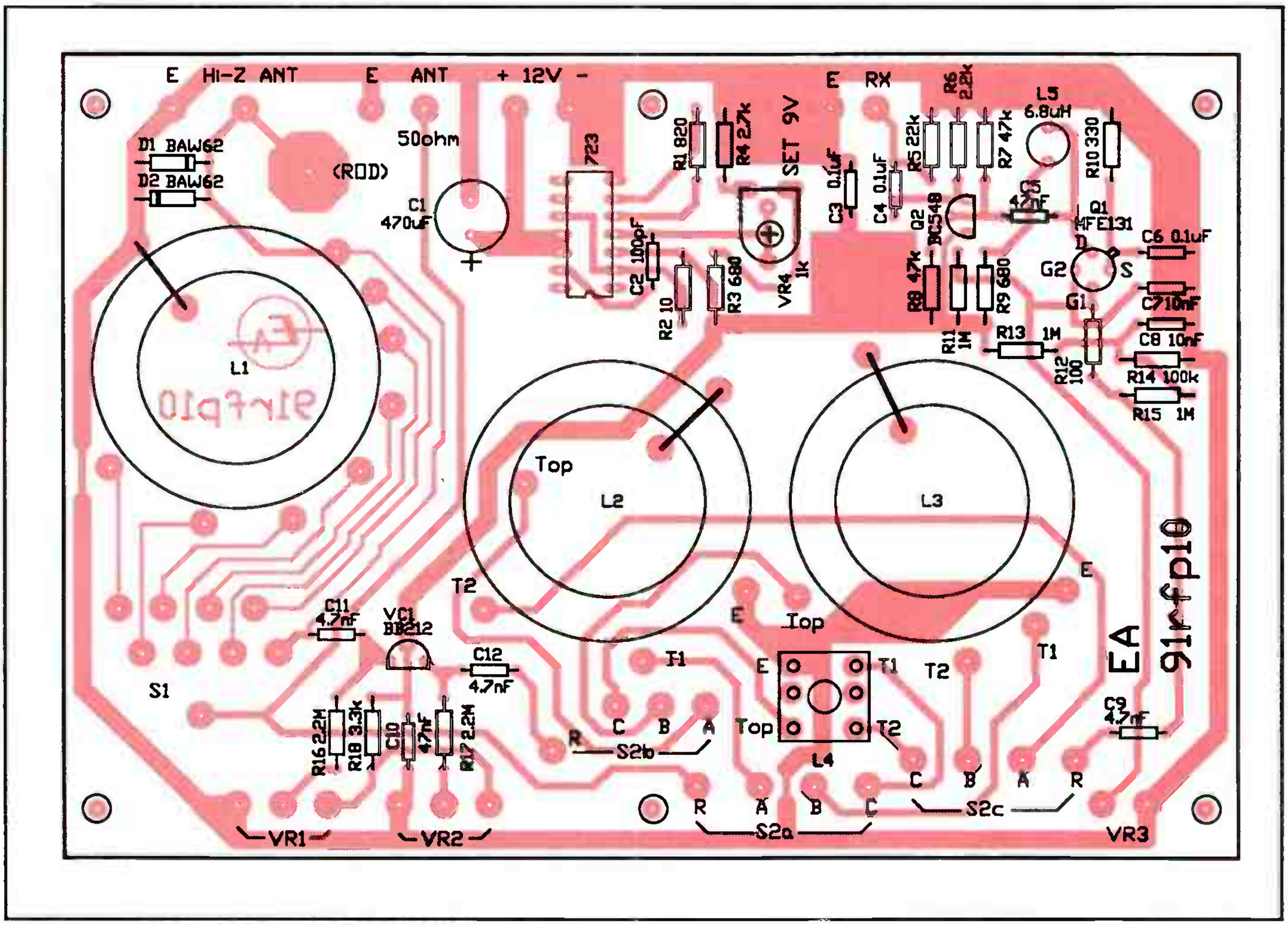
I suggest you wind each section of L4 in turn, soldering its 'start' end to the appropriate pin before winding, and then its 'end' to the next pin afterwards. This works out rather more conveniently than trying to wind the whole thing and then soldering everything to the pins afterwards. Don't forget to wind each section in the same direction, though.

The three other coils are all wound on the Neosid toroids, using a slightly different technique. Here since the coils are mounted directly on the PCB, with their connections made directly to it, the easiest way is to wind them completely first.

This is done using a single length of wire for L3, bringing the taps out as you go by leaving a short loop or 'doubled back' section, and twisting it around tightly to strengthen it before proceeding with the next part of the winding.

After the complete winding is finished, the twisted 'tap leads' can then be scraped and tinned with a hot iron, to burn off the enamel and make them ready to pass through the PCB holes for soldering.

The same basic technique is used for L1 and L2, but as these require longer lengths of wire, and toroids are not easy to wind with such longer lengths, you can actually use shorter lengths and make joins at one or more of the tapping points. As before this is done simply by twisting the 'start' of one wire tightly to the 'end' of the previous length, at the tapping point, and then soldering the two together later when the total winding is completed. As with L4 the main thing to watch is that all sections of each coil are



Here's the PCB overlay diagram for the antenna tuner/RF preamp. Note that the connections for L2, L3 and L4 are indicated as well, along with the connections for the three sections of band switch S2.

wound on the toroid in the same sense — i.e., either all clockwise or all anticlockwise.

When you're winding each of the toroid coils, work slowly and carefully so that your windings are fairly tightly wound around the core. Loose windings will give poorer 'Q', and hence less effective tuning. Also keep an eye on the PCB, so you can see the locations provided for each of the tapping points on each coil.

When all of the coils are finished, the next step is to mount them on the PCB. With L4 this is again very simple — you merely push the former's pins through the appropriate holes (note the polarised spacing), and then solder them to the pad underneath.

The three toroidal coils involve a little more fiddling, as you have to form each of the leads and persuade them to pass through the appropriate PCB holes. With the twisted 'tap' leads, you may find it necessary to enlarge the PCB holes a little with a small round file or drill (say 1.5mm), to make things easier.

Note that all three toroidal coils also have an additional 'U-shaped' link fitted over them, roughly opposite the winding, to help secure them to the PCB. These links can be made from short lengths of hookup wire, which is soldered to isolated pads under the board. (Don't link the pads together underneath, by the way — this would make the wires into shorted turns, and ruin the performance of the coils.)

The completed board assembly can now be mounted inside the lower half of the case, and you can turn your attention to the front and rear panels. These will need to be drilled out to suit the various controls and connectors, which mount as shown in the photos.

The front-panel control positions can be determined easily using as a template a photocopy of the panel artwork, which is reproduced here in the article. Take care in drilling and reaming the holes, though, otherwise you may have difficulty in lining everything up for a neat result.

With the prototype we made a false front panel using 3M's 'Dynamark' photosensitive aluminium sheet, and stuck this to the case's plastic front panel. This gives a very neat appearance.

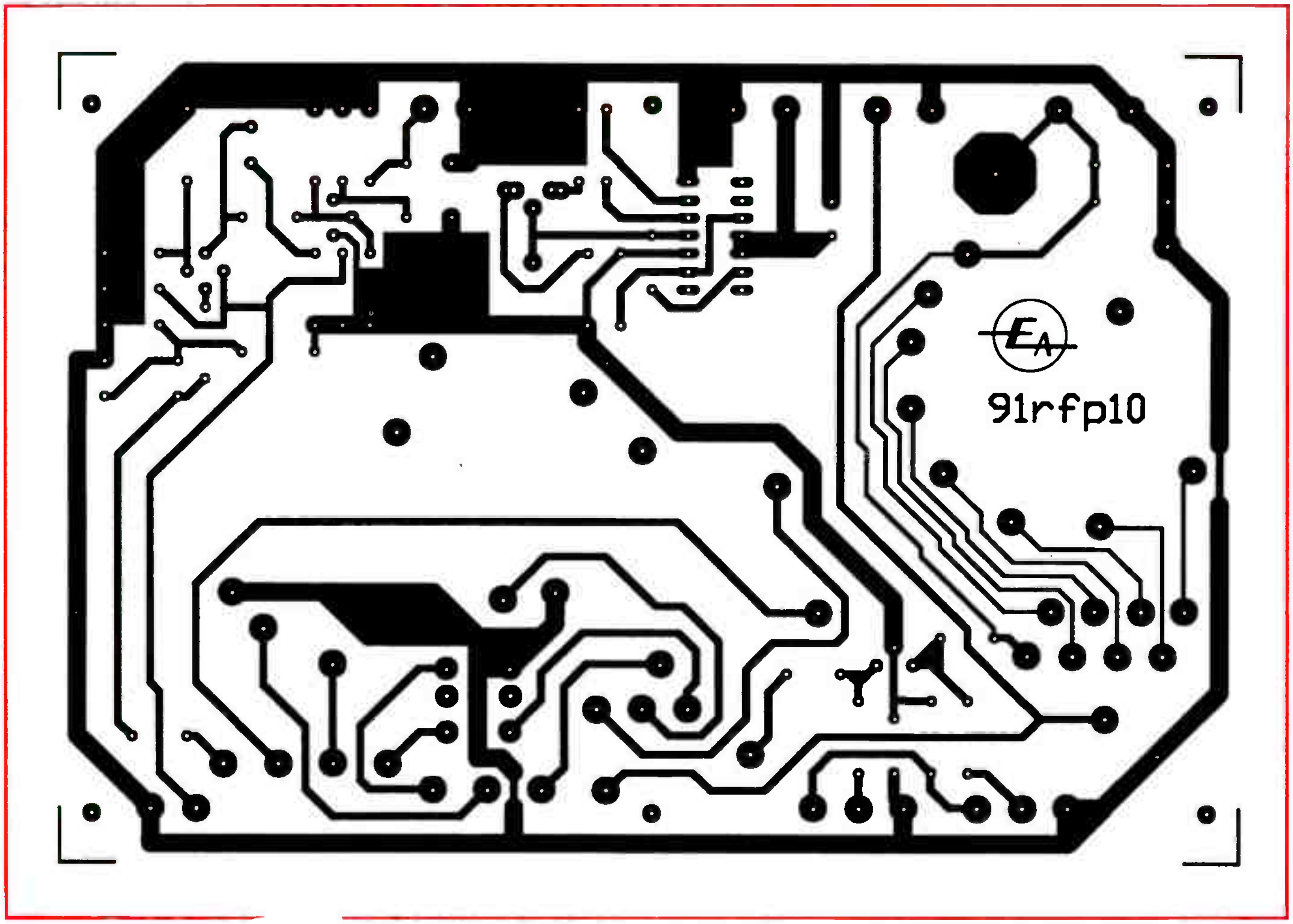
The positioning of the connectors on the rear panel is not particularly critical; the main thing is to keep the RF preamp's output connector as far as possible from the high-impedance antenna terminals, to reduce the risk of instability.

The rear-panel connectors also scarcely need lettering as they are normally only seen on rare occasions.

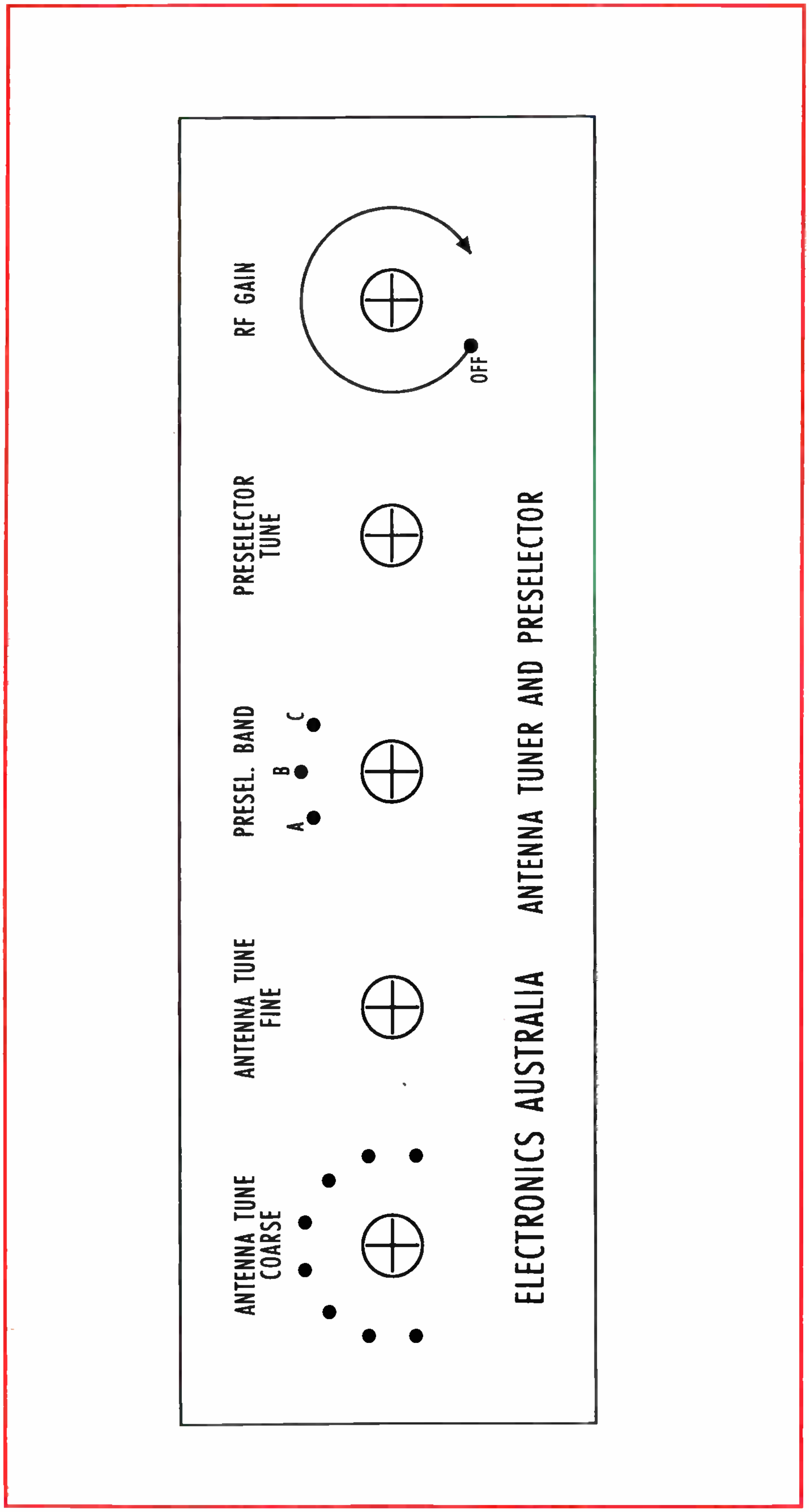
When the controls and connectors are all mounted on their respective panels, the final step is to connect them up to the appropriate PCB pins via short lengths of insulated hookup wire.

We used sections of 'rainbow' ribbon cable, to do the job a little more elegantly. The colour coding also helps ensure that you make the right connections. Note that the connections to the three sections of S2 are clearly shown on the PCB overlay diagram, while most of the rest of the connections are also identified there as well.

When you're wiring up the Coarse Antenna Tune switch S1, connect it so



The PC board pattern is reproduced here actual size, for those who like to make their own. Note that the pattern allows for either vertical or horizontally mounting trimpots for VR4, and also makes provision for a telescoping whip antenna.



Here's an acrual size reproduction of the front panel artwork, for those able to produce their own panel using Dynamark.

that the '80T' top end of L1 connects to the maximum *anticlockwise* lug on the switch, and the lower taps to the lugs which are progressively clockwise. This way, clockwise rotation of the switch will correspond to lower and lower series inductance, with zero at the fully clockwise setting.

Similarly the two fine tuning pots VR1 and VR2 should be wired so that the *clockwise* ends of their elements are connected to PCB earth — ensuring that when the pots are turned fully clockwise, the varicaps in VC1 have maximum reverse voltage and hence minimum capacitance (corresponding to maximum frequency). RF Gain pot VR3 is of course wired so that it has maximum resistance in the fully clockwise position, and minimum at the other extreme.

An important further point to watch is that you wire the power connector so that its positive input line connects to the PCB's '+' input, and its negative line to the PCB ground. It's worth checking the polarity at the connector, with your intended plug pack or battery connected up, before making the connections to the PCB — just to make sure. A mistake here could cause serious damage to the LM723...

With these connections made, your antenna tuner/preselector should now be complete, and ready for testing.

Testing & adjustment

There's very little to do to the completed project, before it's ready for use. The first thing is to set the internal regulated supply rail to +9V, using VR4.

To do this, set the rotor of VR4 initially to a point halfway around the track, and then connect a source of 12V DC to the power connector. Make sure the RF gain control pot is turned 'on', and then check the voltage between the regulated rail and PCB ground, using a DMM or analog multimeter. A convenient place to check the rail is at the end of R3 nearer to coil L2, or at the end of R18 nearer to VC1.

The voltage should measure close to 9V, but will probably be a little higher or lower. It should be a simple matter of adjusting VR4 slightly one way or the other, to set it to the correct figure.

While you have the DMM or multimeter at hand, you can quickly check a couple of circuit voltages to make sure that everything is in order. The voltage across R6 should be close to 3.9V, while that across R10 should be around 1V — but this will vary a bit, depending upon the parameters of your particular

MFE131. A bit of variation here is of no great concern.

If these two voltages seem OK, your circuit is probably operating correctly. The only other adjustment which needs to be made is setting the tuning slug in L4 to its correct position, so the tuning range for preselector band C is the desired 7-30MHz.

This is done most easily when the unit is connected to your shortwave receiver, using a signal generator set to 30MHz. With the preselector fine tuning pot VR2 set to its fully clockwise limit, the slug is then adjusted for a peak in the received signal — as indicated by the receiver's S meter.

If you don't have a signal generator, a reasonably strong and steady off-air signal near 30MHz can be used in much the same way. Again set VR2 to its top end, and set L4's slug for a peak. If the only signal that you can find is significantly below 30MHz, turn VR2 a little back from the clockwise limit to allow for this.

Using it

Using the unit is quite straightforward. With the RF gain pot set at about '12 o'clock' and the preselector band switch S2 set for the correct band for the signal you wish to receive, the receiver should be able to locate your signal and tune it in normally.

After you've adjusted the receiver controls for best reception in this situation, you can then manipulate the tuner/preselector's controls to achieve improved results. In each case, the receiver's S meter and your own ear will be the best guide to the correct control settings.

The first step is to try adjusting the coarse antenna tuning switch S1, to find the setting which gives the best results. As a guide, the positions nearer the clockwise end (minimum inductance) will tend to get best results at higher frequencies, while those nearer the anticlockwise end will be better for low frequencies — with the exact setting depending upon your antenna, or course.

Once you've found the best position for S1, then you can adjust the 'Antenna Fine Tune' pot VR1 for a peak in signal strength. This done, you can swing over to the 'Preselector Tune' pot VR2, and again tune for a peak.

Finally, you can adjust the RF Gain pot for the strongest signal that the receiver can handle, before any overload is evident. Needless to say if overload occurs, this control should be wound back until it disappears.

And that's really all there is to it. You'll find the unit can make a big difference to the reception with an elderly shortwave set, and can also help a modern set cope when your antenna setup leaves a good deal to be desired. Happy DXing! ■

SHORTWAVE ANTENNA KIT FROM DSE

Readers interested in building our new Antenna Tuner and RF Preamp project may also be interested in a kit being marketed by Dick Smith Electronics: the K-3490 Shortwave Aerial Kit. This contains virtually all of the main items needed to built a standard 'inverted L' outdoor antenna, for shortwave reception — about 25m of multi-stranded and insulated copper wire, about 10m of weatherproof plastic rope, and a couple of 'egg' type insulators. It also comes with full assembly instructions. Price of the kit is $29.95, which should make it attractive to those wishing to mate our new project with a suitable outdoor antenna.

PARTS LIST

1 PCB, 166 x 114mm, code 91rfp10
1 Plastic case, 203 x 158 x 67mm
3 Ferrite toroids, Neosid 28-042-34
1 4.83mm former and 6-pin base
2 SO-239 co-axial sockets, panel mount
2 Plastic binding posts, red and black
1 DC power connector
1 Rotary switch, 1 pole 8 position
1 Rotary switch, 3 pole 3 position
37PCB terminal pins
1 Ferrite bead, F29 material
1 RF inductor, 6.8uH
5 Control knobs, as desired

Resistors

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

R1	820 ohms
R2	10 ohms
R3,R9	680 ohms
R4	2.7k
R5	22k
R6	2.2k
R7,R8	47k
R10	330 ohms
R11,R13,R15	1M
R12	100 ohms
R14	100k
R16,R17	2.2M
R18	3.3k
VR1,VR2	100k linear pot
VR3	1M linear pot with switch
VR4	1k miniature trimpot

Capacitors

C1	470uF 16VW PCB-mount electro
C2	100pF ceramic
C3,C4,C6	0.1uF metallised polyester
C5,C10	47nF metallised polyester
C7,C8	10nF metallised polyester
C9,C11,C12	4.7nF metallised polyester

Semiconductors

D1,D2	BAW62 diode
Q1	MFE131 dual gate MOSFET
Q2	BC548 NPN bipolar
U1	LM723 regulator IC
VC1	BB212 dual varicap diode

Miscellaneous

0.5mm and 0.8mm ECC wire for winding coils;
insulated hookup wire, various colours;
machine screws, nuts and solder lugs for fastening connectors to rear panel;
solder, etc.

Construction project:

SIMPLE, LOW COST 'KARAOKE' ADAPTOR

It's time to bring out all those hidden vocal talents that you've always known were there. With this project you can remove the lead vocal from almost any recording, and replace it with your own via a standard microphone. It's a great way to liven up a party!

by ROB EVANS

This project works on the assumption that the lead vocal in most stereo recordings has been placed mid-way between the left and right channels, or is in fact a mono signal. If the two channels are then subtracted, any signals that have the same phase and amplitude relationship will be cancelled. Presto, the vocals disappear...

Just how effective this technique is will depend upon the nature of the recording itself. When a substantial level of stereo reverb has been added to the voice for example, this will tend to remain intact after the cancellation process, leaving a 'disembodied' version of the singer behind. However this can in fact be an advantage, since when your own voice is added to the signal (via the mic) it's accompanied by the original reverb effect — which of course, makes *your* vocals sound better.

Despite the theoretical complications, the concept works surprisingly well, and has been used as the basis of the circuit of our Karaoke box. While a true Karaoke system relies on pre-recorded material that already has the vocals removed (or assigned to a separate channel), our new unit will provide hours of entertainment without the need for specially recorded tapes or CDs. The keynote here (if you'll pardon the pun) is fun at a very moderate cost.

The actual circuit of the Karaoke box is virtually identical to the 'Vocal Canceller' as described by Colin Dawson in the April 1982 issue of *Electronics Australia.*

In our updated version of the project however, the construction technique has been made rather simpler by including much of the interwiring on the printed circuit board (PCB) itself — thus avoiding the need for shielded cable and substantial lengths of hookup wire.

As you can see from the associated photographs, the Karaoke box has just three knobs; a three-position MODE selector switch, a GAIN adjustment, and a NULL control. The MODE switch bypasses the Karaoke circuit in the 'off' and 'normal' positions, and only connects power to the circuit when 'normal' or 'cancel' is selected. While the middle position may seem unnecessary, it allows the user to check the effectiveness of the Karaoke circuit by simply switching between 'cancel' and 'normal', without disturbing the power supply rails by switching to 'off' — switching directly between 'off' and 'cancel' would produce sharp output transients, as power is applied to the circuit.

When the unit is in the 'cancel' mode, the remaining two controls come into play. The NULL adjustment varies the balance between the left and right channels of the subtracting circuit — or in effect, the depth of the null — and the GAIN control alters the sensitivity of the microphone preamp.

The Karaoke box is housed in a standard low-cost plastic 'Jiffy' case (measuring 158 x 95 x 54mm) with four RCA-type sockets mounted at one end, and a 6.5mm socket installed on the upper face. The RCA sockets carry the input and output signals for connection to an amplifier's standard 'tape loop' facility, while the 6.5mm socket acts as the microphone input connector. Any reasonable quality microphone should do the job, however if you're buying one specially for the job and have a choice, a *directional* type should be chosen in preference to one that is *omnidirectional.*

How it works

As you can see from the schematic diagram, the circuit of the Karaoke box is really quite simple. Its operation is based around the action of IC1a, which subtracts the left and right input signals to produce the mono 'cancelled' output, and also passes the amplified microphone signal from IC1b. For those who are not familiar with the differential amplifier arrangement of

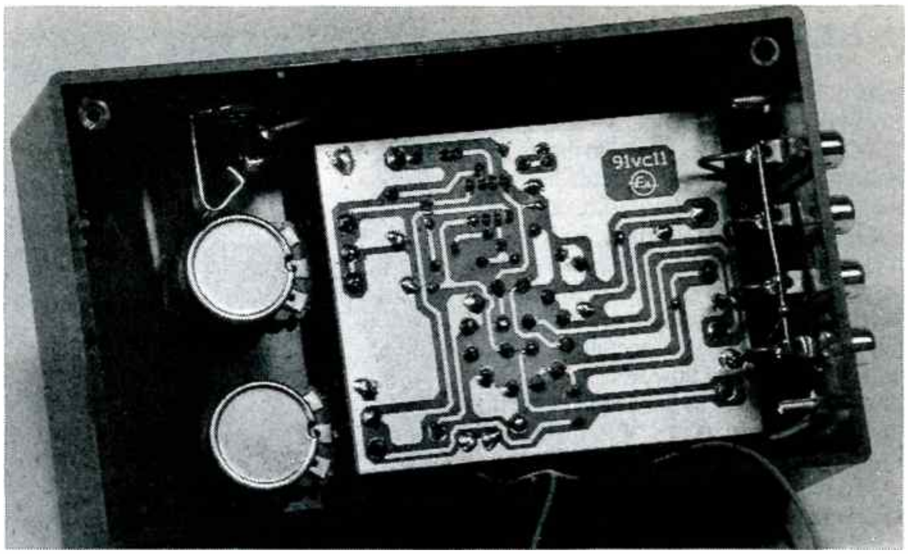
IC1a, it can be considered as the combination of both an inverting and non-inverting op-amp stage. Its operation is however a little more complicated than the circuit diagram may suggest.

Assuming for the moment that RV1 is adjusted to its minimum position (pin 5 of IC1a is grounded), signals at the left input are passed to the output via an *inverting* amplifier formed by IC1a, R3 and R4. Since both resistors are of the same value (47k) the stage operates at unity gain, resulting in an output signal which is simply an inverted version of the left input signal. The signal from the microphone preamp (IC1b) is also passed to the output via this stage — however in this case, the gain is set to around two by the combination of R4 and R6.

When RV1 is adjusted to its maximum setting and no signal is applied to the left input, we can consider the *non-inverting* action of IC1a. Here, a signal applied the right input is amplified by a factor of around three, by a standard non-inverting stage formed by IC1a, R4 and R6 — note that the 'C3-end' of R6 is effectively grounded by the low output impedance of IC1b. As you would expect, if the NULL control (RV1) is adjusted to around one third of its travel, IC1a's output signal will then be identical to the right input signal — the stage is effectively acting as a unity gain buffer (3 x 1/3). In practice however, the left input would be terminated in the low output impedance of the signal source (the amplifier's 'Tape out' connection), which will alter the non-inverting gain equation by placing R3 in parallel with R6. This calculates to a gain of around *four*, which in fact means the NULL control must be at around one quarter of its travel to maintain the overall gain of the non-inverting stage at unity.

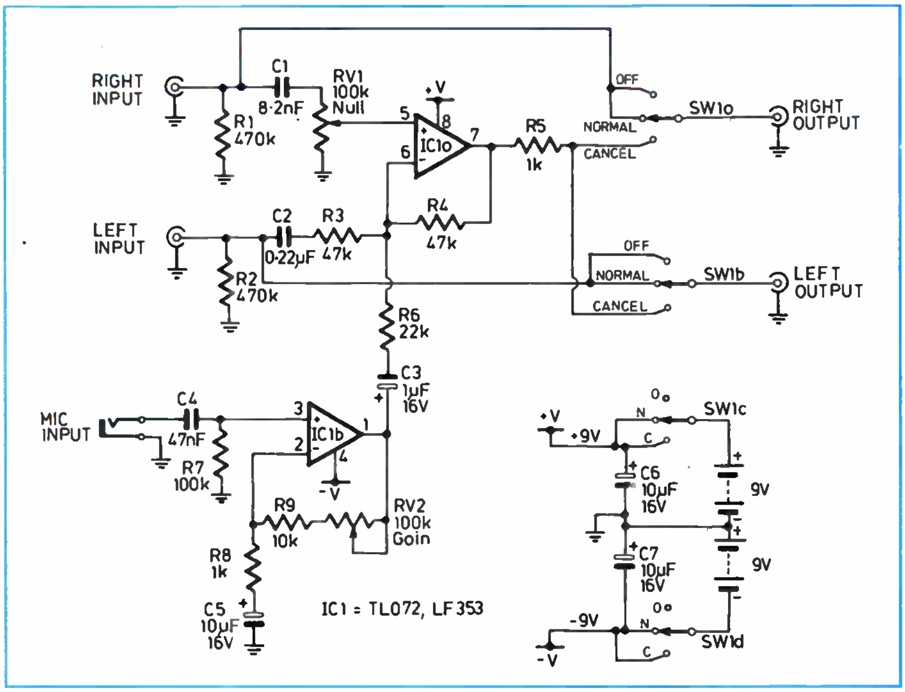
When the above non-inverting and inverting stages are combined, as in the actual circuit, any signal at the right input which has the same amplitude and phase as that of the left input is cancelled out. Thus we have a differential amplifier, or more to the point, a stage that subtracts the left and right input signals.

The microphone preamp is based around IC1b, which has been arranged as a non-inverting amplifier with its gain determined by the combination of RV2 (GAIN), R9 and R8. As RV1 is adjusted between the extremes of its travel, the preamp gain varies from around 10 to 110, so as to cater for microphones of different sensitivity. IC1b's input (pin 3) is coupled to the mic's output signal by C4, and referenced to ground by R7. Also, R8 is coupled to ground via C5, and the amplified microphone signal is passed to IC1a (at R6) via C3.



A look inside the finished Karaoke box. As you can see, the PCB simply mounts to the front panel via the Mode rotary switch, and the sockets and pots are connected by short lengths of wire.

Returning to the main area of the circuit, you can see that input terminating resistors and coupling capacitors are also provided for the left and right inputs — these are R2 and R1, and C2 and C1 respectively. C1 has been deliberately chosen as a relatively low value (8.2nF), so the high-pass filter formed in conjunction with RV1 will restrict frequencies below about 200Hz in the right signal path. The idea here is that when identical bass signals are applied to the left and right inputs, the filter will reduce the signal level at one of IC1a's differential inputs (pin 5). Therefore, since the input amplitudes are now uneven, there will be less cancellation effect (and more bass content) at the circuit's output. This process is necessary since the bass information in most recordings is also the same in each channel (that is, mono), and would be cancelled out by a differential amplifier with the same low-frequency response at each input — in short, the cancelled output would be seriously lacking in bass content on most recordings. As you would expect, the left input filter (formed by C2 and R3) is set for a much lower roll-off point (about 15Hz) so as to pass the complete audio



The circuit uses just one dual op-amp and a handful of components. IC1A cancels or subtracts any signals common to the left and right inputs (such as vocals), while IC1b amplifies the signal from an external microphone.

Karaoke box

range. The remaining parts of the circuit involve the action of the MODE switch (SW1), which applies power to the op-amp and completes a bypass circuit for when the cancelling effect is not selected.

As shown in the schematic, both the left and right inputs are passed directly to their respective outputs when SW1 is in the 'normal' and 'off' positions, which maintains normal stereo operation. When 'cancel' is selected however, the two outputs are connected to the output of the differential amplifier (pin 7 of IC1a) via a 1k isolating resistor (R5).

The remaining two poles of the MODE switch (SW1c and SW1d) connect battery power to the op-amp in the 'normal' and 'cancel' positions. Note that C6 and C7 are included to maintain a low supply source impedance as the batteries run down and their internal resistance increases.

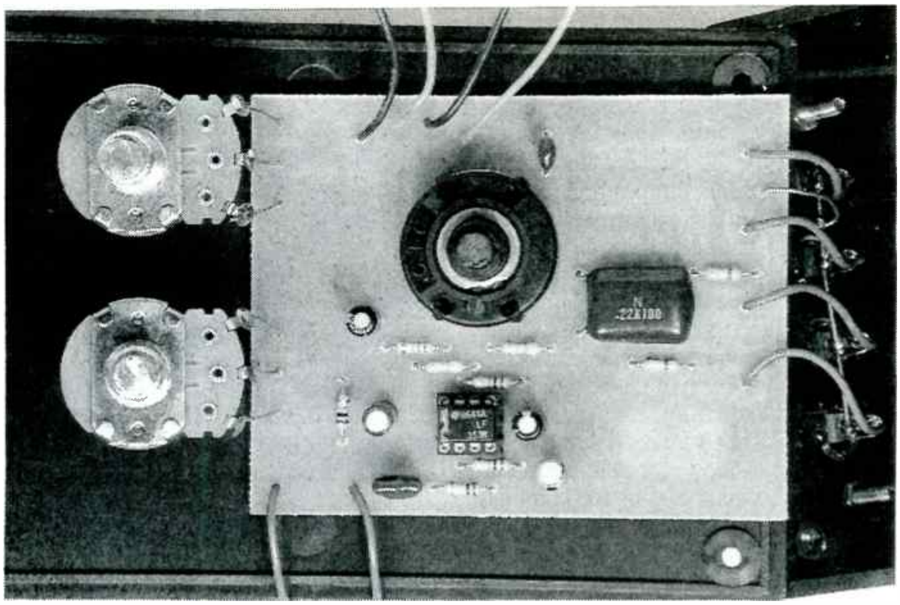
Construction

Building the Karaoke box should be quite a simple task, since virtually all of the components fit on one PCB (coded 91vc11 and measuring 88mm x 69mm) which mounts directly to the front panel via the MODE switch SW1.

Begin the construction by installing all of the lower profile components onto the PCB as shown in the component overlay diagram, while paying particular attention to the orientation of IC1 and the four electrolytic capacitors (C3, C5, C6 and C7). Next, trim the shafts of the two potentiometers (RV1 and RV2) and the rotary switch (SW1) to a suitable length for the knobs, and install the switch into the PCB. Then solder short lengths of wire to each of the PCB pads for the various external connections — that is, the microphone socket, RCA sockets and the two potentiometers. Don't forget to connect the two battery clips.

To complete construction of the unit, install the sockets and potentiometers into the box, and fit the PCB assembly in place by attaching SW1 to the front panel. The external components can now be connected to the appropriate wires from the PCB, as shown in the component overlay diagram, and the 9V batteries installed.

The two batteries can be clamped to the bottom panel (the box lid, in fact) by a small bracket fashioned out of sheet aluminium. However, many constructors (like the author) will find a suitably sized block of foam rubber to be a far simpler solution — this can have battery-shaped cutouts and simply lie between the PCB and the bottom panel (with the batteries facing the panel).



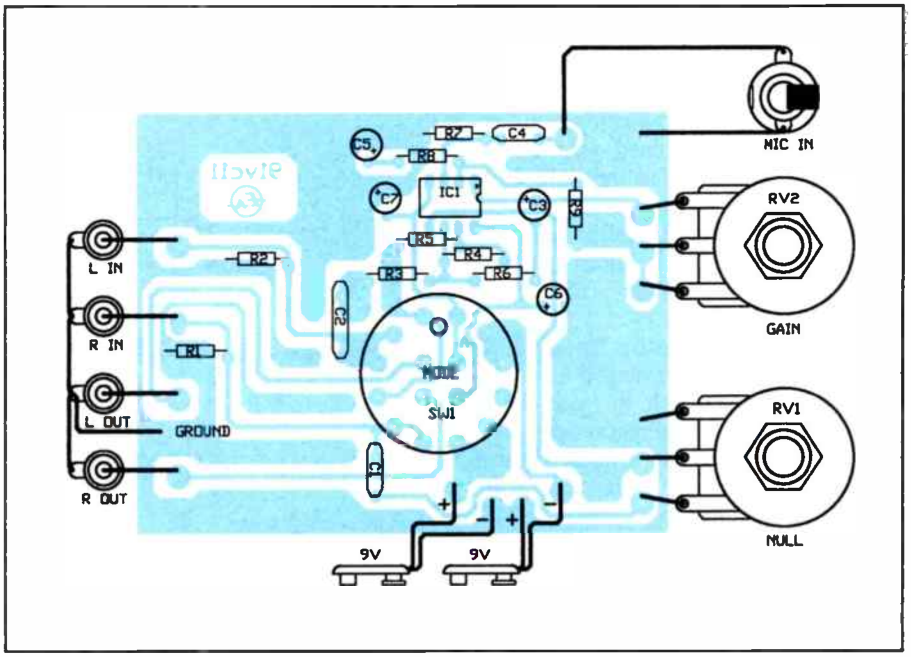
The PCB assembly after construction has been completed — the unit was taken apart for this shot. Note the mounting position for C2 (0.22uF).

Testing: ONE, TWO...

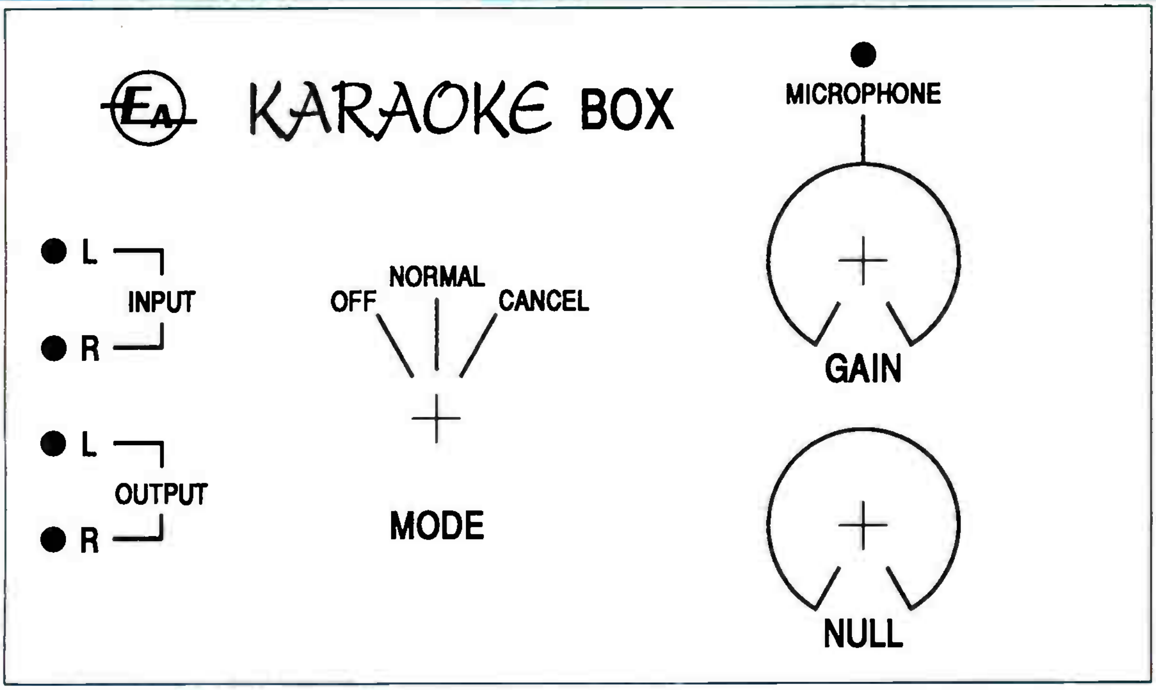
Before screwing the bottom panel in place, the Karaoke box should be connected to a stereo amplifier and thoroughly tested for any wiring anomalies.

First, turn the MODE switch to 'off', and adjust both the GAIN and NULL controls to their fully counter-clockwise positions. Then connect the unit into the amplifier's tape loop facility — that is, the amp's 'Tape Rec' output and 'Tape Monitor' input are connected to the Karaoke box's input and output sockets, respectively.

Now turn the amplifier on and check that normal stereo sound is heard with the tape loop switched in — in most amplifiers this is selected by a 'Tape Monitor' switch or button. There should also be no change in sound when the Karaoke box's MODE switch is then turned to the 'normal' position, since while power has now been connected to IC1, the actual circuit is still bypassed. If all is well, turn the MODE switch to 'cancel', and note the results. The sound should now be mono (the same from both speakers) and the overall volume a little lower — since when the NULL control is at its minimum position, only the left channel signal is heard. Now try adjusting



Follow this component overlay at all times during the construction procedure — pay particular attention to the orientation of any polarised components.



The front panel artwork, shown here at its actual size.

the NULL control until the lead vocal is at its lowest possible level, or most 'into the background'.

Some contemporary recordings use substantial levels of vocal processing, which tends to reduce the effectiveness of the Karaoke box. Nevertheless, on most recordings the unit will successfully reduce the lead vocal to quite a low level, allowing your own vocals to blend into the music as required.

At worst, the original singer will be audible enough to accompany your performance. When it comes to testing the microphone input, it may be wise to monitor the results via a set of headphones rather than the main stereo speakers. This avoids the possibility of an acoustic feedback loop via the microphone and nearby speakers — which not only sounds unpleasant, but can seriously overdrive the speakers themselves.

Once you are used to the action of the unit's GAIN control however, there should be no difficulty in achieving a reasonable music-to-vocals balance and overall volume with the speakers switched in.

By the way, you may also find that the mic input contributes a significant level of noise (hiss and hum) to the main output, until the actual microphone is plugged into the socket. This is because when the microphone is not connected, the mic preamp (IC2) has its input terminated by a relatively high impedance (100k) which in short, degrades its noise performance.

In normal use however, the Karaoke box will have the microphone plugged in, providing the preamp with a source impedance of just a few hundred ohms — which in turn leads to a satisfactory overall noise performance.

Well, that's about it. You'll find the Karaoke box to be the source of hours of fun, as you deliver vocal performances to rival the singers you have 'cancelled'. Remember though, that your neighbours may not appreciate hearing 20 successive versions of 'My Way' through a shared-wall. ■

PARTS LIST

1 PCB 88mm x 69mm, coded 91vc11
1 Jiffy box, 158mm x 95mm x 54mm
1 Panel-mount 4-way strip of RCA sockets
1 Panel-mount 6.5mm mono socket
1 PC-mount sealed rotary switch (4-pole, 3-position)
3 Small knobs
2 9V battery clip leads
1 Dual op-amp: TL072, LF353 or similar

Resistors

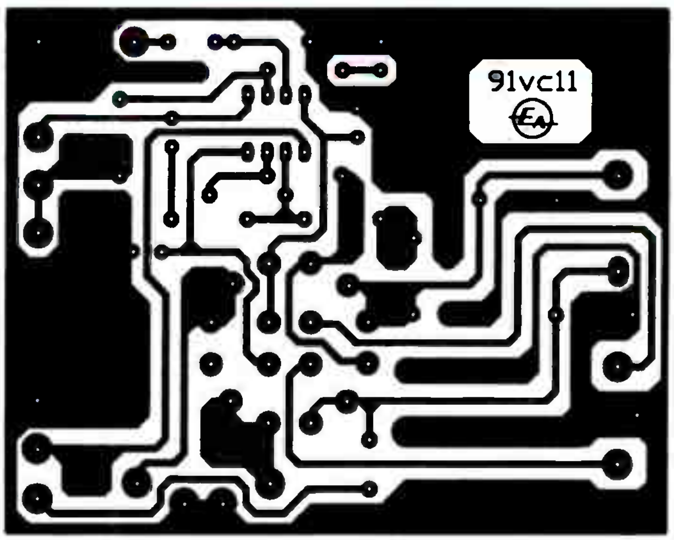
All 0.25W 5%:
2 x 470k, 1 x 100k, 2 x 47k, 1 x 22k, 1 x 10k, 2 x 1k
2 100k linear potentiometers

Capacitors

1 8.2nF metallised polyester
1 47nF metallised polyester
1 0.22uF metallised polyester
1 1uF 16V PC-mount electrolytic
3 10uF 16V PC-mount electrolytics

Miscellaneous

Hookup wire, nuts and bolts, etc.



A full size reproduction of the PCB artwork, for those who wish to make their own circuit board.

FREE CALCULATORS - AMAZING OPPORTUNITY

An American Industrialist once remarked "I believe that half of our advertising is ineffective - the trouble is, we don't know which half!) Well - as the year draws to a close we've decided to conduct a survey on our advertising i.e. to see where our advts are noticed most. So when you see this notice simply ring us Toll Free on 008 999 007, advising us which magazine you saw the advt and we'll be delighted to send you absolutely without charge one of our fantastic X 2110 Desk Calculators - there is no obligation - you do not need to make any purchase. (Limit one per customer).

Sensational Value On UHF Alarm Systems

Main Control Receiver

The main control receiver runs on 240V AC with a 12V 1.2Ah battery for emergency backup. The range between the transmitters and the receiver is normally 80 metres in open space.

Features: • Wireless reception of external and internal sensors & detectors • Selectable home or away modes for selecting internal or external arming or just external to allow movement inside the building • Built in piezo electric siren gives different signals to indicate different functions • Sends signal down power line to activate remote siren • Programmable arm/disarm switch buttons

Passive Infra Red Movement Detector

Ideal for the loungeroom, family room or hallways. Mounts up on the wall or bookshelf. Detects movement within an area of 9 x 9m.

Remote Reed Switch

This consists of an enclosed reed switch and transmitter with a magnet.

Remote Piezo Alarm

This unit is a line carrier receiver, ie. plugs into 240V AC and receives signal through AC line.

Requires no wiring which makes it a cinch to install. Do it yourself and save on installation and over 50% off regular prices.

Front Door Remote Keypad

This handy unit virtually duplicates the function of the main control unit but at a more convenient location, ie. just inside the front or rear door etc. System can be armed or disarmed without the need to go to the main control unit.

SYSTEM 1
Includes:
1 x Main Controller
3 x Remote Reed Switches
1 x Remote PIR Movement Detector
1 x Remote Keypad
1 x Remote Siren
Plus 4 Bonus Large Alarm Warning Stickers
This Month Only **$399**
NORMALLY ~~$865~~

SYSTEM 2
Includes:
1 x Main Controller
3 x Remote Reed Switches
Plus 4 Bonus Large Alarm Warning Stickers
This Month Only **$249**
NORMALLY ~~$515~~

SYSTEM 3
Includes:
1 x Main Controller
1 x Remote Reed Switch
1 x Remote PIR Movement Detector
1 x Remote Keypad
Plus 4 Bonus Large Alarm Warning Stickers
This Month Only **$299**
NORMALLY ~~$630~~

300 Watt Inverter

Go anywhere 240V mains power from your car battery with this fantastic 12V DC to AC Inverter.

This compact inverter will power lights, power tools, electric shavers, radios etc.

A must for farming, camping, mining, boating and wherever 240V power isn't available.

Features:
- Complete with over current circuit breaker
- Fused 240V output
- Built in panel meter to monitor output voltage
- Strong steel chassis.

M 8120 **$199.00**

Superb Dome Tweeter Bargain of 1991 Less Than ½ Price!

Dome Tweeter With Ferro Fluid 60 Watt Max. Power. Silky smooth frequency response 1.5Hz to 20kHz. Wide angle dispersion. Massive power handling capacity. Diam. 94mm. High spectrum. Purity. Incredible low price!

C 3012 ~~$29.50~~
This Month **$12.00**
10 up **$10.00**

Quality Speaker Bargains — Up to 30% Off

Polypropylene

10" Woofer 60 Watts RMS
Rated Power Input 60W
Max. Power Input 100W
Impedance (300Hz) . . . 8 Ohm
Frequency Response . fo — 4kHz
Resonant Frequency . . 45Hz(+/-9Hz)
Sensitivity . . . . 98dB/W(0.5m)

C 3065 ~~$69.00~~ **$60**

Excellent bass register performance

12" Woofer 100 Watts RMS
Rated Power Input 100W
Max. Power Input 150W
Impedance (200Hz) . . . 8 Ohm
Frequency Response . fo — 3kHz
Resonant Frequency . . 30Hz(+/-6Hz)
Sensitivity . . . . 98dB/W(0.5m)

C 3070 ~~$99.00~~ **$85**

15" Woofer 120 Watts RMS
Rated Power Input 120W
Max. Power Input 200W
Impedance (200Hz) . . . 8 Ohm
Frequency Response . fo — 15kHz
Resonant Frequency . . 25Hz(+/-5Hz)
Sensitivity . . . . 98dB/W(0.5m)

C 3075 ~~$129.00~~ **$95**

Poly Emulsion Coated Cone

10" Woofer 80 Watts RMS
Rated Power Input 80W
Max. Power Input 130W
Impedance (400Hz) . . . 8 Ohm
Frequency Response . fo — 4kHz
Resonant Frequency . . 28Hz(+/-5Hz)
Sensitivity . . . . 97dB/W(0.5m)

C 3026 ~~$99.95~~ **$85**

With Barium Ferrite magnets. Very efficient - extremely low distortion (we supply these drivers to some highly respected speaker system makers)

12" Woofer 80 Watts RMS
Rated Power Input 80W
Max. Power Input 160W
Impedance (300Hz) . . . 8 Ohm
Frequency Response . fo — 3kHz
Resonant Frequency . . 25Hz(+/-5Hz)
Sensitivity . . . . 98dB/W(0.5m)

C 3030 ~~$125.00~~ **$105**

15" Woofer 100 Watts RMS
Rated Power Input 100W
Max. Power Input 200W
Impedance (400Hz) . . . 8 Ohm
Frequency Response . fo — 3kHz
Resonant Frequency . . 25Hz(+/-5Hz)
Sensitivity . . . . 98dB/W(0.5m)

C 3032 ~~$235.00~~ **$169**

Carbon Fibre

6½" Woofer 30 Watts RMS
Rated Power Input 30W
Max. Power Input 70W
Impedance (300Hz) . . . 8 Ohm
Frequency Response . fo — 6kHz
Resonant Frequency . . 65Hz(+/-13Hz)
Sensitivity . . . . 97dB/W(0.5m)

C 3034 ~~$82.55~~ **$69**

8" Woofer 60 Watts RMS
Rated Power Input 60W
Max. Power Input 100W
Impedance (400Hz) . . . 8 Ohm
Frequency Response . fo — 5kHz
Resonant Frequency . . 50Hz(+/-10Hz)
Sensitivity . . . . 98dB/W(0.5m)

C 3036 ~~$115.55~~ **$89**

With Barium Ferrite magnets. Similar in performance to our emulsion cone range but with quite astonishing power handling capacity

FANTASTIC KITS TO BUILD

4-Channel Lighting Desk

S/C JUNE/JULY '91
This 4-channel lighting desk is intended for theatre, disco and music group applications. It has heavy duty circuitry and is able to cope with spotlights rated up to 1000 watts or more.

K 5815 **$329.00**

Digital Altimeter

S/C SEPTEMBER '91
This compact digital altimeter can display altitude up to 19,990 feet with 10ft resolution. It has a barametric pressure offset adjustment for heights up to 5000 feet and is ideal for use in ultralights, gliders, hang-gliders and balloons.

K 2580 **$299.00**

LED Digital Tachometer

Case Not Included

S/C AUGUST '91
Have you ever wondered how many revs your car's engine is doing at 100km/h or at any speed for that matter? This digital tachometer will tell you. It works with all ignitions from Kettering to Hall Effect systems and with 4, 6 and 8 cylinder cars.

K 4320 **$31.00**

120 Watt Public Address Amplifier

This professional quality Public Address Amplifier offers performance equal to or better than commercial units at about half the price. Ideally suited for Halls, Churches, Clubs and even temporary setups.
Inputs 2 balanced microphones with 3 Pin XLR connectors. 2 Auxiliaries suitable for direct connection to CD player, tuner etc.
Outputs 4 Ohm, 8 Ohm or 100V line output configuration
Power Output (RMS) 125 Watts into 4 Ohms; 90 watts into 8 Ohms; 120 watts into 100V AC line.

K 5020 Normally ~~$499.00~~ This Month **$399.00**

Powerhouse 600W

Get 240V AC Mains Power From Your 12V Battery With This Handy Inverter
This inverter has the capability to produce 600 watts of mains power which will run a fantastic array of appliances. It would be ideally suited to running power tools, lighting (including fluros) electric motors and much more. A must for farming, camping, mining, boating, remote settlements and wherever else 240V power isn't available.

K 6770 Kit Version **$499.00**

K 6774 Fully Built & Tested 12V Input **$625.00**

K 6775 Fully Built & Tested 24V Input **$625.00**

300 Watt Inverter with Auto Start

NEW IMPROVED MODEL

EA April '88
• Super Compact — kit is supplied in Altronics H 0482 tough ABS case • Uses High Efficiency Toroid Transformer thus keeping down heat dissipation, battery drain and weight • Auto start draws power from your battery only when appliance is plugged in and "turned on" i.e. battery can be left permanently connected if req • Voltage regulated • Current regulated • Current overload unit self limits — Single PC Board construction • easy to build as there is very little internal wiring.

K 6750 Kit Version **$279.00**

K 6755 Fully Built and Tested **$379.00**

40 Watt Inverter

EA Aug '85
This inverter is ideally suited for powering low wattage mains appliances from the car battery while camping. Typically, it can be used to power an electric shaver, electric blanket, electric can opener or a 40W light bulb.

K 6705 Kit **$99.00**

Credit Card Multimeter

Fantastic for the glovebox, toolkit and, of course, your top pocket. Excellent for mobile field work. A great gift idea for your budding genius student.

Q 1060 Normally ~~$65.00~~

This Month **$32.50**

Casio Printing Calculator Bargain

• Black print and red print for subtractions • Sub-total/total • Item counting • Average function • 3 digit comma markers • Full decimal system.
Operates on 4x AA batteries (included) or power supply (not included). Includes one roll of 58mm paper and dust cover.

X 2125 Normally ~~$149.95~~

This Month **$99.00**

8 Channel Audio Mixer

6 Mic & 2 Aux Inputs with Canon Sockets.
Treble, Bass & Master Controls.

A 2051 **$399.00**

High Performance Wireless Microphone

Incorporates ALC circuitry (Automatic Level Control) which helps eliminates distortion caused when input levels are too high.
Can be received on any FM radio. Very professional mic.
Built-in Antenna.

C 0328 **$129.50**

10 Watt Megaphone

Range: 300M approx.
Requires 8 x AA cells (not supplied). Includes electronic whistle activated by button in the handle.

A 1980 ~~$129.95~~ **$99**

High Quality Entertainers Microphone

Uses the famous Shure SM 58 Insert

Assembled in Taiwan, however in our humble estimation sounds every bit as good as the American assembled product.
Fantastic value at this price.

C 0390 **$225.00**

Harris Four Channel Digital Recorder/Announcer

This remarkable product can be simply switch select programmed to fulfill an amazing variety of functions.

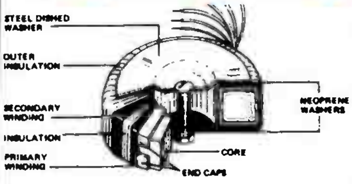
LITERALLY DOZENS OF APPLICATIONS!

The Harris A 2100 provides 4 channels of natural speech recording and play-back. Recording time for each channel is internally selectable to 10, 15, 20 or 30 seconds. The sound quality is outstanding on the lower settings and "industrial" on the higher ranges. Channels can be used separately or linked to provide one long recording/announcement.

A 2100 **$799.00**

Toroid Power Transformers

We've Reduced Our Prices 20% This Month!



Why a Toriod?
• Smaller size and weight to meet modern "Slimline" requirements •Low electrically induced noise demanded by compact equipment • High efficiency enabling conservative rating whilst maintaining size advantages • Lower operating temperature • Simple, quick single bolt mounting

80VA ~~$49.95~~ $40

Cat. No	Sec. V	SEC Current A	SEC Current B
M 3020	12+12	6.6	3.3
M 3025	18+18	4.4	2.2
M 3030	25+25	3.2	1.6
M 3035	30+30	2.6	1.3
M 3040	35+35	2.2	1.1

160VA ~~$65.00~~ $50

Cat. No	Sec. V	SEC Current A	SEC Current B
M 3050	12+12	13.3	6.7
M 3055	18+18	8.9	4.45
M 3060	25+25	6.4	3.2
M 3065	30+30	5.3	2.7
M 3070	35+35	4.6	2.3
M 3075	40+40	4.0	2.0
M 3080	45+45	3.56	1.78

300VA ~~$89.95~~ $72

Cat. No	Sec. V	SEC Current A	SEC Current B
M 3085	12+12	25.0	12.5
M 3086	18+18	16.67	8.33
M 3088	25+25	12.0	6.0
M 3090	30+30	10.0	5.0
M 3092	35+35	8.57	4.29
M 3100	40+40	7.5	3.75
M 3105	45+45	6.67	3.33

500VA ~~$129.00~~ $99

Cat. No	Sec. V	SEC Current A	SEC Current B
M 3120	30+30	16.6	8.3
M 3125	35+35	14.2	7.1
M 3130	40¢40	12.5	6.2
M 3135	45+45	11.1	5.5
M 3140	50+50	10.0	5.0
M 3145	55+55	9.0	4.5
M 3150	60+60	8.3	4.10
M 3155	65+65	7.6	3.8

Telecom Type Line Isolating Transformer

M 1000 Normally ~~$13.95~~

Now **$11.00** SAVE 20%

May be used to provide isolation between Telecom Australia lines and mains operated equipment. Telecom approved to specifications 1053 and 1054.

Impedance: 600 Ohm line/600 Ohm equipment.

Huge Savings on Computer Fans

240V Models

30CFM Air Flow
80mm x 80mm x 32mm

F 1020 ~~$32.95~~ **$20**

80 CFM Air Flow
120 x 120 x 38mm

F 1030 ~~$32.95~~ **$20**

24VDC Brushless Model

120mm x 120mm x 38mm

F 1040 ~~$29.95~~ **$20**

Multipurpose 100VA Transformer

Another quality transformer from Altronics. Wound on expensive grain oriented steel.

HALF PRICE

Primary: 240V
Secondary

12V	8.3A
15V	6.6A
24V	4.1A
27V	3.7A
30V	3.3A

MA 2170 ~~$29.95~~

This Month Only **$15.00**

Variable Temperature Soldering Iron

NEW MODEL NOW INCORPERATES JAPANESE CERAMIC CARTRIDGE!

T 2446 **$49.95**

Aviation Headset

WHY PAY $400 OR MORE FOR A DAVID CLARK SET?

• High performance, noise attenuating earphones. • Noise cancelling microphone • Cushioned head pad •Super sturdy • Great performance • Superb, professional pilot's headset will last a lifetime with reasonable treatment • Includes standard aircraft jacks.

C 9070 Only **$189.00**

Multiple De-Soldering Tool

Ideal for the service technician and hobbyist alike. This lightweight de-soldering iron allows components to be quickly and cleanly removed with one hand. Naturally it's SEC approved and comes with a cleaning wand. Can be used as a soldering iron.

T 1250 ~~$59.95~~

This Month **$49.95**

Micron Soldering Station

The MICRON T 2440 soldering station offers the ultimate in controlled temperature hand soldering. Temperature range is switch selected. So there is no need to change soldering iron tip.

- Zero Voltage Switching
- Grounded Tip
- Low Voltage Element
- Chrome Plated Iron Clad Tip

T 2440 Normally ~~$159.95~~

This Month **$140.00**

MK II Replacement Tips

All **$5.50 ea**
T 2427 0.8mm
T 2428 1.6mm
T 2429 3.2mm

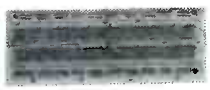
Dalo Pens

T 0033 ~~$5.15~~ **$4**

Breadboards

• Standard 0.1 inch spacings • Accepts all LSI's semis, transistors, diodes, leds and passives

P 1000 100 Holes **$3.25**
P 1005 640 Holes **$12.50**
P 1007 640 & 100 Holes **$14.50**
P 1012 400 & 1280 Holes **$44.60**
P 1015 500 & 1920 Holes **$65.00**



Metal backing plate for shielding of sensitive circuitry.

'D' Series Computer Connectors.

Gold Plated

		WAS	NOW	10 Up
P 3000	DB9 Male 9 pin connector	~~$2.95~~	$1.55	$1.35
P 3010	DB9 Female 9 pin connector	~~$3.25~~	$1.60	$1.40
P 3020	DB9 Male rt/l PCB connector	~~$3.75~~	$3.40	$3.00
P 3030	DB9 Female rt/l PCB connector	~~$2.50~~	$2.20	$1.95
P 3040	DB9 Male straight PCB connector	~~$2.95~~	$2.50	$2.35
P 3050	DB9 Female straight PCB connector	~~$3.95~~	$3.40	$3.00
P 3090	DB9 Backshell cover	~~$1.95~~	$1.50	$1.35
P 3100	DB15 Male 15 pin connector	~~$3.25~~	$1.95	$1.65
P 3110	DB15 Female 15 pin connector	~~$3.85~~	$2.40	$1.70
P 3120	DB15 Male rt/l PCB connector	~~$4.85~~	$3.95	$3.75
P 3130	DB15 Female rt/l PCB connector	~~$5.50~~	$4.40	$3.75
P 3140	DB15 Male straight PCB connector	~~$5.50~~	$4.40	$3.75
P 3150	DB15 Female straight PCB connector	~~$2.95~~	$2.70	$2.50
P 3190	DB15 Backshell cover	~~$2.20~~	$1.90	$1.75
P 3200	DB25 Male 25 pin connector	~~$4.95~~	$3.10	$2.25
P 3210	DB25 Female 25 pin connector	~~$5.50~~	$3.30	$2.50
P 3220	DB25 Male rt/l PCB connector	~~$4.95~~	$4.40	$3.95
P 3230	DB25 Female rt/l PCB connector	~~$8.90~~	$4.40	$3.50
P 3240	DB25 Male straight PCB connector	~~$4.95~~	$3.90	$3.50
P 3250	DB25 Female straight PCB connector	~~$6.25~~	$5.50	$5.25
P 3290	DB25 Backshell cover	~~$2.50~~	$2.05	$1.85

Circuit Breakers

Now there's no need to pay $10 or more for a circuit breaker. Altronics product is USA Underwriters Laboratories listed (and that speaks for itself) and once again is an Altronics Price Breakthrough.

S 5503 3 Amp All **$4.50**
S 5505 5 Amp
S 5510 10 Amp
S 5515 15 Amp
S 5520 20 Amp
S 5525 25 Amp

MU Metal Shielded Audio Transformers

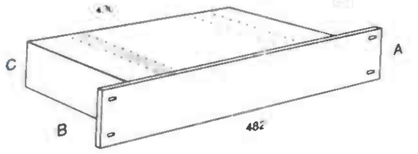
Microphone Type
Primary: 200 Ohm
Secondary: 50K Ohm

M 0701 ~~$34.95~~ **$25**

Bridging/Isolating Type
Use for coupling audio modules. Nominal impedance ratio 10K: 10K (1:1)

M 0702 ~~$34.95~~ **$25**

Rack Cases



Features:
• Raw aluminium, black or natural anodised finish • These beautifully crafted rack cabinet boxes will give your equipment a really 1st class appearance • Aluminium construction with removable top and bottom steel cover panels • All dimensions conforms to the International Standard • Ventilated lid • Deluxe finish front panel • Individually cartoned • Supplied in Flat Pack Form - Easily assembled in minutes.

Cat No.	Unit Height	A	B	C	Finish	Ea.
H 5011	1U	44	32	38	Raw Alum.	$59.95
H 5012	2U	88	76	79	Raw Alum.	$78.95
H 5013	3U	132	54	122	Raw Alum.	$82.95
H 5021	1U	44	32	38	Nat Anod.	$65.95
H 5022	2U	88	76	79	Nat Anod.	$82.95
H 5023	3U	132	54	122	Nat Anod.	$89.95
H 5031	1U	44	32	38	Blk Anod.	$65.95
H 5032	2U	88	76	79	Blk. Anod.	$82.95
H 5033	3U	132	54	122	Blk Anod.	$89.95

• REVOLUTIONARY NEW EXTRUDED DESIGN ELIMINATES THE NEED FOR VISABLE BOLTHEADS THROUGH THE FRONT PANEL

Australian Designed and Manufactured Professional Series Modular Rack Frames

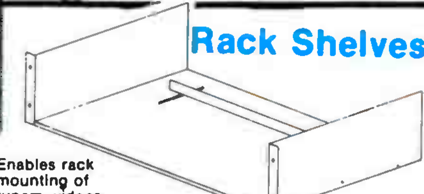
NOW AVAILABLE IN BLACK POWDERCOAT

Suitable for home or commercial use, these fantastic rack frames are durable strong, good looking, light weight and easy to assemble.
The frames are available in either Natural Anodised aluminium or Black Powder Coat aluminium and the side panels in Electric Blue or Black Powder Coat finish.
Ideal for use in home Hi-fi systems, Professional Audio installations, Band Gigs, Computer Patch panel etc.

		Were	Now
H 5204	Rack frame 4U Nat.	$139	$125
H 5205	Panel set for H 5204	$49	$44
H 5206	Rack frame 6U Nat.	$149	$135
H 5207	Panel set for H 5206	$55	$49
H 5212	Rack frame 12U Nat.	$169	$152
H 5213	Panel set for H 5212	$89	$80
H 5218	Rack frame 18U Nat.	$189	$170
H 5219	Panel set for H 5218	$110	$99
H 5230	Rack frame 30U Nat.	$229	$205
H 5231	Panel set for H 5230	$159	$143
H 5238	Rack frame 38U Nat.	$269	$242
H 5239	Panel set for H 5238	$195	$175

		Were	Now
H 5304	Rack frame 4U Black	$139	$125
H 5305	Panel set for H 5304	$49	$44
H 5306	Rack frame 6U Black	$149	$135
H 5307	Panel set for H 5306	$55	$49
H 5312	Rack frame 12U Black	$169	$152
H 5313	Panel set for H 5312	$89	$80
H 5318	Rack frame 18U Black	$189	$170
H 5319	Panel set for H 5318	$110	$99
H 5330	Rack frame 30U Black	$229	$205
H 5331	Panel set for H 5330	$159	$143
H 5338	Rack frame 38U Black	$269	$242
H 5339	Panel set for H 5338	$195	$175

Rack Shelves



Enables rack mounting of tuners, videos, C.D. players, amplifiers etc. which normally can't be rack mounted. Supplied in flat pack form - easily assembled in minutes. Available in black only.

STOP PRESS - NOW AVAILABLE IN 2 & 4 UNIT SIZES !

H 5352 2 Unit (88mm) **$49.95**
H 5353 3 Unit (132mm) **$49.95**
H 5354 4 Unit (176mm) **$55.95**

Great Value Altronics Kits

Sub-Woofer Adaptor

Get an amazing bass improvement from your stereo system. This fantastic adaptor simply "samples" your stereo amp output and provides a single channel output to feed a separate sub-woofer amp.

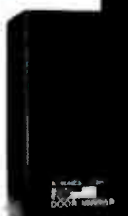
K 5560 **$29.95**
M 9020 12V AC Adaptor To Suit **$16.95**

Universal High Power Amplifier Module

K 5140 **$69.00**

All components, including output transistors mount on a single PCB. Suitable for high quality guitar amp, public address or in a high fidelity stereo amplifier. Kit includes angled heatsink bracket, main heatsink and unlike other kit suppliers, the in-built Polyswitch for loudspeaker protection.

Door Minder



This project will sense a door opening in a large or small room and will sound a two-tone chime. It does not have to be anywhere near the doorway as it uses an ingenious sensor to detect the pressure change caused when the door opens.

K 1915 ~~$45.00~~
This Month **$29.00**

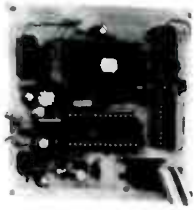
Beat Triggered Strobe

Add Some Life To Your Next Party

Flashes in time to your music. Will also work as normal strobe.

K 5790 **$79.95**
K 5795 Two Tube Option **$16.50**

Speech Synthesizer



Here is a self contained Speech Synthesizer that does not require a computer to control it. It can be connected to almost any appliance, vehicle or home remote control system to let you know when the kettle has switched off, the doors are locked or the water in the radiator is boiling. Blank Eprom included.

K 9500 ~~$95.00~~
This Month Only **$85.00**
K 9502 Pre-Programmed Eprom **$20.00**

Playmaster Pro Series 1 Power Amplifier Module

Fantastic for use in Juke boxes, amplifier racks (multi-amplifier setups) discos etc.

K 5170 **$85.00**

ALTRONICS

174 Roe St. PERTH W.A. 6000 Phone (09) 328 2199
PHONE ORDER TOLL FREE 008 999 007
MAIL ORDER C/- P.O. Box 8350 Perth Stirling St. W.A. 6849

STANDARD DELIVERY & PACKING CHARGE $5.50 to 1Kg, $8 1Kg-5Kg.
AUSTRALIA WIDE — Via. Australia Post allow approx 7 days for delivery.
OVERNIGHT JETSERVICE Up to 3Kg is $10.00, 3Kg to 5Kg is $28.00. **Overnight Jetservice** Courier for delivery next day Country areas please allow additional 24-48 hours.

HEAVY HEAVY SERVICE — All orders of 10Kgs or more must travel Express Road — Please allow 7 days for delivery. $12.00 to 10Kgs. $15.00 over 10Kgs.
INSURANCE — As with virtually every other Australian supplier, we send goods at consignees risk. Should you require comprehensive insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance".
TOLL FREE PHONE ORDER — Bankcard, Visa, Mastercard Holders can phone order toll free up to 6pm Eastern Standard Time. Remember with our **Overnight Jetservice** we deliver next day.

ALTRONICS RESELLERS- Chances are there is an Altronic Reseller right near you — check this list or phone us for details of the nearest dealer.
Blue Ribbon Dealers are highlighted with a ■ These dealers carry a comprehensive range of Altronic products and kits or we'll order any required item for you.

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FLUORO LIGHT WAND

Here's a portable fluorescent light with a difference. Reminiscent of *Star Wars*, the whole assembly fits into a length of clear plastic tubing. The light output is amazing, and the 18W tube is powered by six NiCad cells that give over three hours of operation. The electronics is simply an encapsulated inverter, making construction a snack.

by PETER PHILLIPS

This project comes from the people at Oatley Electronics, who never seem to be short of good ideas. Portable fluorescent lights are not new, but how about one that contains just three components: the light, the batteries and an encapsulated inverter with three terminals.

As the lead photo shows, everything has been fitted into a length of plastic tubing, giving a light wand that radiates light in all directions.

The battery pack is a set of six 'AA' size NiCad cells, arranged to fit in the available space. These give over three hours of operation, due to the high efficiency of the circuit.

To recharge the cells, an external DC supply is required — which connects via a suitable socket fitted to one end of the tube. A diode and current limiting resistor are connected in series with the charging source, and these components also fit inside the plastic tube.

An important point is cost. For around $24, Oatley Electronics will supply all of the electronics and the battery pack. The rest is up to you, and depending on the type of plastic tubing and the fluorescent tube you use, this amazing light will probably cost less than $35. See the end of this article for further details.

Because of its wand like construction, the light is ideal for more than just general lighting purposes. Use it as an emergency beacon, or as a pointer. It makes an ideal signalling device, a car trouble light, an emergency light in the home, a camping light and so on. We said it was a light with a difference!

Incidentally, Oatley Electronics are developing a solar powered charger which can be used with this project. Unlike most solar chargers, this one will be able to recharge the battery pack in a few hours, virtually regardless of the sunlight conditions. Keep watching the magazine for further details!

Before we describe the construction, first a brief look at the electronics.

The circuit

The heart of the project is the inverter module. This totally encapsulated device is designed specifically for battery operated fluorescent lights, and is powered with a DC source ranging from around 5V up to 12V. Current consumption is a modest 100mA at 5V, up to approximately 200mA at 12V.

The frequency of operation depends to an extent on the DC supply voltage, but averages at 2kHz. The characteristic whistle of an inverter is just apparent, and increases in intensity with an increase in the input DC supply voltage. The output waveform is almost a square wave, with positive going spikes on the positive half cycles. These spikes extend to over 1kV when driving a fluorescent

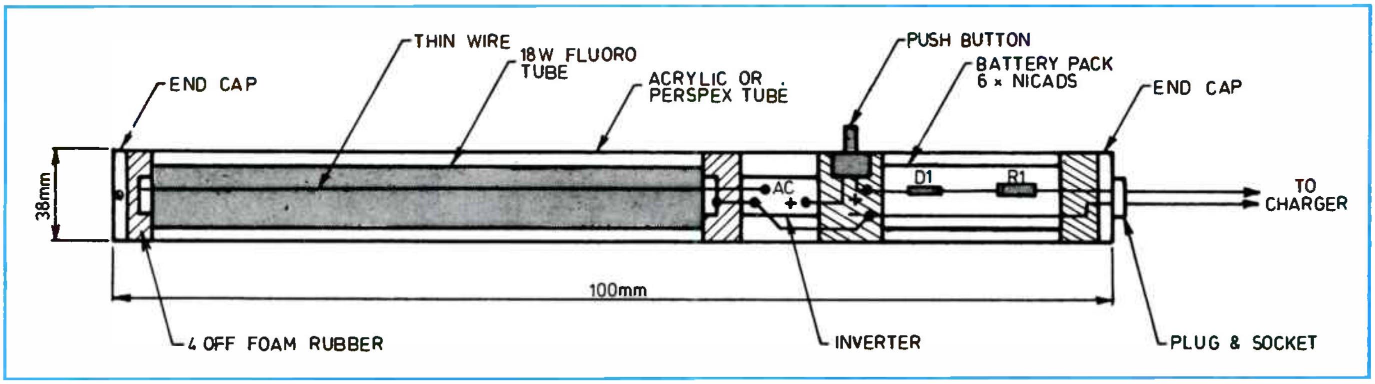


Fig.1: This diagram shows how the various parts fit inside the plastic tube. Neoprene rubber padding is fitted between the various sections to keep everything in place.

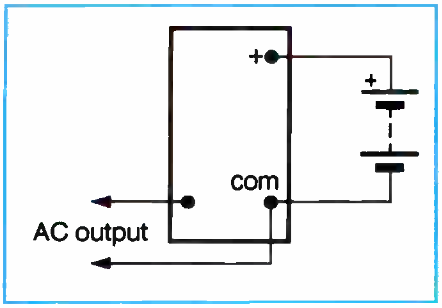


Fig.2: The pin connections for the inverter are shown here. Don't operate the inverter without a load, as the output voltage can exceed 2kV and the inverter may burn out.

tube, and exceed 2kV on open circuit. Interestingly, the DC supply current increases to over 200mA when the load is disconnected. Obviously the inverter is intended to be operated only under load.

Another rather odd characteristic is that if a resistive load less than 50k is connected to the output of the inverter, the output voltage falls to zero. The input current under these conditions is around 140mA.

The rest of the circuit is very simple, and needs little explanation. The value of resistor R1 will depend on the charging voltage, and a value that limits the charging current to around 40mA should prove suitable.

Thus for a 12V charging source, a 100 ohm, 1/2W resistor can be used. This assumes a voltage drop of 0.8V across diode D1 and a battery voltage of 7.2V. If you intend trickle charging the batteries where the charger will be permanently connected, calculate the value for R1 for a charge current of around 12mA. This gives a value of 330 ohms if the charge source is 12V.

If you have a NiCad battery charger (one that has inherent current limiting to suit the cell type), then R1 and D1 aren't really necessary. However leaving these components out is not recommended, and most NiCad chargers will still operate satisfactorily for a resistor value of around 100 ohm.

The series diode is for protection in case the polarity of the charging voltage is accidentally reversed. It also prevents the battery discharging into the charge source, if the source voltage is less than the battery voltage. Any diode able to handle 40mA is suitable, such as the suggested 1N4001 or even a 1N4148 device.

Construction

The diagram of Fig.1 shows how everything fits together inside the plastic tube. The sizes shown are for a 600mm, 18W fluoro. The tube can be made of 3mm perspex, or for the budget conscious, from clear acrylic plastic. A perspex tube has a smoother surface

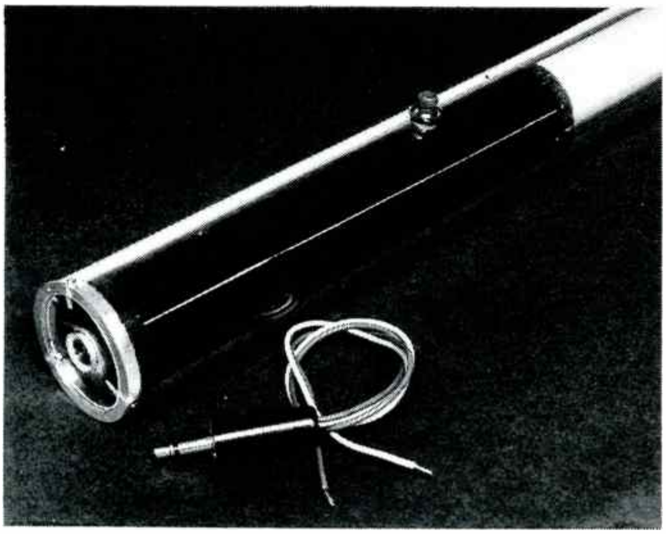


Fig.3: This shot shows the 'business' end of the wand. The electronics are hidden with a piece of black cardboard, to enhance the appearance of the unit.

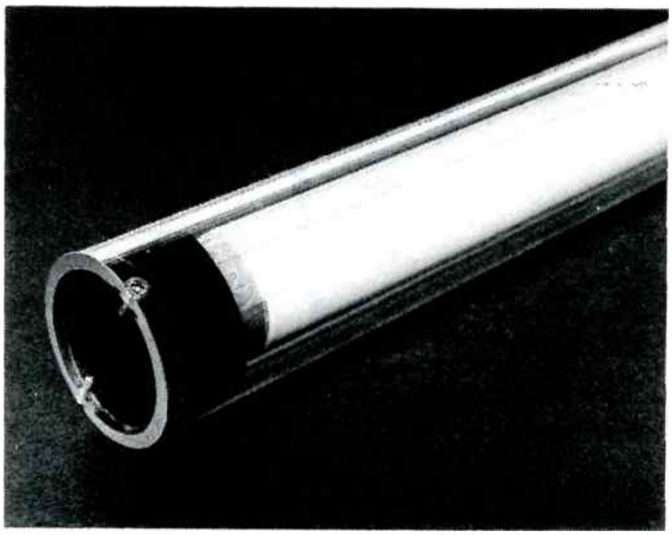


Fig.4: The endcaps are held in place with two screws, as this photo shows.

Fluoro Light Wand

than the acrylic plastic type, and both types are equally transparent. Most plastics suppliers stock suitable tubing, and a scan through the Yellow Pages under 'plastics' should provide the name of a supplier.

The endcaps for the prototype were made from perspex (as was the tube), and are disks that fit inside the ends of the tube. Two screws are used to hold them in place. Of course, the endcaps don't need to be clear plastic, and virtually any material can be used.

Note that a socket is fitted to one endcap to allow the charging source to be connected to the battery pack.

The only other machining required is to drill a hole in the tube for the pushbutton. The photos of Figs.3 and 4 show both ends of the assembly.

The wiring is also shown in Fig.1 and the terminals of the inverter can be identified from this diagram. To make sure refer to Fig.2, which gives the terminal identification more clearly.

The battery pack supplied by Oatley Electronics will need to be disassembled and the cells rearranged, so they can fit inside the tubing. Three banks of two cells each fits nicely. Wire the cells so they are all in series, using the straps welded to the cells as soldering points. Wrap tape around the pack to securely hold the cells together.

The choice of fluorescent light is up to you, and the recommended tube is a white light 18W, 600mm tube. The so called 'power miser' types are not recommended, as their light output is not as good as other types.

The circuit will drive a 40W tube, but the physical length of such a tube makes it rather impractical. The filaments inside the fluorescent tube are not used, and a link should be soldered to join each pair of pins.

Connection is required to both ends of the tube and a length of thin winding wire can be used to connect to the far end of the tube. Fix this wire to the outside of the glass tube with a length of see-through tape.

The series-connected diode and resistor can lay alongside the battery pack, and should be covered with plastic tubing.

Heat shrink tubing is suggested, but any suitable tubing will do. The rest of the wiring can be seen in the circuit diagram, which includes the pushbutton and the connections to the DC input socket.

Assembly

Once the unit has been connected and tested, it remains to fit everything inside the plastic tube. Sponge rubber or neoprene rubber spacers are essential, to ensure all parts are held securely inside the tube.

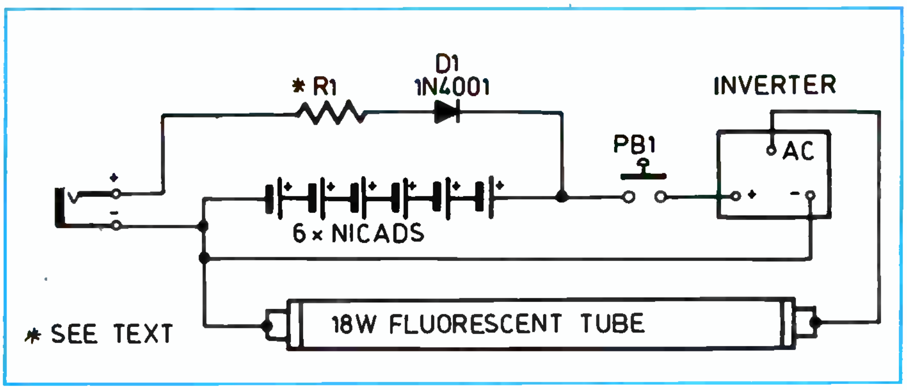
To support the fluorescent tube, fit rubber 'grommets' around both ends. The grommets can be cut out of a piece of sponge, and they act as spacers to prevent the tube hitting the inside of the plastic tube.

As shown in Fig.1, rubber padding is also fitted at both ends of the tube as well as both ends of the battery pack.

To complete the unit, fold a piece of black paper or cardboard so that it wraps around the electronics, then slide it inside the tube. This is purely cosmetic, but it enhances the overall appearance.

And that's it — a useful light for all kinds of purposes. Kids (even grown up ones) may like to fancy themselves as Luke Skywalker and use the wand as a 'force' sword. Obviously the light is not designed for this sort of punishment, and all you'll end up with is a pulverised fluorescent tube.

Apart from the danger of broken glass, the phosphor powder inside the fluorescent tube is poisonous. Tell the kids to leave Darth Vader to Steven Spielberg! ■



The special purpose inverter drives the fluorescent light directly from the 7.2V NiCad battery pack. The charging circuit consists of R1 and D1, and connects to the charge source via the socket.

PARTS LIST

Resistor as described in text; diode, 1N4001 or equivalent;
DC-AC fluorescent tube inverter;
6 x size AA NiCad cells;
3.5mm phono plug and panel mount socket;
N/O pushbutton;
18W, 600mm fluorescent tube;
100mm x 38mm OD clear tubing and endcaps to suit;
hookup wire, rubber packing.

A kit of parts for this project is 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.
The kit contains the pushbutton, inverter, battery pack, diode and series resistor. Cost is $24.
Post and packing is a further $3.

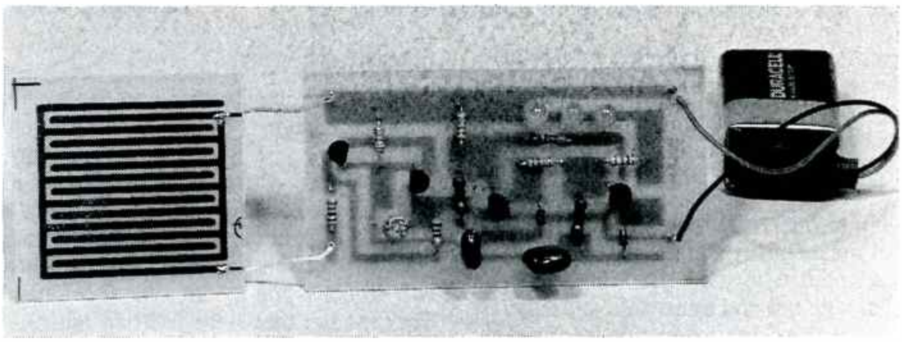
Experimenting with Electronics

by PETER MURTAGH

A simple touch light

You need to get up in the middle of the night — so you reach out and make contact with a touch pad. On comes a light, which means that you don't stumble around in the dark. Touch it a second time and the light goes off. This is just one application for this month's circuit.

If you look at the schematic diagram, you can see that this project needs four transistors. Two of them form a high gain amplifier, to increase the tiny current which flows through our fingers when they are in contact with the touch pad. The other two transistors form a bi-stable flipflop which controls the light. Unlike the astable flipflop in project No.2, which continuously turned on and off, the bi-stable flipflop needs a separate pulse each time you want to change its state.



So the first touch on the touch-pad 'sets' the flipflop, which turns on the light, while the second touch 'resets' it and turns the light off.

Note that our touch light consists of just three LEDs. We have used the three LEDs in series to avoid draining too much current from our 9V battery — but they still give a reasonable light in a dark room.

Any colour LED can be used. We chose yellow because it seemed to give off a bit more light. You can normally choose between red, green, orange and yellow for the same price.

The total current supplied by the battery is about 20mA with the LEDs on, and about 1mA with them off.

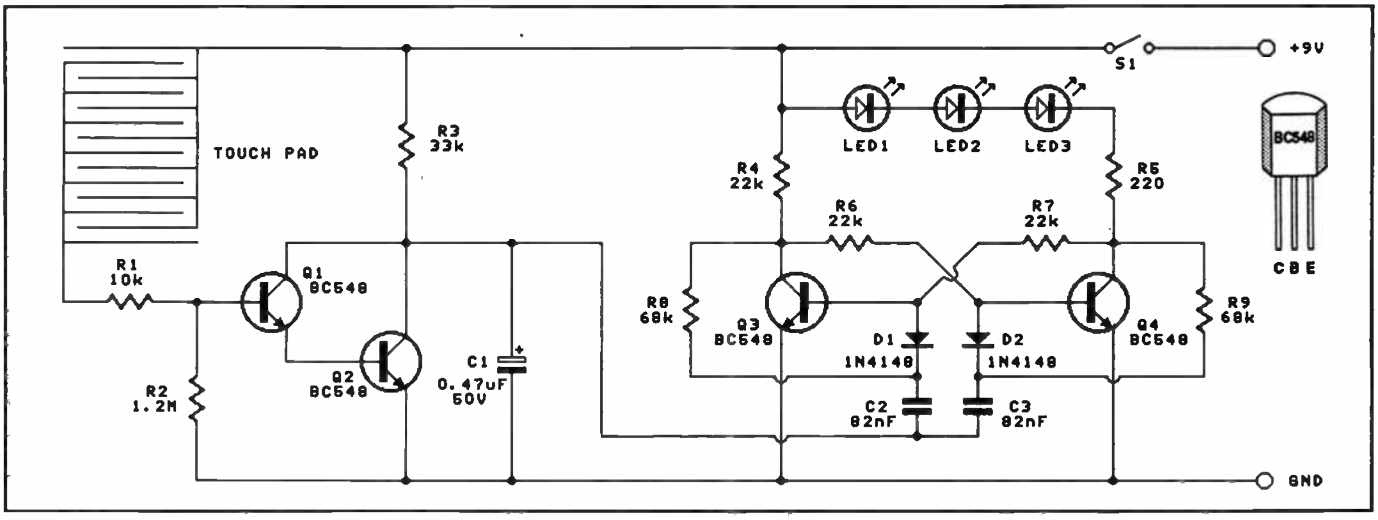
Even this low 1mA will affect the life of the battery, so it is a good idea to insert the switch S1 (shown in the schematic diagram) to disconnect the battery when the light is not in standby mode.

Construction

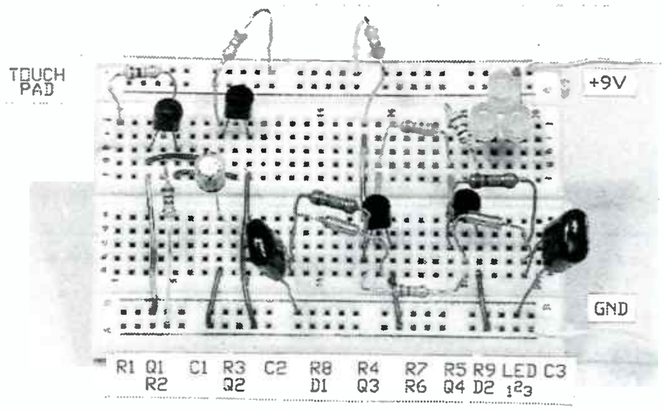
If you have already built our previous projects, then the only new feature in project No.4 is the touch pad. This provides no problem if you use our printed circuit board pattern, because the pattern for the pad is already there. But if you use the strip-board approach, you will have to decide how large you want to make the pad, and then solder loop wires to interconnect every second track to make the touch-pad.

The whole point of the touch-pad is that your finger must make contact with two parallel strips in order to act as a switch. You can see this touch-pad arrangement clearly on the diagrams.

If you make your own PCB circuit boards, and cover them with a protective coating, remember not to coat the touch pad section of this board, otherwise it



The schematic diagram shows the 'amplifier' section at the left and the 'flipflop' at the right. Use this diagram to clarify which leads of which components should be joined together.



For those constructing the circuit on a bread board. A touch pad (not shown) is needed to activate the circuit.

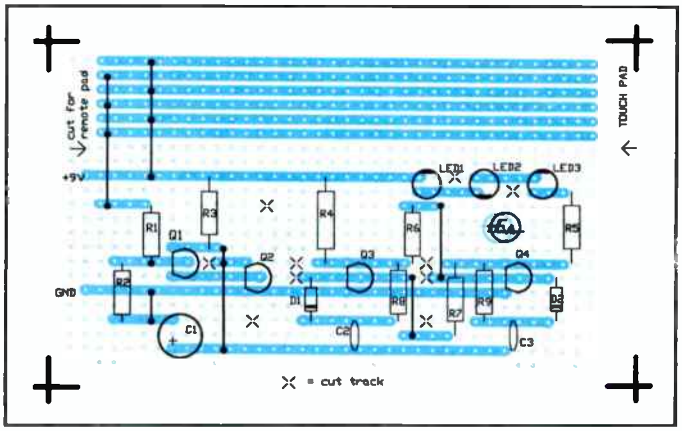


Fig.1: Strip-board construction. Cut where shown so that the copper of the touch pad can face upwards.

won't conduct — your skin has to make electrical contact with two of the parallel strips. As usual, solder the loop wires and resistors first, then the capacitors, LEDs, diodes and transistors.

Capacitors C2 and C3 are the polyester type so their orientation doesn't matter. But the electrolytic capacitor C1 must be connected with the correct polarity. The LEDs, diodes and transistors must also be inserted the correct way. So you must first identify their leads.

The negative end of the electrolytic capacitor is easy to find. Negative signs are printed on the casing with arrow heads pointing to the negative lead. With the signal diodes, the negative end (cathode) is marked with a ring around that end of the body.

The anode (positive) lead is the easiest to find on the LEDs — it is longer. On the PCB layout, the anode of each LED is always towards the left; but on the strip-board, the anode is towards the top with LED1 and LED3, but towards the bottom with LED2.

The BC548 transistors have their collectors to the left, when you view the flat face of the transistor with the three leads pointing down (see the outline on the schematic diagram).

Having identified all these leads, now insert them correctly and solder them.

Changes

The main change that you can make with the design is to separate the touch pad from the rest of the circuit. Small arrows indicate where to cut the boards if you decide to do this.

If you look at the photo of our version, you will see that we have separated the two sections, and inverted the touch pad. This means that both the pad and the components face upwards. It is not necessary to do this, but if you don't, then the board is sitting on the components. This could cause problems with your constant tapping on the touch pad. With the strip-board version, cut along the strip below the pad; with the PCB version, cut down the board to the right of the pad. Then bridge the gap with hookup wire.

Possible uses for a remote sensing pad? The pad could be on your door with the light inside your room, or the pad could be in the garage with the light in the house. We found that the circuit worked quite satisfactorily with the pad 6 metres away. However, a word of warning: the longer the wires, the more chance of RF (radio frequency) interference which can

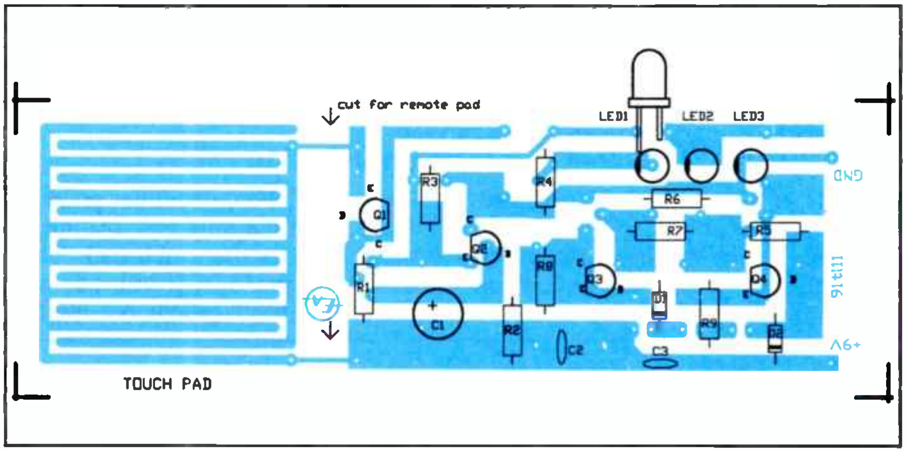
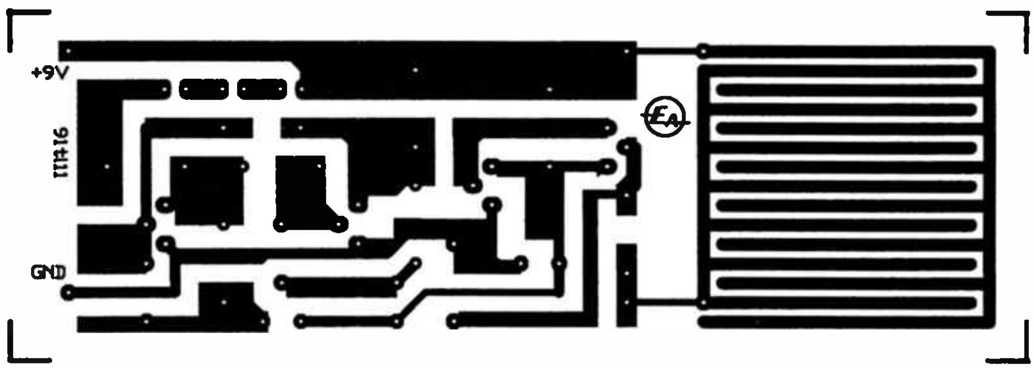


Fig.2: The component layout on the printed circuit board. If required, the touch pad can be placed quite a distance away from the rest of the circuit.

This is a full size reproduction of the PCB artwork which can be used to etch your own board.



cause stray triggering. For a permanent setup, it is far better to make the light the extension feature, and keep the rest of the components close together.

How it works

As already mentioned, transistors Q1 and Q2 form a high gain amplifier. Because the resistance of your skin is quite large, bridging the tracks on the touch pad causes only a very small current to flow. But the tiny current of about 6uA (microamps) in the touch-pad becomes 260uA in transistor Q2 — our amplifier has a current gain of over 40.

Before you touched the pad, capacitor C1 has charged up via resistor R3, and resistor R2 makes certain that the amplifier is turned off by applying a negative voltage to the base of Q1.

When your finger bridges the touch pad, the base-emitter junction of Q1 becomes forward biased. Current now flows through resistor R1 to turn on transistor Q1, which then turns on transistor Q2. The moment Q2 turns on, it quickly discharges C1, sending a negative pulse to the next stage, the flipflop.

The reason for having resistor R1 is in case the touch pad is short-circuited, e.g. if you drop a pair of scissors across it, etc. The 10k ohms will safely limit the base current of transistor Q1. Normally resistor R1 is not needed since your skin resistance is quite high. But, even with R1 in the circuit reducing the current, it doesn't worry our amplifier because it has such a high gain.

Now to investigate the flipflop built around transistors Q3 and Q4.

All flipflops are constructed in such a way, that, as soon as one of the transistors starts to conduct, it turns the other transistor off. If such a circuit is symmetrical, with all corresponding components identical, then it's anyone's guess which transistor will be the first to conduct.

But we want our flipflop to commence with the LEDs off. This is because the circuit uses about 20mA when the LEDs are on, but only 1mA when off — the LEDs and R5 have a lower resistance than R4. This means that the base current of Q3 (flowing through the three LEDs, R5 and R7) is larger than the base current of Q4 (flowing through R4 and R6). So Q3 turns on first.

As soon as Q3 turns on, its collector voltage drops from about 8V to about 1V. This low voltage is applied to the base of Q4, turning it off.

Now consider the two diodes, D1 and D2. The anode of D1 has quite a high voltage from Q4's collector, via R7, while its cathode has a low voltage from Q3's collector, via R8. The diode is very close to conducting, but is not quite forward-biased. The voltages across D2 are the reverse. The diode is reverse-biased, with the higher voltage at the cathode and the lower one at the anode.

When you touch the pad, C1 produces its negative pulse which is transmitted across capacitors C2 and C3 to the cathodes of both D1 and D2.

Diode D2 is reverse biased, so nothing happens. But diode D1 is triggered into conduction. This diverts Q3's base current, so Q3 ceases to conduct, and switches off.

Switching Q3 off switches Q4 on, and sets the flipflop. With transistor Q4 conducting, the three LEDs light up. Diode D1 is now reverse-biased, and diode D2 awaits the next pulse which will make it conduct and reset the flipflop.

So each alternate pulse turns the LEDs on and off.

PARTS LIST

Miscellaneous:

PCB, 135 x46mm, coded 91TL11
3 LEDs
1 9V battery
1 SPDT switch

Resistors:

All 1/4W, 5%:

1	10k	R1	(brown-black-orange)
1	1.2M	R2	(brown-red-green)
1	33k	R3	(orange-orange-orange)
3	22k	R4,R6,R7	(red-red-orange)
1	220	R5	(red-red-brown)
2	68k	R8,R9	(blue-grey-orange)

Capacitors:

1 0.47uF 50V C1 PC-mount electrolytic
2 82nF C2,C3 'greencap' polyester

Semiconductors:

2 1N4148 signal diode D1,D2
4 BC548 NPN transistors Q1,Q2,Q3,Q4

Transparencies

A reminder that *EA's* reader services will continue to offer high contrast, actual size transparencies (negatives) of PCB patterns for only $2 (price includes postage) for each project in this series. These negatives make it a lot easier to make your own printed circuit boards.

Happy experimenting — and don't forget to send us your ideas for future circuits. ■

NOTES AND ERRATA

In Fig.1 of 'Experimenting with Electronics - Project 2 (September 1991, p.98), all of the blue background has been printed upside down. The correct diagram appears in the October edition, where Projects 1 and 2 are combined. ■

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The 25 aerials included in this book have been especially designed, built and tested by Mr. Noll to be sure performers and give surprisingly good results considering their limited dimensions.

25 SIMPLE TROPICAL AND MW BAND AERIALS
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SHORTWAVE LISTENING

by Arthur Cushen, MBE

How to get reception reports delivered

In most countries of the world there is no problem with the postal service, and your reception reports will be delivered to the radio station, unless there are insufficient address details. But when you come to write to Latin American stations, considerable ingenuity is required.

The problem in Latin America is the difficulty in getting your report delivered because of the chaotic postal service and the theft of mail.

Recently, Paul Edwards of Wellington, New Zealand visited many stations in Ecuador, Peru, Colombia and Argentina. He reported that the stations' files of reports showed that those who had used aerogrammes to submit their reception details generally reached the station. It seems that the postal authorities and the mail carriers look on an aerogramme as containing no enclosure, whereas an airmail letter could have US dollar bills or an International Reply Coupon. If the letter has an outstanding commemorative stamp, you can be certain that it will never reach its destination.

Here are some ideas for the new listener to help your reception report reach its destination. If you use an envelope for your report, make sure that it has an inner lining so that the contents cannot be seen from the outside. The envelope should be as plain as possible so that it does not attract attention in a foreign postal service. We should emphasise that many beginners get caught in the fancy stamp idea — beautiful stamps are placed on the envelope so that they will be appreciated by the station manager.

But far too often the letter will be intercepted along the way and never be delivered. So use a plain stamp, and even tear off part of the perforation so that it is valueless to a collector. This is one way of ensuring that the letter reaches its destination. You could even use a franking machine for postage.

On the reverse side of the envelope or aerogramme, make certain that your name and full address appear so that your report can be returned in the case of non-delivery. You can find the correct address of the station to which you wish to send your report in the *World Radio TV Handbook*.

In most cases this also provides the name of the General Manager or Chief Engineer, to whom you can write a more personal letter.

The name and the station slogan, as well as the callsign and full postal address, should appear on the front of the envelope. It is better to use the station slogan than the callsign, because the callsign is not often used for identification in Latin American stations.

In the matter of return postage, most countries of the world will accept an International Reply Coupon. This can be purchased at your Post Office, and can be redeemed by the station for the equivalent of the postage back to your address. In Latin America, even though an IRC can be cashed in the major cities, it is usually preferable to send mint stamps of the country to which you are writing. If these are not available, you could send a tourist booklet and a selection of Australian or New Zealand stamps, commenting that these are for one of the staff who may be interested in philately. This could ensure a letter of appreciation as well as a verification.

Once your report has been posted, it is

AROUND THE WORLD

BHUTAN: The Bhutan Broadcasting Service is being received at good strength during the English programme from 1415-1500UTC. The frequency of 5025kHz is used, and the schedule includes news and local announcements, as well as a music programme from 1430. On Mondays the music includes a selection of country and western songs. The announcement also indicates that the service is operating on 96MHz on FM in the capital. With the new 50kW transmitter, signals are being heard throughout Asia and the Pacific.

ETHIOPIA: Broadcasts from Addis Ababa have returned to shortwave, and the transmission in English has been received from 1300-1400. Don Rhodes of Melbourne reports hearing the frequency of 9560kHz during this time period, and the station also announces that they are using 7165kHz.

ICELAND: Icelandic National Broadcasting Service, Reykjavik, has added a daily news broadcast in English at 0730 on 9265kHz. Iceland uses many out-of-band frequencies, and its present schedule in Icelandic is 1215-1245 on 13830 and 15790kHz; 1225-1245, 1410-1440 on 13855 and 15770kHz; 1855-1930 on 11402 and 13855kHz; 1935-2010, 2300-2335 on 13855 and 15770kHz.

ISRAEL: The Israel Broadcasting Authority has announced some budget cuts and is to reduce its English programming. The cuts are expected to reduce many English transmissions, particularly those to North America, Australia and New Zealand. Israel also relays English news broadcasts from its Domestic Service and the transmission at 0400 is widely heard in the Pacific. The only English sessions to remain will be two broadcasts to Europe at 1900-1930 on 11605, 15640, 17630 and 17685; at 2130-2200 on 11588, 11604, 15100, 15640, 17575 and 17685kHz.

NEDERLANDS: Radio Nederland, Hilversum, as well as altering the frequency of its English broadcast at 0730-0825 from 9715 to 11895kHz, has made some other changes in its transmissions to this area. Its English broadcast at 0830-0925 is now on 21750, replacing 21485kHz, while the Dutch transmission at 1030-1125 is now on 11895, replacing 11890kHz.

YUGOSLAVIA: Radio Belgrade has recently been the centre of worldwide interest, and an adjustment has been made to the frequencies in use for its broadcast to Europe 2100-2145. Two frequencies are now in operation, 5960 and 11735kHz, the latter providing the best reception.

a matter of waiting for a reply. Most stations reply within six months, but some in Latin America may confirm your report by seamail, so do not give up hope. The writer has received verification after nine years recently from Peru, and in another case, a United States broadcaster having a spring clean verified after 16 years. Often the station does not give your complete address on the verification letter — in many cases the writer has had letters addressed with his name and just 'New Zealand'.

The postal service is often to blame, with letters wrongly directed. Two in the mail recently were marked 'sent in error to Ireland' before being directed back to New Zealand.

If you have not received a reply from the station after nine months, then you should write a courteous letter pointing out that your reception report has not been verified. It is advisable to blame the postal service, with remarks such that you feel your first report may not have reached the broadcaster. This often results in a quick reply in which the station will state that they did not receive your first report, and that they are only too happy to confirm the reception.

Daventry to close

The best known transmitting site on shortwave must be Daventry, the first home of the BBC Shortwave Service. Next year the transmitters are to close at this United Kingdom site.

Daventry is the oldest of the BBC transmitting stations, having opened in 1925 with a longwave service. In 1927 a regional service was commenced, and in 1932 the forerunner of the present BBC World Service was opened. In those days it was called the Empire Service. Daventry was also the site of the mediumwave transmitters for Radio 3. Its closure will mean a loss of 30-40 jobs, and the staff will be resettled at other transmitting sites when vacancies arise. However, Daventry will still continue as a base for serving the BBC's domestic radio and television services in the area.

The transfer of the shortwave facilities to the Woofferton site in Shropshire will commence in April next year and should conclude by the end of that year. Woofferton has been operated by the BBC for the transmission of the Voice of America since 1943. Spare transmitter capacity is now available, as the VOA has reduced its services into Europe.

The closure of Daventry will be viewed with sadness, not only by BBC employees, but also by shortwave listeners throughout the world for whom it has been associated with the BBC Shortwave Service. Indeed many pre-war radio receivers have 'Daventry' marked on the shortwave dial scale, along with many other broadcasters of the 1930s.

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.

Venezuela's new voice

For the past 15 years, two of Venezuela's 500kW transmitters have stood idle because of complaints from other stations in the Caribbean area that they caused interference on the mediumwave frequency of 1240kHz. The station has only been running test broadcasts and has never reached its full potential. Recently Geoff White visited the site and reported to Radio Nederland on the progress of the international service of Radio Nacional, Venezuela.

The transmitters are located on some salt flats on the coast, about six hours journey from the capital, Caracas. Two 100m towers serve as the antenna and the station can beam programmes to the Caribbean, Central America and Brazil. The station is using the slogan, 'The Voice of Venezuela', and seven staff are employed to keep the transmitters operational in the event that the broadcasts will be put on air on a regular basis. Meanwhile, Radio Nacional Venezuela, located in Caracas, operates on mediumwave three networks, as well as the 10kW shortwave transmissions on 9540kHz.

Radio Nacional Venezuela has been heard in the South Pacific on this 9540kHz frequency, opening at 1055UTC with an interval signal, with short Spanish identification announcements, and shortly before 1100 with a full identification given in Spanish. News follows the time signal, and at 1140 a programme in English is broadcast. Broadcasts are made in English, Spanish, French and Creole. Plans are under way to expand into Portuguese, Italian and Arabic.

The English programmes, which commenced recently, consist of a 15 minute news segment, Monday to Saturday, which is incorporated in the Spanish section of the broadcast. The same news is also carried in French.

English broadcasts are at 1140, 1440, 1840, 2140, 0040 and 0340, all on 9540kHz. The station is keen to receive reception reports, and these should be sent to Radio Nacional de Venezuela, International Service, PO Box 3979, Caracas 1050, Venezuela, South America. ■

Engine Control

Continued from page 35

capacitor changes the frequency of an oscillator, and this changing frequency is measured by the controller as an indication of some measurable quantity.

There has not been much use made yet of the principle of varying an inductance to indicate a varying quantity, but I believe that this electrical effect will be used in the control system of an active suspension system to indicate to a controller that a car's tyre may be deflating. This information is apparently useful if you are driving a 'super car' capable of travelling at 500kph! As with the varying capacitor, the varying inductance is an indirect sensor — for the same reason.

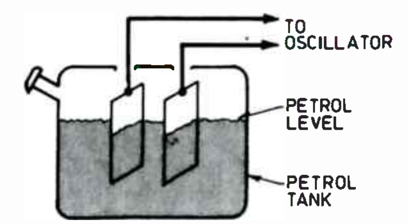


Fig.13

These sensors provide quantity information on 'how much' — i.e. engine temperature, air pressure, air flow rate, etc. Other sensors provide *state* information — i.e. open, closed, 'too hot', etc. These in turn are either mechanical (usually switches) or electromagnetic (usually an inductive pick-up in the distributor or on the flywheel, a large disk with high mass attached to the crankshaft that evens out the torque). This sensor is used to provide engine timing information to the controller.

Finally there are the Hall effect sensors or optical pick-ups. This last group is also used to give the controller timing information, such as the position state of the engine — i.e., where the number one piston is.

All of this good technical guff has caused an enormous upheaval in the ranks of the automotive service industry, who are suddenly confronted with technology and concepts completely alien to their background training.

This finishes our fairly lengthy introduction, to show how electronics came to be incorporated so extensively in the modern motor car. In the next article we'll look more closely at some of the sensors and actuators currently being used.

(To be continued) ■

Vintage Radio

by PETER LANKSHEAR

Class 'B' amplification

Class B operation, which combines maximum efficiency and power output with minimum heat dissipation, is practically universal for transistor power amplifiers. It is not, however, a product of the semiconductor age — in fact it was originally developed about 60 years ago, to improve valve amplifier economy.

During the 1920's there came a realisation of the importance of grid bias for valves. Three classes of operating conditions were defined, governed by the amount of bias, and were known simply as classes A, B, and — not altogether surprisingly — class C.

Distortion is lowest and gain is maximum in Class A operation, which is standard for *voltage* amplifiers. The grid is biased so that a constant anode current flows. Power amplifiers can be either single-ended or push-pull, and maximum efficiency is about 40%.

In class B, the negative grid bias is sufficient to just cut off the anode current with no signal. Anode current thus flows only when the grid is driven positive. Initial receiver applications were for 'biased' or 'anode' detectors, and some oscillators. In effect, only half the signal is amplified.

Must be push-pull

Class B audio amplifiers must be push-pull, with the two halves of the signal waveform recombined at the output. This led to some early references to class B audio amplifiers as operating in 'push push'.

Operating conditions can be set anywhere between class A and class B. This intermediate mode is called — naturally — class AB, and became very important for power amplifiers of all types, but especially those using beam tetrodes. A further sub classification was the use of a numerical suffix: a '1' indicating that no grid current was allowed to flow, or a '2' to show that there was grid current during part of the operating cycle.

For class C operation, the anode load is always a tuned circuit. The control grid is biased far beyond cutoff, and anode current flows only at the very peak of the positive component of the grid signal — resulting in a series of pulses which keep the tuned circuit in oscillation. Efficiency is very high, up to 80%. The only, but important, receiver application is that of the local RF oscillator in a superhet.

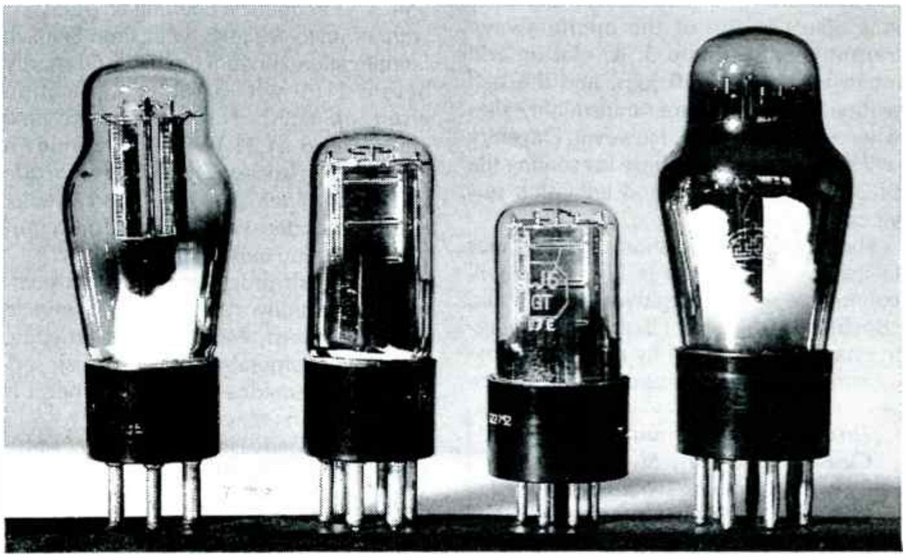
Audio power expensive

During the 1920's, class A was the only recognised type of operation for audio amplifiers. As reasonable outputs could only be achieved with large valves and prohibitive costs in battery consumption, early radios were seriously limited in the audio power that could be produced. Later, the advent of practical mains power supplies and valves such as the the English LS5, the American UX210, UX250, and then the UX245, enabled receivers to produce upwards of a watt of reasonable quality audio power. But battery radio users had to balance output against battery consumption.

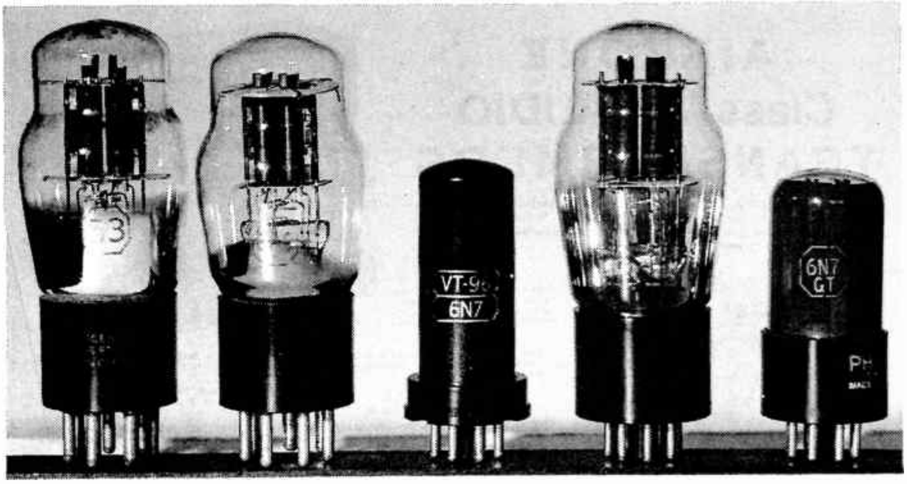
In 1930, British and European output pentodes such as the B443, PM24, 230QT, and PT35 were available, and went some way to solving the efficiency problem. With 150 volts HT at 15mA they were capable of at least half a watt — twice that of the latest American type 231 output triode operating under similar conditions. Although Philips had invented the pentode in 1927, the Americans, for various reasons, delayed its introduction until mid 1931.

New operating mode

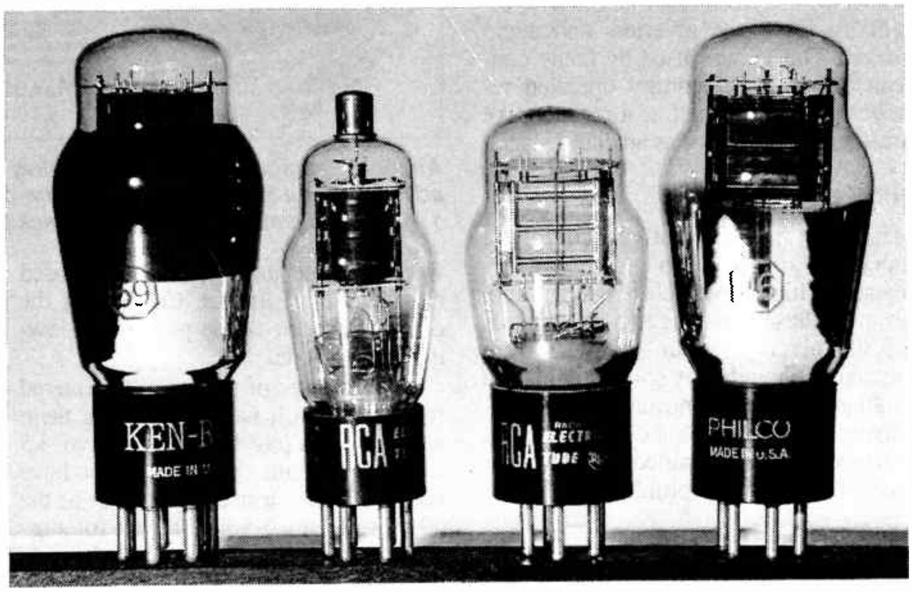
Coincident with the release of the first American pentodes (the 47 for mains operation, the 38 for car radios and the 33 for battery sets) were a couple of papers by Loy Barton in the June and July 1931 *Proceedings of the American IRE*, suggesting the obtaining of high audio power from relatively small valves by using class B operation.



By far the most popular directly-heated class B valves were the 2V double triodes. Shown here from the left are the original 19, a later tubular 19, the octal 1J6GT equivalent and an English version the Cossor 220B or VR32.



***Left:** All brothers under the shell, the 53, 6A6 and their 6N7 octal variants were the largest and most important of the indirectly-heated class B double triodes. They found many other applications, from oscillators to resistance-coupled amplifiers.*



***Below:** The multi-grid class B valves were the most versatile, but as single valves they lost out to the double triodes in terms of cost. From left to right are shown the triple-grid 59 and 89, then the tetrode 49 and 46.*

There are benefits. For a start, the valve anode current is proportional to power output demands and is practically cut off under no-signal conditions. Furthermore, given the nature of speech and music waveforms, the average current is low even for large power outputs.

There are also snags, however — including the necessity for additional valves. To cope with the grid current drawn by the output valves, the driver valve also has to provide power, generally through a step-down ratio transformer. In effect, the driver is an integral part of a class B amplifier.

Different transformers

Class B output transformers operate in a different manner from those intended for class A. The two halves work independently, but must be very closely coupled and the valve characteristics matched to a 5% tolerance. Furthermore, in the transition period — as conduction switches between valves — there can be serious 'crossover' distortion, especially at low volume. Another problem is created by the large variations in anode current, requiring well regulated power supplies.

Although the cheaper option of a single resistance-coupled pentode was available, by early 1932 several American manufacturers, using a pair of the very low powered type 30 general purpose triodes, had produced battery operated receivers producing more than one watt of class B audio power. This dramatically illustrated the significant improvement in efficiency of class B operation. The same valves, operating in class A, would have been struggling to produce 100 milliwatts.

Late in 1932 and into 1933, class B became 'flavour of the season' for mains as well as battery operation. Valves specifically designed for this class of service were developed, and within a year there were at least eight new American releases having class B ratings, outnumbering the range of pentodes available!

Three groups

Except in Britain, high-mu triodes were invariably used for class B operation. The high amplification factor meant that anode current with no signal was nearly at cutoff without negative bias, a considerable advantage with mains powered receivers. Battery powered twin pentodes found considerable favour in Britain and will be described later.

Three different varieties of triode class B valve emerged. Ultimately the most popular were the double triodes. Their advantage was the saving of one valve and socket, and the characteristics of the two halves could be closely matched. Best known were the 2.0 volt filament US type 19 and the similar Philips KDD2 or B240, the Mullard PM2-B and Cossor's 220B and 240B — capable of producing up to two watts. Companions were the 6.3-volt type 79 for car radios, capable of about five watts, and the 2.5-volt mains powered type 53 rated at up to 10 watts.

Valve manufacturers were very fond of repackaging an existing design. To the 53 goes the distinction of having the largest number of derivations, all with 6.3-volt heaters. First there was the 6A6, and then followed the octal metal-enveloped 6N7 and finally the glass variants 6N7G and 6N7GT.

The 19 in octal form was the 1J6G, and a 1.4 volt version was the 1G6G. With an octal base the 79 became the 6Y7G.

New octal variants

There were two new 6.3-volt heater types issued in the octal era. The 6Z7G with a 0.3 ampere heater was intended for storage battery operated sets, but the most unusual were the 6AC5G and 6AC5GT. These were single zero bias high-mu triodes, but were also given class A ratings for operating with a *positive* grid bias and directly coupled to a cathode-follower driver valve. Why such a valve was issued when similar valves such as the 2B5, 6B5 and 6N6 (complete with built-in driver valves) were already in existence, is a mystery.

The indirectly heated double triodes were used to a limited extent in mains powered receivers. Typical was the AWA Radiola 140, incorporating a type 53 valve driven by a 42. It was soon realised however, that HT current economy was of little importance in mains powered receivers and that because of the extra expense and higher distortion, there was little merit in this line of development.

Double triodes proved quite popular as resistance-coupled audio amplifiers, especially for phase inverters and audio mixers. The 19 was used by home constructors of small battery operated receivers, using one half as a regenerative receiver and the other as an audio stage.

Airzone was soon involved in making class-B transformers, as shown by this advertisement from the July 13 issue of Wireless Weekly for 1934. The price of 17/6 each reveals one of the drawbacks of class-B technology — its high cost.

New rectifier

Existing rectifier valves could not meet the stringent power supply demands of high power class B operation. To meet these demands two new rectifiers, the mercury vapour 82 and 83, were created. Although they solved regulation problems, they were never popular in receivers. Their life was short, choke input filters were recommended and they created RF interference problems.

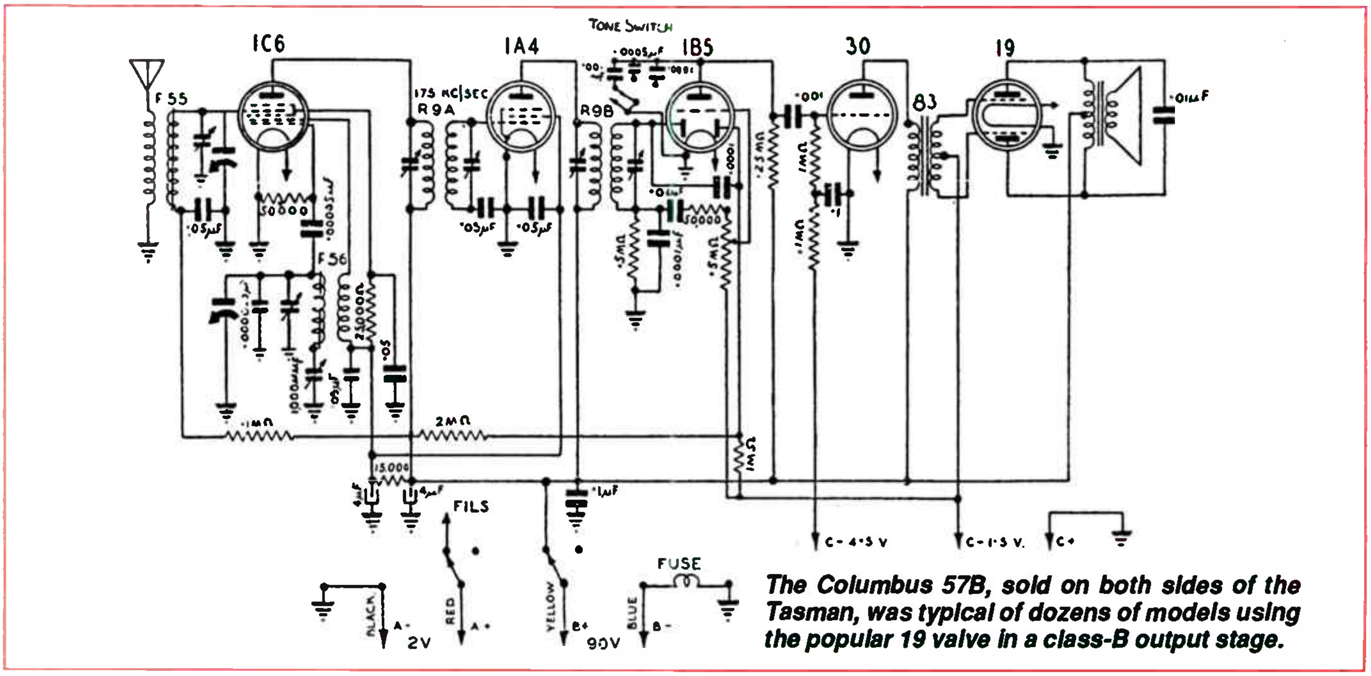
Multi-grid triodes

Concurrently with the 19 there appeared three unique directly heated valves, each with *two grids*. With the grids connected together, these valves were intended as high-mu zero biased class B output triodes. Connecting the outer grid to the anode produced a low-mu driver triode.

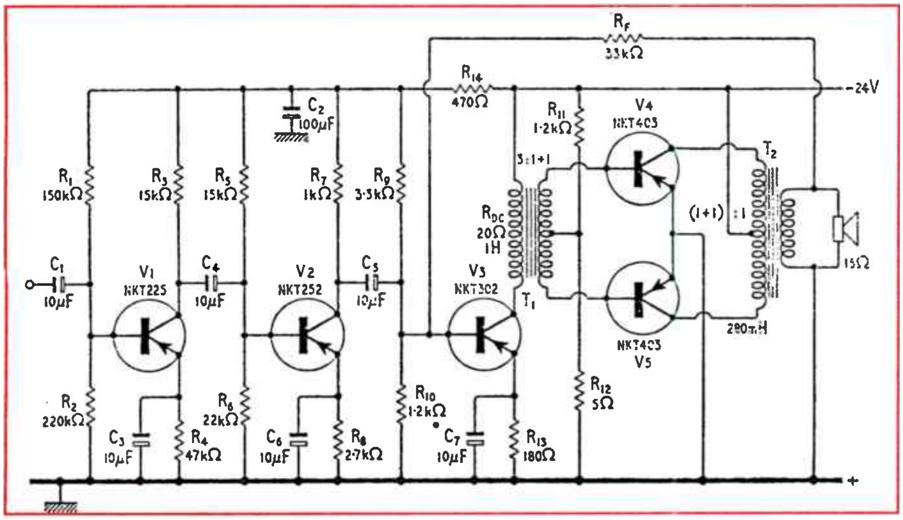
Three classes of service were catered for. For 2.0-volt battery receivers there was the 49, a pair being capable of 3.5 watts at 180 volts. The 52 seems to have used the same electrode assembly as the 49, but had a 6.3-volt filament for storage battery operation. Third member was the large 2.5-volt filament type 46, a pair being rated at no less than 20 watts at 400 volts!

Demand for the dual-grid series was limited. Two valves cost more than a twin triode and they were overpowered for most receiver applications. The 46 and 49 were used to a limited extent around 1933/34, but became well known in other ways.

The 46 found favour in PA work and amateur transmitters, for both modulator and RF applications, but the 49 became best known in this part of the world as the valve for the *Hikers' One*, described in the October 1989 Vintage Radio column. In New Zealand, far more type 49 valves were used by young radio enthusiasts for the *Hikers* series of radios than



The Columbus 57B, sold on both sides of the Tasman, was typical of dozens of models using the popular 19 valve in a class-B output stage.



Early transistor audio amplifiers were closely based on class-B valve technology, as this diagram reveals. Compare its output stage with that of the 57B receiver.

were ever used for their intended purpose. The only user of the type 52 that I can find was United American Bosch, who used it in a DC mains receiver and two police car radios. It was not listed by RCA.

The third type of American-designed Class B valve was represented by the indirectly heated *triple grid* types 59 and 89, with heaters rated at 2.5 volts and 6.3 volts. This versatile pair could be used in three ways. With the two outer grids connected to the anode, they became low-mu driver triodes. With the two inner grids connected together and the outer grid connected to the anode, they were high-mu class B triodes, a pair of type 89's being capable of 3.5 watts. The 59 had similar applications and ratings to the 46 in class B service, with the advantage of an indirectly heated cathode.

The third, and eventually, major application for the 59 and 89 was as conventional power pentodes. They were both rated at around three watts output, the 59 having characteristics similar to the well-known types 42 and the 2A5. But as class A pentodes, the 59 and the 89 were eventually displaced by the more conventional standard power pentodes.

Quiescent push-pull

America and Australasia generally stayed with simple triodes, the type 19 being very popular for battery receivers. In Britain however, where battery powered receivers were very common, practically every valve company produced a double class B pentode, used with about 12 volts bias and operating in what was called the *quiescent push-pull* mode. They were more sensitive than triodes, and drew little grid current, simplifying driving requirements. Apart from the American 1E7G, which had only class A ratings, the double pentode output valve was unique to Britain. Some QPP valve types were QP22A, QP22B, 240QP, QPT2, QP21, QP230 and QP240.

Because of all its complications and distortion, use of the class B valve audio amplifier soon became confined to battery receivers where its economy was important. But in any event, efficient pentodes eventually became available and after 1940, the class B valve receiver output stage was rarely seen.

Class B today

There are still in operation many AM broadcast transmitters using class B valve modulators — and tamed by plenty of negative feedback and accurately maintained operating conditions, producing kilowatts of high quality audio. In this application, the efficiency of class B operation is of real value. It can be quite intriguing to observe lightly damped current meters in the mains supplies to these transmitters, indicating power demand variations in step with the programme modulation!

With the limited dissipation and risk of thermal runaway of early transistors, class B operation would have needed to be invented had it not already existed, and it is not surprising that the technology of the first transistor audio amplifiers closely resembled that for class B valves.

With the development of direct coupling and complementary transistor pairs, the application of considerable levels of negative feedback to solid state equipment became practicable — enabling physically small amplifiers to produce high performance and power efficiently. ■

Basic Electronics

Continued from page 61

mounted the wrong way (diodes, transistors, FET, capacitors).

The direcuit diagram shows the DC voltages obtained on the prototype (no signal) although if excessive current is being taken from the power supply (the output transistors are hot), the actual voltages will probably be less than those shown. If this is the case, turn off the power, allow the transistors to cool down then repeat the set up procedure.

If this still keeps happening, you might need to add resistors R10 and R11. Remember that a fault in a DC coupled amplifier will probably cause *all* of the DC voltages to go wrong.

Modifications

If you want to obtain more output power from the module, a high DC supply voltage is required. The limit is 25V DC, and larger heatsinks will be needed. The quiescent collector current should still be set to 100mA (120mA for supply voltages greater than 20V), and if you run out of adjustment for VR3, reduce the value of R9.

The gain of the circuit can be increased substantially by connecting the bypass capacitor labelled as C8. Because this removes virtually all the AC negative feedback, the sound quality will be reduced, but the module can now be used as part of an intercom.

A small speaker can be used as a microphone, and if you use a 47uF capacitor for C8, the frequency response of the amplifier will be limited, minimising 50Hz hum in the output signal. The emitter stabilising resistors R10 and R11 are optional, although their inclusion will improve the temperature stability of the circuit, with a loss in power output.

These resistors should definitely be included if a supply voltage of 20V or more is used. If the amplifier is being used with a portable radio/cassette player, it may be necessary to connect a 39-ohm resistor across the input terminals of the amplifier.

This resistor will act as a suitable load for the radio/cassette, and prevent distortion. If possible, fit the resistor inside the plug used to connect the radio to the amplifier.

So there it is, a handy little power amplifier module that should prove useful. And hopefully you now know more about power amplifiers.

In the next chapter, along with other things, we'll describe the term 'frequency response' and show how this can be measured. ■

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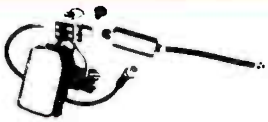

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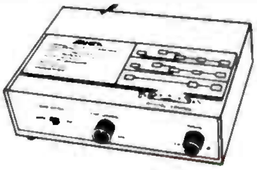

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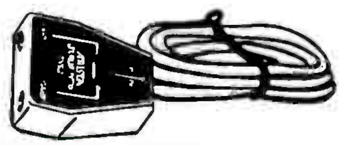

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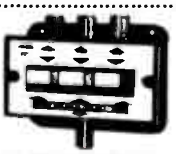

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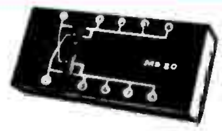

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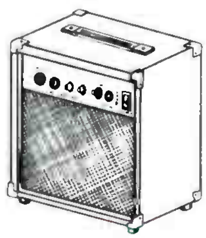

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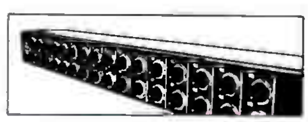

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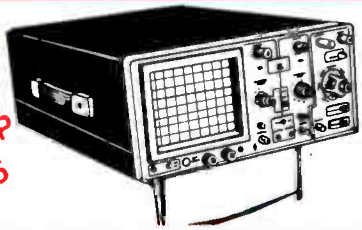

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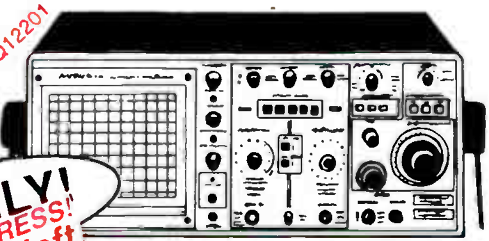

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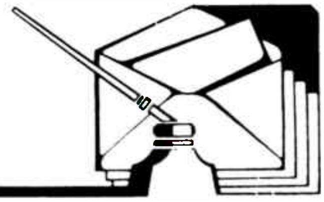


Not deja vu, just further thoughts...

Most of the topics this month have appeared in these columns some time in the last year or so. But is this deja vu? No, it simply means that there is more to say on those topics.

It's always difficult to know when readers are sick of particular topic. My role is to prevent things rambling on for too long, and also to minimise duplication of information. As well, I try to make the column interesting and entertaining. But then, I'm guided by you and your letters, and this month the main bulk of the correspondence is about topics from the August edition and before. So, as all the letters make interesting reading, who am I to argue?

Last month I featured a number of letters about the likely effects of living near a high voltage overhead power line. I expect some more will arrive in due course, and because this topic has extended into realms that affect us all, it seems reasonable to let the discussion continue.

Because this is such a contentious and potentially scary topic, I'd prefer letters that present evidence either one way or the other. Being a technical journal we can leave the emotive reporting to the popular press and just present facts.

We'll start with a letter on this topic — unfortunately it's one that won't make you feel any better about electricity...

Overhead power lines

With reference to the query from G.N., I would like to add a few comments.

Inevitably, where there is controversy about technology, whether it's about electrical power, chemicals or whatever, vested interests retreat behind the safety curtain of 'there is no conclusive evidence'.

Seven American states have now adopted a 'right of way' (ROW) policy, which establishes a 350 foot (106m) 'no dwelling' corridor on either side of high voltage power lines. A Canadian power utility recently made an unprecedented offer to buy a home within 50 metres of a ROW.

The Klein Independent School in Houston, Texas took the Houston Lighting and Power Company to court in 1981 because the power company had taken eight acres of school land and built a 345kV transmission line within 90 metres of a primary school, 40 metres from an intermediate school and 75 metres from a secondary school. The Klein school won the case and were paid substantial compensation. The jury penalised the power company US$25 million for unacceptable conduct. The penalty was subsequently reversed on appeal, although it was agreed that the jury in the original trial had been right in finding 'clear and convincing evidence' of potential health hazards caused by electromagnetic fields.

Also, Dr Stanislaw Szmigielski, an eminent Polish researcher, has reported the results of a five-year retrospective study into exposure to medium wavelength radio frequencies (MW/RF). His findings include the following rather sobering statistics:

(1) A three times higher risk of developing neoplastic disease in those occupationally exposed to MW/RF, the highest risk of malignancies originating from haematolymphatic systems (morbidity x7).

(2) Highest risk factor of cancer morbidity for subjects aged 40-49 after a 5 to 15 year exposure period.

(3) Deaths from neoplasms correlated to period of exposure.

(4) Similar neoplasms developed up to 10 years earlier by those exposed to MW/RF compared to others.

These investigations are supported by research carried out in Sweden, China and elsewhere. There is currently a case in progress in US courts where a Boeing employee is suing the aircraft manufacturer because he contracted a rare form of leukaemia while working in a situation where he was exposed to radio frequency fields. This is a landmark case.

Facts such as these should put to rest any lingering doubts that exposure to electrical fields can cause serious and terminal illness. Respectable journals such as EA should remain in the vanguard of healthy and open debate on contentious issues by providing a forum for discussion. (P.H, Nullamanna NSW).

Thanks for your letter P.H., although I suppose G.N. would rather not read it. You don't mention if the research refers to the sort of field strengths due to high voltage overhead power lines, but I suppose a US$25M damages suit is not good press for the power industry. Also, I wonder if the MW/RF category includes 50Hz. But clearly there is a hazard, according to your letter and one that I hope other readers can dispute. Let's all hope!

Leaving this rather depressing topic for a while, here's a letter about digital switching audio amplifiers.

Switching amps

The next letter is about switching techniques in current generation power amplifiers, in response to a comment by a reader in August. From the letter and information supplied, it's obviously a technique that has reached a level of refinement to make it attractive. Interestingly, the distortion figures don't seem to suffer too greatly and the specifications are certainly impressive.

I work for a company in Melbourne that uses and distributes the Peavey range of public address equipment. One of the Peavey products is the Deca Series of power amplifiers, with a claimed efficiency of 90% using a digital energy conversion system. The top of the range unit produces 1200 watts (continuous) into an 8-ohm load (in bridge mode), from a package that is only two rack units high and weighs less than 18kg. Not bad! (R.W., Scoresby Vic).

R.W. also included a page from the

Peavey catalog, which gives some specifications of these amplifiers. The total harmonic distortion is specified at 0.1% due to a 'digital version of Peavey's patented DDT compression circuitry'. It also claims that 'no measurable transient intermodulation or slew-rate-induced distortion is introduced by the circuitry, even with very complex signals and at high concert sound levels'.

The 90% efficiency rating is perhaps the main reason for using switching techniques, as most linear amplifiers are pushing to get better than 60%, and then at a distortion level that may be intolerable. Purists would not be happy with the 0.1% specification of the Deca range, and this amplifier is not aimed at the hi-fi market. But for outdoor concert use it's probably more than adequate, where physical size and input power become important. I imagine a typical outdoor set-up would have at least 10 to 20 of these amplifiers, and the smaller and lighter the better, particularly if you're the 'roadie'.

Tuneable Hum

Oh yes! There's still more on this perplexing topic, arising from a letter by J.M. from Aldinga Beach, which I included in the March issue. In my reply I suggested that earth currents could be the cause, although subsequent letters offered an amazing array of possibilities. The first letter is from J.M., who has done some more research:

Thanks for publishing my letter and for your reply. Since this time I have found that 5AN doesn't close at all, so I cannot determine if the hum disappears when the station is off the air. The hum has subsided considerably over the last few months, contrary to previous years at this time. I suspect this is due to the extremely dry period we have experienced since December, assuming earth currents are the cause.

Regarding earth currents, during WW2 I was a battalion signaller and one of the pieces of equipment we used early in our training was the Fuller-phone. This machine sent a low value of DC current in Morse code along a telephone line, with an earth return. At the receiving end, another machine made the signal intelligible by using a buzzer that responded to the code sent by the current.

The purpose of the exercise was security, as the enemy could not use the line for listening in with a pick-up loop as you can with standard telephone signals. But the Fuller-phone was never a great success, because DC earth currents usually masked the signal. That's DC currents, not AC currents. Confusing, isn't it! Maybe someone can throw some light on this matter. Thanks for an excellent magazine. (J.M., Aldinga Beach SA).

Thanks for your letter and the nice comments J.M. I am surprised about the DC earth currents, as one wonders where they come from. I can understand AC, as there's plenty of sources. Still, electricity is a weird force.

The next letter offers some more reasons for tuneable hum, including one that I think no one has so far described:

On reading the letter by J.M., my reaction was 'this could have been me writing.' I have the same problem, except it's at 751kHz — the frequency of 1YA, Auckland. As in J.M's case, the hum comes and goes and varies in volume. Rotating the set reduces it.

I agree with you that it is 100Hz hum, and is related to the power lines. Switching off the main switch at the switchboard does nothing to help, and my theory is that it's coming from the main lead to the switchboard.

When the station is off the air (rarely, as it's a 24-hour station), there is no hum, which suggests a beat note — except this doesn't explain the random pattern. But that's not all!

I occasionally listen to a cheap Walkman-type portable, which with decent headphones gives most impressive results except for an annoying buzz. This sound varies according to the position of the headphone lead. Suspecting a parasitic oscillation, I tried various earthing techniques, but with no improvement.

Then one night, around 1am, I was listening to the portable, and — guess what — no hum! It turned out that the local TV stations had closed down. Obviously this was the cause, apparently due to sync pulses being picked up by the headphone leads. At least I have discovered the reason, although there's not much I can do about it. (L.M., Auckland NZ).

This is one I've not heard of before. Headphone leads would make a good antenna, although you'd think that the impedance would be low enough to prevent this kind of interference pick up. Given that these devices are so prevalent, it's surprising more people haven't had this problem. Then again, perhaps they have, and we don't know about it. Or perhaps the more expensive portables get around this with better filtering. I'd be interested to know if other readers have experienced the same thing as L.M.

Conductive neoprene

In the August column, I mentioned a problem I'd had with a circuit board sitting on neoprene rubber. The next letter makes some interesting points that I wish I'd known at the time:

I was interested in the comments you made about neoprene rubber in the August edition. From your description, it sounds like the neoprene may have been a piece of neoprene 1/8" conveyor belting cover, or perhaps a prepared laboratory sample of the same thing used for testing FRAS neoprene.

FRAS stands for Flame Resistant, Anti Static and is specially compounded to achieve a specific maximum resistance across a measured distance between two electrodes. FRAS neoprene (or FRAS PVC) conveyor belting is used worldwide in underground collieries and also in the sugar industry, for the obvious safety reasons its name suggests.

Natural rubber is an absolute 'no-no' underground, as it allows a static build-up and a dangerous spark discharge in an area containing methane. (B.G., Nth Balywn Vic).

Thanks for your letter, B.G. The amazing thing about this is that the problems I experienced happened under a grand piano in North Balwyn. Perhaps you even heard my 'cussin'! It's a small world.

The rubber in question was imported from a player piano supply company in America and was actually 1/2" diameter rubber tubing, which I had used to insulate the metal supports for the board.

As tubing for player pianos is probably taken from the same roll used to supply industry, I guess you are quite right. (Triple the price for player piano technicians and sell the rest to a mining company!) However, the same rubber tubing from local suppliers doesn't have the conducting characteristics, as I've used it in this same application before. Still it's interesting to know that conductive rubber is not only manufactured, but is a legal requirement in a hazardous location.

Digital TV

In December 1990 I made the admission that I didn't know if a digital TV set performed better in poor signal locations. I subsequently received information about how digital TV sets work, and I gave a brief run down on their operating principles in the April 1991 edition. However, this still didn't answer the original question.

Now at last I have an answer. A correspondent (N.H, Morwell Vic) has since sent me copies of literature about a number of VCRs and digital TV sets, including a Grundig TV and a Siemens model FS 985 which was reviewed in *EA* for September 1989. Both these sets store the entire picture in memory and display it at a field rate of 100Hz, rather than the usual 50Hz. This significantly reduces flicker.

Scanning through the literature supplied by N.H, it was obvious that 'digital' can be correlated with 'noise reduction'. This applies to both VCRs and TV sets and all the literature makes quite a point about the benefits.

However, I've recently collected brochures on large-screen TV sets, which all feature things like 'picture in picture', Teletext and other digital enhancements. The interesting thing is that none mention digital processing or noise reduction. Perhaps the only sets that really reduce noise are those that store the whole picture in memory, such as the Siemens and the Grundig.

An interesting alternative is to use a monitor TV (such as a Sony) with a digitally enhanced VCR. Some VCRs include picture memory (or field memory), which can give a range of special effects, along with dramatic noise reduction. While this setup would be expensive, it could be cheaper and more versatile than a Grundig or Siemens TV set on its own.

Colour splitter

Our final topic is new to these columns, and comes from a reader who wants to do all kinds of things with video signals:

I was recently looking through back issues of EA in search for a genlock circuit. I wanted to combine two (or more) composite video signals together into a single composite output, or to combine a composite video signal with the RGBI outputs of my Amiga 500 computer, for use in video presentations, or just for fun.

Also, I was looking for a circuit that would 'split' a colour composite video signal into each of its red, green and blue components. This way I could take each of the filtered RGB outputs, combined with the sync pulses to give a 'shaded' black and white output. I want to do this so I can digitise a colour picture from a VCR using my Amiga 500 and Digi-View hardware. Commercial versions of this type of colour splitter are available for around $500, which is a bit pricey. Any chance of a project for either or both of these? (D.F., Canberra ACT).

Regarding the genlock project, I have to admit that this is the first time I have had a request for such a circuit. Still, you never know, perhaps it might be a possibility.

As for the colour splitter, perhaps you could derive the RGB signals from a TV set, or the relevant bits of a TV set. An essential function in any colour TV set is to retrieve the RGB information from a composite video signal. The colour decoder is relatively complex, but boils down to a circuit board that can fit into the palm of your hand.

A VCR generally has a direct video output, so the chroma decoder board could possibly be driven directly without the need for a tuner, IF stage and demodulator. You may need to fiddle some voltage levels to ensure compatibility with the input requirements of your computer, but otherwise it should be simple enough.

What??

We've not had a question on switching before, so here's one that might cause some head scratching. It comes from Frank Cahill of Camden NSW, who was originally asked the question by a student. The solution (next month) is Frank's. The question concerns two- way switching of lights connected to the mains:

A customer wants four lights that can be operated independently with a switch. That is, each light can be turned on or off with its own switch. However, the customer also wants a master switch that will turn *on* any lights that are currently off. For example, if lights 1 and 3 are on, operating the master switch has to leave these lights on, and also turn on lights 2 and 4. Unfortunately, the customer is on a pension and wants the job done with conventional two-way switch mechanisms (single pole, double throw) to keep the costs down. Design the circuit, using no more than five conventional light switches.

Answer to October's What??

The lost energy is dissipated in the circuit resistance. In a theoretical case where the capacitors are perfect and the resistance of the circuit is zero, an infinite current flows for zero time. This is called a Dirac function. The Fourier transform of a Dirac function reveals an energy spectrum of white noise. So the energy is radiated over the entire spectrum, as white noise. ■

NOTES & ERRATA

IMPROVED SERIAL I/O INTERFACE FOR PC'S (July, August 1991):

In the triac output driver module, the lug used as a termination for the earth wires of both the mains input cable and the output sockets should be fastened to the chassis directly, via a dedicated machine screw, spring washer and nut — not via the same screw used to attach the mains cord clamp, as shown in the photograph on page 86 of the August article.

IMPROVED SERIAL I/O INTER FACE FOR PC'S (July, August 1991):

A reader, Mr David Brownridge, has sent in an improved program to operate the interface. The program is in the form of a listing on paper, but one that is self-explanatory and very thoroughly documented. Copies of the six-page listing are available from the Reader Information Service for interested readers, for a fee of $5.00 to cover copying and postage.

LOW COST 18V/1A BENCHTOP SUPPLY (August, October 1991):

The lug used to terminate the earthing wires from the mains input cable, the output earth terminal and the heatsink should NOT be anchored under one of the transformer mounting screws, but should be attached to the transformer mounting foot via a 3mm (or 1/8") machine screw, spring washer and nut, through a specially drilled additional hole. Any varnish or lacquer covering the mounting foot should be scraped away around the earthing screw hole, to ensure a good and reliable electrical contact to the transformer clamp and core.

Also the lug used to connect the earthing wire to the heatsink should not be anchored via one of the heatsink mounting screws, but via a separate dedicated machine screw, spring washer and nut. The plastic rear panel should also be removed from the area around this screw, so that the solder lug can be clamped directly to the heatsink and fully tightened without any layer of plastic being involved. A clearance hole of 8-9mm diameter in the plastic should allow this to be done. ■

NEW KITS FOR EA PROJECTS

SPEECH PROCESSOR FOR TRANSCEIVERS (September 1991): Jaycar Electronics has advised that it is supplying a short-form kit, which includes the relay, mic socket and virtually all components apart from the box. The kit is coded KA1737 and is priced at $29.95.

LOW COST 18V/1A BENCH SUPPLY (August 1991): Kalex has advised that it is supplying a kit for this project. The kit is for a modified version, using an IEC-type mains connector for simplified assembly, and also features a clear plastic lid and adhesive plastic front panel. It 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.

RADIO AND TV BROADCASTING SERVICES

After the January 1991 issue of Electronics Australia went on sale, we received a number of letters advising that the information we had printed in our article on Radio and Television Broadcasting Services was quite wrong. Listed below are the stations that were left out, those that have changed from AM to FM and those that have changed their call signs. Also listed are television channels and various other information that was obviously not included in the original listing from which we obtained our information, and has been forwarded to us by readers.

AM Radio

NSW

Newcastle	2RN	1512
Newcastle	2PB	1458
Sydney	2PB	620
Sydney	2RN	576
Sydney	2RPH	1629

Victoria

Melbourne	3RN	621
Melbourne	3PB	1026
Melbourne	3RPH	1179
Wangaratta	3RN	756

Queensland

Brisbane	4RN	792
Brisbane	4IP	1008
Brisbane	4PB	936
Brisbane	4WM	1296
Brisbane	1296RPH	1296
Brisbane	97 AM	972

South Australia

Adelaide	5RN	729
Adelaide	5PB	972
Adelaide	5RPH	1197
Murray Bridge	5MU	1125

West Australia

Perth	6RN	810
Perth	6PB	576

Tasmania

Hobart	7RN	585
Hobart	7RPH	1620
Hobart	7PB	729

ACT

Canberra	2RN	846
Canberra	2PB	1440
Canberra	2PPP	1620

FM Radio

NSW

Gosford	2N/A	101.3
Lismore	2NCR	92.9
Newcastle	2NEW	105.3
Newcastle	2JJJ	102.1
Sydney	2SER	107.3
Wagga	2RVR	101.9

Victoria

Churchill	3GCR	104.7
Eastern Suburbs	3ECB	98.1
Footscray	3WRB	97.4
Geelong	3YYR	100.3
Geelong	3BAY-FM	93.9
Geelong	3K-ROCK	95.5
Inner North East	3—	96.5
Melbourne	3ZZZ	92.3
Melbourne	TTFM	101.1
Melbourne	3KZFM	104.3
Melbourne	3MMM	105.1
Melbourne	3JJJ	107.5
Melton	3RIM	97.9
Mildura	3NA	104.3
Mornington	3RPP	98.7
Plenty Valley	3—	88.6
Shepparton	3ONE	106.9
Shepparton	3SUN	107.7
Southern Suburbs	3SCB	88.3
Warrnambool	3WAY	100.9
Yarra Valley	3VYV	99.1

Queensland

Brisbane	4B105-FM	105.3
Brisbane	4MMM	104.5
Brisbane	4JJJ	107.7
Brisbane	4MBS	103.7
Brisbane	4QFM	106.9
Brisbane	4101-FM	101.1
Brisbane	4OUR-FM	91.5
Brisbane	4ABC-FM	106.1
Gold Coast	4FM-91.7	91.7
Gold Coast	4SEA	90.9
Gold Coast	4KROQ	92.5
Thursday Island		107.7
Weipa		107.3

South Australia

Adelaide	5DN	102.3
Adelaide	5KA	104.7
Adelaide	5SSA	107.1
Adelaide	5JJJ	105.5
Port Augusta	5RN	N/A

West Australia

Perth	6PMFM	92.9
Perth	6JJJ	99.5

Tasmania

Hobart	7TTT	100.9
Hobart	7JJJ	92.9

ACT

Canberra	2JJJ	101.5
Canberra	2ABC	102.3

Northern Territory

Darwin	8JJJ	103.3
Darwin	8DDD	N/A

Television

Bowral	Ch.30
Bowral	Ch.33
Bowral	Ch.42
Bowral	Ch.45
Crookwell	Ch.33
Goulburn	Ch.10
Goulburn	Ch.64
Nowra North	Ch.29
Nowra North	Ch.32
Nowra North	Ch.41
Nowra North	Ch.44
Stanwell Park	Ch.30
Stanwell Park	Ch.33
Stanwell Park	Ch.42
Stanwell Park	Ch.45
Wollongong	Ch.32
Wollongong	Ch.35

Illawarra	ABWN/56	H	Mono	600k
Illawarra	WIN/4	H	Mono	
Ilawarra	CTC/62	H	Dual	600k
Illawarra	CBN/65	H	Dual	600k
Wollongong	ABWN/3	H	Mono	2.5k
Wollongong	SBS/32	H	Dual	2.5k
Wollongong	CTC/44	H	Dual	2.5k
Wollongong	CBN/47	H	Dual	2.5k

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.

November 1941

City-wrecking Bombs: The possibility of developing an atomic bomb which could destroy a city with a population of several millions has been hinted at by a Russian scientist.

"In principle we can foresee an increase in the demolition power of explosives by about 100%. The use of sub-atomic energy is a step in that direction. But difficulties in the use of this energy are so great today that I do not think that the atomic bomb will be used in this war — unless the war lasts a very long time."

Electric Frequency Clocks: Electric frequency clocks not only substitute one power for another — say, electrical for mechanical energy — but the time itself is controlled by the frequency of the power mains.

But they will not work in those parts of Australia which still have direct current supplies, such as many places in the city of Sydney, a few parts of the city of Melbourne, and some country centres.

November 1966

Microwaves Across The Nullarbor: The PMG has signed a contract for the installation of a 1500 mile microwave link across the Nullarbor Plain to link Western Australia with South Australia and the eastern states. The system will initially comprise two channels, each capable of carrying up to 600 telephone circuits or an each-way television replay.

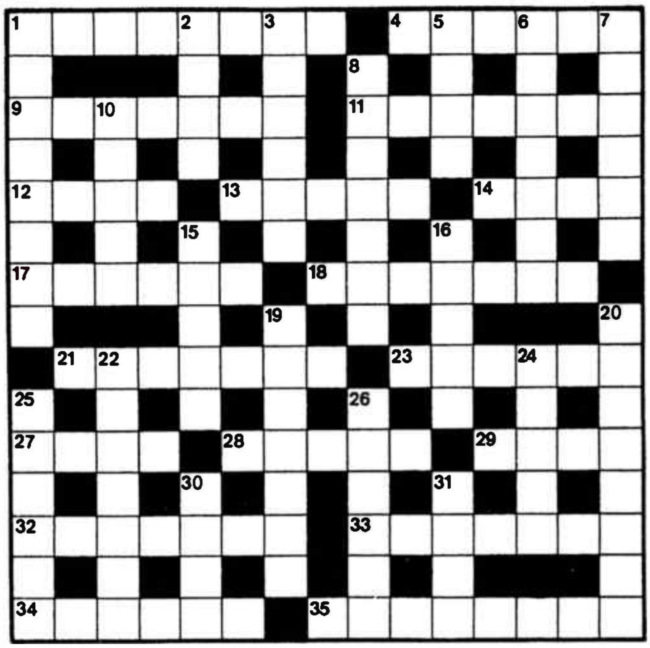
Traffic will be relayed at a frequency of 2000MHz through 61 repeater stations on 250 foot towers, at 25-mile intervals along the route. Fifteen years ago, there were five telephone circuits between Perth and the eastern states; five years ago the number was 28. Since then an additional 30 have been added with a target total of about 120 circuits by the end of 1968.

Stereo Broadcasts In Uk: In Britain, the BBC is undertaking a substantial development in stereophonic programs each day.

The transmission will be on the pilot-tone system, which is the established system in the US, Germany, France, Italy and Holland. The system is fully compatible, so that listeners with radios not equipped for stereo will hear the programs in the normal way.

Colour TV Decision: The French SECAM III colour television system was finally adopted by more than 30 countries, including France and the USSR, at a recent meeting in Oslo, Norway. A French proposal that the SECAM IV system be adopted as the sole standard for the European broadcasting zone was seconded by the USSR. But the proposal was rejected by the two main promoters of the rival PAL system, the UK and the German Federal Republic, because they were too far advanced with the preparation of the PAL system, which would be used for the introduction of a colour televison service in August, 1967.

EA CROSSWORD



ACROSS

1. Device for destructive disposal of documents. (8)
4. Agents into electronic eavesdropping. (6)
9. Exert a pulling force. (7)
11. Data recorders. (7)
12. Tape machine. (4)
13. Computer failure. (5)
14. Original shape of cathode ray generator. (4)
17. Pertaining to element Rh. (6)
18. Device that alters format of data. (7)
21. Bolts of lightning. (7)
23. Group of cells. (6)
27. Spot on radar screen. (4)
28. Page of information on a visual display. (5)
29. Prime number. (4)
32. Emitted in rays. (7)
33. Vulcanite. (7)
34. Mode of broadcasting. (6)
35 TV transmission. (8)

DOWN

1. Source of constant emf, the —— cell. (8)
2. Dynamic random access memory. (4)
3. Begins use of computer at keyboard. (6)
5. Summon. (4)
6. Execessive workload. (7)
7. Group of interlinked components. (6)
8. Spacecraft with polar solar mission. (7)
10. Huge Moon crater named after astronomer Brahe. (5)
15. Indicator light, the — lamp. (5)
16. Principles of reasoning. (5)
19. Mix of ceramic oxides of iron. (7)
20. Information service on TV. (8)
22. Twist the knob. (7)
24. Branch of literature often with futuristic theme. (3-2)
25. Terminates a mission. (6)
26. A coulomb per second. (6)
30. An electronic control (4)
31. The —— control varies the bass

SOLUTION FOR OCTOBER

EA with ETI marketplace

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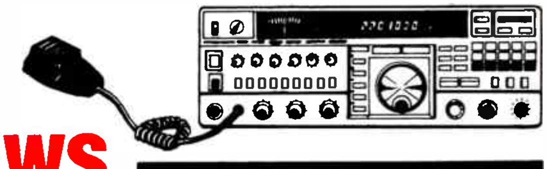
Amateur Radio News



US amateurs lose 220-222MHz

US amateur magazine *73* reports that in late August, American amateurs lost a 2MHz slice of their 1-1/4m VHF band — from 220MHz to 222MHz. The lost segment has apparently been re-allocated to the Private Land Mobile Service, and divided into 400 channels 5kHz wide, which will be used as 200 duplex channel pairs. The US Government is reserving 10 of these for its own use, while the courier company UPS is expected to gain many of the rest.

According to *73*, the remaining 3MHz segment of the band is likely to be quite crowded, with weak-signal EME and narrow-band modes competing with novices and others using FM repeaters.

Hopefully this action in the USA will not be used as a precedent by Australia's DoTC, to whittle away at our own less than crowded 70cm band.

DoTC shuts down ATV repeaters

Oxley region in NSW has apparently been advised by DoTC that its ATV repeater VK2RPM will have to cease operation this month (November), in favour of UHF TV broadcasting. According to a recent NSW Division broadcast, Newcastle region has also been advised that its ATV repeater is due to go shortly too — possibly before the end of the year. The writing seems to be on the wall, for many of Australian amateur radio's UHF ATV resources.

Higher power for 2m pagers

The same NSW Division broadcast also advised that a power increase from 500W to 1kW has been authorised for paging transmitters in the 148-149MHz band. These have already been causing problems for amateurs using repeaters near the top end of the 2m band, so the problems seem likely to increase...

Ray Tyson honoured by WICEN

At its recent annual general meeting WICEN, the Wireless Institute's civil emergency network, awarded honorary life membership to Ray Tyson — former head of the NSW Police Rescue Squad, and Patron/Training Officer of the Volunteer Rescue Association. The award was both to recognise Mr Tyson's assistance to WICEN in gaining its accreditation under the new emergency services regulations, and also for his almost 50 years of rescue work.

DSE donates 23cm antennas to VK2RWI

Tim Mills, VK2ZTM, reports in the latest edition of *Amateur Radio* to reach our office that Dick Smith Electronics has made a further very welcome donation to the NSW Division.

A couple of years ago, the firm donated equipment to allow the Division's station VK2RWI to operate on the 23cm band. Now DSE has followed up with a pair of high-gain vertical antennas for the same band, to provide improved coverage. It's great to see that the firm is continuing in its active support for amateur radio.

Amalgamation preferences...

In recent months the 'letters' pages of *Amateur Radio* have again been taken up with the hoary old question of whether or not the WIA should 'amalgamate' its magazine with a commercial publication — in this case *Amateur Radio Action* — in order to reduce costs. One recent letter, from Harry Atkinson VK6WZ of Mount Lawley in WA, really made us chuckle. He began:

Amalgamate with (translation: "be swallowed by") ARA? Not 'My Fair Lady' likely! I'd sooner see us amalgamate with 'Women's Weekly'!

After listing his objections to a link with *ARA*, he went on to remind readers of an earlier version of the debate:

What became of the rumour that we were negotiating with 'Electronics Australia'? If we must join forces with someone, let it be that magazine. It has always had a sympathetic attitude towards our hobby...

Ironically, there was an advertisement for *Amateur Radio Action* on the page immediately following Mr Atkinson's letter! I guess *we* should be flattered, though: at least one WIA member rates *EA* as being somewhere above *Amateur Radio Action*, and perhaps on a par with *Women's Weekly*! ■

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YOKOGAWA'S DL1200A FOUR-CHANNEL 100MHZ DIGITAL SCOPE AND MATCHING ARBITRARY FUNCTION GENERATORS

NEWS HIGHLIGHTS

AUST BREAKTHROUGH ON COMPACT FLUORO PF

Australian electronics engineer David Whitby, working with Victorian firm Electronic Ballasts, has developed a new type of low cost electronic ballast circuit which is claimed effectively to solve the high harmonics/poor power factor problem associated with compact fluorescent lamps, while not incurring a penalty in terms of reduced efficiency.

Early versions of the new 'LECTROLITE' ballast have been tested by the Richmond testing laboratories of the SECV, in conjunction with standard CF lamps, and gave power factor figures of 0.8 — much higher than most standard CF lamp and ballast combinations, which were all below 0.55 and generally below 0.5. At the same time, the LECTROLITE combinations also gave a measured efficiency of 62 lumens per watt, significantly higher than that of standard combinations (which typically gave figures between 43 and 58 lumens/watt).

The current-harmonic levels achieved with the new ballast are apparently well below the maximum levels specified in the proposed Interim Australian Standard, and it is claimed to meet the stringent limits of AS3168 — which European manufacturers recently claimed to set 'unachievably' low harmonic levels. Despite this the ballast is claimed to involve a 'relatively small increment' in lamp manufacturing costs.

Electronic Ballasts is setting up a new factory in Bayswater, Victoria, to manufacture the new ballast. This was expected to be in production by late October 1991. Negotiations are apparently also taking place with overseas manufacturers seeking to license the technology, for which international patents have been applied.

BRISBANE ELECTRONICS EXPO

Queenslanders will have the opportunity to see the latest in consumer electronics and music products this month when the *B105 Electronics and Music Expo* opens at the RNA Showgrounds, Brisbane.

The Show is the biggest event of its kind in Queensland and will feature the latest developments in hi-fi, video and television, musical equipment, keyboards, recording and sound reinforcement gear, car stereo and personal computers. According to the organiser Mr Rob Woodland, visitors will be able to see, hear and compare new release products from Australia and overseas.

The B105 Electronics and Music Expo will be from Friday 8th November to Sunday 10th November at the Exhibition Building, RNA Showgrounds, Brisbane. Admission is $5.

For more information, ring Rob Woodland at Queensland Exhibition Services on (07) 345 8800.

BREAKTHROUGH BY AUST CODEC TEAM

After a little over 12 months intensive research, the Universal Video Codec project team has made a breakthrough in integrated Video Communications — a dramatic reduction of the bit rate penalty paid when separating video signals into layers.

The project team, with representatives from Siemens, Monash, Telecom and the Australian Defence Force Academy, is developing a multi-service communications system which will enable the use of a single screen for a variety of image services — such as colour facsimile, television, video conferencing, videophones and digital high definition television.

Support for the project has been provided by a Communications Generic Technology grant from the Industry Research and Development Board.

According to Mr Phillip Stevens, a Siemens' member of the project team: "This will put an end to the perennial chicken and egg problem. For instance, if service providers wanted to broadcast in 3-D television, they would find it difficult to attract advertising revenue to their new service, because there are no customers who could pick up the service on their televisions. However, no one would want to buy a 3-D television as long as no service provider broadcasts this service. The system currently under development by our project group will put an end to these problems."

While conducting research in this area, the project team discovered a bit rate (information rate) penalty that had to be paid when separating video signals into layers. Layering of the video signals is an integral part of the multi-service video system. The team found that in doing the layering, a lot of extra information needs to be sent across the network. In fact, there had been a penalty of up to 50% paid in the amount of information to be sent; the team has developed a method to reduce this to less than 10%.

CSIRO, QLD GOVT LAUNCH ON-LINE SUPERCOMPUTING SERVICE

A new joint venture between the CSIRO and the Queensland government has been set up to provide on-line supercomputing facilities to industry, research and commerce around Australia.

Named Queensland Supercomputing Laboratories (QSL), the facility is based on a Convex supercomputer system which will be housed at the Queensland Centre for Advanced Technologies (QCAT), currently being built in Pinjarra Hills to the west of Brisbane. The system has multiple CPUs and provides high performance scalar and vector processing, combined with very high system bandwidth to give massive system throughput. It runs under the Posix-compliant UNIX operating system, and the systems software includes advanced compilers and other utilities. Also mounted are a range of data analysis and simulation packages, to suit users in many areas of research and industry. Users will be able to access the system via high-speed modems and data links, over landlines, optical fibres and satellite links.

At the recent Sydney launching of the facility, QCAT Director Dr Bruce Hobbs noted that Australian industry still lagged behind much of the developed world, in its use of supercomputing. He believes that the establishment of QSL will help remedy this, both by providing industry with access to true supercomputing facilities at a reasonable price (typically below $900/hour), and by its philosophy of promoting the 'supercomputing mindset'.

However Dr Hobbs also commented that a major hurdle to firms and organisations using the facility effectively is Australia's current paucity of high bandwidth communications links. "Inadequate communications bandwidth is the real reason why Australia is a third-world country", he claimed.

SCIENTIFIC-ATLANTA ANTENNA FOR TVNZ

Scientific-Atlanta Australia has been awarded a $1.25 million ($NZ1.65 million) contract for the supply and installation of an INTELSAT 'Standard B' earth station to streamline incoming and outgoing satellite broadcasting signals for Television New Zealand (TVNZ). The 11m diameter antenna with video uplink and receive electronics is currently being installed on top of the TVNZ architectural award winning building in Auckland.

The electronics include the new Scientific-Atlanta inclined orbit tracking system, to enable TVNZ to operate with the inclined satellite at orbital position 177°E.

Because TVNZ required the antenna to be operational in an exceptionally short time frame, Scientific-Atlanta was able to manufacture and ship the antenna from the USA within 21 days of contract award. The electronics, racking, wiring and testing were completed even faster and the electronics shipped just 19 days after order placement. The normal time scale from placement of order to commissioning of INTELSAT B station is six to nine months.

NORTH AMERICAN MARKETING GROUP

A group of executives formerly with AUSTRADE have formed the NORAM Group, a North American marketing network with offices strategically located in San Francisco, New York, Chicago and Miami. The network is positioned to assist Australian and New Zealand firms wishing to enter the diverse and complex North American markets, and can provide in-depth services for market entry and development, along with continuous post-launch support. The business and marketing professionals in the network have extensive experience in both the private and public sectors, working with the Australian Trade Commission and Australian firms, both in Australia and the USA. The network offers services for consumer, industrial/technical and commercial sectors. Fees are significantly below comparable government and private export/international facilitation services.

Further information is available from Philip Dodge of KDP Group International, PO Box 147, Novato CA 94948; phone (415) 897 0034, fax (415) 897 0162.

AUST DEVELOPED VEHICLE TRACKER

The need to track the movement of vehicles or marine vessels in real time has been high on the priorities of security and transport companies, police, search and rescue operators for many years. Previous technology has been severely hampered by limited range, the need for ground-based tracking stations and excessive cost

NEWS HIGHLIGHTS

penalties. Now Australian software developer, CEANET, has announced the release of a Vehicle Tracking System (VTS) called V-TRACK, which performs real time tracking of one or more vehicles. It is also suitable tracking marine vessels.

Developed by CEANET in its Perth office, V-TRACK is a fully integrated VTS system using GPS (Global Positioning System), specialised PC software and either a cellular telephone or radio communications.

By selecting one menu option on a personal computer located at the office or base, any vehicle/vessel on the system may be tracked in real time. The moving vehicle is displayed on the PC monitor as a moving symbol on the map displaying street centrelines. Maps of all major Australian cities and towns are available. If no maps are available, you can make your own map using a special option.

If a vehicle already has a suitable cellular telephone or radio, a complete V-TRACK system excluding the PC, could cost less than $7000 installed. The system is ideal for security services, mining, courier companies and other companies needing fleet management.

The system comprises four components: an antenna, a box containing instruments (located in the vehicle), computer software and either a cellular telephone or a UHF/VHF/HF radio.

V-TRACK is available to interested distributors from CEANET's offices in Sydney, Melbourne, Brisbane and Perth.

NASA ACCEPTS OZ SPACE TELESCOPE

Australia's Endeavour space telescope is to receive its first images on board a United States shuttle in January 1992, following its acceptance by NASA for the flight. In a joint announcement, the Minister for Industry, Technology and Commerce, Senator John Button, and the Minister for Science and Technology, Mr Ross Free, said the Government funded Endeavour project is one of a number of initiatives under a revitalised National Space Program.

Built by Auspace Ltd of Canberra, in collaboration with other Australian companies, Endeavour is Australia's first indigenous space payload for more than two decades. The Government has fully funded Endeavour through the Australian Space Office in the Department of Industry, Technology and Commerce.

"Australian engineers and technologists have designed and made an ultraviolet radio telescope to the rigorous quality and performance standards demanded by the US National Aeronautics and Space Administration," Mr Free said.

"Endeavour is designed to survive shuttle-launch forces and to operate faultlessly in the harsh environment of space. Its photon-counting array is designed and built as a 'space qualified' device and for subsequent use in larger, free-flying space telescopes."

AWADI WINS ATC ORDER FOR VIETNAM

Hanoi International airport in Vietnam has chosen an advanced Australian air traffic control system, in a breakthrough deal with AWA Defence Industries (AWADI). Although such systems have already been delivered to the Australian government and are functioning successfully, it is the first time that an Australian firm has designed an entire air traffic control system to the specific requirements of another government and successfully exported it.

"Many people don't think we have this capability in Australia", comments Ron Gosbee, General Manager of AWADI's Aerospace Systems Division, "but in fact we are world leaders in the technology."

The contract, initially worth some $4.5 million to AWADI, comes soon after AWADI launched an export sales drive for its air traffic control equipment, based on the company's fully integrated communications system AWANET.

Says Gosbee: "We won against top-class International competition. Our system was elected for the Vietnamese authorities by the International Civil Aviation Organisation — a United Nations body with the very strictest standards. They chose it as the most cost effective solution which best met the technical specifications.

RAMTRON INTRODUCES 16K FERROELECTRIC RAM

Ramtron International Corporation has announced a 16K-bit nonvolatile ferroelectric random access memory (FRAM) the FMx 1408. Organised as 2K x 8 bits, the FMx 1408 is the second member of Ramtron's FRAM product family. The FMx 1408 is manufactured using a 1.5-micron silicon gate CMOS technology with integrated ferroelectric storage cells.

Ramtron's FRAM products are the first semiconductor memories to combine the read/write performance and unlimited endurance of DRAMs with the nonvolatility, or ability to retain data without power, of magnetic memory.

"There is growing customer interest worldwide in FRAM products for applications ranging from critical data storage in computers and communications systems to video games and other high-volume consumer electronic products," explains Richard Horton, Ramtron's president. "Ramtron's expanding FRAM memory product family offers fast, symmetrical read/write performance with unlimited endurance, low power, and nonvolatility in a single product. These combined features make the FRAM an ideal memory for consolidating functions traditionally performed separately by semiconductor RAM and ROM, or magnetic memory."

The high dielectric constant and spontaneous polarisation characteristics of the ferroelectric cells developed by Ramtron

NEWS BRIEFS

- ***CIMA Electronics*** is holding a 'Digital Signal Processing Workshop' at Oakley, Victoria from 13th-15th November, 1991. Enquiries: phone (03) 568 1699. CIMA recently moved to new premises at 51 Chapman Street, North Blackburn 3130.
- Mr Mark Gribble has been appointed ***TDK***'s Commercial Sales Manager for its newly formed sales division.
- Former QANTAS executive Peter Barnes has joined the global airline telecommunications organisation ***SITA*** to advise on strategic development within the Asia Pacific region.
- ***Webster Computer Corporation*** has appointed Craig Philp as Queensland Branch Manager. Craig was formerly Engineering Manager for Webster.
- Arnold Toynbee has been promoted by ***Hypertec*** to the position of its Australian General Manager, having previously been its Dealer Manager and National Sales Manager.
- Phoenix Components of Brookvale is now a NSW distributor of ***Utilux***'s electronic connector products.
- ***SMCBA***, the Surface Mount and Circuit Board Association, has appointed Dianne Hunt as Executive Officer to develop the Association's programs and services for the Australian electronics industry.

allow the FMx 1408 to operate in two modes — dynamic and nonvolatile. Nonvolatile applications that require unlimited read/write endurance can use the dynamic mode of operation with a mode conversion cycle to nonvolatile mode during power down or power loss.

Applications that are not memory cycle intensive (<10^8 read/write cycles) can continuously operate the product in nonvolatile mode and eliminate the need for refresh and mode conversion.

Ramtron's FRAM products are produced at the company's Class 1 submicron six-inch wafer fabrication facility in Colorado Springs, and the facility of Ramtron's licensed manufacturing partner, Seiko Epson Corporation in Fujimi, Japan.

MORE JAPANESE FIRMS SIGN UP FOR DCC

Four Japanese manufacturers of radio hardware — Yamaha, Sharp, Tandy and Sanyo — have entered into preliminary agreements pertaining to Digital Compact Cassette (DCC) licences with Philips Electronics. Tape-duplication companies Sonopress and CINRAM have also recently signed on with Philips.

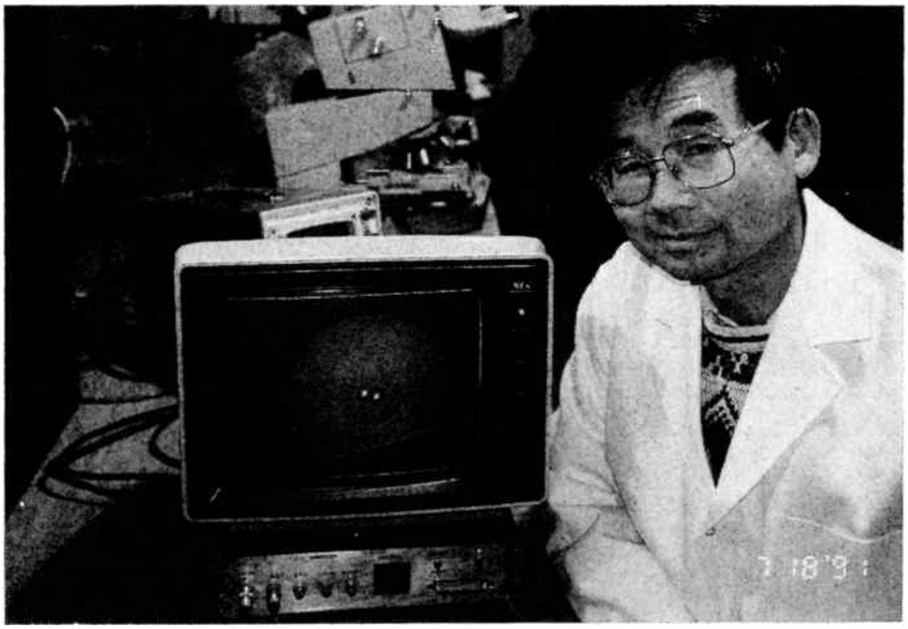
This announcement was made by Wim Wielens, managing director of Philips Audio, at a DCC press conference in Berlin, where many representatives of audio hardware companies and the music industry expressed their support for DCC, the Digital Compact Cassette.

Wielens said that constructive negotiations on licenses are taking place with the record companies EMI, BMG and Warner. PolyGram, the third largest record company in the world, gave its support to DCC earlier.

Wielens also said that 27 other parties have expressed interest in DCC specifications and have signed confidentiality agreements in this context. He concluded by stating that DCC, taking the broad support by hardware and software companies into account, is now set to become a world standard.

The DCC system, which offers digital sound quality, was initially developed by Philips together with Matsushita. Some music companies have also contributed to the final definition. The DCC tapedeck features a new type of head, developed by Philips and the American company Seagate.

DCC is backwards compatible, which means that not only new digital cassettes but existing analog cassettes as well can be played back on the DCC tapedecks.



Professor Pak Chu showing a twin core fibre section manufactured by University of NSW which is one of the new fibre types to be developed into multicore fibre devices under a $1.2 million GIRD grant recently awarded to a team consisting of members from UNSW, ANU and Siemens OFTC.

CCD SENSORS FOR BROADCAST TV

Toshiba Corporation has developed two CCD (charge-coupled device) area image sensors that use a newly developed micro lens to improve performance. The new CCD's achieve 1.4 times the sensitivity of previous models, and are expected to be used for NTSC (TCD5120AC) and PAL (TCD5130AC) TV broadcasting cameras.

In the 400,000 pixel devices there are 800 horizontal rows, each containing 500 sensors. In a conventional CCD each row of sensors is covered by a single micro lens. While offering high image quality, the linear shape of the lens prevents part of the incident light in the vertical axis from being directed to the photodiode. Engineers have taken full advantage of the company's integrated capabilities in microprocessing technology to form individual 'island-shaped' micro lenses on each of the 400,000 image sensor elements in the new CCDs. This newly developed lens system achieves a marked increase in the light-gathering ratio.

The new devices also incorporate highly regarded features of conventional devices;

(1) S^3 (Surface Shield Sensor) structure: In this structure, dark noise caused by generation of electrons on the surface of the photodiode is suppressed by a p+ layer covering the surface, so achieving a high S/N ratio.

(2) Optimised design of the light shield layer: To control the direct entrance of light into the transfer section, the company has optimised the design of the light shield layer. This reduces the generation of smear, which appears in pictures as white linear noise.

AUST LASER INDUSTRY 'LAGS'

Australian research in lasers has reached a high level of activity, but the manufacture of lasers and laser-based equipment is generally not as highly developed. These are the major findings of a report on the Australian laser industry and research published by the Commonwealth Dept of Industry, Technology and Commerce.

Lasers Australia 1991 identifies several impediments to the growth of laser manufacturing and research, and recommends the establishment of a laser industry association to overcome impediments and promote growth.

A few Australian companies manufacture lasers in small quantities, mainly for niche markets or for incorporation into their laser equipment. Most 'laser companies' do not produce lasers as such but rather import lasers and build them into value-added equipment. These companies perform a high level of research and development and export a high percentage of their output.

Further information and copies of the report can be obtained from Leo Wood, Exploitable Science and Technology Section, phone (06) 276 1233. ■

NEW PRODUCTS

Automatic ID display

Identification of portable and mobile 2-way radios is simple with the SIGTEC A1458/20 Automatic Number Identification decoder/display unit.

When used together with mobiles and portables fitted with ANI encoders, the system provides the operator with the means to identify nuisance callers, curb excessive talkers and record job statistics.

The A1458/20 features: queueing of up to 10 calls, status and alarm indication and the ability to log all calls to a printer or computer.

For more information circle 241 on the reader service coupon or contact Signalling Technology, 107 Seaford Road, Seaford 3198; phone (03) 786 0077.

Thermocouple meter

The Summit DT012 Digital Thermometer is supplied complete with carry case, battery, basic thermocouple probe and instructions. A wide range of interchangeable probes is available for air, surface and liquid measurements, and the carry case features a fold-back cover which converts the case to a tilt stand.

The high contrast 12.7mm LCD indicates the measured temperature in °C, and gives a visual warning when the battery needs replacement. The measuring range of -40°C to 650°C makes the instrument suitable for many applications such as testing ovens, grills, fryers, process ovens, dryers, measuring stack temperatures and other industrial applications.

The DT012 is available in two models to suit the thermocouple types K and J.

For more information circle 243 on the reader service coupon or contact Amalgamated Instrument, 5/28 Leighton Place, Hornsby 2077; phone (02) 476 2244.

Digital meter has large display

The BVM-35 voltmeter is a high quality instrument with 130mm high digits, designed to be viewed over a distance of up to 50 metres. This allows a plant operator to monitor various process variables, in order to maintain correct system performance.

Input to the instrument may be in the form of voltage or current, either AC or DC. The unit may be user configured, as all ranging is performed by onboard switches. The flexible input and scaling facilities allows easy connection to process-generated signals, i.e., 4-20mA, tach-generators, shunts, current transformers, etc. The case is constructed using an attractive aluminium extrusion providing a rugged and durable industrial enclosure.

The unit can be used to display flow, temperature, pressure, weight, speed, amps, volts, ratios or thickness parameters.

For more information circle 244 on the reader service coupon or contact Applied Electro Systems, PO Box 319, Woodridge 4114; phone (61 7) 208 6911.

Rugged digital multimeters

Dick Smith Electronics has released its new range of high quality digitor multimeters. The new multimeters are built to survive professional use under the harshest conditions. A high impact Valox case protects the multimeter from fire, oil, most solvents, and accidental falls, and 'O' ring seals on every joint protect it from dust and liquids.

The best possible input protection is provided with both fuse and transient voltage filters.

For added safety, the meter will give a loud 'beep' should it come into contact with a dangerous voltage.

The Digitor range includes a true RMS digital multimeter with analog tone (Q-1586), $215), a 29 range digital (Q-1584, $179), an auto-ranging digital with manual range override (Q-1582, $149), and a pencil-style digital with a data hold button (Q-1580 $149) designed specially for electricians and servicemen.

For more information circle 242 on the reader service coupon or contact Dick Smith Electronics, PO Box 321, North Ryde 2113; phone (02) 888 3200.

PCB production aids

A squeeze-type flux dispenser and a solvent applicator with brush are two new production aids from Scope Laboratories in Melbourne.

The 60ml flux dispenser Model FD-3 comes with three capillary tubes (measuring 0.25, 0.50 and 1.37mm, to allow the user to meter fluxes of different viscosities. A nylon brist-led applicator/cleaner brush is fitted to the model SD74 solvent dispenser. Finger pressure on the 60ml bottle controls solvent flow rate.

For more information circle 250 on the reader service coupon or contact Scope Laboratories, PO Box 63 Niddle 3042; phone (03) 338 1566.

UHF diplexer, masthead amps

IKUSI products from Spain, now available in Australia, include specialised low-loss diplexers for VHF & UHF combining of various antennas. These devices are the IKS V-U, which is a basic low loss VHF/UHF diplexer, and the IKS V-U P/C which is a user selectable power passing diplexer.

The P/C model allows power to be passed to existing VHF or new UHF amplifiers, being installed before or above the diplexer. The user can select the path to where the power is required, or allow power to be passed to both VHF and UHF inputs when operating two mastheads.

Also available is a 27dB VHF/UHF Masthead Amplifier, in both DC and AC formats, which can be powered straight up the coaxial cable. This incorporates a very effective FM bandstop filter, and separate switches to switch on and off the separate VHF and UHF amplifiers built within.

Another range of IKUSI products is the SZ-5 series single-channel amplifiers and downconverters. With the single-channel amplifiers, one can totally control the gain and output of every incoming channel configured on the system. The SCA series devices have an average gain of 55dB (+2dB) and are highly selective.

For more information circle 246 on the reader service coupon or contact MMT Australia, 7 Amsted Road, Bayswater 3153; phone (03) 720 8000.

0.5mm ZIF connectors

Elco Corporation claims to have released the smallest range of ZIF type FPC connectors in the world. The Metricon series 6210 connectors, only 2mm high and with a pitch of 0.5mm, are ideal for very small electronic devices such as pocket telephones.

They are also well suited for use in high temperature environments. The 6210 has a single in-line contact and is supplied in embossed tape for surface mounting. The connectors come in 6-30 contact configurations, with 0.5mm contact spacing. Contact rating is 1A maximum, with a 50V maximum voltage. They have a minimum dielectric withstanding voltage of 500V RMS. The contact material is tin-lead over copper, while the insulator is of nylon 46, UL94V-O. The slider material is glass-filled PPS, UL94V-O.

For more information circle 247 on the reader service coupon or contact M. Rutty, 1/38 Leighton Place, Hornsby 2077; phone (02) 476 4066.

Eveready security products

Rising crime levels in Australia and an increase in deaths resulting from fire provide much of the impetus behind the launch of Eveready's 'BeSafe' range of security and safety products.

The range includes a smoke alarm, fire blanket, portable light, intrusion alarm and a hand-held personal alarm.

With the exception of the fire blanket, all of the BeSafe products are battery-operated. The Smoke Alarm has two in-built safety features to ensure prompt replacement of batteries and carries a five year limited warranty.

The BeSafe Intrusion Alarm, designed for use on doors and windows, is activated by vibration and emits a loud beep until turned off.

The BeSafe Personal Alarm is designed to fit into the hand, purse or pocket and is triggered by removing a pin.

And the BeSafe Anywhere Light provides light for areas like cellars, attics and cupboards, where there is no wiring.

For more information, circle 248 on the reader services coupon, or contact Eveready Australia, 30 Harcourt Parade, Rosebery 2018; phone (02) 667 0444. ■

Mini Construction Project:

All-purpose wideband amplifier

This wideband amplifier design, with its bandwidth of 5Hz - 32MHz, is suitable for use with audio, video, RF and pulse signals. It has the great attraction of being constructed from commonly available, inexpensive components.

by ANDREW PIERSON

The general specifications of the design for this multi-purpose wide band amplifier are as follows. Its FET input stage has a high impedance of 1 Megohm and a low shunt capacity, with an overload level of greater than 2V p-p.

The output stage is capable of driving a terminated 75 ohm co-axial cable, and can tolerate a short circuit indefinitely at any level of gain. Its bandwidth is 5Hz-32MHz (-3dB), and the voltage gain is smoothly variable from 0 times to at least 20dB (22dB typical).

The maximum output voltage swing is 3.8V p-p (unterminated) and 1.8V p-p (terminated in 75 ohms). This makes the design very useful for audio, video, RF and pulse signals, or as a CRO or instrument preamplifier around the lab or workshop. In addition, its output level meter can be used to make audio and RF level measurements.

The amplifier

The high impedance input stage Q3 is a FET source follower which obtains its operating bias from resistor R10. It is DC coupled to the emitter follower Q4. This enables the input signal to be presented across the low impedance variable attenuator RV2, which controls the gain without being frequency sensitive. (The upper -3dB frequency varies only between 32MHz and 35MHz over the entire rotation of RV2).

The input overload level depends to a certain extent on the I_{DSS} parameter of Q3, but it will always be greater than a healthy 2V p-p.

A selector switch allows four different input options: high impedance and very low capacitance; high impedance and adjustable capacitance (for use with a 10X probe); 75 ohm impedance or 50 ohm impedance.

The amplifier proper consists of Q5 and Q6, which form a DC coupled NPN-PNP pair. The collector of Q6 is DC coupled to the dual output emitter follower stage Q7-Q8. Two BC549 transistors are used in parallel to obtain sufficient high frequency output current drive, by maintaining favourable f_T and h_{FE} parameters for each device.

As already mentioned, the operating bias is supplied across R10. This bias is stabilised by LED1 and D5, and is assisted slightly by negative DC feedback via R5 from transistors Q7 and Q8.

The feedback voltage is developed across the Q7 and Q8 collector load R4, which also serves to minimize power dissipation in these transistors under both normal and overload conditions. LED1 also acts as a 'power-on' indicator.

The thermal coefficients of LED1 and D5 are partially offset by the thermal coefficient of Q5, after having been attenuated by the bias network RV3-R14-R15. C13 and C14 provide HF compensation by introducing gain regeneration at high frequencies, by decreasing the emitter load impedances of Q5 and Q6.

Frequency compensation is provided for the amplifier in order to produce a maximally flat response. This means that pulse waveforms will be reproduced with a minimum of distortion. The frequency verses phase characteristic is substantially linear, and the HF rolloff above the -3dB frequency is smooth.

The signal voltage at the output is driven up by Q7 and Q8, and pulled down by R21, R25 and the output load resistor in series with R22/R24 and C16. The function of C9, together with C15, is to maintain a low impedance at all frequencies for the collectors of Q7 and Q8.

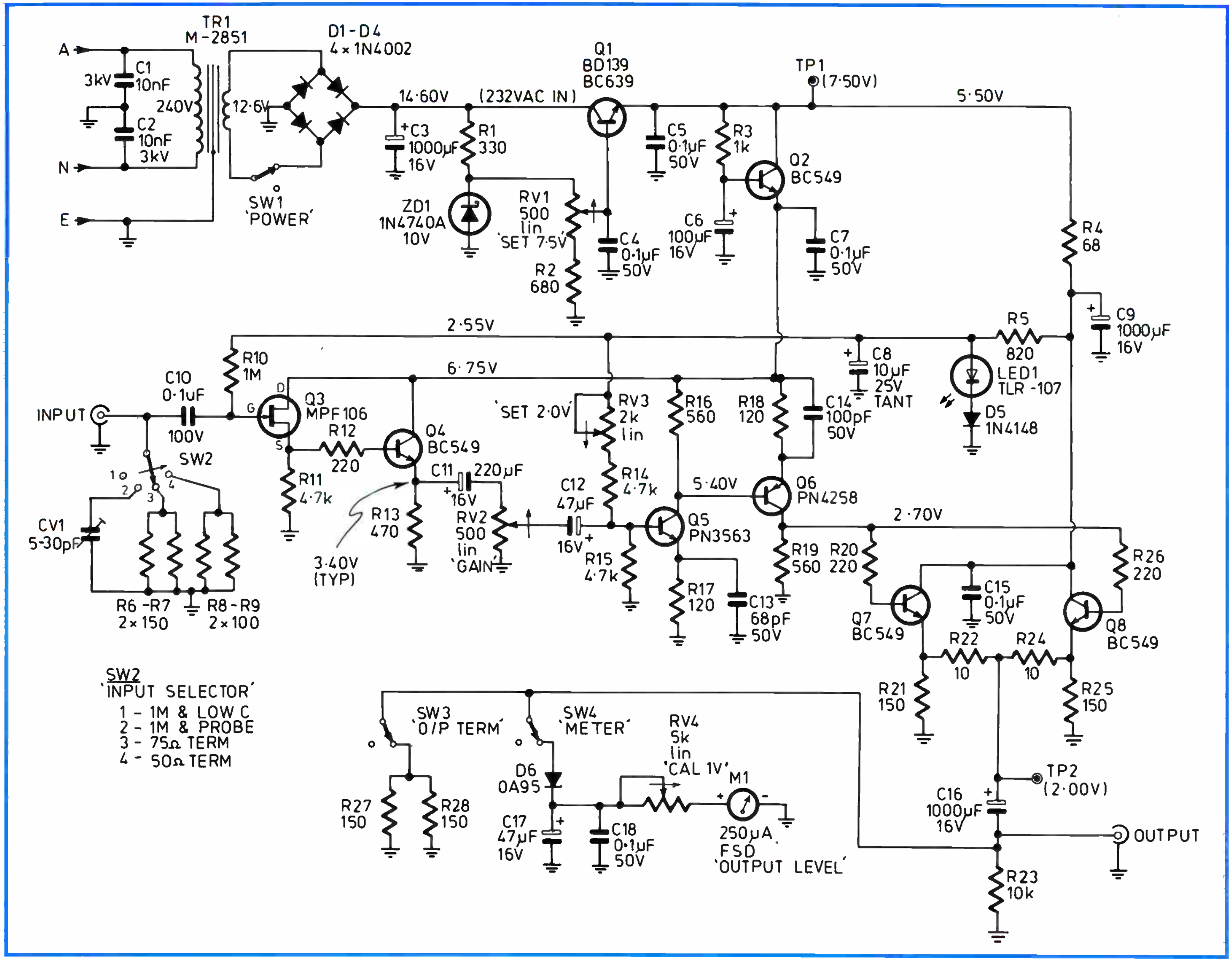
Resistor R23 ensures that the leakage resistance of C16 cannot produce a DC potential at the output when the amplifier is running unterminated. Further resistors R12, R20 and R26 are connected to the bases of Q4, Q7 and Q8 in order to suppress parasitic oscillations.

The output level metering circuit consists of a half-wave rectifier D6, the filter capacitors C17 and C18, the calibration trimpot RV4 and the meter M1. The meter should have an FSD current of approximately 250uA, but 450-500uA types may also be used. In the latter case, the maximum deflection at 1V p-p will be just over centre-scale with RV4 at minimum resistance.

The meter reading should only be regarded as accurate at 1V p-p, as the scale calibration would be most unlikely to match exactly the characteristics of the rectifier circuit used here. Nevertheless, even a simple metering circuit like this can be very handy, as it assures you that the amplifier is not overloaded when your're not monitoring the output.

Note that for the metering circuit to read correctly, the signal waveform must be symmetrical. Also, the output must be terminated, either externally, or internally by resistors R27 and R28 connected by switch SW3.

Continued on page 136



Here's the circuit for the author's wideband amplifier design. As you can see it uses commonly available discrete components to keep costs to a minimum. With a bandwidth extending to 32MHz, and gain variable between 0 and 20dB, the amplifier is suitable for many applications in either signal distribution or instrumentation.

Powerful tools for waveform measurement, generation:

YOKOGAWA'S DL1200A, AG1200 COMBINATION

The Yokogawa DL1200A is a compact portable 100MHz four-channel DSO which offers very long sample memories, extensive triggering options and a powerful post-sampling trace magnification facility. The same company has also released the AG1200 Arbitrary Waveform Generator, which can produce an almost limitless range of signal waveforms for specialised testing.

by JIM ROWE

The name Yokogawa is no doubt well known to many *EA* readers, as the company's test instruments have been sold in Australia for quite a few years now. However it's only quite recently that they've set up an Australian subsidiary, to market their products directly rather than via distributors.

It's also only recently that they've announced the two new instruments which form the subject of this story — the DL1200A, a compact 100MHz four-channel digital sampling scope, and the AG1200 Arbitrary Waveform/Function Generator. Both instruments belong to the latest breed of microprocessor-based test instruments, and provide an impressive combination of high performance, operational flexibility and simplified operation via on-screen menues.

DL1200A scope

The DL1200A is a very compact instrument, with an overall shape rather different from most other instruments. In fact its shape is in the 'portrait' configuration, as opposed to the 'landscape' format adopted by most modern scopes, and is rather reminiscent of the 'Classic' Apple Macintosh computer. Yokogawa's sales material describes it as having an 'A4 footprint', which is very close to the mark: it measures 204 x 270 x 303mm (W x H x D), and weighs a modest 8kg.

Yet in that compact package, Yokogawa has packed a four-channel 100MHz DSO, complete with 178mm (7") amber-phosphor CRT, GPIB/-IEEE488 communications interface and — wait for it — a high resolution thermal printer. The last of these is actually an optional extra, although it fits right inside the case; there's also an optional RS-232C interface which also fits inside, in the same way.

As you'd expect, the DL1200A has four A/D converter channels for the input signal sampling. These have an effective sensitivity of 2mV/division, and are each capable of 8-bit sampling at up to 25MS/s. When all four channels of the instrument are being used, and for single-shot measurements (i.e., real time sampling), the ADC's are in fact run at 20MS/s wherever possible. However when only two channels or one channel are in use, the instrument is arranged so that the ADC's are time-multiplexed to the active channel or channels, to achieve higher sampling rates. As a result the maximum effective sampling rate for two-channel measurements is 50MS/s, and this doubles to 100MS/s for single channel measurements.

Even more impressively, this ADC multiplexing is also used for the random equivalent-time sampling mode, used for capturing very fast repetitive signals. Here *each channel* is effectively able to sample at 100MS/s, regardless of the number of channels in use, giving an equivalent time resolution of 200 picoseconds (equivalent to sampling at 5GS/s).

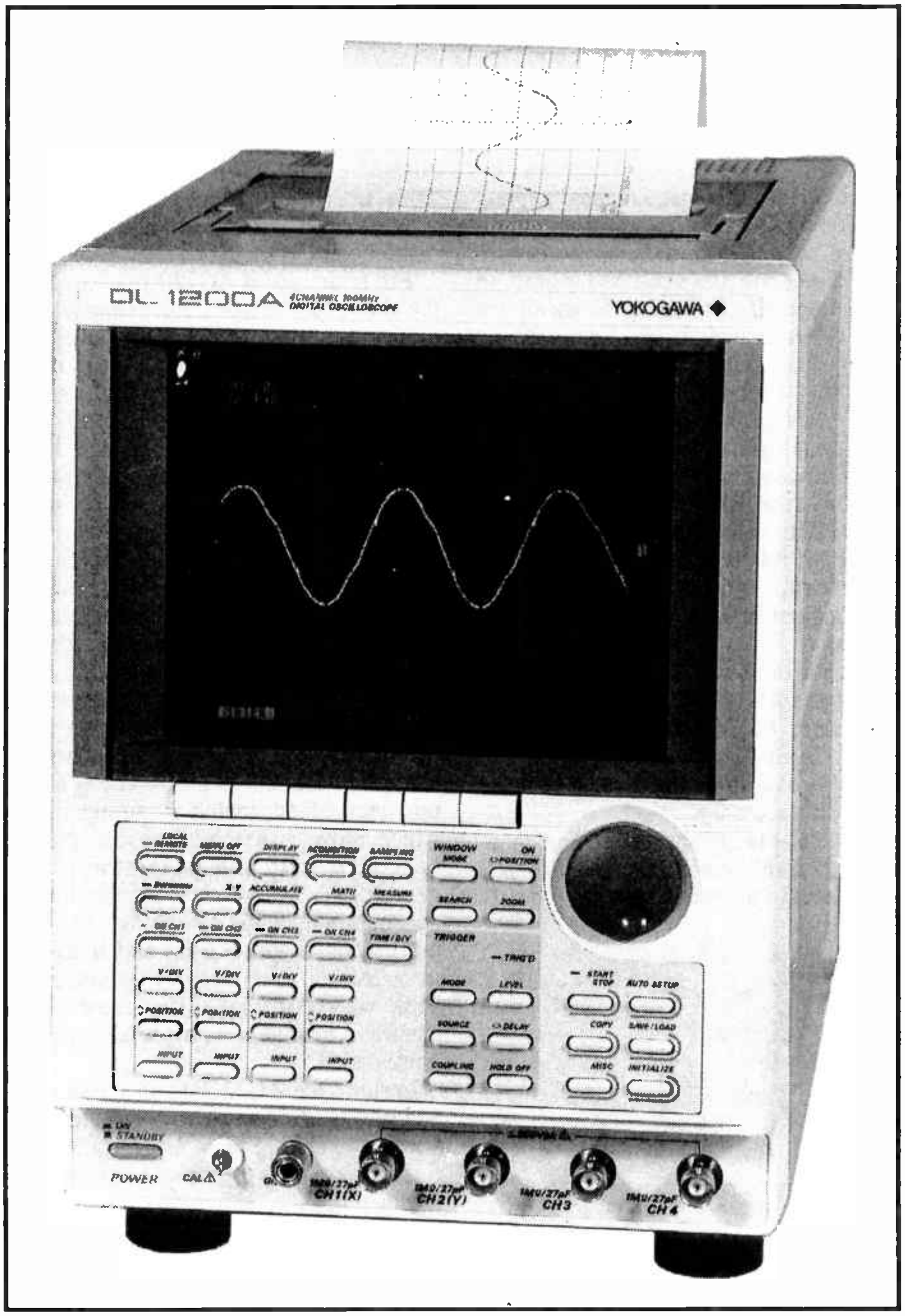
Another impressive feature of the DL1200A is its large capture memory. This amounts to a total of 128K words, which can be allocated among the input channels according to the user's needs. The normal arrangement would be to have the full 128K available to one channel for single-channel operation, reducing to 64K per channel for two-channel operation and 32K per channel for four-channel measurements. However this allocation can be varied as desired; for example if three channels are being used, one channel can be allocated 64K and the other two 32K each.

As Yokogawa points out, the instrument's large capture memory 'length' means that it can maintain its maximum sampling rate for a wider range of timebase speeds, improving resolution and reducing aliasing problems. Instruments with less capture memory are generally forced to 'shift down' to lower sampling rates, when the timebase speed is reduced, to prevent overflow of their memory; and of course lower sampling rates not only lower the time resolution, but also lower the effective digital bandwidth and hence increase the likelihood of aliasing.

(Aliasing occurs when the frequency of a signal being sampled exceeds the 'Nyquist limit', or half the sampling rate. In the case of a DSO, this results in the appearance of spurious signal components and amplitude variations, giving false and misleading measurements.)

A further advantage of the DL1200A's very long capture memory is that because there is generally a lot more information captured than can be displayed on the screen, it becomes possible to provide a 'zoom' or horizontal magnification facility. This can operate not only during real-time sampling of repetitive signals, but also *after* the capture of single-shot events. With the DL1200A the 'zoom' facility allows magnification by up to 1000 times; also the magnified trace window can be slid anywhere along the capture memory, giving the equivalent of an analog scope's delayed timebase facility.

The DL1200A has very impressive triggering facilities, too. In addition to all of the basic triggering modes it offers adjustable delay (0 to -10 screen divisions) and holdoff time (120ns - 80ms), plus the ability to trigger not just on rising or falling slopes, but on *both* if desired. And for those who need to measure TV and video signals, it also offers full TV trig-



Despite its compact form, Yokogawa's DL1200A combines a 4 channel 100MHz digital scope with an optional inbuilt printer, GPIB and RS-232C interfaces.

gering facilities with the choice of odd or even fields, and the choice of any designated line.

Like most modern DSO's the DL1200A also offers the ability to make a full range of waveform parameter measurements: amplitude (p-p, RMS, average, max, min), frequency and timing (risetime, falltime, overshoot, undershoot, period, + width and - width). These can be performed either automatically, or by manual cursor manipulation. There's also the ability to perform various kinds of intra- and inter-waveform computing: inversion, addition, subtraction and multiplication. The last of these can be used for such purposes as displaying the instantaneous power dissipation of a switching transistor, for example.

The DL1200A is also particularly flexible when it comes to acquisition modes and display options. It gives you a choice of any of five different acquisition modes: normal (all acquired data displayed); averaging (over a designated number of signal cycles, to suppress noise — only valid for relatively steady repetitive signals); smoothing (averaging over successive data samples — reduces noise for suppressing noise on both single-shot and repetitive signals); 'envelope' (where the sample rate is varied, to allow close examination of low-frequency signals around the points of maximum and minimum envelope amplitude); and 'decimation' (where only every 'nth' sample is displayed).

There's also a choice of displaying sampled waveforms as either the unconnected sample dots, or connected with interpolation using either a linear or (sinX/X) function.

Another feature is a 'dynamic accumulation' mode, which superimposes succeeding waveform samples on the screen, with an adjustable effective 'persistence' (from 100ms to 50s). This allows convenient observation of jitter, digital signals with varying data content, communications signal eye patterns and so on.

The operating controls of the DL1200A are fairly typical of modern DSO's, and reasonably intuitive. An array of some 43 pushbuttons, grouped logically according to function, are used to select all main control modes and parameter settings. A single rotary control knob is then used in many control modes, to adjust that mode's primary parameter. So generally any particular parameter can be adjusted merely by pressing a button, and then turning the knob. The function of the knob at any time is clearly indicated at the bottom right-hand corner of the display screen.

Along with this basic control setup there's also a set of six keys along the bottom of the display screen, whose function at any time is determined by the DL1200A's internal software. These are essentially used for all 'sub menu' function selection, with their functions again indicated along the bottom of the screen. The DL1200A's inbuilt GPIB interface allows it to be fully remote controlled from a PC, for automated testing. It can also be instructed to 'dump' a copy of the contents of any of its capture memory or display memory buffers, for transfer of waveform data to either the PC or other instruments (such as the AG1200 Arbitrary Waveform Generator). The same remote control/comms functions are also available via the optional RS-232C serial interface, which is fully programmable in terms of data rate, format etc.

Of course with its optional thermal printer fitted, the DL1200A can itself produce high resolution hard copy on 112mm-wide paper. The printer can also deliver a detailed 'status report' showing all control parameter settings, in addition to a hard copy of the actual screen display, for convenient documentation. It has a resolution of 6 dots/mm, or around 150dpi, and is very quiet in operation.

Further features of the DL1200A include one of those great 'Auto Setup' buttons, to produce a stable and triggered display of virtually any new signal, with a single keystroke; a built in non-volatile memory, capable of storing up to eight different waveform displays, and four panel setups; and an optional interface for static RAM cards, which fits on the underside of the case, to allow such cards to be used for external, transportable memory.

AG1200 generator

Although Yokogawa's other new instrument the AG1200 looks very much like another DSO, it is in fact quite different — at least in terms of function. Despite its 228mm (9") CRT display, it is actually a signal generator; and a particularly flexible one, which can be programmed to produce virtually an infinite number of different signals.

The AG1200 is an *arbitrary waveform generator* or 'AWG', which means that it can produce signals with virtually any desired waveform. Like virtually all other AWG's it does this by generating the waveform using a D/A converter, driven by digital waveform data under the control of an inbuilt microcomputer.

In the case of the AG1200 the data describing the desired waveform can be originated in three different ways: by 'drawing' it on the CRT screen, by describing it via a mathematical expression, or by downloading it from either a computer or a DSO such as the DL1200A, via the AG1200's built in GPIB interface. And once the waveform data is originated, it can be saved on floppy disk and re-loaded again at any time, via the inbuilt 3.5" FD drive.

The AG1200 uses 12-bit words to represent each data sample of the signal waveform, so that the waveforms have a vertical resolution of 4096 discrete levels. With a maximum output voltage swing of ±10V, this means that the waveform can effectively be programmed in 4.8mV increments, over that range.

The maximum data sample clocking rate of the AG1200 is 10MHz, giving a minimum horizontal resolution of 100ns. And for each waveform the AG1200 can store up to 32K sample words, if necessary.

As well as being able to produce these fully 'custom' waveforms, the AG1200 can also be set to operate as a fairly standard function generator — to produce general-purpose sine, square, triangle or ramp waveform signals.

In this mode it can produce sinewave signals with synthesised frequencies anywhere from 10mHz to 2MHz, or from 10mHz to 200kHz for the other waveforms — in both cases with a resolution of 10mHz.

The basic model AG1200 can do all of the above for a single output channel, but models are also available with either two or four output channels — all independently programmable. With these models it's also possible to have the signals produced by various channels locked together with a fixed delay/phase relationship, which can be set in increments of 0.1°.

One version of the four-channel model is also able to switch two of its output channels from analog to digital output, when desired. In digital output mode the two channels concerned can each output 16-bit binary words, in synchronism with the arbitrary waveform signals produced by the two other analog output channels.

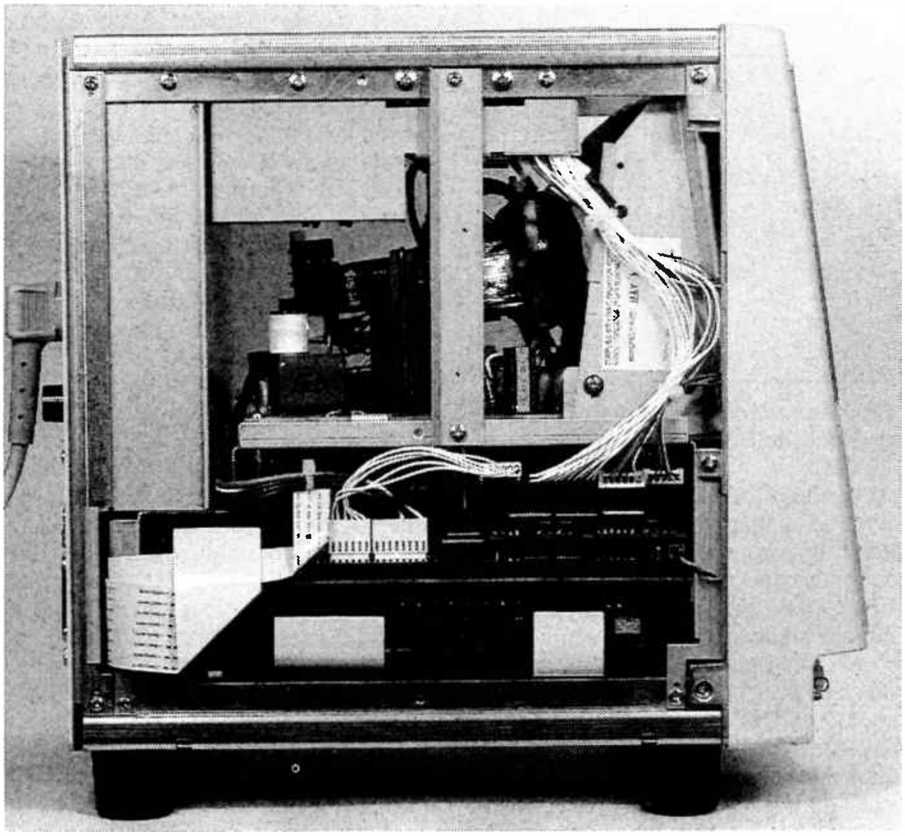
Another feature of the AG1200 is the provision of an analog summing input, which allows an external analog signal to be mixed with the generator's own generated waveform. With the multi-channel models this also allows the output of one channel to be added to that from another, to produce even more complex waveforms — for example a sinewave toneburst with pseudo-random noise added.

In short, the AG1200 is a *very* flexible and powerful instrument. By the way, if you're wondering what an AWG is used for, the answer is to produce any kind of signal that other generators can't — or can't without a lot of trouble. The sort of signals that otherwise would require the design and construction of quite complex 'hard wired' circuits.

Examples of the kind of signals that can be produced quite simply using an AWG are synthetic EKG, ECG and other biomedical signals; complex multi-frequency tonebursts; multi-level test signals for LCD panels; impulse test signals with shaped profiles, such as 'Gaussian' or 'SinX/X' pulses; and sinewaves with 'notches' and 'spikes', for testing power supply regulators and filters.

Trying them out

Yokogawa Australia very kindly loaned us samples of both of these new instruments, so that we could try them out for a few days. The sample DL1200A was fitted with both the thermal printer and RS-232C options, while its companion AG1200 was the top model with



Removing the cover reveals the DL1200A's elegant internal design. The printer mounts just above the video monitor module, with the switch-mode power supply at the rear. The DSO circuitry itself is on the boards below the monitor.

four output channels and the digital output option.

We tried out the DL1200A first. This proved to be fairly 'friendly' and intuitive in terms of operation, although a little less so than models that have controls arranged in the more familiar 'analog scope' fashion.

For example we found it took quite a while to get used to the idea of having to press a different function button, before being able to adjust each different scope parameter — vertical range, position, timebase range and so on. Even when you get fairly used to this, it still seems a little less convenient than simply adjusting separate dedicated controls.

But on the positive side, we did like the ability to magnify the trace horizontally, using the 'zoom window' function. It's especially convenient and helpful to be able to do this *after* capturing a single-shot signal, so that you can look more closely at the fine details.

Another advantage of the zoom facility is that it effectively allows you to extend the fast screen update 'analog' operation of the DL1200A, for signals that would normally require setting the timebase speed to a range which would invoke equivalent-time sampling and its inevitably lower update rate.

For example when you're using only one channel, the DL1200A normally changes from real-time sampling to ET sampling when you change the timebase range from 500ns/div to 200ns/div.

To defer this change while still allowing reasonable horizontal resolution of faster signals, you can leave the timebase set at 500ns/div (for real-time sampling and fast update), while enabling the Window Zoom facility and using this to magnify the horizontal resolution as desired.

Of course you have to be careful doing this. Since the maximum sampling rate of the DL1200A is 100MHz for single-channel mode and real-time sampling, Nyquist's criterion still applies: you can't observe signals above 50MHz, without aliasing 'taking over'. For signals over 50MHz you really have no option but to allow the scope to go into ET mode, to lift the effective sampling rate.

Other things we especially liked about the DL1200A are the choice of display options (dots-linear-sinX/X interpolation); the TV triggering function, which is very handy for examining video signals; the ability to display an X-Y plot as well as the normal Y/T plot, which makes it much easier to monitor the relative phase shift between two signals; and of course the built-in thermal printer — which makes it extremely easy to produce crisp hard copies of virtually any desired display. We also liked the option of printing out the scope's control status, along with the waveform itself.

We tried connecting the DL1200A up to a PC via the RS-232C port, and using a small utility program (kindly supplied by the folks at Yokogawa Australia) to transfer the contents of one of its capture memories.

This went smoothly, and we found the scope's comms setup menues quite easy to drive. We also tried downloading a waveform to the AG1200 generator, via the GPIB port, and this too proved to be quite straightforward.

On the down side, we found the display updating speed a little slow in ET sampling mode. In real-time sampling mode the DL1200A is commendably fast, with display updating virtually indistinguishable from an analog scope. But it can take quite a few seconds for the display to 'clean itself up' at times, when you're running at the highest ET sampling rates in order to look at or measure high-speed signals.

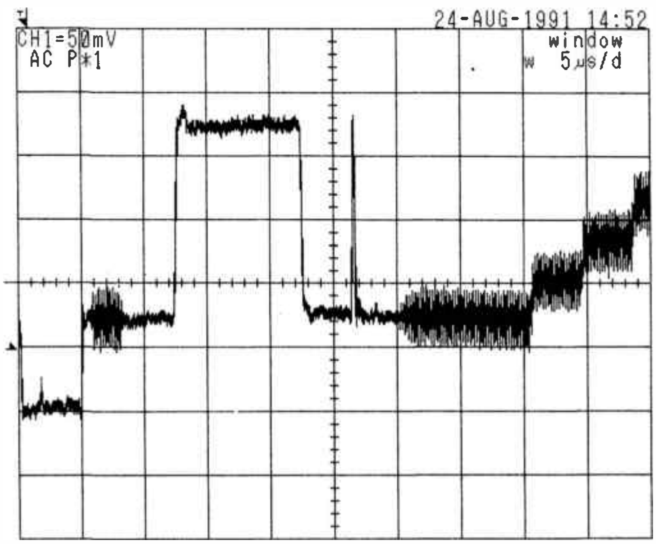
Apart from this and the slightly fiddly nature of the DL1200A's 'many buttons and one knob' control system, though, we found it an excellent performer. The frequency response appeared to be virtually flat to 100MHz, with a -3dB point at around 150MHz, and all other parameters were also comfortably within spec.

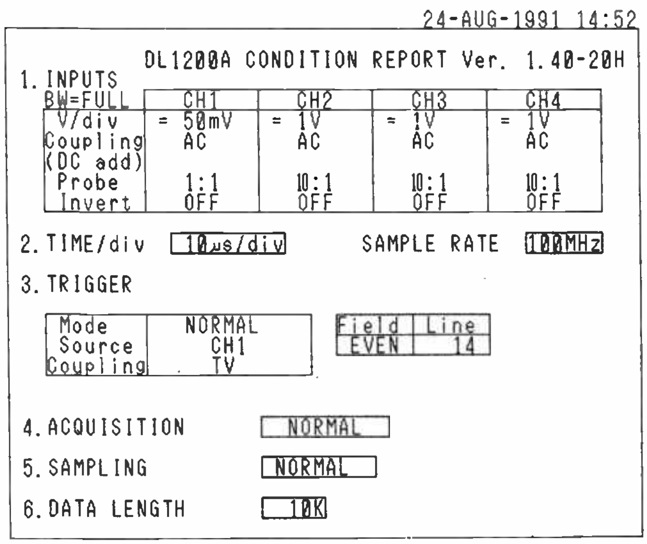
For the quoted price of $6900, for the basic instrument, it seems good value for money. The optional thermal printer, RS-232C and static RAM card unit are each available for an additional $920, by the way.

After becoming familiar with the DL1200A, we were able to try out the AG1200 — both separately and linked to the DL1200A.

We found the generator almost mind-boggling in its flexibility. It can be programmed to produce virtually any desired waveform, in the frequency range covered, and in that sense is a very powerful instrument indeed. But at the same time, it can't be said that it's an easy instrument to drive — quite the contrary, in fact.

Part of its operational complexity seems to stem from the fact that *two* components are required before the AG1200 can produce a waveform: a file containing the actual waveform data or mathematical description, and another

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DL1200A CONDITION REPORT Ver. 1.40-20H

1. INPUTS

BW=FULL	CH1	CH2	CH3	CH4
V/div	= 50mV	= 1V	= 1V	= 1V
Coupling (DC add)	AC	AC	AC	AC
Probe	1:1	10:1	10:1	10:1
Invert	OFF	OFF	OFF	OFF

2. TIME/div 10µs/div SAMPLE RATE 100MHz

3. TRIGGER

Mode	NORMAL
Source	CH1
Coupling	TV

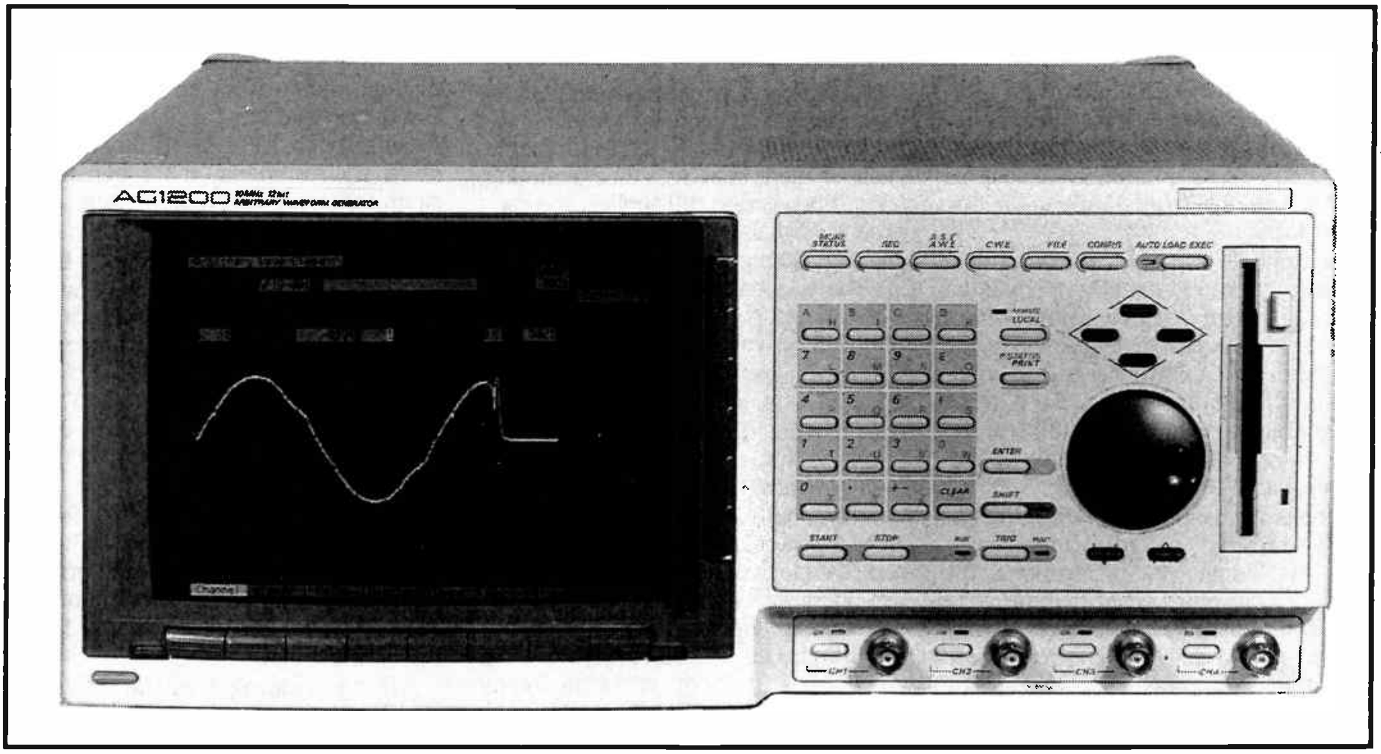
Field	Line
EVEN	14

4. ACQUISITION NORMAL

5. SAMPLING NORMAL

6. DATA LENGTH 10K

Two examples of the hard copy printout from the DL1200A's internal thermal printer. At left is a copy of a captured TV signal waveform, while at right is one of the DL1200A's status reports. Both are reproduced here actual size.



With its 228mm CRT display, floppy disk drive and control keyboard, the AG1200 looks more like a digital scope than a generator. But a generator it is, and one that will produce almost any conceivable signal waveform.

containing the 'sequence program'. The latter is virtually a small program telling the AG1200's inbuilt micro how the waveform data is to be used in generating the final signal.

Another aspect which is hard to get used to is the way the AG1200's waveform maths expressions are essentially defined directly in terms of internal 'master clock' cycles — i.e., on a sample-by-sample basis. If the master clock is 10MHz and you want a signal with a frequency of 10kHz, for example, it seems to be up to you to work out that this will involve 1000 samples (i.e., clock cycles) per signal cycle, and to work out your expression accordingly.

This doesn't tend to be a problem with waveforms that you 'draw' on the AG1200's screen, or with those that you download from a DSO. But it *does* make things harder when you try to define the waveform more elegantly, via an expression.

A third factor that seems to contribute to the AG1200's operating complexity is its rather inelegant keyboard, with 20 keys that are made to serve for full alphanumeric input, using a rather clumsy 'self cancelling shift key' system.

This takes quite a while to get used to, and one can't help wondering if it wouldn't have been easier to provide the machine with a standard plug-in QWERTY keyboard.

And finally, we found the AG1200's system of functional submenues, with eight software-defined keys along the bottom of the screen and another six down the right-hand side, surprisingly confusing.

Especially when the on-screen definitions for the vertical keys don't always line up with the keys themselves, so that you tend to press the wrong key by mistake...

These criticisms aside, it actually didn't take *too* long before we were able to get the AG1200 to produce a series of quite 'special' waveforms, and look at these using both the DL1200A and a suitable analog scope. These exercises certainly demonstrated the ability of the AG1200 to produce an almost unlimited range of special-purpose signals.

We were even able to capture a signal on the DL1200A, download it into the AG1200 using the GPIB interfaces, manipulate the AG1200 to regurgitate the waveform at a much higher frequency, and then capture it again on the DL1200A — finally printing it out. A rather convoluted exercise, to be sure, but it demonstrates the great flexibility and power of this kind of DSO-AWG combination!

Incidentally the AG1000 actually has an output socket to directly drive either an Epson LQ or NEC PR series parallel printer, so you can get hard copy printout of its waveforms directly, for documentation. However it's a 14-pin Amphenol 57N-series socket, so that a special printer cable is needed. What a pity that Yokogawa didn't fit a DB25 socket, wired like that on IBM- compatible PCs, so a standard low-cost cable could have been used...

The AG1200 also has an auto-loading facility, by the way, whereby it can be arranged to automatically load one or more waveform data files and sequence program files from a floppy disk, when the instrument is powered up. This can both save time, and make it much easier to set up the AG1200 to generate often-needed special waveforms.

On the whole, then, the AG1200 seems an extremely powerful instrument, and one that is undoubtedly capable of producing signals that can't be obtained any other way apart from a specially-built instrument.

It's not the sort of instrument that you can sit down with and drive immediately, though — there's quite a significant learning period. For the quoted price of around $11,000 for the basic single-channel model it's also not cheap; although probably still a lot cheaper than designing and building up one or more specialised generators.

Further information on both of these new Yokogawa instruments, as well as others in the firm's range, are available from Yokogawa Australia, Centrecourt D3, 25-27 Paul Street North, North Ryde 2113; phone (02) 805 0699. ■

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Semiconductor lasers

High power and compact dimensions are the outstanding features of the semiconductor lasers shown by Siemens recently in Germany. The cases, which are designed for external cooling, are available both with a plain window (TO-220) and with a spherical lens and welded connector socket. The lasers are thus ideally suited to situations where high power is a more important requirement than narrow wavelength range. Typical applications are laser soldering, isolated energy transmission and repair of detached retinas in eye surgery.

For a number of applications, where power matters more than frequency stability, semiconductor lasers can forego a built-in Peltier element in favour of external cooling. This allows the construction of high-power lasers in small cases, as represented by the Siemens types SFH487401 and SFH487406. At an emission wavelength of 809 ±5nm, a continuous wave power of 1W is obtained. The integrated optics give an efficiency of 75% for launching from a 200um^2 laser surface into a 125um^2 optical fibre. The dimensions of just 16 x 10mm allow compact designs in which the emissions from a number of lasers are combined into a multifibre unit.

The power densities achieved by these methods permit such innovative applications as laser soldering or power feeding via optical fibres, which is required for measurement devices in areas where there is a risk of explosion.

For more information, circle 271 on the reader services coupon or contact Siemens, 544 Church Street, Richmond 3121; phone (03) 420 7314.

Very bright green LED

Toshiba Japan has developed a prototype light emitting diode (LED) which emits green light at a very bright level.

The new device uses high quality indium-gallium-aluminium-phosphide (InGaAlP) and a new structure to attain a brightness of 1.5 candela.

Conventional green light LEDs use gallium phosphide (GaP) and achieve a maximum brightness of only 0.8 candela. Toshiba introduced InGaAlP into LEDs to attain high efficiency in light conversion. The company developed a 3 candela orange light LED (at a wavelength of 620 nanometres) in 1990. By further shortening emission wavelength, it has succeeded in developing the 1.5 candela green light LED at a wavelength of 573 nanometres.

Achieving green light emission requires a high Al composition in the LED active layer. However, as Al is oxidisable, this causes a reduction in radiative efficiency. For the new green LED, researchers introduced a gallium arsenic (GaAs) off-angle substrate to enhance the layer quality. The substrate, which is formed by slicing GaAs ingot at a 15° angle to the conventional LED substrate, helps shorten the emission wavelength and protects the layer from deterioration due to high Al composition.

Further improvements include installing a reflector, consisting of a multilayer semiconductor, above the GaAs substrate to prevent light loss. And to prevent the electrode, which is mounted on the top of the LED, from blocking the emission of light, a current blocking layer is installed below the electrode, on the p-cladding. This channels electron flow to the active layer and prevents emitted light from hitting the electrode.

Single chip for Ethernet LAN

National Semiconductor claims to have introduced the industry's first single-chip 10Base-T Ethernet product which offers a 20% reduction in board space and only one-fourth the power of previous adapter chipsets. This makes it an ideal solution for desktop, laptop and notebook computer applications.

The new product, the DP83902, is called the ST-NIC, derived from Serial Network Interface Controller for Twisted Pair. The ST-NIC combines in one chip all of the functions of National's three-chip Ethernet solution, including the network interface controller, encoder/decoder and 10Base-T transceiver, yet requires no change to existing hardware and software.

The ST-NIC is designed to support all IEEE 802.3 media options, including the recently approved 10Base-T section of the standard. It also supports other media, including both thick and thin coaxial cable and fibre optic media, through a full Attachment Unit Interface (AUI) port on the chip.

For more information, circle 274 on the reader services coupon or contact National Semiconductor, 16 Business Park Drive, Monash Business Park, Nottinghill 3168; phone (03) 588 9999.

Ultralow noise FET op-amp

Analog Devices' AD745 monolithic FET-input operational amplifier combines the ultralow voltage noise characteristics of a bipolar input amplifier with the inherently low current noise of a FET-input device.

It offers a very low combination of noise specifications for its class: current noise is 6.9fA/√Hz at 1kHz and voltage noise — with 10kHz inputs — is 2.9nV/√Hz (4nV/√Hz guaranteed and tested maximum). Its 0.0002% total harmonic distortion at 1kHz makes the AD745 an excellent preamp or current-to-voltage converter in systems with high source impedances.

Equipment used to capture low level input signals (including sonar arrays, hydrophones, oximeters, ECG, ring-laser gyros and spectrometers) can benefit from its wide 20MHz bandwidth, fast 12.5V/us slew rate, and compensated gain up to and above +5 or -4. The AD745's combined low offset voltage and noise performance support a minimum of 140dB dynamic range.

For more information circle 273 on the reader services coupon, or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

High speed A/D converter

Micro Networks has released its MN5903 and MN5903A high speed 6-bit monolithic A/D converters which have guaranteed conversion speeds up to 75MHz.

The MN5903 is pin-for-pin compatible with the AD9000, but significantly outperforms it with signal-to-noise ratios of 38dB at 540kHz and 36dB at 35MHz compared to 36dB and 22dB for the AD9000. The MN5903 has a full power bandwidth of 140MHz, which is considerably greater than the 20MHz full power bandwidth of the AD9000.

The MN903 has a low input capacitance of 25pF and a 13k output impedance which allows the input to be easily driven by interfacing circuitry. Its broad input bandwidth of 140MHz and low aperture uncertainty of 25ps eliminate the user's need for an additional track-and-hold amplifier. The MN5903 also provides an overflow signal which indicates when the analog input signal exceeds the $+V_{REF}$ voltage. In addition, a hysteresis control function is provided that allows the user to modify the comparators' sensitivity.

For more information, circle 275 on the reader services coupon or contact Priority Electronics, 23 Melrose Street, Sandringham 3191; phone (03) 521 0266

Single supply 12-bit DAC

Requiring just a single +5V supply, Analog Devices' DAC8412 and DAC8413 12-bit digital/analog converters (DACs) eliminate the need for a negative supply used solely for analog I/O. Housed in a compact 28-pin package, this monolithic device provides four independent analog outputs, sharing a common bus interface (with fast 70ns access time) and digital readback.

For additional flexibility, the DACs can provide bipolar outputs when powered from dual (up to ±15V) supplies. Applications include automatic test equipment, servo control, military and aerospace systems and industrial process control.

The output span of these DACs is set by the user-supplied high and low references; reference voltages can be from ±2.5 to ±10V.

Power dissipation is less than 60mW for +5V operation and less than 330mW with ±15V supplies. The DAC8412 has 'reset to centre scale' operation; the otherwise identical DAC8413 resets to minimum scale.

For more information, circle 276 on the reader services coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

Fast static RAM

Motorola is now offering a 10ns 64K fast static RAM in production quantities. The MCM6290CJ10, 16K x 4, has an output enable feature that increases system flexibility, making it easier to eliminate bus contention problems.

Features of the new RAM are: fully TTL compatible — three state output; single 5V ±10% power supply; fully static — no clock or timing strobes necessary; equal address and chip enable access times; and low power operation.

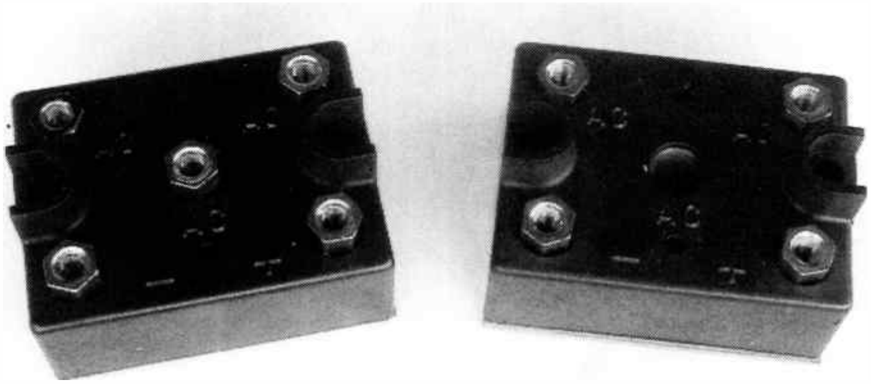
For more information, circle 277 on the reader services coupon or contact Motorola, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711.

High voltage diodes

Semtech USA has released high voltage, small axial-lead packaged diodes, with working reverse voltages from 2kV for the 1N3645 SM20 to 10kV for the SM100.

They have a 2.5ms reverse recovery time and average forward current ratings of 600 and 300mA.

For more information, circle 278 on the reader services coupon or contact Composite Electronic Components, 47 Talavera Road, North Ryde 2113; phone (02) 878 5099.



High current bridge rectifiers

Micro Semi has released a new range of bridge rectifiers. The EH series is available from 50-100A ratings at 120°C, in voltage ratings from 200-1200V. Single phase versions are available in 60 and 75A, with 75, 80 and 100A ranges available in three phase configurations.

For more information, circle 272 on the reader services coupon or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 748 4066. ■

H-P'S NEW 30W BENCH SUPPLIES

As part of its renewed activity in the lower-priced general purpose sector of the instruments market, Hewlett-Packard has released a new pair of regulated DC bench supplies with a power rating of 30W. Both feature dual digital readout of voltage and current, fully adjustable CV/CC transition and low ripple and noise output.

It's nice to see H-P releasing some more products at the lower-priced 'general purpose' market, because this means that today's students, people working in small firms and even serious hobbyists will be able to get first-hand experience with at least some of the firm's well-engineered products.

All too often it's seemed in the past that good engineering has equated to high prices, and effectively withdrawn this kind of gear up into the rarified air of research establishments...

The new E3610A and E3611A bench supplies are good examples of what the venerable H-P's teams of engineers can achieve, when they aim to combine the firm's traditional approach to engineering with reasonably competitive pricing. Although priced at below $500, the supplies offer excellent performance coupled with very solid construction and a high order of user convenience. Rated at 30 watts, the two supplies offer a choice of voltage/current combinations. The E3610A provides lower voltage and higher current, while the E3611A goes to higher voltage levels with lower current.

Each supply further subdivides the range it covers into two, again with a different ratio between voltage and current limits. Hence the E3610A provides a choice of either 8V/3A or 15V/2A ranges, while the corresponding ranges on the E3611A are 20V/1.5A and 35V/0.85A. Apart from these differences (probably achieved by internal selection of transformer taps), the supplies are virtually. identical. Both supplies are housed in a case measuring 212 x 318 x 88mm (W x D x H) overall, and weighing 3.8kg. They feature dual digital metering, with one front panel 3-1/2 digit LED readout monitoring output voltage while the other monitors current. Separate LEDs to the right of the displays indicate whether the supply is operating in constant-voltage (CV) or constant-current (CC) mode.

Further to the right again are the controls to adjust output voltage and current limit. The voltage control uses a 10-turn pot for ease of setting the desired level, while the current control uses a standard single-turn pot.

Below the displays are three pushbutton switches. That on the left is the power switch, while the centre button selects the supply's operating range. The third button is labelled 'CC SET', and allows you to conveniently set the current limiting without having to apply an external short circuit across the output.

Below the output controls are the output terminals, which are of the usual binding post type. The output itself is floating, and rated to withstand up to ±240V with respect to ground. However the third terminal is connected to mains earth, and either main output terminal may be linked to it as desired.

The rear panel of the supplies is a solid finned heatsink casting, with an IEC-type captive mains plug fitted into the centre between the two sets of fins. Cooling is via convection air flow, through both the rear fins and arrays of ventilation slots moulded around the case, near the rear.

Rated load regulation of the supply output voltage is 0.01% + 2mV, for the full rated loading, while the current regulation is 0.01% + 1mA. The line regulation figures for both are also identical with these figures. Transient recovery time in CV mode is 50us maximum, to recover to within 10mV of the nominal voltage after a load current change of 50% of maximum output. Maximum output ripple and noise within a bandwidth of 10Hz - 10MHz is rated at 200uV RMS (2mV p-p) for voltage and 200uA RMS (1mA p-p) for current. The rated accuracy of the inbuilt digital meters is 0.5% + 2 counts of the least significant digit.

Output drift of the supplies over an 8-hour period, following 30-minute warmup, is 0.1% + 5mV for voltage and 0.1% + 10mA for current. The output temperature coefficient per °C, also after 30-minute warmup is 0.02% + 1mV for voltage and 0.02% + 2mA for current.

In practice

Hewlett-Packard Australia kindly made one of the new E3611A supplies available to us, so that we could try it out.

We were impressed with the solid construction of the unit, which looks as if it would take a lot of rough handling — a worthwhile feature in a bench supply! In fact the sample unit appeared to have suffered a severe knock, because one of the rear heatsink fins had been broken off; but despite this it seemed to operate normally.

Thanks to the convection cooling, the supply operated very quietly. We also found its controls very convenient in use, in combination with the dual digital readouts. The 'CC SET' button also makes it very easy to set the current limit level, or check it at any time.

We carried out basic tests of most aspects of the supply's performance, and the figures were generally well within the rated specs.

The only figures we couldn't quite match were the ripple and noise output, which measured a little high at around 5mV p-p. However we weren't able to use a 10MHz low-pass filter in our measurements, and most of the noise visible on the 100MHz scope connected to the supply's output terminals appeared to be well into the RF region; the ripple level was almost imperceptible.

We have a fairly high level of RFI in our area, and it may well be that this was the cause of the higher noise level rather than the supply itself — which could still have been within spec. Either that, or the noise performance of the sample supply may have been degraded when it suffered the physical damage.

We were particularly impressed with the excellent regulation of the supply, and the way it switches cleanly and automatically between CV and CC modes according to the control settings and the load conditions. The regulation is maintained very tightly up to the changeover 'knee', in either mode.

By the way, the supply also appears to maintain regulation to about 5% higher than the rated output voltage or current levels, providing the 30W power limit is observed.

Overall, then, the E3611A struck us as an excellent little supply, and one that along with its sibling the E3610A should find a place in many electronics labs.

For further information on the supplies, including availability, contact Hewlett-Packard Australia's Customer Information Centre by phoning (008) 033 821. (J.R.) ■

New Supplies and Converters

Wide range DC/DC converter

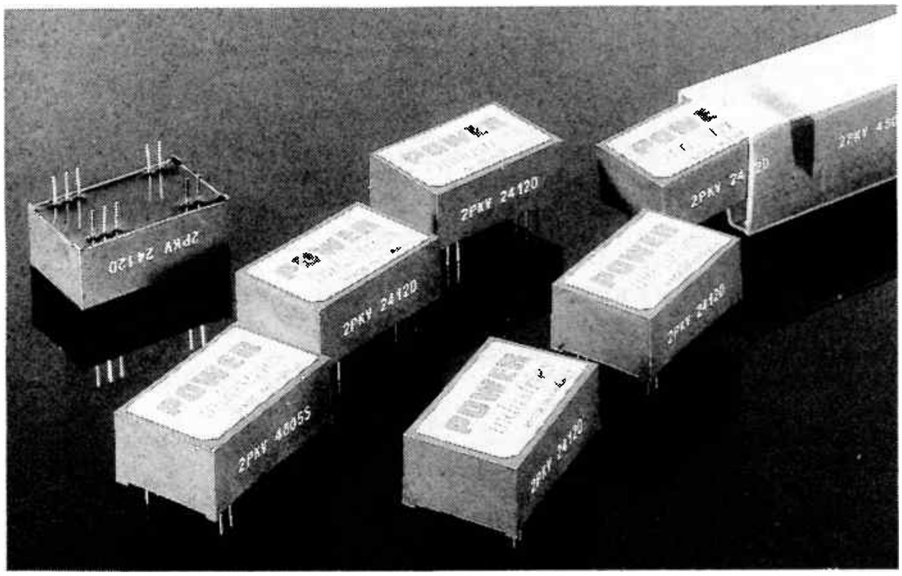
The 2PKV Series 2.5-3W is the latest release from the Power Industries range of DC/DC converters from Ericsson Components.

The converters are manufactured by using thickfilm hybrid technology and offer efficiency to 85% with a very wide input range: 9-36V DC (nom. 24V DC) and 18-72V DC (nom. 48V DC). Standard output voltages are 5, 12 and 15V DC in single and dual versions.

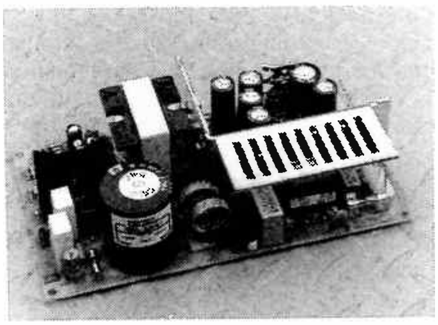
The 2PKV Series has input undervoltage shutdown, output short circuit protection and overtemperature protection. It has an internal input filter and requires no external components for normal operation.

It also offers an MTBF of over 300,000 hours.

For more information circle 201 on the reader service coupon or contact EC Capacitors, 59 Radford Road, Reservoir 3073: phone (03) 462 2855.



'Universal'65W switcher



Power General's FLU3-65 series is a family of highly reliable, triple output 65-watt switching power supplies. Four models provide output combinations of 5, 12 and 24V DC. All models are approved for international safety standards including UL, CSA and TUV (VDE).

Features of the series include a universal input voltage range of 85V AC to 265V AC (100V DC to 370V DC). Universal inputs allow equipment manufacturers with international markets to specify and stock one power supply and also eliminate field system failures caused by the incorrect wiring of the power supply input). An onboard input line filter exceeds the requirements of VDE/FCC Class 'B' by an average margin of 10dB, virtually eliminating noise due to conducted emissions (and in many cases eliminating the need for an external line filter). Output ripple and noise is 1% maximum.

Other features include 0% minimum load on auxiliary outputs, indefinite short circuit protection, soft start, overvoltage protection and a hold-up time of 16ms. The minimum MTBF is 175,000 hours. The high maximum output current capability on selected models makes these units ideal for applications requiring transient load capability, such as disk drives and tape back up systems.

For more information circle 203 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham. 3191; phone (03) 521 0266.

Compact 30W switchers

Dewar Electronics has released its latest range of Skynet 30W switch-mode power supplies which suit diverse requirements such as terminals, industrial control, external floppy and hard disk drives. Voltages vary from 5 - 24V and are available in three rail, two rail and single rail versions. The SNP-288 series SMPS are type approved to the latest international safety standards, IEC950, UL1950, CSA950 and EN60950.

With dimensions of 130 x 70 x 30mm, three 30W flyback free running switching power supplies have overvoltage crowbar protection on the primary output and power foldback protection on all outputs. They sell for $50.18 in OEM quantities.

For further information contact Dewar Electronics, 32-34 Taylors Road, Croydon 3136; phone (03) 725 3333.

Multifunction DC bench supplies

Tektronix Australia has released two new bench power supplies, the PS280 and the PS283. Both are multifunctional portable DC power supplies for the laboratory, production test and education markets.

The PS280 and PS283 are regulated supplies, providing one fixed 5V/3A supply for powering logic circuits, and two variable outputs for a wide variety of test and experimental uses. Each contains two identical, independently adjustable DC power supplies that can be varied from 0-30V and 0-2A (PS280), and from 0-30V, 0-1A (PS283). Front panel red LEDs display volts and amps, along with switches to select one of the three modes of operation: independent, series or parallel.

For more information circle 202 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066.

Modular power system

Hewlett-Packard has introduced a mainframe-based modular power system that holds up to eight 150W, DC power-supply modules in just 18cm of rack space. Each power-supply module has the full functionality of a stand alone programmable power supply.

The new HP 66000A system requires one-fourth the rack space of HP's existing single-output, programmable power supplies with similar power. The small space requirement of the new system reduces the need for additional racks, thereby minimising costs and floorspace needs. Modules can be removed without the need to power down the system.

HP offers three models: the 8V, 128W DC module (HP66101A), the 20V, 150W DC module (HP66102A) and the 35V, 150W module (HP66103A).

The modules use a low noise switching design to achieve noise specifications of 5 to 10mV peak to peak, while still preserving normal switcher compactness and efficiency.

For more information ring Hewlett-Packard on 008 033 821.

150 watt DC/DC converter

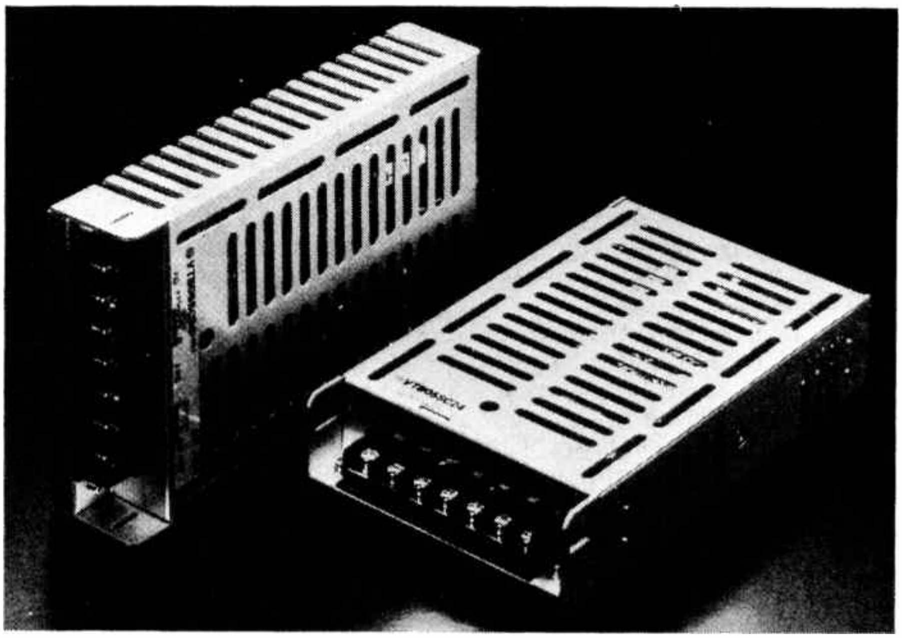
The range of ETA DC/DC converters now includes models rated at up to 150W, with nominal input voltages up to 110V DC. The converters are extremely reliable and are manufactured to meet UL standard specifications.

On the 110V model, the input voltage can be between 85V and 140V, positive or negative, and is a floating input. Outputs available are from 5V to 48V with output ripple and noise 1% plus 50mV $_{p-p}$ (DC to 100MHz).

The converters have an efficiency of 75% typically and transient recovery time of 0.5ms. Operating over a temperature range of 0 to 50°C, they include fold-back current limiting, over-current protection and zener limiting over-voltage protection.

Typical applications for the 110V DC models have been within the electrical generating industry and the railways, and for the 48V model, telecommunications equipment.

For more information circle 205 on the reader service coupon or contact Amtex Electronics, 13 Avon Road, North Ryde 2113; phone (02) 805 0844.



Wide range power modules

Powercube has introduced its new line of 75W 'X-tra wide series' modules. These are rugged, low profile switching regulators, providing fully isolated, efficient power conversion from an extremely wide DC input range of 6-60V. Single outputs are available in 5, 12, 15, 24 and 28V models.

With a 10:1 input voltage ratio, the modules meet MIL-STD 1275A 'cranking' specifications without auxiliary modules. Module components have been derated to meet or exceed NAVSO P-3641 guidelines.

For more information circle 206 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.

UPS for computers

LINX UPS models provide clean, uninterrupted power for computer-critical applications up to 3kVA. Modules are short-circuit protected and integral by-pass circuitry protects against overload. LINX UPS are also intelligent, providing optional remote and peripheral communications, as well as automatic battery testing during operation.

For larger UPS applications, SUPERLINX (36kVA to 12kVA), allows module exchange or maintenance to be undertaken online, ensuring no interruption to vital processing. Optional load shedding and RS232 communications are also available. All LINX and SUPERLINX systems, comprehensive lightning protection circuits are included to provide protection to 6kV, 3000A. In a recent electrical storm, the lightning impulses exceeded the LINX specification (3000A). The protection devices inside the UPS were destroyed, but they still protected the computers, and the two systems kept running with-out error. LINX and SUPERLINX are designed and manufactured by Maitec, and sold throughout Australia and the Pacific Rim.

For more information circle 207 on the reader service coupon or contact Maitec, PO Box 724, Castle Hill 2154; phone (02) 634 6211.

Upgraded ECL supply

The latest upgrade to the Burr-Brown PWR62XX series of DC/DC converters is a 5.2W regulated supply of -5.2V, suitable for ECL logic, high speed ADCs and other applications.

The input voltages available are from 5 to 48V DC, while the output current is 1A. The supply is isolated to 500V and encapsulated using a flexible encapulant, to ensure excellent thermal dissipation and superior reliability.

Input and output filters are incorporated, so external components are not required to obtain the performance as specified. Typical ripple and noise is only 25mV $_{p-p}$.

The use of surface mounted devices and improvements in the manufacturing process have enabled a low price to be maintained.

For more information circle 209 on the reader service coupon or contact Kenelec, 48 Henderson Road, Clayton 3168; phone (03) 560 1011. ■

Wideband amp

Continued from page 123

Power supply

The amplifier's self stabilizing DC characteristics mean that a fancy regulated power supply is not required, even for low level signal applications. A DC rail of 7.5V is generated by the power transformer TR1, a bridge rectifier and a simple adjustable zener diode stabilizer circuit (ZD1, Q1 and associated components).

Any remaining ripple and line voltage variation is smoothed by the dynamic filter R3-C6-Q2-C7. This is mainly for the benefit of the input source follower stage, as the common mode configuration of the amplifier will cancel any supply rail ripple.

The input mains voltage tolerance is greater than plus or minus 10%. (The 14.6V measured at the output of the bridge-rectifier was obtained with an AC mains voltage of 232V.)

Construction

Being a wideband device with considerable gain, the amplifier should be built in a fully shielded box using correct RF layout techniques.

This is especially necessary if the 1M input impedance facility is going to be used. In fact, the input connector, input selector switch and input FET circuitry should be placed in a separate shielded compartment, or be enclosed by a suitable earthed shield.

The combination of a high impedance input, wide bandwidth and considerable gain can be a formula for oscillation, unless the amplifier is properly constructed.

If the power transformer is mounted inside the box, the mains RFI filter capacitors C1 and C2 should be fitted.

The impedance of the mains wiring will then be kept low at radio frequencies, and the tendency of the amplifier's input stage to pick up any spurious mains-borne signals will be reduced.

For 'RF only' applications, it is desirable to limit the low frequency response by scaling down equally all the coupling capacitors in the amplifier (C10, C11, C12 and C16). For 'audio only' use, omit C13 and C14 at the emitters of Q5 and Q6.

Set-up

To line up the amplifier, short circuit the input to Q3, and adjust RV1, at the base of Q1, to give 7.5V at test point 1 (TP1) at the collector of Q2. Then adjust RV3 (connected to the base of Q5 via R14) to give 2.0V near the output terminal (TP2). To resolve a small amount of interaction, repeat the above two steps.

Finally, apply a sine wave signal to the input. By using a CRO or other instrument, adjust RV2 (connected to the base of Q5 va C12) until the output level is 1V p-p. Then adjust RV4 (at the 'output level' meter) to make the needle on M1 reads either centre-scale or 0VU, whichever is applicable.

If you wish to use the amplifier with a 10X CRO probe, it will be necessary to adjust CV1.

This capacitor, connected to the 'input selector' switch, can vary from 5-30pF. The probe is correctly adjusted for your CRO when a square wave response is obtained.

Now you can freely transfer the probe between the CRO and the amplifier, without having to make any further adjustments.

All resistors used in the circuit are 1/4W, 5% tolerance. All non-electrolytic capacitors are disc ceramic, with the exception of C10 at the gate of Q3 which is a polyester type.

The 'gain' adjusting resistor RV2 is a non-inductive, carbon potentiometer. ■

Memory cards: will they replace hard disks?

Plug-in ROM and SRAM memory modules the size of a credit card have been around for a couple of years, and have found limited use in portable computers, instrumentation and data logging. But Intel's recent development of the 'flash' memory chip has opened the way for memory cards to replace lower capacity hard disk drives.

by RORY O'CONNOR

Examine a few of the latest notebook and pen-based computers closely, and chances are you'll find something that looks more like a credit card than an array of computer memory chips. Proponents of these little cards, tucked into thin slots on the sides or bottom of an increasing number of 'mobile' computers, say the cards are more important than they may look.

Older versions of the memory cards, storing programs and data, have taken the place of floppy disk drives in some machines. And the new technology, called 'flash memory' cards, puts so much data on a single card that the cards are being offered as an alternative to hard disk drives.

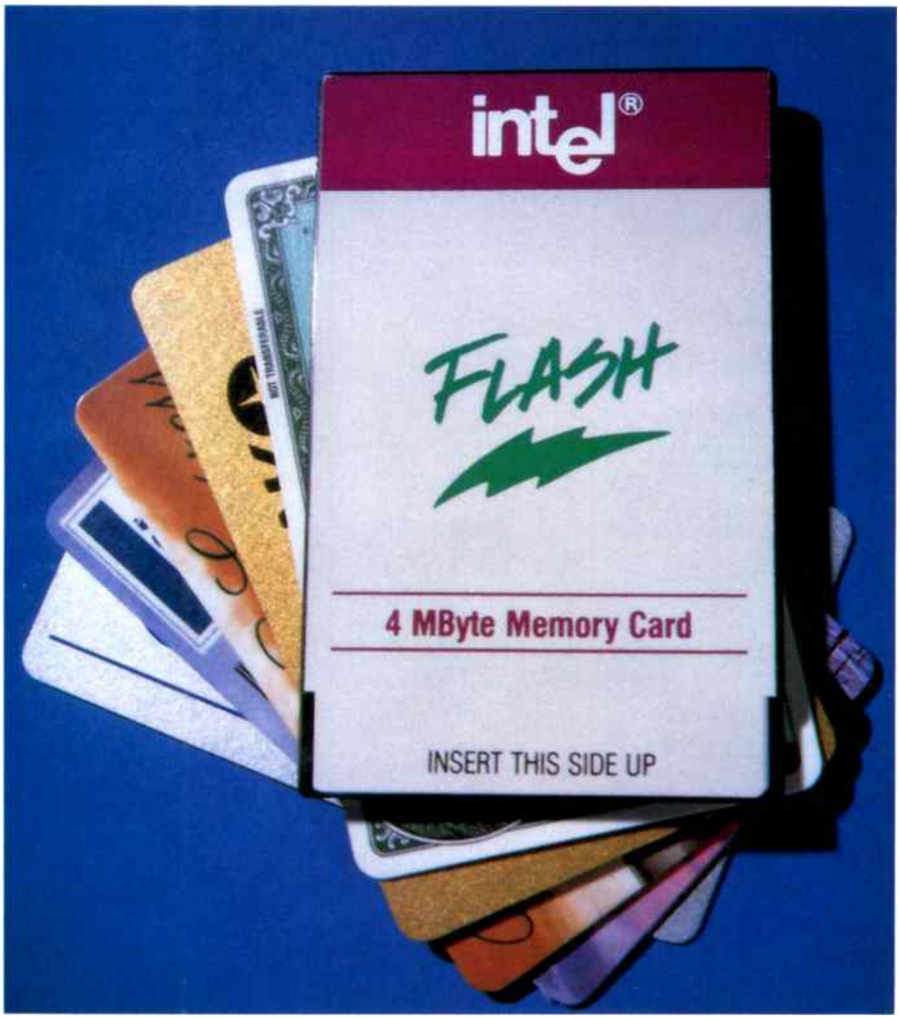
Boosters of the cards say they eventually could lead to a plethora of plug-in options for users, ranging from modems to cellular telephones to circuits that hook a mobile computer into a corporate computer network.

"In the next three years, this is going to have a great deal of impact on portable computers," says John Reimer, chairman of a computer and chip industry group that has developed standards for the card.

In mobile computers — a term coming to mean small notebook machines, pen-based computers and handheld or 'palmtop' devices — flash cards offer several advantages over hard disk drives.

For one, the cards, being a set of computer chips, require far less power to operate than disk drives, which have motors and other moving parts — a crucial factor to users who demand maximum battery life in a mobile machine.

The cards are also far lighter than disk drives, addressing another user demand that mobile comptuers weigh as little as possible. Their proponents add that flash cards are more reliable than disk drives in mobile computers because they won't 'crash' when they are thumped on a table or dropped by a delivery truck driver. And because they can be removed without losing their data, flash cards can let mobile computer users share programs and data or custom-configure a machine as needed.



First uses

The first memory cards began to appear about two years ago in mobile computers, notably the NEC UltraLite notebook and the Poqet palm-top computer, as a way to supply programs like Lotus 1-2-3 or increase the computer's main memory without opening its crowded interior.

But those cards have drawbacks. The data on the cards that typically supply programs — called ROM cards —can't be changed or expanded by the user. If a new version of the program is written, users have to get a new cards.

Intel's Flash Memory Card can store the same amount of information contained in a dozen standard 5.25" floppy disks, while occupying no more space than a common credit card. Using the Flash Memory Card will allow portable personal computers to weigh less, perform faster, and last longer.

SRAM expensive

Another type of card, called SRAM, can be changed by the user. But the cards must contain a small battery, similar to those used in watches and cameras, to provide the power they need to keep from 'forgetting' their contents. They also have limited capacities — two megabytes at most today — and they are expensive, with users paying as much as US$1400 each.

The 'flash' cards introduced last October by Intel get around both problems. Data can be changed by users, but the flash cards don't need a battery to remember data. And they cost about half what SRAM cards do per megabyte. What's more important to many manufacturers, though, is that flash cards offer more data storage than similar size SRAM cards.

Intel has begun selling 4MB flash cards, and even larger ones are expected within the next few months.

Grid Systems of Fremont, which now uses SRAM cards in its pen-based GridPad computers, will offer flash cards in a coming series of the portable machine, says product manager Kate Purmal. The reason? "Capacity," she says, even though flash memory is somewhat slower than SRAM.

Replacement for HDD's

While disk-drive makers are skeptical about the ability of the cards to replace hard drives, Intel insists that flash cards can capture plenty of the market.

"Pretty soon, nobody will make a 20 or 20-megabyte hard disk. The cards will eat into the diskdrive market from below," says Lou Hebert, Intel's product marketing manager for the devices.

For example, Sundisk of Santa Clara is planning to introduce a hard disk replacement based on flash memory that initially will come in 2, 5 and 10 megabyte capacity, with a 20 megabyte version in the planning stages.

"Our first production will be 100% compatible with a 2 x 2" hard disk," said Reimer, who is also Sundisk vice president of marketing.

The chief drawback to flash cards is not performance, but cost. Even though it is half the price of SRAM, flash memory is still too expensive for many applications.

Intel's four megabyte version costs US$650 in large quantities, Hebert says. But few if any companies have that kind of demand yet. Poqet Computer, one of the earliest to adopt memory cards for its handheld MS-DOS computer, charges customers US$1400 for a 4MB flash card.

"The product will be too expensive until they get some more things using them outside the PC industry, like cards or washing cmachnes," says William Lempesis, who publishes a Pleasanton newsletter on portable computers.

Standards adopted

An industry group is trying to hasten that day. The Personal Computer Memory Card International Association was formed by Databook, a Massachusetts company that makes memory card drives and the interface between the drives and the system.

The PCMCIA was formed at first to deal with a vexing problem: each manufacturer of memory cards had developed its own connectors and technical specifications for using the cards. The PCMCIA last year issued a single standard for the physical size of the cards, and decreed they should have a 68-pin connector — allowing all kinds of cards to be interchangeable.

Recently the group approved the second revision of the specification, allowing manufacturers to make communications modules and other peripherals on a card — or even combine memory and peripherals on a single card.

"Modems are the first thing people will do with the new specification," says Bill Densham, director of PC enhancements for Poqet. Next will come ruggedised disk replacements, he says. Others say network connections and even cellular telephones could be built into the cards, giving mobile computer users a wealth of options that can simply be plugged in when they're needed.

There are even more intriguing possibilities, Reimer says. Eastman Kodak and Polaroid are considering how to use the cards to capture images in electronic cameras, and then plug the cards into computers where the images could be used by insurance adjusters recording damage to a car or sales executives who want to display their wares. ■

Silicon Valley NEWSLETTER

Intel plans 100MIPS 586

Intel executives have cautioned a group of Wall Street analysts not to expect the company to be 'frozen out' of the future desktop computer market, just because IBM and Apple have signed a letter of intent to cooperate on a new PC that will run on an IBM-designed processor to be manufactured by Motorola.

Regardless of the outcome of that deal, or the success of the ACE alliance, Intel believes it will continue to be a microprocessor market leader. To secure that position and to minimise the effect of clone makers such as AMD, Intel has speeded up the timetable for bringing new processors to market.

Specifically, Intel executives said, the forthcoming top-of-the-line 80586 chip will go into volume production as early as the end of next year. And when it is introduced, the chip will operate at a blistering 100 million instructions per second (MIPS). At that speed, the 586 will be able to compete head on with any Sparc, MIPS, 88000, HP Precision Architecture processor, RS/6000, or any other RISC processor on the market.

Computer makers will be able to build next generation computers around the 586 that will be as capable as any new machine produced by Apple, IBM or ACE members.

Network Computing Devices of Mountain View, already the leading supplier of Xterminals, has just released a new model built around Motorola's 88100 RISC processor. The NCD 19C is the first RISC-based terminal to feature integral floating point processing capability allowing it to compete with powerful graphics based workstations, costing two or three times its US$6400.

Fujitsu rejects IC patent, TI sues

Fujitsu has become the first major Japanese semiconductor producer to refuse to recognise the patent that Japan's Patent Office granted Texas Instruments in 1990 for the invention of the basic integrated circuit. As a result, TI has filed a lawsuit against Fujitsu to enforce its patent. To date, four large Japanese chip makers have signed IC patent licence agreements with TI. Enforced to its fullest extent, TI will be able to receive royalty payments on every semiconductor produced in Japan, between now and 2001.

In the lawsuit filed in Tokyo, TI is asking the court to bar Fujitsu from selling all semiconductor products that infringe on TI's basic IC patent. In effect, that includes every chip Fujitsu makes.

At the earliest, it could take until the next Northern hemisphere summer before the case could be heard in court. In a worst case scenario, the court could order Fujitsu to suspend the manufacturing and sale of its entire semiconductor operation, and bar the firm from selling any computer, VCR, cameras, and other electronic equipment that contain Fujitsu components. Most likely it will never go that far. Even if TI wins, both companies would probably sign an court-of-court settlement.

A spokesman for Fujitsu America said his company is confident Fujitsu's products don't infringe on TI's patents because the patent covers only a very narrow technology.

Meanwhile, TI said it is trimming its worldwide workforce by 3200, mostly through early retirement incentive programs for which the company has set aside US$130 million. The one time charge was largely responsible for TS's $157 million quarterly loss.

IBM banks on X-rays for future DRAMs

IBM is taking the first step towards the conversion of the production process for its leading-edge DRAM memory chips from conventional light sources to X-ray lithography. Before the end of the year, the first chips produced with the revolutionary new machines are expected to roll off the production line. By the end of the decade, IBM hopes all of its memory chips will be produced by the X-ray technology it has been developing in a joint venture with Motorola.

The current IBM system is a huge 27-

ton colossus. Industry experts say the IBM technology may soon be eclipsed by efforts in Japan, which are focusing on building less complex and much less expensive systems that use X-ray laser beams. The IBM-Motorola project is the only one of its kind in the US. Earlier, Perkin-Elmer scrapped an X-ray lithography development project, and start-up Micronix in Silicon Valley was unable to find customers for its revolutionary system, which was developed in the mid-to-late 1980's. Micronix has since gone out of business.

Meanwhile, at least 10 X-ray lithography development projects are currently underway in Japan.

Computer industry in worst slump

From IBM on down, including such previous stellar performers like Apple Computer and Compaq — as well as Amdahl, Tandem, MIPS, Wang Unisys, Digital Equipment, and just about every other computer company — they're all suffering from what is shaping up as the worst slump to hit the computer industry.

Between Apple, DEC, Unisys and Wang, US$2.5 billion of red ink was spilled in the last three months alone. Earlier, IBM took a US$3 billion write-off to restructure itself. Unemployment in Silicon Valley has nearly doubled in the past year, from 3.4% to 6.5%.

Following years of prosperity, computer companies are scrambling to stem the flow of red ink, reduce expenses, cut their workforce, and take other measures to deal with a computer market that may not show signs of improvement for another six months, according to some analysts.

Although makers of larger computers such as Wang, Unisys, IBM and DEC have been struggling for several years to adopt the rapid changes taking place in the computer market, the slump is virtually a new phenomena to companies making desktop PC's and workstations.

The new realities are forcing companies to make significant changes in their operations, including the sell-off or closure of certain product lines, massive lay-offs, and speeding up the development of new products that are best suited for the markets of the 1990's. Whereas the 1980's were characterised by product generations that followed an evolutionary upgrade path, computer makers are gearing up for next generation products that offer radical depatures from existing formats and standards. The best example may be Apple's decision to drop long-time partner Motorola in favour of a computing architecture from arch rival IBM. IBM, by the same degree of unlikeliness, eagerly linked up with Apple in order to free itself from the bondage of Microsoft and Intel.

But to get out of their slump, cutting costs, automating production and reducing the workforce won't be enough. Analysts believe companies will have to change the way they sell computers. Already increasing numbers of customers buy computers from no-frills discount super computer stores, through toll-free '800' telephone services, and catalogs.

They must also make sure their products can be sold in open distributed network computing environments, large networks in which computers from a wide variety of vendors work and communicate together smoothly.

Trimble to build vehicle tracking system

Trimble Navigation, the Silicon Valley company whose portable 'Trimpack' global positioning systems became popular with soldiers in the Saudi Desert during Operation Desert Storm, announced it has linked up with Etak, a company that makes navigation positioning systems for automobiles and trucks.

Under the agreement Trimble will license Etak's technology, including map display technology and the disks that contain digitised versions of maps of every street in the United States. Trimble plans to combine its GPS technology with the Etak system to develop an advanced vehicle tracking and fleet management system for transportation firms.

Using the system, a delivery truck driver can call his GPS coordinates into his centrally located dispatcher.

After entering the coordinates into a graphics based workstation terminal that stores Etak's digitised maps, the dispatcher will be able to locate on the map, track its progress, or guide it to a certain destination. In the long run, Trimble said it hopes to build a dashboard system that would incorporate its GPS system and the Etak mapping and display technology so drivers will be able to locate their position on the streetmap.

Etak is owned by the conglomerate belonging to publisher Rupert Murdoch.

Toshiba to build drives in valley

Many companies design products in Silicon Valley and then manufacture them elsewhere. Toshiba has decided to do the opposite, in a move that could create 400 new jobs. The Japanese company's US arm has set up a research and manufacturing centre in San Jose that will build an advanced disk drive capable of storing one billion bytes of data in desktop-computer workstations.

Toshiba, which designed the drive in Irvine (Orange County), said that its new, 200,000 sq.foot plant will employ 100 people by the end of this year and four times that number by the end of 1994, when it will have the capacity to churn out up to 500,000 drives per year. The announcement contrasts with recent news of a wave of layoffs in the valley — notably the 1650 layoffs by Scotts Valley-based disk drive maker Seagate Technology.

Toshiba said it needs skilled disk drive engineers, who are in short supply in Irvine, and wants to be close to suppliers of key components and customers. "We believe that Silicon Valley is the centre of disk drive and other technology," said Frank Buckley, vice president and general manager of the disk products division of Toshiba America Information Systems.

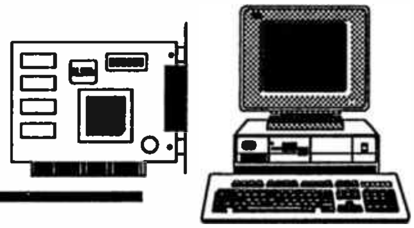
Sematech changes course

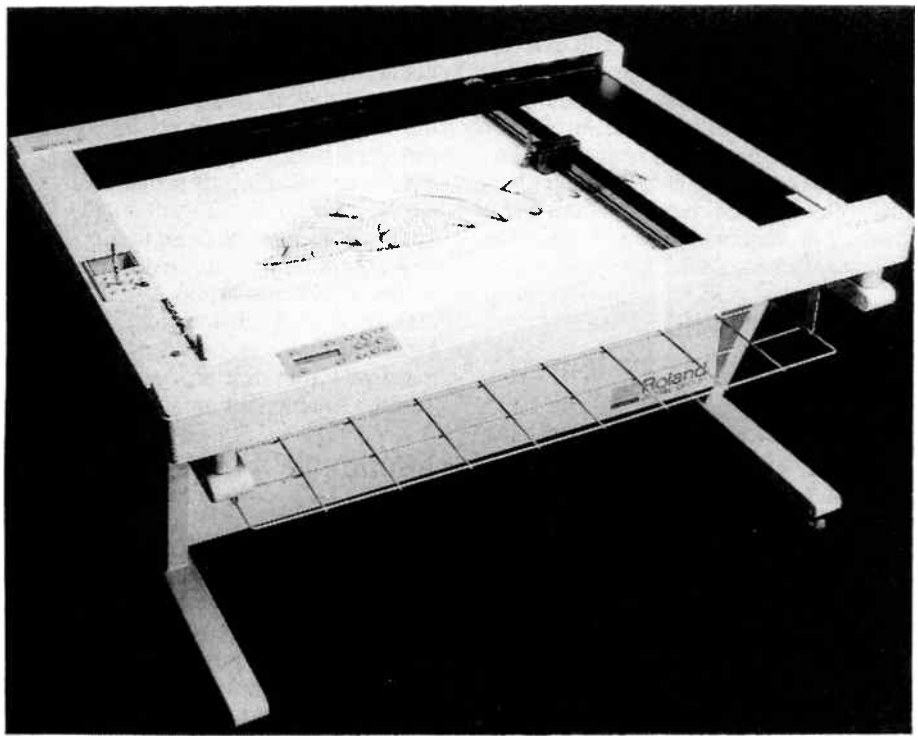
Sematech, the consortium founded four years ago, is trying to survive beyond its intended five year mission to help rebuild the sagging US semiconductor industry. Sematech officials have announced a new strategy to 'get more bang for the buck' and to keep the facility's doors open for several more years.

The high profile consortium, based in Austin, Texas, has decided to back away from its ambitious — but costly — goal of setting up a complete test factory that could produce samples of next generation memory chips. Instead, Sematech has decided to develop individual pieces of manufacturing equipment and software that could be used more flexibly to produce a wide variety of future microchips.

The change in direction was disclosed by Sematech chief executive officer William Spencer. If implemented it could have a significant impact on the consortium's ability to reverse the steady decline of the US semiconductor industry observers said. It may also influence the outcome for a major lobbying battle, as Sematech gears up to persuade the Pentagon and Congress to continue paying for the controversial venture after its initial five years of financing expires in 1993. The Defense Department through the research agency known as DARPA, contributes about US$100 million each year to Sematech, with an equal amount drawn from 14 US semiconductor makers. ■

Computer News and New Products





Flatbed plotter

Roland's new DPX-4600 completes its range of flatbed plotters, now available from A4 to A0.

The new A0 plotter is targetted for mapping, surveying, geographical, PCB design, civil engineering and complex mechanical engineering applications.

The flatbed design benefits include the ability to use virtually any size or type media, plus the capability to draw right to the edge of the paper without any risk of paper slippage or crimping.

Once the media has been set on the electrostatic pad, users can leave the plotter unsupervised whilst producing drawings without risk of distortion. The DPX plotter range has built-in intelligent software, including fully automatic communications, plot optimisation (i.e., full pen and vector sorting for fast drawing processing), automatic pen and pencil recognition, plus automatic speed and pressure setting. Added to the plotter 650mm per second speed is a 3.1 micro resolution.

For more information, circle 161 on the reader services coupon, or contact Roland Digital Group, 233 Burwood Road, Hawthorn 3122; phone (03) 818 0633.

Video printer

Hitachi's latest video printer, the VY150E, can be coupled to a VGA to PAL card, giving the printer direct connectivity to an IBM or compatible computer. Anything on the PC screen can now become a 110 x 75 glossy print, making photorealistic artwork and graphic design accessible to the IBM computer artist.

The printer can also be coupled directly to any video source such as a VCR, video camera, TV or still video camera. Its onboard frame grabber will capture a single frame simply by pressing a button, producing a near photographic quality print within 100 seconds, without interfering with the viewing of the TV or VCR, or the operation of the camera.

The VY150E retails at $2980.

For further information circle 162 on the reader services coupon or contact Lako Vision, 1/45 Wellington Street, Windsor 3181; phone (03) 525 2788.

Line driver extends RS-232C

A new line driver from Datacom Technologies of USA provides a simple solution for users wishing to extend the distance between RS232C devices.

Constructed on the back of a standard DB25 plug or socket, and self-powered by using voltage levels normally provided by the interface, maximum driving distance can be extended to 16km at 1200 baud, and 5.5km at 19,200 baud. Installation is further simplified with the use of RJ11 connectors, and 4-wire unshielded twisted-pair telephone type cable. Model 30 mini line drivers have been extensively used in completing the Tuggeranong LAN implementation Project, for the Dept of Social Securities new facility at Tuggeranong in ACT. With many of the printers in the Token Ring Network located up to 100 metres from the nodes, the Model 30 has provided a reliable, low cost means of extended distance data transmission.

For more information circle 163 on the reader services coupon or contact Elmeasco Instruments, PO Box 30, Concord 2137; phone (02) 736 2888.

Low cost 600 x 600 laser resolution

The Truepoint laser controller card is a high resolution laser device which allows improved quality for desktop publishing. Combining the Truepoint board with, for example, a Canon SX or LX laser printer engine, can give true 600 x 600 dots per inch printing for under $6000.

The board actually addresses 360,000 dots per square inch — it does not just offer a vertical 'adjustment' of pixel size.

The Truepoint controller is a full size card with an onboard Intel 80960 16MHz RISC processor, and the memory to build a full page.

The printer I/O card contains a full function video and parallel port to control the printer and use high speed video printing on the fastest PostScript-compatible printer available.

Duo-compatibility allows the printer to be used with either Truepoint, or in its native mode to retain normal printer operations.

Complete compatibility is offered for all PostScript appliations, including the transportation of EPS files.

Truepoint is simple to install and use — it simply sets itself up as the next available printer port, and so is available to the network if installed in a server. It offers full Windows 3.0 compatibility.

The Truepoint controller, cable and software retail for $3600.

For more information circle 166 on the reader services coupon, or contact

TI RISC microLasers

Texas Instruments has announced two additions to its microLaser printer family, the nine page-per-minute (ppm) microLaser Turbo and the 16ppm microLaser XL Turbo. Based on RISC technology, both produce dramatic improvements in performance, producing images up to six times faster than standard 68000 processor-based printers.

Enhancements to the new models include intelligent switching between interfaces and emulations without requiring user intervention, and also PostScript Level 2 from Adobe, giving users access to the newest version of the industry-standard page description language.

Both new microLasers ship with 35 PostScript fonts and PCL4 emulation, giving users the benefit of both PostScript and HP LaserJet Series II compatibility. Each include drivers for Windows and Macintosh environments.

The microLaser Turbos also offer concurrently active communications, which allows them to communicate to Macintosh, OS/2, UNIX R or MS R-DOS systems at the same time using the standard parallel, and the optional RS232,RS422 or AppleTalk interfaces without user intervention.

To provide optimum throughput, the printers feature a dual processor design, with a 16MHz Weitek PXL8220 RISC processor on a PostScript processor board and a Motorola 68000 processor on the main controller board.

For more information about the printers, including a simple upgrade for existing microLaser users, circle 165 on the reader services coupon, or contact Texas Instruments, 6 Talavera Road, North Ryde 2113; phone (02) 878 9000.

COMPUTER NEWS

Stonehenge Enterprises, PO Box 496, Drummoyne 2047; phone (02) 719 8080.

Compact industrial PC

The Siemens SICOMP PC32-M is a new industrial PC in a compact sealed design which can be easily built into controls, automated manufacturing machinery, test and measurement equipment and diagnostics systems. Heat is distributed evenly throughout the casing interior by an internal fan and dissipates by natural convection and conduction through the casing walls.

The SICOMP PC32-M system unit consists of a strong anthracite-coloured casing made of aluminium, with a 58W power supply, a backplane with a slot for the CPU board and two free AT slots for expansion boards. The entire RAM is located on the CPU board, along with the VGA video controller. The casing can accommodate a 3.5" floppy disk drive and a 30 or 60MB hard disk drive.

The new industrial PC is 81 x 200 x 398mm (W x H x D) and weighs in at around a mere 6kg. With the use of slot CPU boards and the 80286 12MHz 80386SX 16MHz, 80386 25/33MHz and 80486 25/33MHz processors, the SICOMP industrial PC provides users with CPU power to suit their needs.

For more information circle 167 on the reader service coupon or contact Siemens Industrial Automation, 544 Church St, Richmond 3121; phone (03) 420 7218.

PC-driven synthesisers

Capable of ultra-wide frequency synthesis, the FSC-30 and 50 are half length cards for any PC-XT/AT/386 which provide up to two independent TTL level programmable square wave generators, at low cost.

Both models come with one or two independent synthesisers per card, with each channel crystal controlled for excellent stability. An optional external reference input is also available, with the reference source then being jumper selectable between external or onboard frequency source. The FSC-30 has a range of 0.024Hz to 30MHz, while the FSC-50 has a range of 2.98Hz to 50MHz, with resolution for both being 27,000 steps per decade. The cards have three switchable addresses, for multiple card use, and are connected via 50-ohm coax with BNC connectors.

For more information, circle 164 on the reader services coupon or contact Boston Technology, PO Box 415, Milsons Point 2061; phone (02) 955 4765.

Inhouse multiplexers

General Technology has released a range of line driver/multiplexer equipment, designed and manufactured at its premises in Pymble, NSW.

The range of 'Maximux' inhouse multiplexers is designed to provide a low cost solution for short haul asynchronous data communications. The Maximux is conveniently packaged in eight channel, four channel and four + four channel arrangements. The Maximux communicates over standard twisted pair telephone cable, at distances up to 2km, with each channel capable of supporting asynchronous full duplex data at rates up to 19,200bps. Each channel also supports two bidirectional end-to-end control signals. By using a simple user-configurable strapping arrangement on each channel, the control signals may be forced true, wrapped locally or propagated to the opposite end.

For more information circle 168 on the reader services coupon or contact General Technology, PO Box 18, Pymble 2073; phone (02) 498 2066.

2048 x 2048 display in 24-bit colour

Primagraphics has configured three Vanguard display controllers to provide true colour at ultra-high screen resolution: 24-bit colour at a screen resolution of 2048 x 2048. The configuration will open up new possibilities in simulation and training, radar and sonar, printing and medical applications. Each Vanguard is a double Eurocard VME-based ultra-high resolution 8-bit frame store, with colour video output and a fill speed of 480M pixels per second. Two Vanguards may be combined to provide 16-bit images. This feature is useful for applications in which an overlay is required, or to minimise storage requirements for colour images. Each Vanguard can drive one, two or three independent monochrome screens, or as described above, display up to 256 colours from a palette or 16 million colours.

For more information circle 169 on the reader service coupon or contact the Dindima Group, PO Box 106, Vermont 3133; phone (03) 873 4455.

Optical modem

A new optical modem from Shimadzu Corporation is directly plug-compatible with a standard RS232C installation, but offers the benefits of fibre-optic transmission.

The HK-3310 which conforms to the EIA RS232C specification, permits signals to be transmitted up to a distance of 1km. Because the transmission cable is polymer-clad fibre, the signals being transmitted are not subject to electromagnetic or radio frequency interference. The modem supports a full duplex transmitting system, with a bit rate of 64kbps maximum asynchronised and 19.2kbps maximum for a synchronised system. The bit error rate is less than 10^{-9}.

For more information circle 171 on the reader service coupon or contact Anitech, 52/2 Railway Parade, Lidcombe 2141; phone (02) 749 1244. ■

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						•	
Geoff Wood Electronics	NSW	•	•	•	•	•	•	
Jaycar Electronics	Eastern	•	•	•	•	•	•	•
RCS Radio	NSW			•				
Rod Irving Electronics	VIC	•	•	•	•	•	•	•
Scientific Devices	VIC						•	
Sheridan Electronics	VIC		•	•	•	•		
Tandy Electronics	ALL		•		•	•	•	•
Wagner Electronics	NSW		•		•	•	•	

KEY TO CODING
A. Kits and modules
B. Tools
C. PC boards and supplies
D. Components
E. IC chips and semiconductors
F. Test and measuring instruments
G. Reference Books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

"Electronics Australia" provides the following services:

SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Co, PO Box 199, Alexandria 2015; phone (02) 693 6666.

BACK ISSUES: Available only until stocks are exhausted. Price $5.00.

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.

ADDRESS: Send all correspondence to The Secretary, 'Electronics Australia', PO Box 199, Alexandria, NSW 2015.

Please note that we are unable to supply back issues, photocopies or PCB artwork over the counter.

Name:..

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....................................Postcode:..................

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....

Photostat Copies:..

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No. of issues required:....x$5.00 = ...

No.of copies required:......x$5.00 = ...

No.of copies required:...x$10.00 = ...

TOTAL PAYMENT ENCLOSED = ...

Signature:..
(Unsigned orders cannot be accepted).

METHOD OF PAYMENT: (Please circlecorrect method).

Cheque   Money order   Credit Card: Mastercard / Visa   American Express / Bankcard

Expiry Date:..

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ADVERTISING INDEX

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SOLAR PANELS

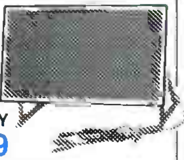
AT SUPER LOW PRICES

BRAND NEW, AMORPHOUS SILICON SOLAR PANELS, CONSTRUCTED ON IMPACT RESISTANT GLASS

10 WATT-12 VOLT SOLAR PANEL

For the more serious cost effective applications. This one will almost fully charge a fully discharged 12V-6.5AH get cell in one day! Minimum charging current into a 12V battery. 700mA. Voc: 16V (max) 20V.
DIMENSIONS: 300mm X 900mm.
Order Solar Panel: SP3
ONLY $99
DELIVERY BY SKYROAD EXPRESS

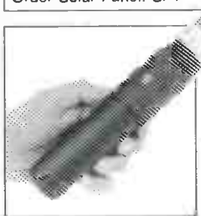
2 WATT 12V SOLAR PANEL



Can charge 0-12V batteries at approx. 150mA. More than adequate for maintaining 12V batteries in cars and boats, or charging batteries in portable appliances.
DIMENSIONS: 150mm X 300mm
Order Solar Panel: SP2
ONLY $29
DELIVERY BY SKYROAD EXPRESS

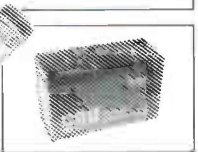
1 WATT 6V SOLAR PANEL

Experimental delight! One of these panels will fully charge a 6V-500mA HR nicad battery pack in about 4 hours! You can also connect as many of these panels in series or parallel to produce the voltage and current required.
DIMENSIONS: 200mm X 200mm
Voc: 8V (max) 10V
Isc: 250mA (max) 300mA
Order Solar Panel: SP1
ONLY $12 $3 P&P



VISIBLE LASER DIODE PIONTER AT A SPECIAL PRICE

Based on a "state of the art" 3mW visible re laser diode, and a matching heatsink/collimator assembly. The circuit even has provision for digital switching. Use them for pointers, sights, communications, security, etc. This kit includes the laser diode, collimator, PCB and components, and all the casing. Everything you need to make a complete pointer! PRICE IS REDUCED BY OVER 20%!
$179 + $5 Cert P&P



NEED A BATTERY TO CHARGE WITH YOUR PANEL?

How about our BARGAIN PRICED brand new, industrial grade, 6.5AH sealed GEL batteries, at a fraction of their real value. Yes, 6.5 AMPERE HOURS! Use them in alarms, communications equipment, HE-NE laser power supplies, lighting, solar powered systems, etc. Excellent low temperature performance: 90% of full capacity at 0 deg C! Limited stock at
ONLY $34 Ea.
DIMENSIONS: 150 X 95 X 65mm. Weight of one battery is 2.54kg.

LASERS are not for kids: DANGER

ANY OR AS MANY ITEMS DELIVERED BY SKYROAD EXPRESS TO YOUR DOOR: $10

OATLEY ELECTRONICS
PO BOX 89, OATLEY, NSW 2223
Telephone: (02) 579 4985
Fax: (02) 570 7910

SPOT A BARGAIN

VISIBLE LASER DIODE HEAD

A small 3mW 670nM visible laser diode head. Just connect it to a battery via a switch. Produces a well collimated beam. You could pay three times our price for a laser pointer or gun sight that uses a similar head
$199

MAINS SWITCHES

Stock up on these modern, high quality, plastic panel mounting mains rated switches, at a fraction of their real prices:
Large 3A, with green rocker and black body $1.20 ea. or
10 for $7
Large 15A, with black rocker and a black body $1.50 ea. or
10 for $10
Small 4A illuminated type, with a red rocker and black body $1.50 ea. or
10 for $10

INFRA RED LASER DIODES

Brand new 5mW 780nM - 820nM IR Laser diodes. Visible in low light. Some data/application circuits provided. A suitable driver circuit and the components for this circuit are included. Excellent for IR sights, data links, high quality audio links, security perimeter protection, laser "bugs", etc.
$30
Need a collimating lens and a heatsink to suit?
$20

12V OPERATED GAS LASER BARGAIN

A used but guaranteed 1mW He-Ne tube, and our reliable 12V UNIVERSAL LASER POWER SUPPLY KIT. The supply and the tube fit into inexpensive 50mm SWV plastic tubing. One tube and one supply for $99. And if you want to add an extra tube to the bargain, just add an extra $25. Yes, two tubes and one supply for a total of
$124!
Need mains operation? We can provide a similar package with the same tubes, and a small professional, fully potted, 240V laser power supply. RING.

MAINS FILTERS

A complete mains filter employing two inductors and three capacitors fitted in a metal shielded IEC socket. We include a 40 joule varistor with each filter!
$8.90 ea.
or 10 for $65

INFRA RED NIGHT VIEWER

Not a complete kit but just the absolute essentials. A new 6032 IR tube and a ready made power supply. You get the tube, the supply, a circuit and basic instructions.
$150

ARGON LASER TUBE

A used but guaranteed Argon laser tube with. It needs forced air cooling, 3V at 25A for the filament, 400V trigger voltage, and 90 to 100V across it, at about 8A to run. All this to produce minimum output of 30mW, of BLUE BEAM! For the more serious laser enthusiasts! We should have suggested power supply circuits.
$800

VISIBLE LASER DIODE BARGAIN

We supply a used and guaranteed 3mW, 670nM visible laser diode, a heatsink, a collimator, a simple constant current driver circuit and components to suit. A little effort is required to mount and adjust the collimator, but look at the price
$94

SOME UNUSUAL COMPONENTS

Hall Effect ICs $2 ea or
10 for $15
1000 pF 15KV Capacitors $12 ea or
5 for $45
11KV Diodes $1.50 ea or
10 for $10
TV Triplers $12 ea or
5 for $50
15KV EHT Power Supply (used) $45 or
3 for $100
Photo Multiplier Tubes
$90
Broken Silicon Solar Cells. Enough for 6V @ 1.5W
$9

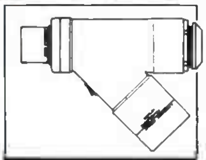
Some of the above items are in LIMITED SUPPLY
ANY OR AS MANY ITEMS FROM THIS LIST DELIVERED BY SKYROAD EXPRESS TO YOUR DOOR: $10

OATLEY ELECTRONICS
PO BOX 89, OATLEY, NSW 2223
Telephone: (02) 579 4985
Fax: (02) 570 7910
Certified p&p $6 in Aust NZ (Airmail) $10

Melbourne Distributor: Electronics World
(03) 723 3860 or (03) 723 3094

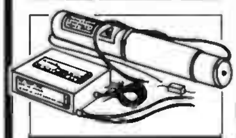
OATLEY ELECTRONICS

FOR No.1 KITS



INFRA RED NIGHT VIEWER

A very small complete kit • Includes both an adjustable lens and an eyepiece • The matching tubes, lenses and eyepieces were removed from new German night vision equipment • Simple construction: Instructions provided • For a limited time only the kit is supplied with a high quality military inverter: Draws only 25mA from the 9V battery • IR illumination is required in the dark, and good ranges are possible with just medium powered focussable torches, fitted with an IR filter • You would normally pay over $3000 for a view like this!
DON'T MISS OUT!
ONLY $329
Includes the IR tube, lens eyepiece, electronics kit and the case kit: KIT No. IRNW5. 75mm round IR plastic filter: $16



2mW PHILIPS LASER HEAD WITH 240V POWER SUPPLY

Uses a brand new visible red He-NE LASER HEAD Encapsulated He-Ne tube • Very tight beam (0.95mR): More suitable for most applications • Head dimensions: 37mm diameter by 260mm long • Supplied with a very small professional 240V power supply, that even has a TTL interlock: Needs 3-5V @ approx 3mA, across two isolated terminals to switch the laser on: Opto isolator built into the supply • Use it for surveying, science experiments, laser displays, holography, etc. • Priced at about 1/3 of the expected price and ONLY WHILE STOCKS LAST AT:
$210 FOR THE PAIR!
2mW PHILIPS head, the commercial power supply, warning labels, ballast resistor and the instructions: KIT No. LK14.

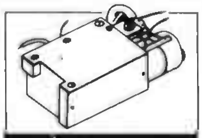
VISIBLE LASER DIODE

Similar story to the IR diode but this one is very visible: 3mW @ 670nM ONLY $169
For a 3mW visible laser diode, collimator/heatsink assembly, a suitable driver/digital switch kit and the instructions.

LASERS are not for kids: DANGER

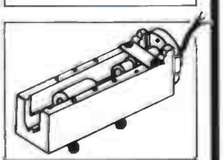
2mW PHILIPS LASER HEAD WITH A 12V POWER SUPPLY

Same head as the LK14, but this unit is supplied with our newest 12V laser inverter kit, which will power most laser tubes • The supply is easy to construct and comes with a totally prewound transformer, and simple instructions • The switched mode power supply with MOSFET output is very efficient and a guaranteed design • THE INCREDIBLE PRICE?
$175 FOR THE PAIR
2mW PHILIPS head, 12V supply kit, warning labels, ballast resistor and the instructions: KIT No. LK13



EXPERIMENTAL E.H.T. POWER SUPPLY

Can produce sparks about 1cm long, whilst drawing approximately 35mA from a small 9V battery! • Great for many high voltage experiments • 3-16V operation and very low power consumption • E.H.T. voltage output depends on OC supply voltage: Approx 16KV output with 14V supply • As a bonus, this unit will power all the IR tubes! Ask about some unusual and well priced tubes we will have in stock • Professional unit with a sealed voltage multiplier section • Circuit provided • Approximate dimensions: 105 X 56 X 37mm.
ONLY $39
For E.H.T. power supply and the circuit/instructions.



IR LASER DIODE

A 5mW/780nM laser diode mounted in a precision made adjustable collimator assembly • Removed from new and near new equipment • Very tight beam and is just visible to humans in a darkened room • Requires only a constant current source to operate: Approx 80mA/2V • Use it for communications, security, medical research, scientific experiments, invisible laser pointer: Very visible to an IR Night Viewer! • Suitable low voltage driver/digital kit is included in our SPECIAL INTRODUCTORY PRICE:
ONLY $89
For the collimated assembly illustrated, and a suitable experimental driver/digital switch kit and the instructions.

OATLEY ELECTRONICS
PO BOX 89, OATLEY, NSW 2223
Telephone: (02) 579 4985
Fax: (02) 570 7910
Certified p&p: $6 in Aust. NZ (Airmail): $10

Melbourne Distributor: Electronics World
(03) 723 3860 or (03) 723 3094

READER INFO NO. 32

Adilam Electronics

The Component Specialists

Short Form Catalogue

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SYDNEY
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191 Ramsgate Road,
Sans Souci 2219
Telephone: (02) 529 2277
Facsimile: (02) 529 5893

READER INFO NO. 33

● Capacitors ● Connectors ● Fans ● Filters ● Headers ● LEDs ● Plugs ● Rectifiers ● Relays
Resistors ● SCRs ● Triacs ● Sockets ● Swtiches ● Terminal Blocks ● Varistors