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AUSTRALIAN ELECTRONICS Monthly

Elektor Electronics

WELL, THAT WAS 1986! For us, it was a year of surprises, our 1st birthday, prizes (our 1st birthday contests) and lots of hard work!

It has been a tough year for electronics retailers, consumer electronics firms and electronics importers, but the times have been kinder to quite a few local manufacturers, according to a report from the Australian Electronics Industry Association, covered in our News Review lead item on page 6, this month. Export opportunities have not been lost on local manufacturers who have chalked up successes with products such as traffic lights (AWA), digital ionospheric sounders (KEL Aerospace), and FM station antennas and systems (Antenna Engineering), to name some good examples.

Mr Terry Kelly, Managing Director of KEL Aerospace, said recently, "It is essential that a greater and more realistic importance be attached to government procurement of high technology goods and services from Australia's smaller indigenous companies that are bound to be tomorrow's exporters". Hear, hear.

According to the CSIRO Office of Space Science and Applications (COSSA), for much of the electronics industry the future is looking up — literally! There are many developing business opportunities in space science and engineering it seems, in both local and export markets. And this is despite the loss of NASA's space shuttle Challenger last January and several losses of several European Space Agency's Araine launchers, setting back many satellite launch programs.

Some Australian companies have already tapped the burgeoning space hardware and software market. AUSSAT has certainly opened up some opportunities in our domestic market which companies large and small are taking advantage of. But it doesn't stop there. Remote sensing from satellites is an area in which Australia has considerable expertise, the technology for which will become of increasing interest as applications expand around the world.

In space applications and technology, in end-user expertise and space-related R&D, this country is in a strong position to exploit opportunities. Let us not fumble the ball now.

To finish, all of us here at AEM wish you, our readers and advertisers, the best of the season. May you prosper in 1987.

Roger Harrison
Editor

Roger

EDITOR Roger Harrison VK2ZTB

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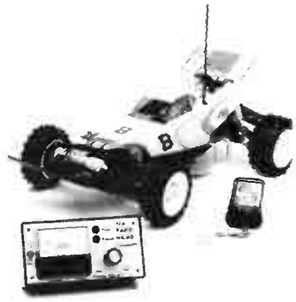
COVER

RC models are popular Christmas gifts and our feature project this month keeps their batteries charged, ready for action! The Porsche, just one from their vast range, is from Dick Smith Electronics. The Boomerang is courtesy Bruce Routley of Jaycar. Pic, Mark Rowland. Design Val Harrison.

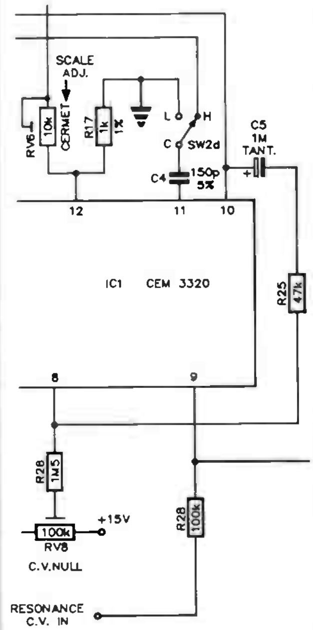
PROJECTS TO BUILD



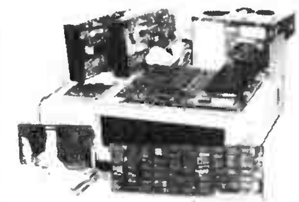
CIRCUITS & TECHNICAL

ELEKTOR IN AEM

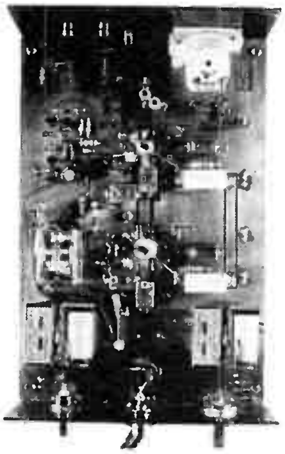
Pages 33-66



PRACTICAL COMPUTING



COMMUNICATIONS SCENE



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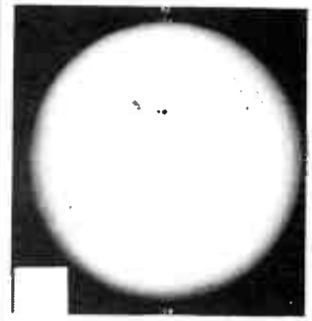
NEWS & GENERAL

NEXT MONTH!



KISS THE LAST OF THE BIG SOLAR MAXIMA GOODBYE!
If you've been an amateur or shortwave DXer over the past decase or two, then say goodbye to the last of the big solar maxima — it's just gone! In this feature, Leo McNamara and Roger Harrison VK2ZTB take a look at sunspots, their history and recent work on predicting future solar maxima.

BUILD OUR 'WORKHOUSE' POWER AMP MODULE
Here's a robust, easy to build amplifier module that delivers a healthy 50 W into 8 ohms or 100 W into 4 ohms, has less than 0.05% THD at rated output and features electronic protection that makes it virtually 'unstuffable'. Great for low-cost stereo power amps, guitar amps and public address systems.

DIGITAL DATA/LOGIC PROBE
Servicing microprocessor and other complex digital hardware can be extremely difficult with a standard logic probe. Often, it's important to know whether pulses arrive in the correct sequence and at the correct time to operate a peripheral device. The ability to obtain the status of any data or address bit at a precise instant is another necessity. This project goes a long way to meet the above criteria.

RF MILLIVOLTMETER
If you're into RF, then this project's assential for your workbench. It covers the range right through the UHF and reads down to 500 uV. Construction is straightforward and the price is way under comparable commercial units.

While these articles are currently being prepared for publication, unforseen circumstances may affect the final contents of the issue.

Electronics leads export battle

According to the Australian Electronics Industry Association (AEIA), this country's telecommunications and electronics industry is making a major export push on world markets and the current $50 million level of exports is projected to soar to $600 million in the next decade.

Professor Graham Hellestrand of the Joint Microelectronics Research Centre at the University of NSW says that electronics is ". . . currently the only industry which can have a significant effect upon the economic fortunes of Australia during the next 20 years.

Both large and small companies are leading the export drive, selling a broad product range from sophisticated antennas and mobile radio units to complex telecommunications and defence equipment.

Philips has chalked up millions of dollars of export earnings in recent years with sales of radiocommunications equipment including microprocessor controlled radios and subscriber radiotelephone links. Some 25% of the radio telephone equipment it manufactures here is exported, mostly to S.E. Asia and China.

Kel Aerospace from Sydney recently won a contract with the Canadian government worth A$700 000 for the supply of a network of unmanned digital ionospheric radars. KEL Aerospace won a federal Government Export Award in 1985 for its successes in selling Australian radar hardware and software to more than 20 countries around the world.

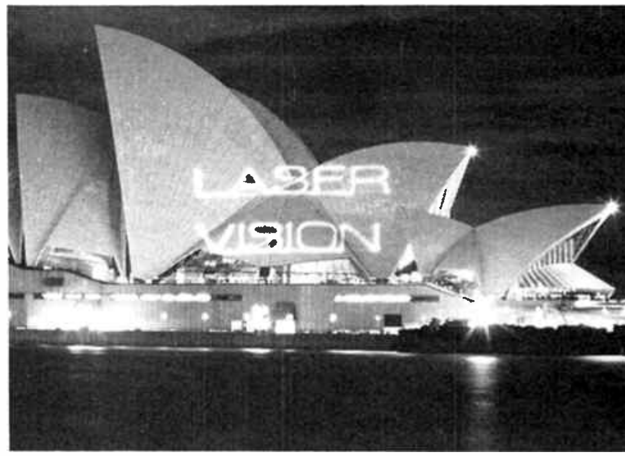
It seems the industry is gaining something of a toehold in China, judging from the Australian companies exporting product to there.

AWA is doing good business with its traffic controllers in China, while Printronics (the pc board manufacturers) recently signed a $10 million export contract with that country for ongoing sales of technology in printed circuit boards. A digital radio concentrator system developed here for Telecom by NEC (Aust.) has found buyers in China as well as around the world.

Closer to home, Antenna Engineering has supplied just about every FM station in New Zealand with equipment, including antennas, combiners and switch frames, in the past 18 months and they are also exporting to the rest of the Pacific Basin, Asia and the Middle East.

The AEIA believes the industry is still only scratching the surface of potentially huge export sales. In a report compiled for the Department of Industry, Trade and Commerce recently, the Association pinpointed these potential export growth areas: — communications equipment and systems for rural and remote areas — small satellite ground stations on the 12/14 GHz band — submarine fibre-optic systems — HF radio systems, and — specialist business communications systems.

The AEIA believes that by concentrating on these areas, the industry can double its export sales within three years. The Association claims that the industry , through them, is now working closely with Austrade and other Federal Government departments to build strong and lucrative long-term export markets.



PROJECTING AN IMAGE

The Australian company, Laser Vision (Aust.)Pty Ltd, has launched a "real time laser beam projection system" that can 'write' words and still or animated images with laser beams on almost anything, anywhere, any size, the company claims. Dubbed the laser Writer, it can write on clouds, mountain sides, boats or buildings, to name but a few of the possibilities.

International patents are held on the computer controlled system which features an in-built animation facility. Given only the first and last frame of an animation sequence, the laser system's controller can provide an infinite number of intermediate images to provide smooth animation, says Laser Vision, and this can be achieved by an operator after just a few hours training.

Images can be zoomed in and out, moved around the display location or interrupted with a 'fresh' message. The operator can 'cut' from one image to another, 'melt' one image into another or adjust the size, slope, angle, position and speed of text display. Also, the system provides the ability to display a number of different text messages at different locations from one controller.

The company sees it as a unique promotional and advertising medium with advantages over existing static promotional displays. Full details from **Laser Vision, 50 Carters Rd, Dural 2158 NSW. (02) 651 1166.**

High-tech view of 'inner-space'

A New Zealand company plans to open the world's first "opto-electronic micrarium" next month, giving visitors to this 'museum/zoo of the microscopic world' a view of those things and creatures that cannot be viewed by the unaided eye.

"Nine-tenths of the world is microscopic and for most people, has never before been seen or experienced. Our aim is to make this first experience as exciting and memorable as possible", says Dr Lannes Johnson, one of the directors of the company.

The world's only other micrarium, opened in Buxton, England in 1981, employs projection techniques. The New Zealand micrarium will employ new opto-electronic technology devised and patented around the globe by two New Zealanders. It will provide improved quality of the magnified images allowing viewers, for the first time the company says, to participate in the inspection of live displays using video-microscopic scanning equipment.

The micrarium will be located in central Auckland, housed in a NZ$3 million complex which will be an entertainment, educational and tourist attraction, the company — Microworld of Inner Space — says.

The topics covered will include the spectrum of marine life, medical and dental, forensic, industrial and electronic displays, zoology and botany, chemistry, plus geology and gemstones with viewing consoles arranged in themes.

New Zealand distributor for T.I.

Channel Master, claimed to be one of the fastest growing components dealers in New Zealand, will now handle all Texas Instruments Semiconductors in New Zealand.

T.I. believe the NZ/Pacific area is one of the most dynamic growth markets for semis as they are being designed into a host of locally manufactured products. The NZ market alone was worth NZ$42 million last year.

Channel Master's T.I. semis range will include CMOS and LSI products, power products, linear and interface devices, DRAMs and EPROMs, 8/16/32-bit processor chip sets and digital signal processors.

Data sheets

Dear Sir,

I am writing concerning the data sheet on the MC6850 ACIA that appeared in your May 1986 issue. Firstly, I would like to commend you on the printing of these data sheets. Quite often, the reader is deprived of the information in magazines, but not in yours.

I am certainly glad I bought that issue of your magazine, I had been searching about for a serial communications device that would run at least 32K baud and, bingo!, your magazine has a data sheet on the MC6850 that runs up to 1M baud. I am now looking for further data on the MC6850 ACIA and was hoping you could refer me to the suppliers of this information.

Also, do you have the address of the electronics division of Hitachi?

Your help is greatly appreciated.

Craig Tollis,
Port Macquarie, NSW

Thank you for your appreciative comments. We're glad to know our Data Sheets provide a useful service. As seen from the data sheet on page 91 of the May issue, the data comes from Motorola. VSI Electronics in Sydney are Motorola semiconductor distributors. The MC6850 data is included in their "8-Bit Microprocessor & Peripherals Data" book. For a copy, you might try Jaycar at 115 Parramatta Rd, Concord 2137, (02) 745 3077, or Geoff Wood Electronics, 229 Burns Bay Rd, Lane Cove 2066, (02) 427 1676. The French-based multinational, Thomson-CSF, second-sources the 6850 as the EF6850. Promark Electronics are the distributors; you might try them for the Thomson-CSF data book "Microprocessors & Peripherals", at (02) 439 6477.

Hitachi semiconductors are represented in Australia by Ellistronics, retailing through Active Electronics, 887 Springvale Rd, Springvale 3171 Vic., (03) 547 1046.

Roger Harrison

Modems wanted for C64

Dear Sir,

Could you please tell me if your magazine has ever published, or is intending to do so, a project for a modem (300 and/or 1200/75 baud) for the Commodore 64 personal computer?

K. Hahn,
South Kempsey, NSW

We have published three modem projects to date: The AEM4600 Dual-Speed Modem (Dec. '85), the AEM4610 Supermodem (April-August '86) and the AEM4605 Super Simple Modem (Sept. '86). All may be used with a Commodore 64. However, you will need a serial interface and suitable communications software. We published a Commodore Modem Coupler interface in the August '86 issue, which may be of interest. A complete kit of this project, with instructions, may be obtained from Flexible Systems, 219 Liverpool St, Hobart 7000 Tas.

Back issues of the May, August and September issues are available for $4.00 each, post paid. The other issues mentioned are now unavailable, unfortunately. Photostats of individual articles cost $4.00 each, post paid.

Note that, with some software, where the transmit and receive baud rates are different (as with Viatel, for example, which requires sending at 75 baud and receiving at 1200 baud), a 'baud rate converter' will be necessary unless the software effects the baud rate conversion itself.

Roger Harrison

'Telephone line coupler' for hobbyists

Dear Roger,

AEM is outstanding! Congratulations!

I wish some enterprising person would put a 'telephone line coupler' on the market. It would solve a lot of problems for home constructors and, for that matter, equipment makers — not to mention Telecom.

It should be easy to arrange that it meets Telecom's requirements and still not cost too much.

Jim Jacobs,
Engadine, NSW

Read Roy Hill's Dial Up column this month! (Mr Jacobs provided a suggested circuit for such a line coupler, incorporating transformer isolation, line protection, a line siezure relay and ring detect circuitry).

An approved line coupler, as suggested, would obviate the current situation where home constructed modems cannot be used on Telecom lines without the necessary approval — which costs $600, at least. The same device would prove a boon for radio amateur 'phone patch operation, currently held back by red tape and equipment approval complications.

Roger Harrison

ERRATA

AEM4505 Code-to-Speech Synthesiser, June '86. On the circuit diagram, page 87, R5 and R6 should be shown as 270k, as per the Parts List. In the Parts List, RV1 is a 10k trimpot, not 1k. It is advisable to add pull-up resistors to pin 9 of IC3 and pin 9 of IC11. Use 4k7 resistors to a convenient nearby +5 V point. These are tri-state lines and may "float" at an indeterminate or "illegal" low state, disabling the project.

Modem Coupler, August '86. On page 72 the program as listed will not run on the C64 because the "pound" sign is used instead of the # ("hash") in lines 90 and 130. The two lines should be entered as follows:

```
90 GET #1,A$:  IF A$="" THEN 120
130 IF K$<>"" THEN PRINT#1,K$;
```

Practicalities, Sept. '86. Pages 62-63 were swapped with 64-65, so that page 61 reads on to page 64 and page 65 reads on to page 62. On page 61, second paragraph, the second line should read ". . .except for linear controls which are generally 10%/volt, . . ."

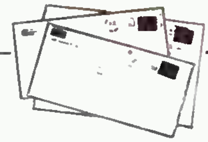
On the circuit diagram, p.64, the output labelled (D) is just an output and doesn't have to go to the synch section, although it may be patched to the synch. in some applications. The OCTAVE SELECTOR is marked a little confusingly. The switch pole is actually set on the 8′ position, the next two anticlockwise being the 16′ and 32′ positions. The last, which goes to (B), connects to the TUNE pot. shown in the synch. section circuit. In the synch. section circuit, p.65, the 100k pot. marked TUNE is actually part of the VCO (an essential part!), as is the 100k pot. immediately below it, on the C.V. IN. They are RV1 and RV4, respectively. A little confusion arose out of how the author arranged the original circuits.

On page 68, the third paragraph should read ". . . same pitch as C2 . . ." (not C3). Two sentences went missing after this. It should read on as follows: "This is easier if the VCO pulse width is adjusted to give a square wave output. Switch the octave selector to 4′ and adjust RV7 to the same pitch as the C3 output on the tuning aid."

Project Modems, Update 1, Sept. '86, p. 88. The circuit shows a modified line interface, but C13 is incorrectly shown connected to pin 3 of IC2. It should connect to the junction of R11 and C7, as the text explains. In addition, the 47k resistor and 100n capacitor below R11 and C7 should be reversed.

How to Terminate Common RF Connectors, Sept. '86, p. 94. Step 5 in the two PL259 columns is missing the last sentence which reads: "Solder the centre conductor to the plug's centre pin and trim off any excess wire."

AEM8501 Car Alarm, October '86. The circuit diagram shows R15 as 4k7 when it should be 4M7, as per the Parts List. Diode D13, a 1N914, was omitted from the Parts List.



Content with content

Dear Sir,

Let me congratulate you on the excellent content of your magazine, it is refreshing to see a magazine with an absence of "page filler" articles and projects, which seem to be the norm of other electronics monthlys.

In particular, September's article on RF connectors was very useful.

Terry Koziniec,
Forrestfield, W.A.

RTTY, AMTOR and stock exchange reports

Dear Sir,

I have a YAESU FRG 8800, and would like to know if there is any information transmitted in codes e.g. RTTY, AMTOR regarding the latest stock exchange reports. If there is this type of information transmitted do you know what frequencies and mode of the transmissions?

Could you outline the necessary equipment to receive a good signal and would some of this equipment be compatable with a "Viatel" system.

Also I would like to know if there are any books or literature available on RTTY AMTOR set-ups as I find it hard to find any information in Electronics magazines.

A. W. King,
Telfer, W.A.

I don't know of any HF transmissions that carry stock exchange reports. Many services transmit on HF using RTTY and listings may be found in a variety of books available through Dick Smith Electronics stores or GFS Electronics, 17 McKeon st, Mitcham Vic. 3132.

Equipment to decode RTTY and AMTOR transmissions is stocked by GFS as well as Emtronics, Box K21, Haymarket NSW 2000. Books on the subject may also be available from them, or you could write to the Wireless Institute of Australia, Federal Publications, PO Box 300, Caulfield South 3162 Vic., who may possibly assist.

Roger Harrison.

Amplifier power output and the AEM6103 speakers

Dear Sir,

I am writing in regard to the power rating of the AEM6103 three-way bass reflex speakers. I have built your '6010 Ultra-fidelity Preamp and teamed it with an amplifier delivering an output of 145 watts RMS per channel into 8 ohms, which I also built. I am going to build your '6103 speakers, however, in your article you specify they be driven by an amplifier capable of 100-150 watts as a minimum. The question is, is this figure music power or RMS? Can I use my amplifier without having to worry about the volume control?

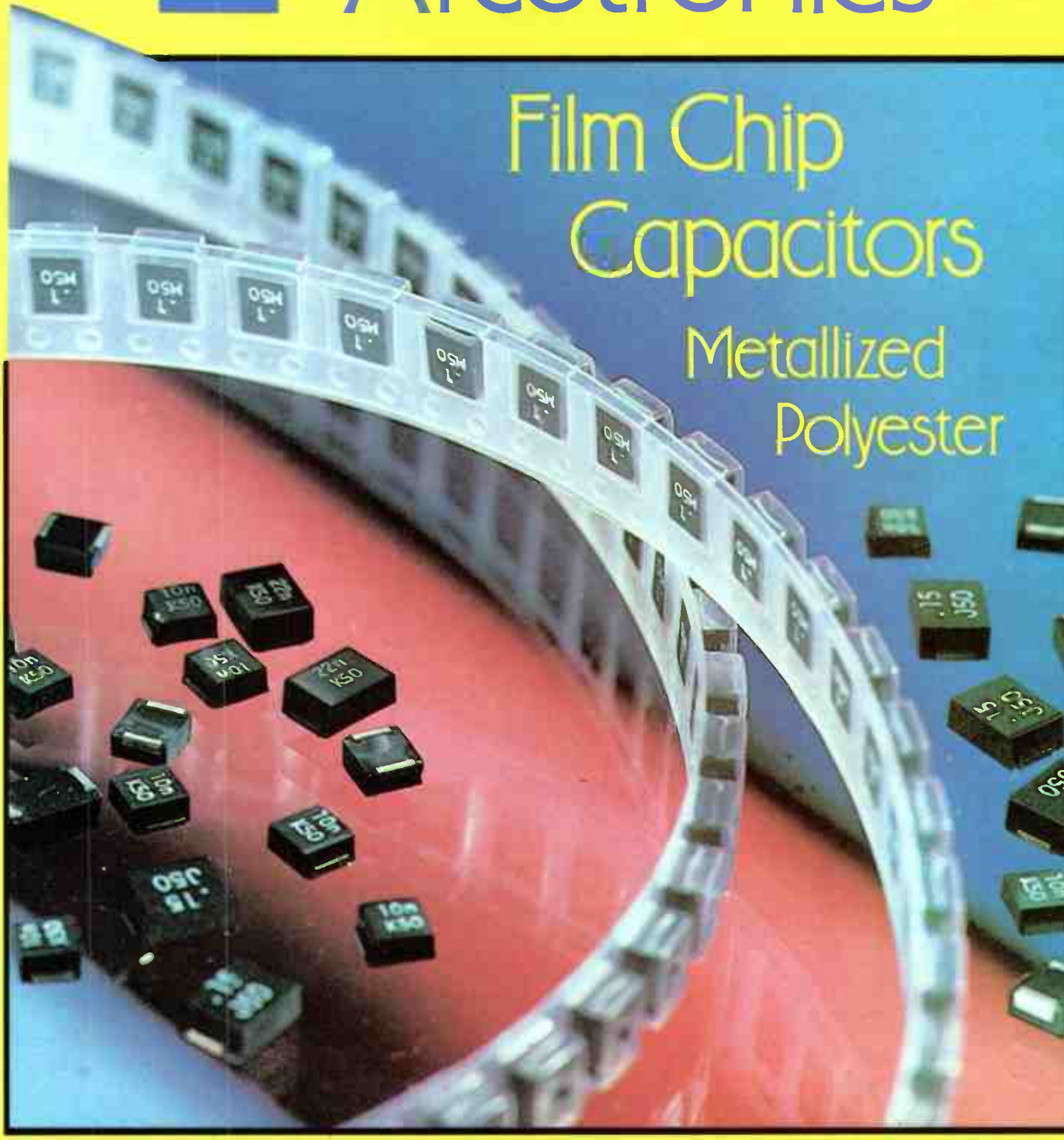
I would appreciate it if you could clear up this matter.

S. Clarke,
Eungai Creek, NSW

The drive power rating for the '6103s quoted in the article refers to RMS power, not music power and the speakers may happily be used with your amplifier. We might caution though, that the amp. should not be run into clipping. For a start, this generates large amounts of high frequency energy which may easily exceed the voice coil dissipation of the tweeter. Secondly, it gives rise to an effective dc output which may damage the bass driver's voice coil as there's a dc path via the low pass filter inductance.

Roger Harrison

Arcotronics



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Home entertainment and consumer electronics

— from now to the year 2000

Part 1
Dennis Lingane

So what's happening with today's audio, video and other consumer electronics products? Is there a hi-fi in every home, or just a sophisticated radiogram? Will DAT be the death of CD and the bane of confused consumers? A 'state of the nation' report.

THE TYRANNICAL EDITOR of this salubrious magazine in setting this assignment said: "In a two part overview give me a state of the nation in the consumer electronics field, and how it will grow to the year 2000." Compared to some of his directives it wasn't bad, so I quickly responded:

CURRENT TREND

The cupboards of Australian homes are filled with microcomputers, video recorders, video cameras, electronic games, telephones and sundry other transistorised gadgets collecting dust.

FUTURE TRENDS

The cupboards of Australian homes will be filled with personal photocopiers, personal fascimile machine, personal business computers and electronic communication by the year 2000, all equally collecting dust.

THE END

I figured that should do the trick. It certainly tells the story, and although it is of few words it must be a plus that I didn't take up pages and pages, thus leaving lots of room for other writers. But it was not to be, our editor likes his pound of flesh — albeit in ink and prose.

"More!" he screamed.

I felt like telling him the story about the music reviewer of the British daily newspaper *The Guardian* who was sent all the way to Liverpool to review a recital on a massive theatre organ. He wrote: "Last night a recital was played on a huge theatre organ in Liverpool. It weighed 100 tons."

Incensed, the musician complained to the editor who, to pacify the theatrical temperament of the organist, sent the reviewer back to Liverpool to attend the recital for a second time. This time the reviewer wrote: Last night a second recital was played on the Liverpool Theatre organ, AND IT STILL WEIGHS 100 tons."

But the quivering beard of our editor indicated he wasn't in the mood for such frivolities.

Tidal waves of gadgets

Over the last 15 years I and many other journalists in the industry have enthused over the tidal waves of gadgets pouring out of Japan, all of which were to revolutionise our lifestyles. Computers were going to create a paperless society and save all our trees, microwave ovens were going to save electricity and let mum have more time with the kids, video recorders were going to let us choose our own nightly entertainment free of boring commercials, and powerful hi-fi systems were going to bring distortion-free concert hall realism to our musical evenings.

Computers, in fact, increased junk mail alarmingly — so much so we now have a separate rubbish disposal service to collect the myriad press releases, "notice to home owner," and "opportunity of a lifetime" mail that pours through our letter box to be recycled.

Microwaves saw the demise of roasts for Sunday lunch and the increasing use of frozen pies and pasties as the staple diet of latch-key kids.

TV stations fought back against videos with interminable, boring mini series so on the odd occasion one feels like a night in front of the telly, the selection is no longer available and more and more of the populace is becoming bonded to the tube as they follow these endless mini series into oblivion. Meanwhile, the legions of video tapes that weekly pour through our doors for review indicate that the movie companies ran out of worthwhile movies years ago and are either making or discovering a bottomless pit of the most terrible B class movies to complement the odd block buster.

And my special pet project "a hi-fi every home" has really backfired on me personally. All these years of telling people they needed more RMS power turns out was a bit like telling young drivers they have to have a V8 engine in every car.

They don't use the V8 power for effortless cruising, long life, and getting out of a tight spot, but for dangerous high speed driving. Likewise, the power we pass into the hands of the average radiogram buyer isn't used for distortionless listening to high quality musical renditions, but *raw volume*.

And now, when I sit in our garden on a Saturday afternoon I find myself sandwiched between a battle of RMS between the neighbour behind me (rock and roll) the neighbour on the right (reggae), and opera on the left.

"Serves you right," says my wife as I bow my head in pain.

The problem is, we didn't have the foresight of our British musical reviewer, nor some of the leading lights in the pure hi-fi industry, like Raymond Cooke of KEF fame.

True hi-fi is not for everyone

I remember sitting in a Parisian hotel some years back sipping coffee, with the sophisticated sounds of the Festival du Son as a back drop. Cooke said that we as an industry (writers included) were making a big mistake in foisting high quality esoteric hi-fi gear on the public. "The Japanese will one day wake up to the fact that only 10 per cent of a modern society wants genuine hi-fi equipment," he said. "When they realise that they will pack up and move on to other products leaving the genuine hi-fi manufacturers to pick up the pieces and rebuild the industry."

"Don't get me wrong," he continued. "The other 90 per cent will want their music as well, as a background to housework, dinners and parties. But they only need radiograms and transistor radios. Forcing expensive high quality sound systems on them is unfair.

He was so right in so many ways. The only exception to his scenario is the Sony Walkman style personal audio. That created something of a sound revolution because it offered high quality sound and portability. Not only did Sony have a big win as a company with this concept in audio, but it was a great social win as well. There was a time when, within 10 metres radious on a beach or in a park, we would have a multitude of transistor radios and cassettes all fighting each other. All flat out, all on different stations, and all out to prove who has the best portable.

Now these former noise-aholics are using Walkmans and inflicting industrial deafness on themselves without bothering the rest of us.

But for the rest of the world life has returned to pre-hi-fi hysteria. Now sound systems and portables are bought without the same analysis of many years ago. Sound quality is the last consideration, preceded by looks, gimmicks, lights buttons, and cabinet. Sound quality is assessed, as it was in the past, on 'boomability'.

It became so bad at one time that I threatened if I had to face up to reviewing one more $799 hi-fi system I would do it on the wood veneer, quality of hinges, and the locks. As it was, I found myself mentioning in reviews the fact some had cupboards ideal for mum's knitting, somewhere to put ▶

Maybe videophotography — be it 8 mm or VHS-C — will boom where 8 mm cine did not. That's the hope, anyway. Just think, family snapshot albums in living colour, with movement. But will consumers have the patience to edit and assemble tapes?

a vase of flowers, and the fact that some have bullet-proof glass so kids could'nt smash them with their dinky toys. Interesting as these facilities are, it was a long way from talking about the real sound quality of the system.

So, exactly as Raymond Cooke forecast, the mass of society has gone back to low-fi (although much improved on past low-fi) which the Japanese are pounding out in increasing amounts, and the hi-fi industry has returned to whence it came — to the British and American manufacturers (although a few Japanese now rank amongst them) and while low-fi has improved over the years so has hi-fi.

It should now be called 'Hi-Tech-Fi' using as it does many technologies spun-off from NASA space research programmes. But it is only appealing to a minority market — something the Japanese manufacturers refuse to believe is a viable entity. To them, it is all or nothing. But by the same token driving beach buggies through the sand, riding wave-jumpers, sailing boats, building electric train sets, and flying radio control planes are all the pursuits of minority sections of the community — but all are booming.

CD and videophotography — the bright spots

The idea that every home in Australia should and WILL have a train set, radio controlled helicopter and beach buggy is nonsense. And it isn't until the electronics industry accepts this that it can get on with winning stable markets. Just because colour TV reached a saturation of 98 per cent it doesn't automatically mean every home will also have a video recorder. In fact, with a penetration of around 50 per cent into Australian homes, video is on the slide. Computers reached around 10 per cent before tailing off, and hi-fi around 28 per cent before it slumped. And it was arguable in the later days whether what was being sold as hi-fi in our terms really was hi-fi or an upmarket radiogram. So, was 28 per cent penetration a reality?

The only two bright spots on the electronic consumer horizon are CD and videophotography. But can these be relied upon to really reach the current levels of penetration being sought by the industry? For example, why should the video camcorder really become a mass consumer item when the 8 mm cine which enjoyed terrific growth in the 60s died a death? It lost popularity because it was too expensive, cumbersome and incredibly boring to all except those who like to sit down for hours editing the clips of films into some sort of story line with sound.

It isn't any different with videos. In between the odd cute shot of the baby will be miles and miles of badly shot boring bits which need editing out. That means sitting down and spending the same hours we did with 8 mm cine, and frankly, the average person can't be bothered.

Don't get me wrong. Videophotography will be a success, but only in terms of specialist retail stores, manufacturers and enthusiasts. People who kid themselves that every house will have a camcorder, editing suite, mixer, special effects generator, enhancer, sound processor etc really are kidding themselves.

There will be the enthusiast who will opt for all this simply because he enjoys playing with the technology and making movies — a budding Cecil B. DeMille. And amateur/professional film makers will blossom and most people will choose to have their weddings, anniversaries, births etc recorded by these people for posterity — for as long as the format it is shot on sticks around for it to be played back on.

Even CD, the bright spot in this electronic gloom, isn't performing to expectations. The industry expected to sell around 200,000 units in 1986. Now they will be lucky to reach 120,000 unless Christmas produces a few surprises. Why, with only four per cent penetration, it has slowed below expectations depends on whom you ask. The software industry blames the hardware industry for volatile pricing, while the hardware industry blames the software industry for making CD recordings too expensive.

There is some truth in both claims. As one software spokesman said: "Who is going to buy a CD player when they think it is going to be $150 cheaper next week."

Ian Withers of Philips says that if the software industry dropped its prices to $20 for a disc it would dramatically lift sales across the board. "But when the demand for CD recordings exceeds supply how can anyone make the software industry lower prices," says Withers. "From a consumer's point of view, who is going to pay $28 for 40 minutes of music when you can get it for a fraction of that on cassette."

Withers says that "Mr six pack" doesn't give a stuff about the advantages of CD such as frequency response, dynamic range, longevity, etc. He knows that the cost of a CD recording is about 5–10 per cent of the cost of a player, and that means it's expensive. So the CD industry currently is surviving on sales mostly to male buyers between the age of 18 and 35 buying players in the $499 to $699 price bracket. This accounts for well over 55 per cent of the CD turnover.

Working on the principle that every home should have one, even portables have not come up to expectations. Sales of these personal portables vary dramatically from between five and 15 per cent of sales of CDs. That's why so many companies are reluctant to take on Sony and Technics in this area. They see it as an unpredictable arena with no clear indicators as to who or what the portable CDs appeal to. Sony would disagree with this because the Discman is selling so well. But they are only one company.

For the most part, kids seem to prefer to stick with their cassette Walkmans — possibly because the software is so much cheaper. However, that may change next year. World ▶

Sony's Walkman cassette players introduced the concept of 'personal stereo' and has probably created the only 'new' market in audio in decades. It sure beats blaring trannies everywhere competing for the loudest distorted sound in the area!

supply for CDs is finally expected to exceed demand and that will mean some bargain buys, probably as specials in the pop area.

What could change the situation in the software industry's campaign to shift buyers from cassettes and LPs to CDs is the increasing popularity of CD boomboxes, and the eventual inclusion of CD players in cars at manufacturing level. But that is a few years away. So even our latest love is not performing up to Japanese expectations for a totally mass-marketed prospect.

DAT ain't where it's at

That leads us to the final non-starter in this negative scenario. DAT (digital audio tape). The industry isn't even waiting for the consumers to become negative to this. They have all jacked up against it themselves. After a 12 month postponement it was finally officially unveiled in Japan at the annual October Audio Show, but was very low key. The software industry say that they won't put any software on it because to release it now would cause confusion in the consumer market which is still trying to come to terms with CD.

That may sound incongruous to those of us in the industry when it is so obvious that CD has many more advantages than DAT, including random access and play. But the fact is it can cause amazing confusion, and just how fickle is our consumer when an article in the weekend *Australian* said that it would replace CD. That caused a major headache for the industry it is only now getting over. Even people who own CD players and love them were philosphical that they had once more been had by the electronic industry which is for ever yelling about the latest and greatest products and six months later announcing it obsolete.

But in this case the story couldn't have been more wrong because CD is really the basis for a huge new entertainment and educational industry. Even down to mini video discs carrying two pop songs complete with video clips and an educational medium for the home. But more about those next month.

The CD industry fought its way out of that crisis with lower prices and strong campaigning. But then up goes the price of discs from $20 to around $30, depending on manufacturer. Even the slowest learner can work out that for this you could get three cassettes (in bargain basements). Also, given that a young person's taste in music is as volatile as his or her love affairs, one can see that investments of $30 on discs isn't economic. They know that while they may be the hottest sound this week they will definitely be next week's bore.

Not the most positive marketing environment to be in.

Shifting emphasis

It is no wonder major consumer electronic manufacturers choosing between insanity and bankruptcy are shifting their emphasis now as I write to a new and yet untapped market — the home office. They see every home with personal facsmile machines, phoocopiers, security computer systems etc, etc. There is certainly a market, but one in every home?

Well, I have already got all these gadgets because I work a lot of the time at home, and there is no doubt that some of them do have a place in the home.

Photocopiers, for example, are a surprising item. Before you get one you wonder what you possibly want with it. But now ours is used quite a lot for schoolwork, recipes and other personal items, as well as office work. For example, when I want to work on one of my cars I don't take the workshop manual to the garage and get it dirty, I photocopy the relevant pages and take these down. Afterwards they get thrown in the bin. Likewise that's all the garage gets when they ask for information on my aging vehicles.

My wife photocopies the relevant pages of her cookbooks and uses these in the kitchen when cooking, and guests at dinner parties get copies of recipes when they ask. And my

The compact disc achieved rapid penetration in homes at first, but has slowed recently. Maybe it really is for the audiophile, and not for the mass of consumers who really want background music from sophisticated radiograms.

son and his school mates spend hours around the copier, although nobody volunteers what the fascination is and I get the impression it's better for me not to know . . .

So when they get down around the $500 mark, and they will, believe me, I see them becoming a big, popular item in many homes but still only in the yuppie consumer market, or with concerned parents who want their children to have every facility to achieve at school.

But personal facsimile machines, and electronic newspapers? They take some believing in the light of recent experiences for me.

For example, I agree that to have your newspaper delivered electronically through a facsimile machine would be great. And for that I could see people buying one, as well as to send messages to friends and relatives in disant places. But what will kill this new golden goose before it ever becomes a reality is Telecom's bloody-minded determination that all people joining the new age of technology will be publicised, and in doing so make them victims to the endless stream of junk mail that now clutters up our existence.

Take Viatel. No sooner had I joined that than my Viatel 'mail box' became overstuffed with junk mail. I found myself paying eight cents a minute at the time (it's now more) to clear it all. In fact, Viatel became such an expensive liability that I tried to opt out. Not easy. While Telecom preaches the benefits of electronic communications they have in many ways yet to learn to use it. A telephone call to ask them to cancel my subscription was rejected. "You'll have to write to our Melbourne office and request the service to be discontinued," I was told.

My simple response in situations like this is to no longer pay the subscription and in the end, the service will be discontinued automatically. No so with this communications monopoly. After three months my $2.50 monthly subscription had become a *massive $7.50*.

Telecom got tough.

Pay up, they threatened by letter, or we will disconnect your telephone service! For a lousy $7.50 cents they were prepared to wipe out a telephone service that brings them in $1600 a year! Talk about cutting your nose off to spite your face. ▶

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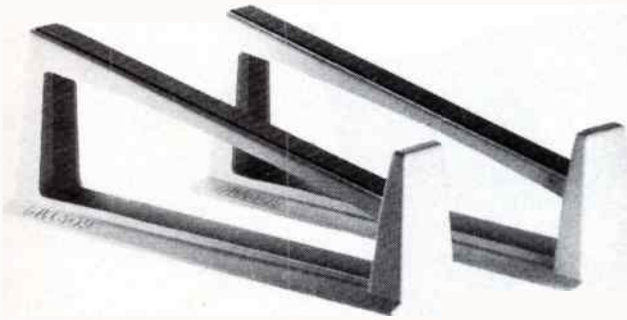
'PREVIEW' PRODUCT OFFER



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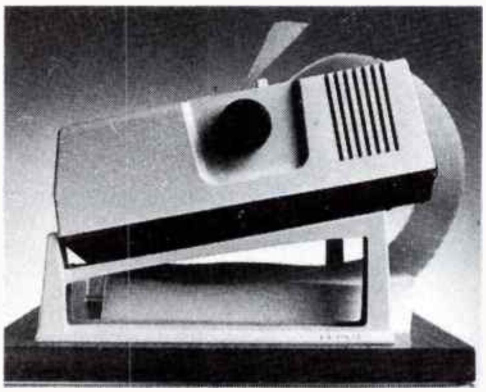

The distributor of Allsop products in Australia, Communications Power Inc., have a strictly limited quantity of these stands which they are willing to offer to AEM readers for just

$49.95

plus $5.60 post and handling

This offer is made by the Australian Allsop distributors, Communications Power Inc., and the magazine is acting as a clearing house for orders.

Don't delay, take advantage of this offer now.

Complete this coupon and send it to:
"Allsop Printer Stand Preview Offer"
PO Box 289, Wahroonga 2076 NSW.

Allsop have long been known for their innovative and well-designed products in audio and video. Now they bring their expertise to the computer field.

The ALLSOP UNIVERSAL PRINTER STAND is designed for the home or office with limited work space. The two-piece construction is durable and stable and readily adjustable to fit most printers and portable computers. The product provides convenient paper storage and a comfortable viewing angle. You can even stay seated and see what you're printing.

We grabbed one of these printer stands to install under the high speed dot matrix printer on the 'editorial desk' here at the magazine and it has proved a real space saver. Now the paper sits tidily beneath the printer and not underfoot on the floor! The stand tilts the printer so the controls are readily seen and reached now, as well as making paper loading much easier. And now the printer is quieter, too!

But it's not just a printer stand. You can stand your video monitor on it or prop up a transportable computer for better screen viewing and disk drive access.

PLEASE RUSH ME.......... Allsop Printer Stand(s)

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Who Said That?
Make Your Computer Talk!

Here's a fantastic offer on a great new speech synthesiser for your Commodore C-64

THE VOTALKER C-64

VOTALKER C-64 PLUGS DIRECTLY INTO THE EXPANSION PORT

This is the most sophisticated yet easy-to-use synthesiser ever introduced for the Commodore 64 computer. This powerful speech tool comes packed with advanced features unmatched by any other synthesiser. The Votalker makes a great gift for any 64 enthusiast.

Just look at these features:

UNLIMITED VOCABULARY

VOTALKER C-64 comes equipped with the popular Votrax SC01A speech chip that constructs speech using a set of 64 phonemes. VOTALKER C-64 comines these phonemes using a highly sophisticated algorithm. This method of speech synthesis allows VOTALKER C-64 to vocalise an unlimited English vocabulary with amazing accuracy. In addition to standard text, VOTALKER C-64 correctly pronounces symbols, numbers (from -999,999,999 to +999,999,999, including decimal places) and even BASIC commands, functions and screen messages.

VOTALKER C-64 adds 13 new BASIC commands!

POWERFUL NEW "SPEAK" COMMAND

VOTALKER C-64's text-to-speech algorithm is easily accessed through the powerful SPEAK command. SPEAK is used much like a PRINT statement except that is vocalises the expression instead of printing it to the screen. SPEAK an be used with numbers, phrases, and complex expressions. Pitch and volume control can also be included with a SPEAK statement to create even more natural-sounding speech. With the addition of speech, BASIC programs, take on an exciting new dimension.

SCREEN ECHO MODE

With the screen echo mode on, many programs can talk without any modification. All words, numbers and symbols are automatically spoken as they are printed to the screen. Listen to your program listings, disk directories, or use your communication software to create a talking terminal! VOTALKER C-64's screen echoing can also be an invaluable aid to the visually impaired.

SELF-CONTAINED "HELP" FUNCTION

Among VOTALKER C-64's new BASIC commands is the HELP feature. This handy command provides a quick screen summary of new commands.

THREE SPEAKING MODES

Different situations require different types of text-to-speech translation. VOTALKER C-64's MODE command lets you chooose between conversational, verbatim, and character modes The conversation mode speaks text as though you were reading it, pausing appropriately at punctuation marks. The verbatim mode is similar; however, all symbols are spoken, including punctuation. The character mode pronounces each character separately. The MODE feature is extremely important when VOTALKER C-64 is echoing the screen during the conversation mode. The verbatim and character modes are useful for program listings and disk directories.

SINGLE KEY ACCESS TO MANY FUNCTIONS

VOTALKER C-64 allows you to easily toggle speech, echo, upper/lower case, and translation modes using the four standard functin keys. This is a definite time and keystroke saver.

NO SOFTWARE TO LOAD

All of VOTALKER C-64's powerful features are immediately available when you turn your computer on. The inconvenience of having to load text-to-speech software and BASIC enhancement routines is eliminated. All required programs are contained in on-board ROM, thereby eliminating the need for computer memory. VOTALKER C-64 is so quick and easy to use it practically talks right out of the box!

INVALUABLE AID TO THE VISUALLY IMPAIRED

With its screen echoing feature, VOTALKER C-64 will speak program listings, disk directories, and screen messages. A special set of translation rules has been added to insure that abbreviated BASIC commands, functions, control characters, and messages are vocalised correctly. The character-by-character mode of translation may be used to determine exactly what a spoken line contains. Single key access to many functions and the ROM-based software also simplify use by the visually impaired.

BUILT-IN AMPLIFIER AND SPEAKER

The unit contains its own amplifier and speaker to provide the best possible sound quality. An external speaker jack also is provided.

COMPLETE WITH COMPREHENSIVE USER GUIDE

VOTALKER C-64 comes complete with a detailed User Guide that fully explains all features and new BASIC commands. Many examples and programming tips will make you a VOTALKER C-64 expert in no time at all. Adding a voice to your computer has never been so easy and so much fun!

The Votalker C-64 normally retails for $299. But, as AEM readers, you pay only

$229!

Save $70

plus $10 packing & delivery

This offer is made through the manufacturers representative and AEM is acting as a clearing house for orders.

COMPLETE THE COUPON NOW AND SEND TO: "VOTALKER OFFER"
Australian Electronics Monthly
PO Box 289 WAHROONGA 2076 NSW

Offer closes 30th January 1987

PLEASE RUSH ME: . . . VOTALKER C-64(s)

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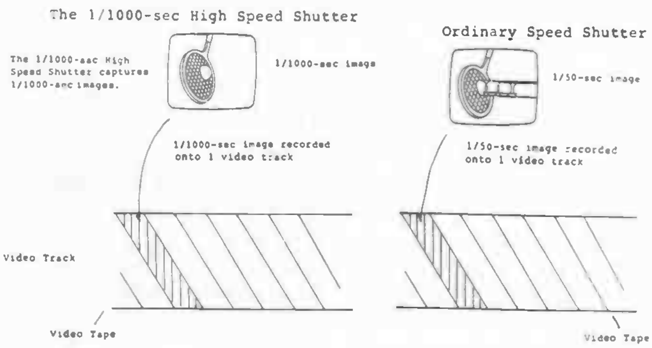
Please allow up to 20 working days for normal mail turnaround and cheque/credit card clearance delays.

New camcorder features high speed shutter

National Panasonic's new video camcorder, the VHS Movie NV-M5, provides a new feature for camcorder enthusiasts with a high speed shutter function that effectively provides 'stop motion' recording of fast-moving scenes such as tennis serves, golf swings, car races or children's rides.

The feature allows playing back action scenes in slow motion or the still mode on your VCR, giving images that show no blurring and have sharp edges and crisp details.

The NV-M5's high speed shutter records just 1/1000th of a second of video information whereas the shutter speed for conventionally recorded picture is 1/50th second (in the PAL system).



Instead of recording all the action occuring in 1/50th second, the high speed shutter mode records only 1/1000th second images, which is fast enough to 'freeze' many action movements, allowing you to reveal move-by-move detail on playback.

The NV-M5 takes a full-size VHS cassettee and you can play back through the electronic viewfinder (EVF). Shooting status and other information is displayed in the EVF. Other features include full automatic operation incorporating a 'piezo auto focus' system which restores focus even with drastic changes in shooting distance, auto tracing white balance. HQ (for high quality) picture enhancement circuitry, sensitivity down to 10 lux (i.e. birthday candle light levels!) and extended recording and playback time of four hours.

The NV-M5 is to be launched nationally (pardon the pun!) this month. Full details from your nearest National dealer or **National Panasonic, 95-99 Epping Rd, North Ryde 2113 NSW. (02) 886 0270.**

RC thrills!

For the thrills and spills of radio-controlled racing, Dick Smith Electronics boast they have a winning team.

The world-famous Mugen Bulldog racer, at $295, is hard to beat on or off the track, they say. The new Runner racer (which reaches an impressive 48 km/h) comes complete with a two-channel radio control transmitter for just $249.

And in time for the America's Cup defence, DSE's 510 mm long, radio-controlled 12-metre racing yacht (complete with radio control transmitter) turns any pool or pond into Freemantle for a mere $109.

See your local Dick Smith store or dealer.

Record factory converts to CDs

The Polygram record and cassette factory in Louviers, France, is to swing over to CD production with the first discs to roll off the assembly line in the first half of 1987.

The decision was made by Philips and Du Pont Optical (PDO) of Nieuwegein, the Netherlands, and Polygram France. The new factory, currently under Polygram management, will become part of an international network and a significant part of the production will be exported world-wide.

The factory has a design capacity of 30 million discs per year, and full capacity is expected to be reached by the end of 1988. Total investment will amount to almost 250 million French francs.

Get your turntable now, for tomorrow they . . .

Bartlett HI-Fi, of Drummoyne in Sydney, specialise in analogue record playing components, claiming they have the finest selection available at a variety of price levels.

Top of the range is Michell's Gyrodec, claimed to have set performance standards for suspended turntables over a number of years and respected the world over for ". . . its almost magical ability to reveal the full breadth, depth and scale of recordings".

For $2365 you might consider it an investment in the future if you plan to maintain your vinyl disc collection beyond the next decade and still have something to play them on at the turn of the century.

Having something to play those precious discs on is all very well, but to extract the sound from the grooves you'll need a comparable quality tonearm and cartridge.

Bartlett stocks a range of arms from the renowned Grado range, as well as Michell's own along with Syrinx. In cartridges, they stock products from 'names' like Grado, Supex, Audioquest and Denon.

You'll find **Bartlett's Hi-Fi at 137 Victoria Rd, Drummoyne 2047 NSW. (02) 819 6499.**

Cordless Stereo headphones

A new Sennheiser stereo headphone has been released here through R.H. Cunningham in Melbourne. The HDI/SI stereo headphone is completely cordless, offering the wearer freedom and versatility through an infra-red link. The HD12 unit provides lightweight reception of a stereo source anywhere within a 25 square meter area from the S12 radiator. Within this area any number of receivers may be used.

The receiver provides switchable mode selection, incorporatin stereo, mono left or mono right as well as providing individual volume control. This makes the unit ideal for use with stereo TV, Hi-Fi, stereo radio, (AM/FM) and compact disc, which at a weight of only 80 grams enables hours of comfortable listening.

For more information, contact **R.H. Cunningham Pty Ltd, 146 Roden St, West Melbourne, 3033 Vic . (03) 329 9633.**

New 8033A MKII Speakers from Audiosound

Audiosound Laboratories' latest version of their popular 8033 now sports a larger re-designed enclosure with four-pillar bracing for the bass unit. This new, meticulously built enclosure is finished in American walnut veneer and the loudspeaker baffle is fully felt covered to minimise diffraction effects.

The bass unit has been re-designed to give perfect Thiele/Small alignment in this enclosure down to 35 Hz at -3 dB and the treble unit is recessed to improve phase performance. A three position switch is fitted for treble balance adjustment by the user.

The refined crossover filter has an 18 dB octave slope to greatly reduce out-of-band frequencies in the tweeter which reduce power handling and increase distortion.

The ABC have over 100 of the 8033 series loudspeakers installed throughout Australia.

This new model sells for $1168 a pair and a brochure is available from **Audiosound Laboratories, 148 Pitt Rd, North Curl Curl, 2099 NSW. (02) 938 2068.**

CD sans frills

As the mainstream CD players become ever more decorated with an increasingly complex array of controls, buttons, lights and displays, that maverick among the hi-fi manufacturers, NAD, releases a CD player which ". . . contains all of the features that are really needed — and no others".

NAD's design objective for their new player, Model 5530, was: "the simplest, lowest cost CD player we can make without sacrificing quality".

Boasting that the NAD 5530 is ideal for the first-time CD purchaser, the company claims that the controls are so simple, logical and easy to use that even a mature adult can use it!

The controls are not quite so spartan as they appear at first glance. There are two 'skip scan buttons. Pressing one skips the player forward or back to the beginning of a track. Pressing one skip and play produces an "audible scan" forward or backward within a track. A repeat button provides immediate repeat of the track just played.

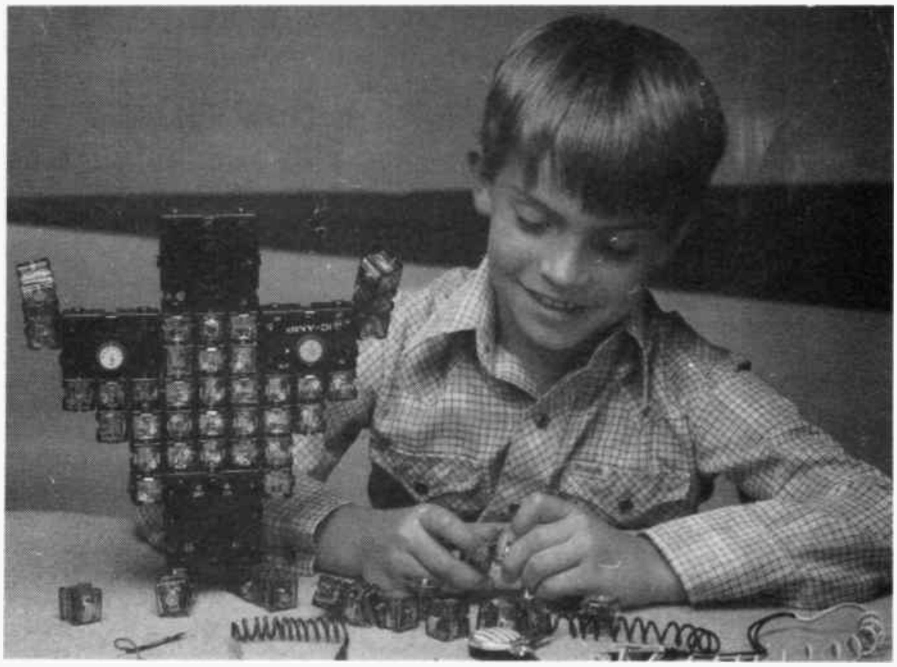
The NAD 5530 employs a solid metal chassis for stability, reliability and resistance to unwanted vibration, NAD say.

The player employs a compact new low-inertia laser, refined error correction circuitry and a sophisticated servo system that the company claims provides superior tracking of flawed discs.

The NAD 5530 is priced at $799 rrp. Details from **Falk Electrosound, PO Box 234, Rockdale 2216 NSW. (02) 597 1111.**

Bloc-Tronics — the electronic 'Lego'

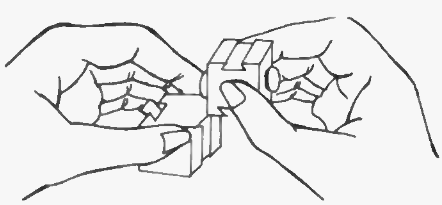
Corey Harrison



Here's a great 'starters' kit for children interested in electronics. Battery operated and entirely safe, no soldering is required. A system of snap-together blocks makes it easy.

ONCE children reach a certain age they want to make things for themselves that move around and do various things. Thus, they move from ordinary Lego to Technical Lego, or similar constructional sets. But when it comes to 'things' electronic, there are very few products on the market at the moment which children can build totally by themselves. Now here is just the thing. Block-Tronic is an electronic construction set that comes in different packages to suit the capabilities or needs of the individual. It is a building block system that requires no soldering and you can build many different combinations of relatively simple working circuits, ranging from a morse code practice set to a transistor radio.

The blocks are hollow plastic cubes with rounded edges and corners. There is no soldering needed because the parts are built into the blocks with a symbol and identification number on them. The blocks snap together fairly easily with a 'dovetail' on two sides and a 'slot' on another two. The kit is run with a nine volt transistor radio battery so that there is no danger of electrocution.



How the blocks go together.

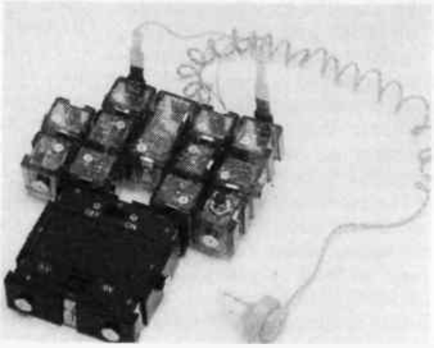
Four sets are available — A, B, C, D. Each has a group of blocks to build various combinations; 15 combinations for Set A, 50 combinations for Set B, 90 combinations for set C and over 160 combinations for set D. If you start with set A, you can later obtain a 'build-on' set which gives you the additional pieces to make up the next set. An instruction manual has to be bought separately, and it suits all sets, containing over 160 examples of things to build covering the whole Bloc-Tronic range.

Getting into it

We got set B to review, along with the instruction manual. It comes packed in an attractive and useful storage case that measures 300 mm across by 215 mm wide by 40 mm deep. It includes the set of blocks, a battery case and a meter unit. A pair of flying leads and a small earpiece are also included. A note came in the box warning that the blocks would be stiff at first. How right they were! It definitely requires an adult to get them apart the first few times they're used, but they free up after a while. Also, I cracked a few blocks trying to separate them, but they didn't break up.

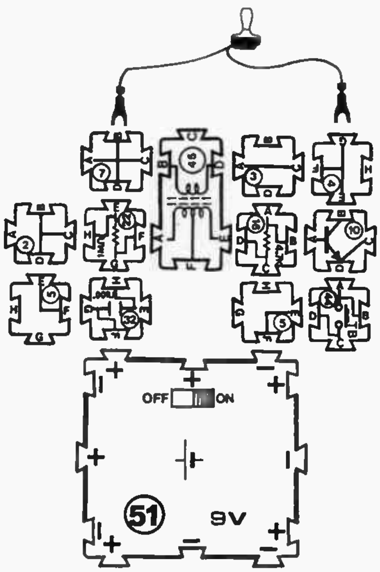
Wasting no time, I tackled a few 'experiments' from the instruction book. It's very easy to follow. Diagrams show the arrangement of the blocks and a proper circuit is given with each experiment. A short explanation of the circuit and how to use it is given with each. The English isn't the best, but it's understandable.

All the circuits I tried worked every time, which is encouraging. They are simple, but show the electronic principles as well. I learned a few things. And you can have fun! The two most popular circuits were the Lie Detector and the Electronic Shocker! We got lots of laughs with those two (. . . use your imagination).

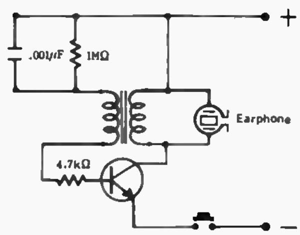


A built-up experiment, the morse practice set.

* 34. Morse Code Practice



A page from the manual.



This is a circuit similar to Exp No. (33). It will produce a sound much like that of a telegraph. You can practice Morse code with it if so inclined.

See front of book for morse code table.

The instruction manual includes experiments which demonstrate electronic and electrical principles, such as series and parallel connection, charging and discharging capacitors, basic logic circuits, etc. For learning the principles of electronics, Bloc-Tronic would be good but you'd need to use it under instruction and/or in conjunction with some good, simple books.

I found a few faults with the system, but only minor. The writing on each block slowly rubs off with use. However, the numbers and symbols are impressed in the plastic so all is not lost. Secondly, most of the bits can fit in the average vacuum cleaner hose (if whoever is doing the vacuuming is not watching).

Summing up

It is always being said that electronics will increasingly be used in almost everything we do, be it having a meal or designing a yacht for the America's Cup. If we want to know about the principles behind different electronic products then learning through experimenting with various basic circuits is a good way. Bloc-tronic helps us do just that. It's simple to use, works every time and you can progress through a series of experiments. For that, it's worth the price. From a Block-Tronics set, progressing to making projects and experimenting with electronics would be an easy step.

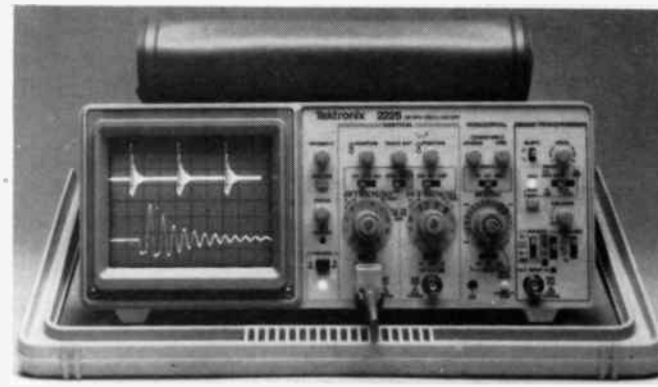
New 2200-series Tektronix CRO

Tektronix has just launched a new low-cost portable oscilloscope aimed at the field and on-site service applications, manufacturing and production test environments, hobbyists and educational users such as schools and universities, says Alan Richards, NSW sales manager for Tektronix instruments.

The new CRO, Model 2225, has been dubbed the "Euroscope" as it was designed and is manufactured in Europe. It is a dual-channel instrument with 50 MHz bandwidth, alternate magnification, 500 μV sensitivity, peak-to-peak auto trigger level and HF/LF trigger filtering.

The 2225 is also suited to a variety of TV and video applications as it includes selective triggering on the TV line or field frequencies.

Tektronix states that the 2225 has three important new features for a 2200-series CRO: (i) The alternate magnification provides many of the benefits of a dual-TB CRO but with the simplicity of a single-TB unit as you can view both the magnified and unmagnified sweep onscreen simultaneously, and the mag. sweep may be positioned independently of the unmag. sweep; (ii) the 500 μV sensitivity is four times more sensitive than previous 2200 'scopes; (iii) the trigger filter capability provides selective filtering of unwanted low or high frequency somponents from the trigger signal, improving display stability with complex waveforms.



The 2225 also features a peak-to-peak auto-triggering mode, providing virtually "hands-free" triggering, says Tektronix, along with variable trigger holdoff for easier triggering on complex waveforms, a beam-find button for quick waveform location and simplified instrument setup.

Full details available from **Tektronix, 80 Waterloo Rd, North Ryde 2113 NSW. (02) 888 7066.**

Hand held remote control for CRO

A VHF oscilloscope featuring a handheld remote control unit has been introduced by Philips Test & Measurement. TV-style infrared operation provides the selection of up 25 front panel settings on the 350 MHz PM 3296 oscilloscope using a keyboard on the hand unit.

The 25 settings can be expanded to 75 as an option. Remote operation of the powerful "autoset" facility is also possible.

The new instrument provides all the facilities of the highly successful 350 MHz PM 3295. These include dual-channel input, real and delayed timebases, trigger view and versatile triggering.

The same hand-held unit can be used to run more than one oscilloscope — or an identifier code can be added to each instrument to ensure it is the only one that reacts.

Use of these new infra-red controls provides a simple alternative to IEEE (IEC) instrument bus control. The PM 3296 can also be controlled by an IEEE (IEC) bus controller. Full details from **Philips Scientific and Industrial, 25-27 Paul Street North, North Ryde 2133 NSW. (02) 888 8222.**

Miniature dipped tantalums

According to the importers, Crusader Electronic Components, the new Kemet "Ultra Dip II" capacitors offer designers of quality instruments and entertainment systems the advantages of solid tantalum capacitors at competitive prices.

This new range of capacitors are compact with self-insulating cases and exhibit low dc leakage, low esr and impedance and have excellent temperature stability, says Crusader.

The capacitance range available extends from 100n to 680 μF at voltages from 3 Vdc to 50 Vdc. Complete data is available from **Crusader Electronic Components, PO Box 14, St Peters 2044 NSW. (02) 519 6685.**

New Pro-sound amps from Crown

Bose Australia has released a range of four new amps from American Crown, each in two versions — the 600 and 600LX, and the 1200 and 1200LX, plus a range of new pressure zone (PZ) microphones.

The Micro-Tech series incorporate features like front panel input attenuators, XLR connectors, switch-activated mono mode and compact 19" rack-mount construction. Each model features reversible forced-air cooling, offering flexibility in cooling arrangements.

Crown's Output Device Emulator Protection (ODEP) circuitry, so successfully employed on their earlier Micro-Tech 1000 is incorporated in the new series. It reduces output power under overload instead of shutting down the amp, avoiding signal interruption. The LX models include relay-driven power supply interruption for dc output protection.

While each model can drive loads from two to 16 ohms in normal two-channel operation, they may be used in bridged mono format or parallel mono drive. The bridged mono format provides high voltage drive into loads four ohms and above, the 600s delivering 600 watts into 4 ohms in this mode, while the 1200s give 1200 watts. The parallel mono drive mode supplies high current into loads below 4 ohms, the 600s giving 550 watts in this mode, while the 1200s again deliver 1200 watts.

The LX models include a plug-in-panel (PIP) on the back of the amp., which comes with female XLRs. This allows for the addition of custom plug-in accessories for future system expansion without the necessity of major redesign. The non-LX models have a blank rear plate for installing such things as non-standard connectors, etc.

The LX models include new LED displays showing status and operation, the power indicators dimming as the ODEP system functions. The signal LEDs vary in brilliance with signal level, jumping to full brilliance at 0.05% distortion.

Crown's new range of PZ mics includes a range of units that incorporate in-built electronics that can be directly phantom powered. There are six surface-mounting mics in the range, two lavalier mics, and a corner reflector type for table or lectern mounting. Crown has also released two miniature electret mics for instrument miking, professional recording and sound reinforcement applications.

Details from **Bose Australia, 11 Muriel Ave, Rydalmere 2116 NSW. (02) 684 1255.**

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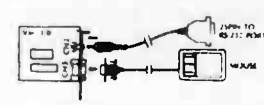

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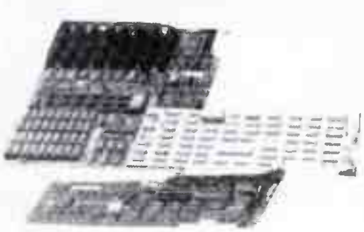

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Merry Christmas and a Happy New Year from Bob and Tony

An experimenter's modular music synthesiser

Part 2 — VCF, mixer and noise source

John East

This month we have details on building a voltage-controlled filter, a four-input mixer and a noise source.

IT IS INTENDED in this series to present one major module function in each article. However, other minor module functions will also be included that are most useful in conjunction with each main module. This will enable a system to be built up in an immediately useful form, and also means that a very comprehensive complement of modules will result by the end of the series. In this article the four-pole VCF (voltage-controlled filter) will be presented, together with a four-input mixer and a noise source. In a later article, a two-pole state-variable (or universal) VCF with complementary facilities to the four-pole version will be included to give a synthesiser with a large range of VCF facilities not normally found together on commercial systems.

Design

For the VCF, it was decided that the CEM3320 chip gave an appropriately flexible and stable filter structure, while simultaneously reducing the cost and complexity greatly compared to the multiple, discrete IC approach normally employed. The 3320 contains four identical filter sections, bias and regulator circuitry, the exponential converter and a voltage-controlled resonance feature. One section of the filter is shown in Figure 1. When viewed together with Figure 2, showing the suggested front panel layout of SW1 and SW2, the operation of the filter stage can be easily understood.

With SW1 in the "LP & Phase" position, and SW2 in "LP" position, a signal at the input will be lowpass filtered at 6 dB/octave at the output, at a cutoff frequency determined by the control current (Ic) into the variable gain cell, ΔA. (Ic is output by the control voltage-to-exponential current converter on the chip). Buffer B prevents excessive loading of the gain cell/capacitor combination by external circuitry. Resistors Rc and Rb are bias and scaling resistors for low-

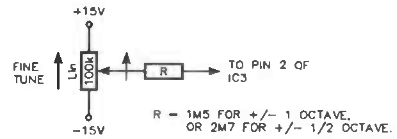


Figure 3.

pass operation. If however, SW1 is in "HP" position, and SW2 is in "HP & Phase" position, an input signal will be high-pass filtered at 6 dB/octave at the output.

Now, if SW1 is in "LP & Phase" position and SW2 is in "HP & Phase" position, the output will not be filtered in the conventional sense but will exhibit a phase change from low to high frequencies that passes through 90 degrees at the cutoff frequency.

The result of all this is that with four sections in series a four-pole, or 24 dB/octave, response is possible in highpass and lowpass modes. Also, when switched to phase mode, with two of four poles selected by SW3, and the input mixed in with RV3, a one or two notch phaser (respectively) is created.

Resonance can be applied to any of these response shapes, and can be voltage controlled at the Resonance CV Input. (Note that this input can be fitted with an attenuator. It was only deleted in the prototype due to lack of panel space.) A 10 volt change at the control input or the full range of the Resonance control will take the filter from a rather rounded response shape, through peaking, to self-oscillation when it produces a sine wave. The VCF in this mode can be used as a sinewave VCO.

The Tune control has a range of 12.5 octaves and is summed at pin 2 of IC3 with the other frequency control voltage inputs. The control voltage input is later calibrated against a VCO for a 1 V/octave response from the keyboard. The Envelope CV Input has a gain of two, allowing for a 10 octave filter sweep from the 5 V envelope. (See Figure 2 in Part 1). A Fine Tune control could be useful, especially in sine-VCO mode. This can be simply added with a 100k linear pot and resistor "R", as in Figure 3 here.

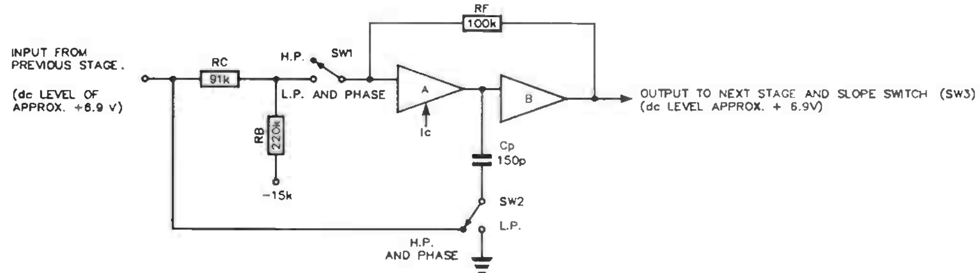


Figure 1.

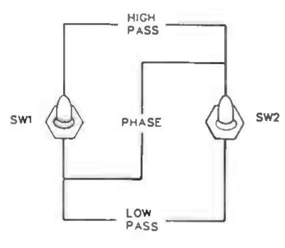
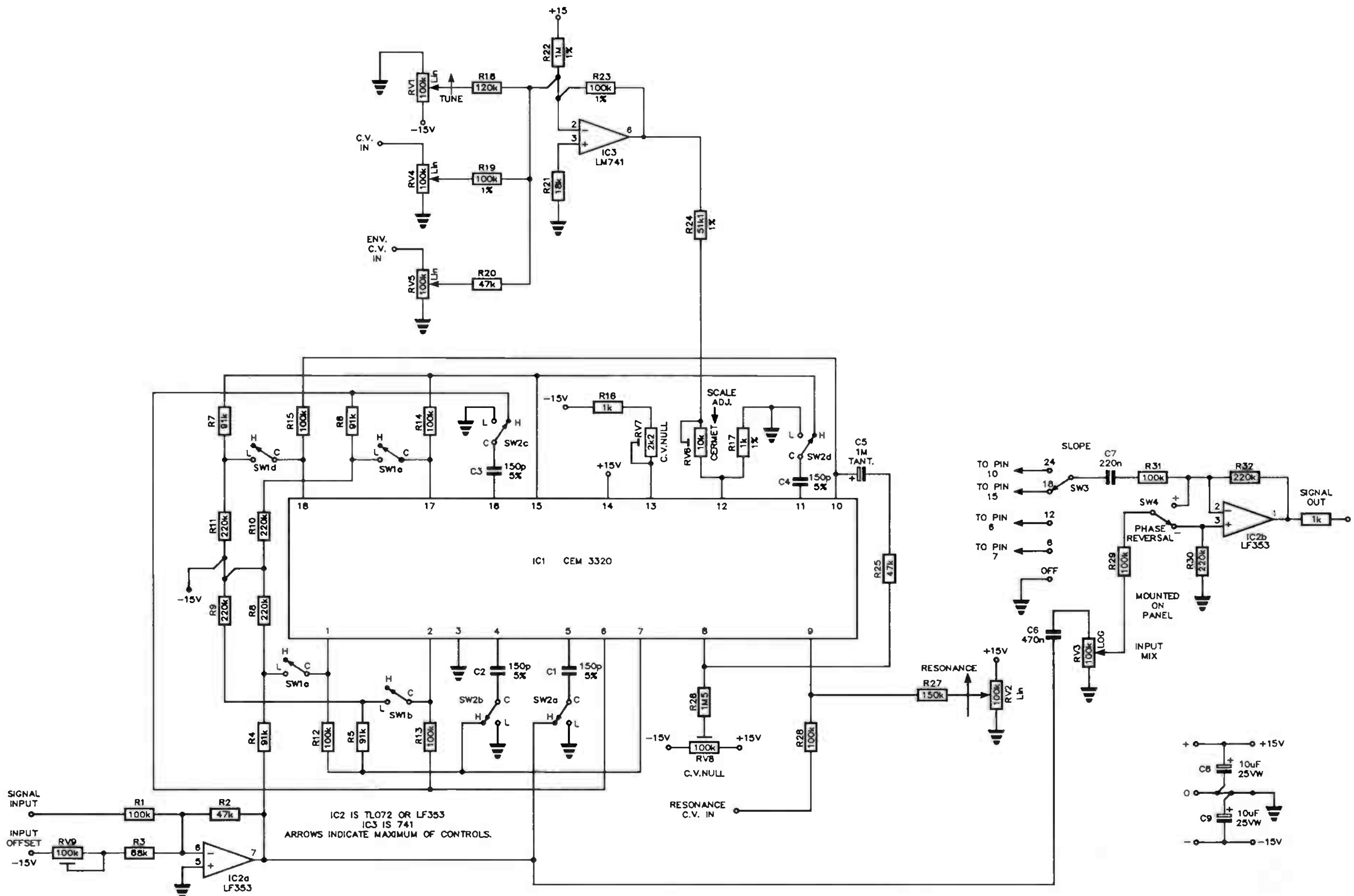


Figure 2.



+15
R22 1M 1%
RV1 100k Lin
R18 120k
TUNE
-15V
R23 100k 1%
IC3 LM741
R21 18k
C.V. IN
RV4 100k Lin
R19 100k 1%
ENV. C.V. IN
RV5 100k Lin
R20 47k
R24 51k1 1%
R7 91k
R15 100k
R6 91k
R14 100k
SW1d
SW1c
SW2c
C3 150p 5%
-15V
R16 1k
RV7 2k2 C.V.NULL
+15V
SCALE ADJ.
RV6 10k CERMET
R17 1k 1%
SW2d
C4 150p 5%
C5 1M TANT.
R11 220k
R10 220k
IC1 CEM 3320
R25 47k
R9 220k
R8 220k
SW1a
SW1b
C2 150p 5%
C1 150p 5%
SW2b
SW2a
R4 91k
R12 100k
R5 91k
R13 100k
R28 1M5
RV8 100k C.V.NULL
R26 100k
RESONANCE
R27 150k
RV2 100k Lin
+15V
RESONANCE C.V. IN
SIGNAL INPUT
R1 100k
R2 47k
INPUT OFFSET
RV9 100k
R3 68k
IC2a LF353
IC2 IS TL072 OR LF353
IC3 IS 741
ARROWS INDICATE MAXIMUM OF CONTROLS.
SLOPE
TO PIN 10
TO PIN 15
TO PIN 6
TO PIN 7
SW3
OFF
C7 220n
R31 100k
R32 220k
SIGNAL OUT
1k
SW4
PHASE REVERSAL
IC2b LF353
R29 100k
R30 220k
MOUNTED ON PANEL
C6 470n
RV3 100k LOG
INPUT MIX
+15V
C8 10uF 25VW
C9 10uF 25VW
-15V

As the 3320 chip will only allow a 12 volt pk-pk signal before clipping, and standard synthesiser levels are 10 volts pk-pk, IC2/A halves the level of the input signal and IC2/B doubles it again, to reduce the possibility of undesired clipping, especially when high resonance settings are used. This clipping is the only disadvantage of this filter; it does not have the "warm" distortion characteristics when overdriven of some other VCFs, notably the Moog. Its versatility however, more than makes up for the lack of this characteristic. SW4 is used to reverse the phase of the input signal added to the filter output, as some interesting response shapes can result. Note also that when SW3 is "Off", the VCF module as a whole can be used in an external patch as a switchable inverter and volume control in an audio frequency path.

All resistors can be 5% carbon film except for R19, R22, R23, R24 and R17, which should be metal film or similar for temperature stability. Note that R17 can be a Tel. Labs Q81 for correction of control scale temperature sensitivity. The Q81 is a rare and expensive species, and only worth the trouble if the filter is used a lot as a VCO. RV6 is a 15-turn cermet, RV7-RV9 are ordinary, large upright carbon presets. If you can't get 91k resistors for R4-R7, use 100k in parallel with 1M, or 90k9 metal film. C1-C4 should be polystyrene, C6 and C7 can be greencaps, C5 is tantalum, while C8 and C9 are electros. IC2 is a bi-FET input type (LF353) for high slew-rate and the dual package convenience.

The mixer is simple as it is only used at synthesiser levels. Note that the gain from any input to the output is two times and could be reduced to one by simply making R1-R4 100k each. The extra gain is very useful however, and should be retained. Also, there is no reason to stick to only four inputs. Up to a dozen or more can be reasonably useful, and depends only on your needs. The LED, D2, should be the red diffuse variety. Capacitors C1 and C2 are electros, C3 and C4 greencaps. Resistors are 5% carbon film.

The noise source uses the time honoured reverse-biased diode method, as it is simple, cheap and provides a signal which is closer to being truly random than do digital shift-register techniques. The circuit is fairly straightforward up to the white noise output. IC1/C and associated components produce a response which is flat at 0 dB gain down to about 1 kHz, then rises at 6 dB/octave to a final gain at low frequencies of 15 dB. This produces a sound which, for want of a better name, could be called "red noise". The sound contrasts more sharply with the "white" output than the usual "pink noise" provided on commercial synths, which is white noise filtered at approximately 3 dB/octave.

IC1/D forms a second-order (12 dB/octave) lowpass filter, manually variable from 1.6 Hz to 160 Hz. This has been found to be very useful when the Random Voltage output is used as a control voltage to other modules. None of the components are critical, but try several BC107s or BC108s and select the one with the greatest output. Capacitors C1, C8 and C9 are electros, C2 to C7 are greencaps. Resistor Rx is used in setting-up.

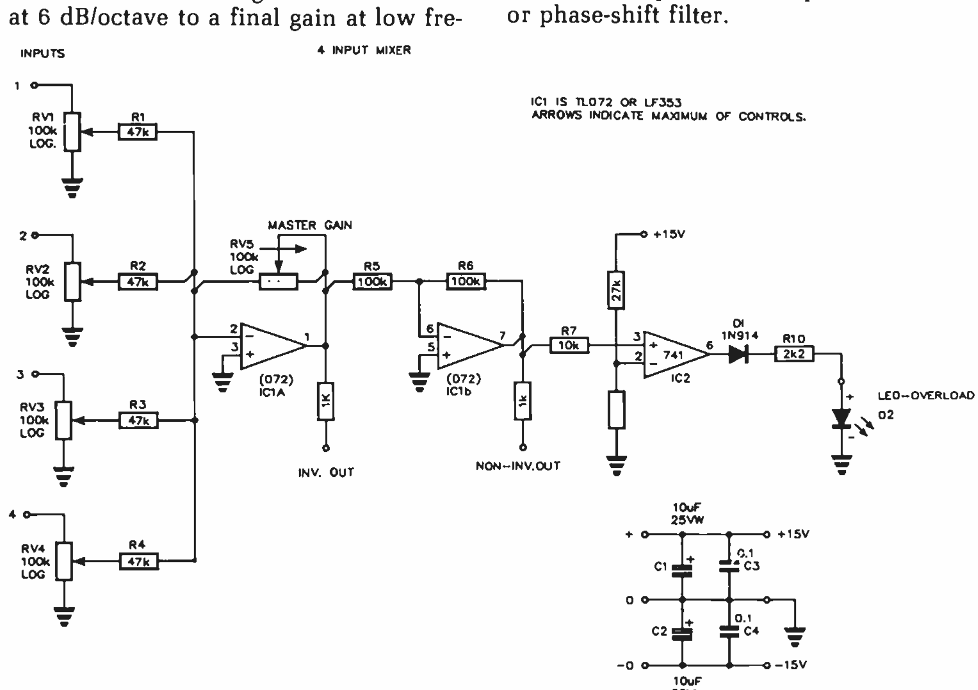
Here follows a description of the operation of the circuit modules.

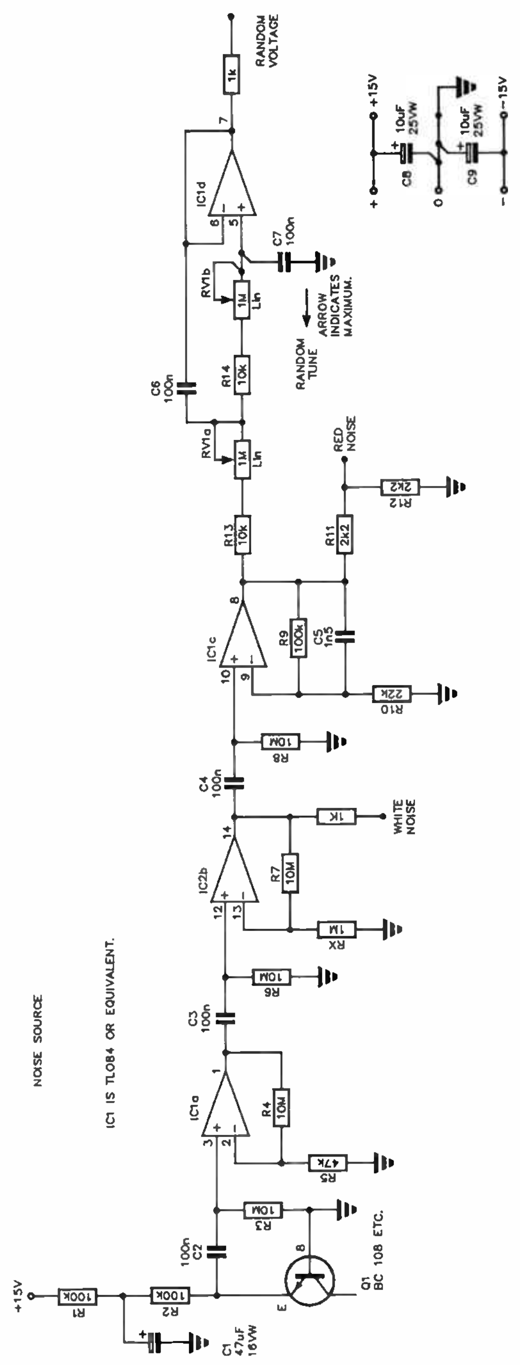
Voltage-controlled filter

Most of the VCF functions are contained in IC1, the 3320. On the chip are four separate tracking filter sections, an exponential control voltage converter, bias circuitry and a voltage controlled resonance capability.

IC2/A buffers and scales the input to a gain of 0.5 (for increased dynamic headroom) and provides an adjustable dc offset for the first filter section, to match that of the other sections. C1-C4 and R4-R15 are the only required external components for the four filter sections, IC2/B and SW3 buffer and rescale the filter outputs and allow the filter slope to be selected by switching to the output of any of the filter sections. RV3 and SW4 also allow mixing of direct input signal back into the output, with selectable polarity, for phasing applications. IC3 is a summing amplifier for control voltages that set the cut-off frequency of the 3320. R22 provides a necessary –27 mV offset at pin 12, to set the correct range of the internal exponential converter. RV6 provides for adjustment to exactly 1 V/octave.

C5 and R25 provide for resonance capability via an internal voltage-controlled gain cell, which feeds directly back to the first filter-stage input. Control voltages for this cell are summed at pin 9. The four-pole switches, SW1 and SW2, in combination provide for operation as a lowpass, highpass or phase-shift filter. ▶





Mixer

IC1 is a standard inverting, summing-node type mixer, with RV1-RV4 as input signal attenuators and RV5 as an overall gain control. The Master Gain range is from 0 to 2 times. IC1/B provides a non-inverted output at the same gain. IC2 is configured as a comparator which lights LED D2 if the mixer outputs a signal of more than 5 V positive, which could overload some inputs of modules that are patched to the mixer outputs.

Noise source

Q1 is reverse-biased by R1 and R2 to provide a source of white noise which is highly amplified by IC1/A and IC1/B. Rx can be changed to adjust the output level. IC1/C modifies the white noise to have a boosted bass content, with feedback components R9, R10 and C5. R11 and R12 form an output divider to optimise output level and give an output impedance of approximately 1k.

IC1/D and associated components form a manually tunable lowpass filter to modify the "red" noise to a form more suitable for use as a control voltage.

Construction

The only real construction problem is the wiring to the switches, SW1, SW2 and SW3. SW1 and SW2 are four-pole toggles and it is a good idea to plan the physical layout to minimise the distance involved. Rainbow cable was used in the prototype, and certainly helps to avoid confusion. SW3 is a five-position rotary type and SW4 a single-pole toggle. I assembled all components on a single board, except the 1k output resistor and R29, both of which are panel hardware mounted. Don't forget an earth strap from the circuit earth, fixed under a mounting bracket screw. IC1 should prefably go in a socket, but the other chips would be okay soldered in.

The mixer and noise source should present no problems in construction. Don't forget the 1k resistors on output sockets (excluding the Red Noise output), and earth straps as mentioned above. I found it unnecessary to use shielded cable on any of the prototype modules. However, if signal wiring runs were more than a couple of cm or so, it might be a good idea; control runs should be okay. Following are lists of front panel controls to be provided for each module, to remove any doubt.

PANEL CONTROLS

VCF

Knobs	Switches	Sockets
Tune	Mode	Signal In
Fine Tune (optional)	(SW1 & SW2)	Signal Out
Resonance	Slope	Resonance CV Input
Input Mix	(SW3)	Freq. CV Input
CV Attenuator	Phase Reverse	Freq. CV Input (Envelope)
Envelope CV Attenuator	(SW4)	
Resonance CV Input Attenuator (optional)		

Four Input Mixer

Knobs	LEDs	Sockets
Gain-Input 1	Overload	Input 1
Gain-Input 2		Input 2
Gain-Input 3		Input 3
Gain-Input 4		Input 4
Gain-Master		Inverting Output
		Non-Inverting Output

Noise Source

Knobs	Sockets
Random Tune	White Noise
	Red Noise
	Random Voltage

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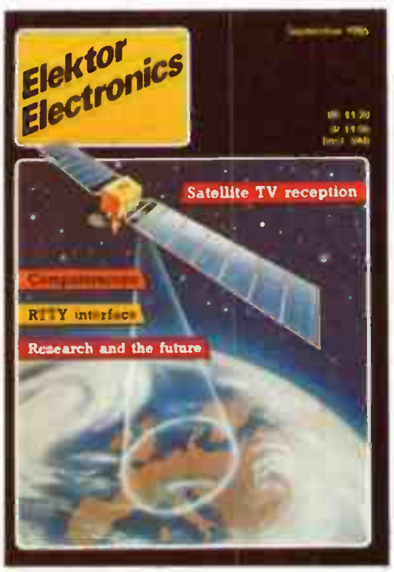
Elektor Electronics in AEM

CONTENTS

PROJECTS

ARTICLES

SEE 'RETAIL ROUNDUP' ON PAGE 67 FOR A GUIDE TO SUPPLIERS STOCKING KITS OR COMPONENTS FOR PROJECTS IN THIS SECTION.



BAROMETER/ ALTIMETER

Entirely in tune with the general idea of this month's front cover photograph, this article deals with a portable, easy to use instrument which combines the functions of altimeter and barometer to delight amateur aviators, mountaineers, and meteorologists alike.

The proposed portable instrument is in essence a true aneroid barometer featuring a 3½-digit read-out indicating millibars (mb, barometer function) or relative height (m, altimeter function) as selected with a switch. The maximum parameter values are about 1200 mb and 1999 metres, respectively, which would appear to be suitable for most practical applications.

Standard atmosphere

It is generally known that the atmospheric pressure at sea level differs from that at a certain altitude; in fact, pressure falls with increasing height. It is only when atmospheric pressure changes suddenly that we notice the inverse relation with altitude, for instance in a fast lift, or a ride in mountainous areas. However altitude is not the sole factor determining atmospheric pressure; the structure of the relevant air layer, the temperature of upper layers, relative humidity and weather conditions, and latitudinal position also play a distinct role. As to the latter factor, it should be realized that the earth's atmosphere is highest above the equator, due to the centrifugal force and the relatively high temperature which causes the air to expand. Given the above parameters, measuring altitude with some degree of accuracy would call for a fully equipped meteorological station to be carried on aircraft; and yet, altitude measurement based on the barometric principle is general practice in aviation, although there is at present a strong tendency to use radar and laser techniques for higher precision.

To rule out the effects of most of the previously mentioned parameters determining atmospheric pressure, an international *standard atmosphere* has been adopted to represent a specific average composition and condition of air. Aviators thus take altitude readings assuming a position in standard atmosphere. In addition, a correction factor is taken into account, specifying instantaneous atmospheric pressure at sea level in the relevant area.

It goes without saying, therefore, that the measured altitude may differ slightly from the actual altitude above the earth or sea. In this context it is readily understood that aviators use the term *pressure altitude* rather than simply altitude. Since every aviator is assumed to fly by pressure altitude, the actual altitude of the aircraft is considered less important. Before entering a specific area, the pilot receives the previously mentioned correction factor from the relevant control tower.

Absolute pressure is related to pressure altitude according to

$$P = 1013.25\,[1 - 22.555 \times 10^{-6} A_{(p)}]^{5.2563} \quad \text{[mb]}$$

where
P = absolute pressure;
$A_{(p)}$ = pressure altitude [m];
1013.25 = standard atmosphere at 0 m [mb].

The non-linear correlation is mainly due to temperature effects and air being compressible. If, however, the altitude span of the proposed meter is chosen to lie within a reasonable range of, say, 2,000 metres, linearization causes a maximum deviation of 0.6% only. This value was considered satisfactory in view of most practical applications. Moreover, the pressure sensor proper can be expected to cause an error in excess of the stated linearization error. Figs. 1a and 1b further illustrate that linearization over the target span of ±2,000 m can be done with impunity.

At sea level, the pressure gradient is about 0.12 mb/m, while at 2,000 metres it is about 0.10 mb/m. For a linear correlation in the 0-2,000 m range the gradient should be 0.108 mb/m, which explains why the maximum error of 0.6% occurs at about 1,100 m altitude.

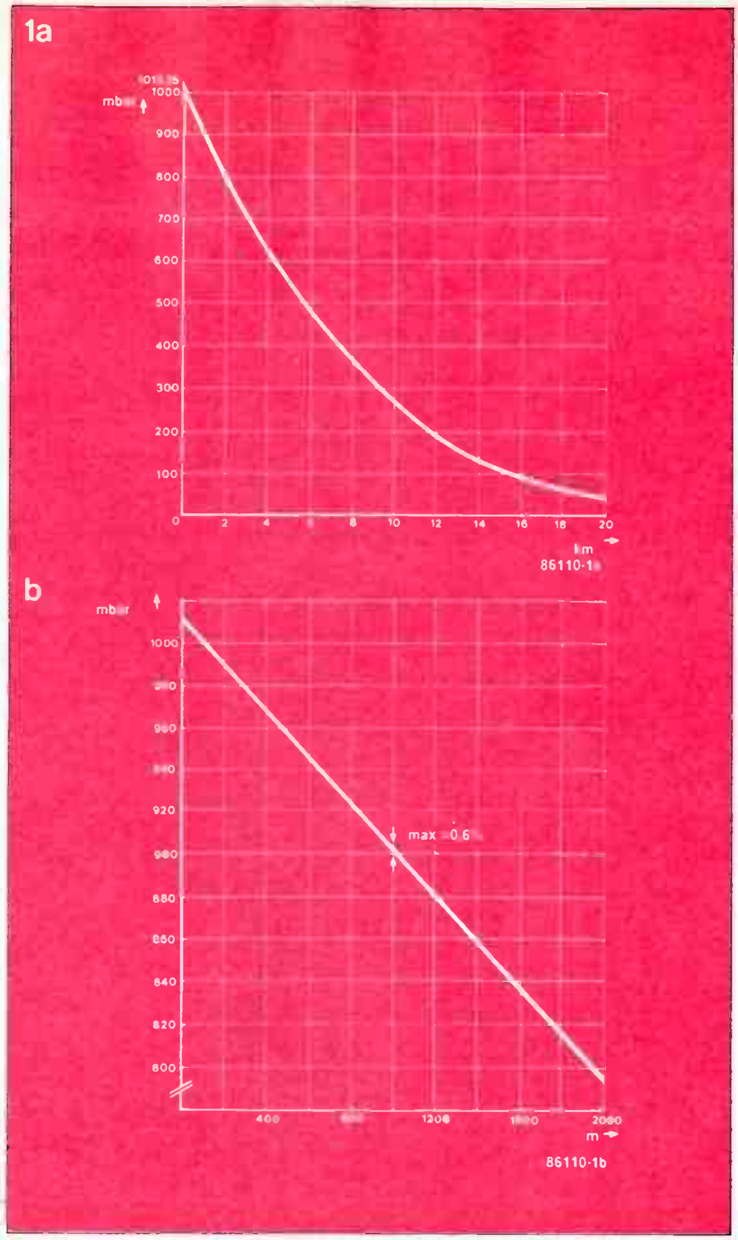


Fig. 1. Correlation between altitude and atmospheric pressure over a large altitude range (non-linear, Fig. 1a) and a limited range (linearized, Fig. 1b).

Altimeter or barometer

Although in aviation the foot has been accepted as the standard unit expressing altitude, it was deemed rather impracticable for use with a 3½ digit LCD readout, as 2,000 feet is too limited a span, and the next alternative, 20,000 feet, is unattainable owing to the inevitably large linearization error.

Since the present design is in essence a precision absolute pressure gauge, it was thought useful to incorporate a true aneroid barometer facility. The altimeter/barometer function is simply selected with a small switch. Pressure up to 1.2 bar can be measured with the Type KP101A fitted, while the two other pressure sensors given in Table 1 go up to 2 bar. Although fitting either one of these would extend the pressure range of the meter, its function as an altimeter suffers owing to the lower sensor sensitivity (also note the higher supply for the KP100A).

A semiconductor pressure sensor

At the heart of this circuit is a Type KP101A monolithic pressure sensor from Philips/Mullard. The development of reliable, robust and miniature-size pressure sensors has been prompted by medical scientists, who required an electronic means of continuously monitoring a patient's blood pressure. Mullard, among other semiconductor manufacturers, came up with device based on semiconductor strain gauges connected to provide a flex-dependent output voltage to processing circuitry.

The underlying principle of the KP100 series of pressure sensors is the piezo-resistive effect in certain metals and doped semiconductor material, whose resistivity is a function of flex. In practice, this effect is exploited by fitting strain gauges onto objects to determine the rate of flex. While developing the pressure sensor, it was found that silicon-based strain gauges offered the double advantage of being relatively sensitive, and at the same time readily implantable in a diaphragm enclosing an evacuated chamber (see Figs. 2 & 3). The strain gauges are configured in a Wheatstone bridge, so that ambient pressure variations are translated in bridge unbalance and hence a proportional output voltage (see Fig. 4). At 25 °C and a bridge supply of 7.5 V, the Type KP100A typically produces a bridge output of 13 mV/bar. However any practical application of the sensor should include an offset com-

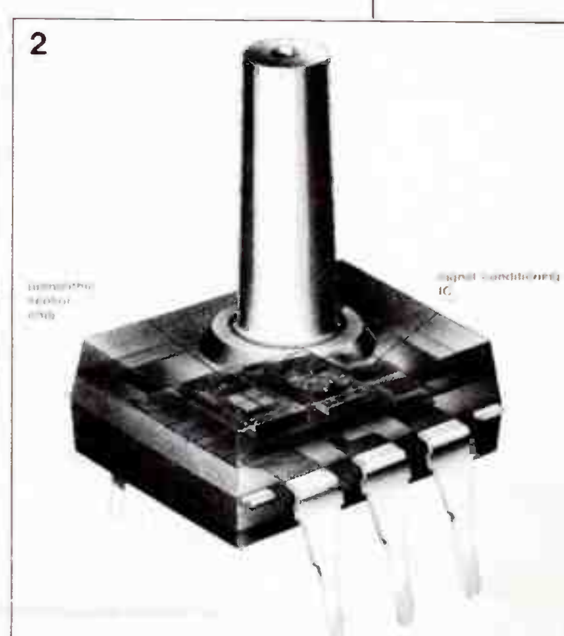


Fig. 2. The Type KP100A pressure sensor with its characteristic nozzle-like inlet.

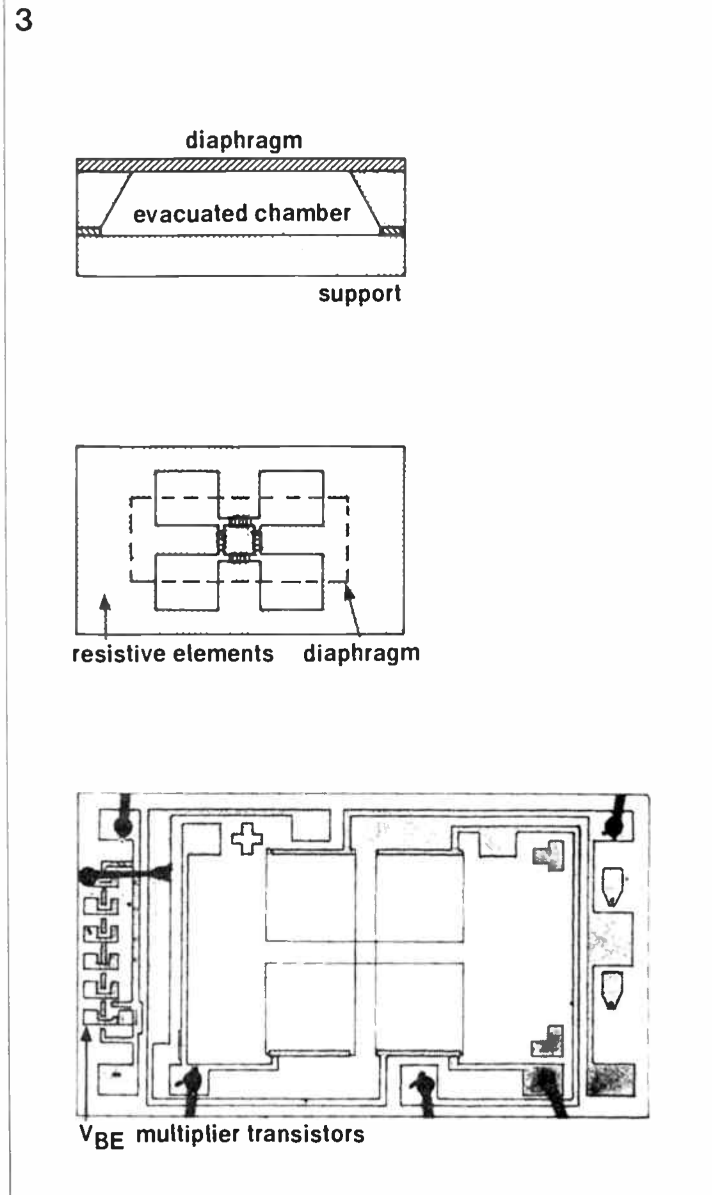


Fig. 3. The pressure sensor comprises four piezo-resistive strain gauges implanted in a sealing diaphragm on top of an evacuated chamber

pensation facility to level out quiescent bridge unbalance due to production tolerance of the strain gauges. As to the temperature coefficient of the bridge, the KP101A features an internal compensation circuit realized as a multi-transistor V_{BE} multiplier which caters for an increase in bridge supply voltage with rising ambient temperature. The regulating effect of the temperature compensation is illustrated in Fig. 5; note that the improvement in temperature stability is tenfold (−0.02%/K rather than −0.2%K), at the cost, however, of some loss in sensitivity, as a specific bridge supply voltage band needs to be reserved for the series regulator to operate correctly.

Circuit description

With reference to circuit diagram Fig. 6, the proposed barometer/altimeter is essentially a sensor-driven differential voltmeter with offset compensation circuits for the pressure sensor and for the setting of the relevant sea-level atmospheric pressure (zero-level). The overall sensitivity of the meter can be dimensioned to suit specific types of sensor in the KP100 series. Switching between operation as an altimeter or an aneroid barometer is accomplished with a single switch. An additional, external, temperature compensation circuit, plus a highly stable internal 5 V supply complete this simple to built unit. A single PP3 type 9 V battery ensures sufficient capacity to feed the low-power circuit for extensive periods.

The circuit around T_1-A_1-D_1 is a precision 5 V regulator; for this design, the ubiquitious Type 78(L)05 regulator offers entirely insufficient stability. D_1 is an adjustable, high stability, 2.5 V reference diode whose cathode voltage is doubled by A_1. Note that D_1 is biased from the 5 V output rail to create a feedback loop which includes T_5 to go round the problem of A_1 having to raise its output to the supply voltage level, which in the present case can be left conveniently at 5 V. P_5 allows fine adjustment of the 5 V supply to compensate for the tolerance of R_{25} and R_{26}, as well as for any offset introduced in A_1.

In all, the design of the 5 V regulator, and the fact that all opamps are fed from a common 5 V rail ensures a high degree of stability of the circuit, even if this is fed with a nearly exhausted battery.

The sensor output voltage can be taken from pins 2 and 3 of IC_4, but due account should be taken of a common-mode offset voltage amounting to half the bridge supply voltage; moreover, both are temperature-dependent to the same extent. As the wanted sensor output voltage is only a fraction of the common-mode level, a virtual ground rail is created at common-mode potential by means of bridge supply dividers R_{14}-R_{15} and buffer A_2.

The first differential stage, A_3, not only achieves a bridge output signal amplification of 17, it also enables a bridge offset compensation circuit to be realized with network R_{32}-R_6-R_{33}-R_{34}. Furthermore, adjustable, external, temperature compensation is effected with R_7-R_8-R_9-P_3-P_4, deriving the temperature compensation voltage from the +5 V rail.

At a given ambient temperature, P_3 should be set for 0 V between its wiper and the output of A_2. The temperature compensation signal at the wiper of P_4 is therefore 0 V as well at

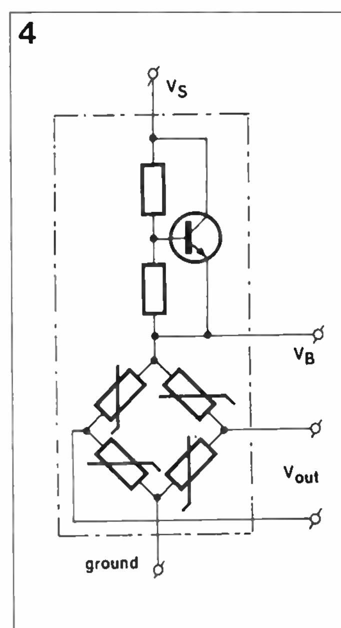


Fig 4. Equivalent circuit of the pressure sensor. Note that the strain gauges have been connected in a Wheatstone arrangement

the reference temperature. If, for instance, the ambient temperature rises, the bridge supply voltage, and thereby the output voltage of A_2, rises accordingly. In this manner, the compensation voltage to temperature gradient is adjustable with P_4. Addition of the compensation signal to the measured signal is either via R_{12} or R_{13}, depending on the requisite polarity for the specific sensor; this will be reverted to in the section on setting up.
The amplified, offset-free, temperature-compensated output voltage is available between pin 1 of A_2 and pin 7 of A_3. This voltage is linearly related to the absolute ambient pressure. Altitude measurement, however, calls for a relative rather than an absolute value, since the atmospheric pressure at 0 metres is to be subtracted yet; P_7 and A_4 have been included to this effect.
The LCD readout circuit is a conventional design based on the well-known type ICL7106, whose operation is briefly detailed in *LCD panel meter*, *Elektor Electronics*, October

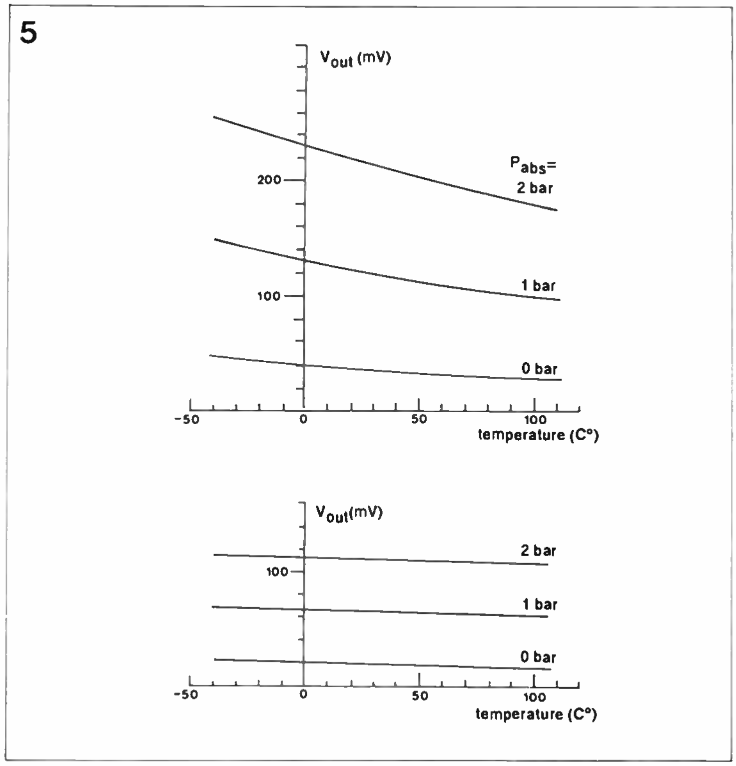


Fig. 5. Correlation between temperature and bridge output voltage with pressure as a parameter, without internal compensation (5a), and with internal compensation enabled (5b) resulting in higher stability yet lower sensitivity.

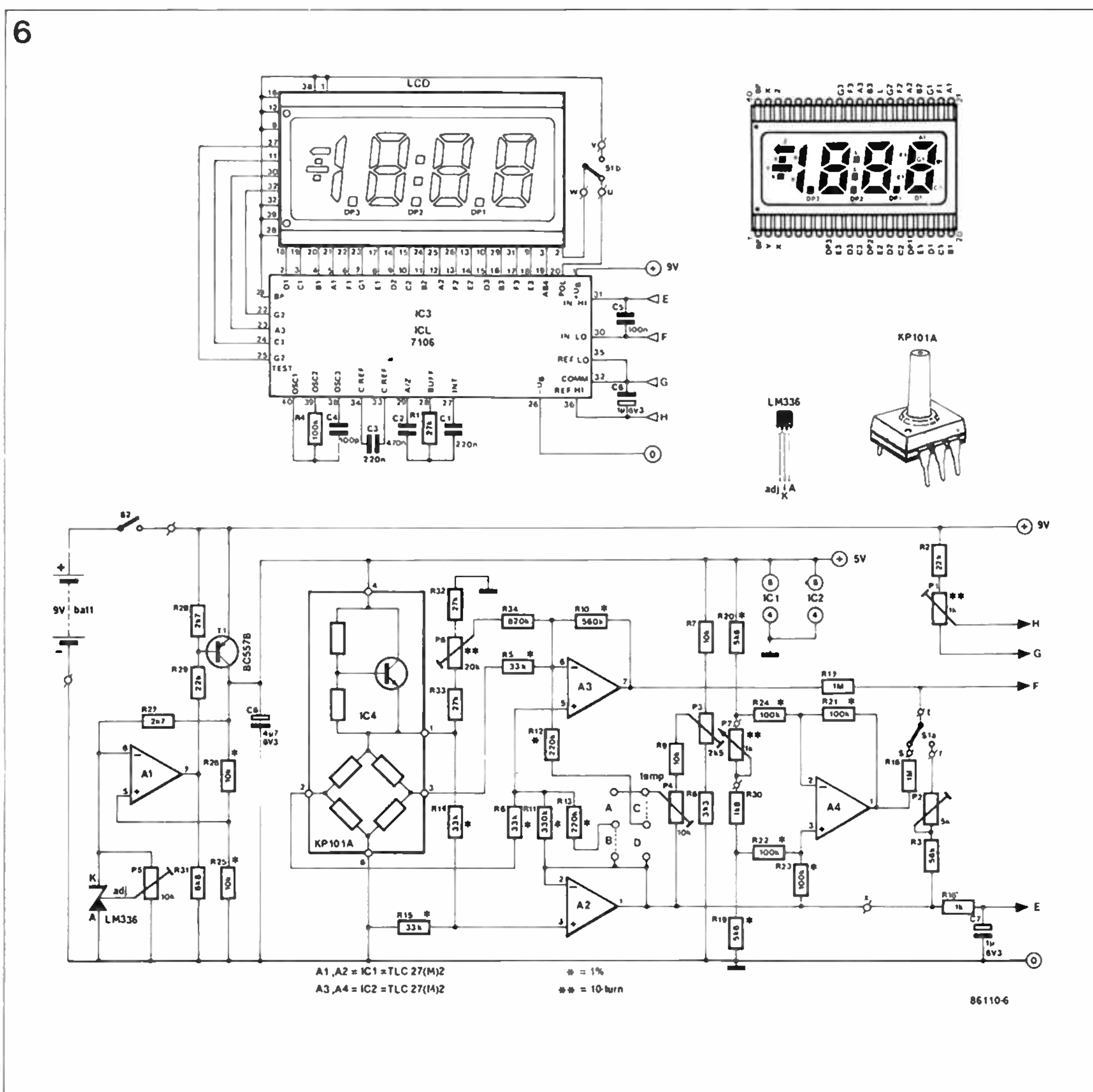
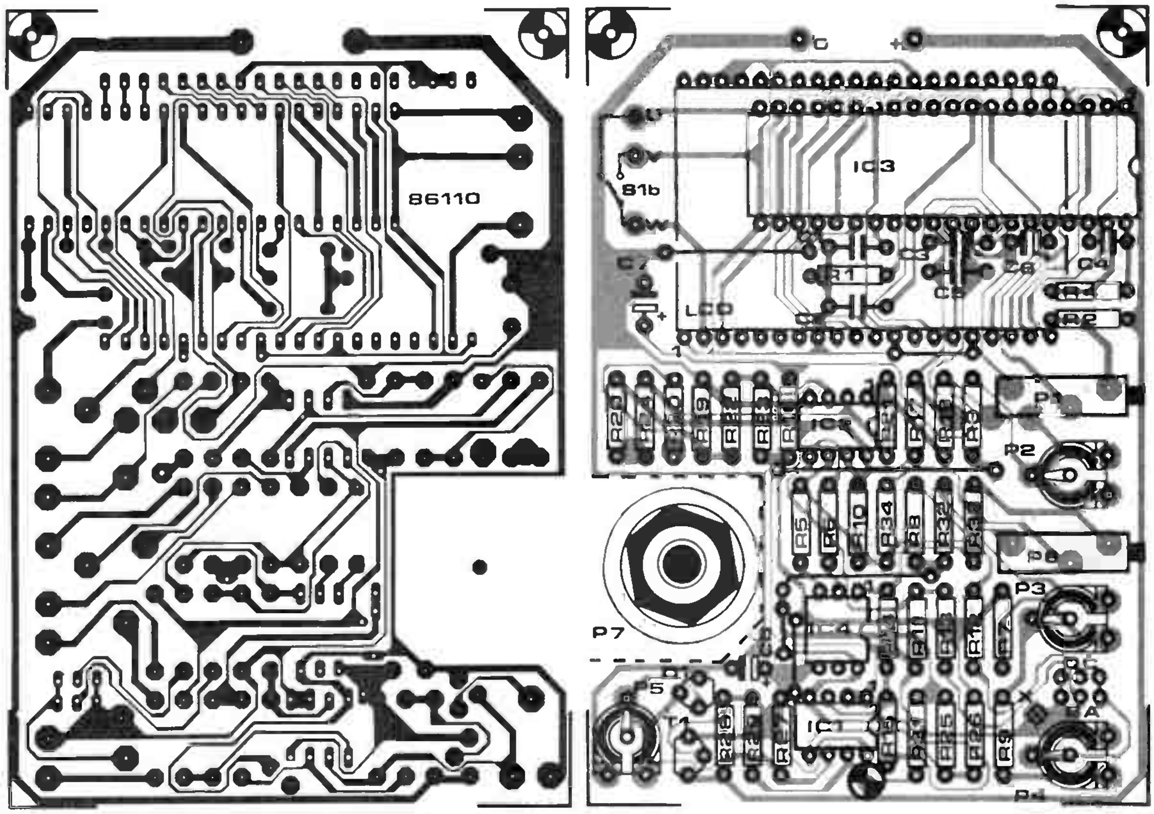


Fig. 6. Circuit diagram of the barometer/altimeter.

Fig. 7a. Component mounting plan and track layout of the barometer/altimeter PCB, which is conveniently fitted in a hand-held Verobox. Note that C_3 is a solid capacitor, not an electrolytic type as printed on the PCB.

Fig. 7b. S_1 and P_7 are wired to these points on the PCB track side.

7a



Parts list

Resistors:

R_1;R_{32};R_{33} = 27 k
R_2;R_{29} = 22 k
R_3 = 56 k
R_4 = 100 k
R_5;R_6 = 33k2; 1%
R_7;R_9 = 10 k
R_8 = 3k3
R_{10} = 562 k; 1%
R_{11} = 332 k; 1%
R_{12};R_{13} = 221 k; 1%
R_{14};R_{15} = 33k2; 1%
R_{16} = 1 k
R_{17};R_{18} = 1 M
R_{19};R_{20} = 5k62; 1%
R_{21} ... R_{24} incl. = 100 k; 1%
R_{25};R_{26} = 10 k; 1%
R_{27};R_{28} = 2k7
R_{30} = 1k8
R_{31} = 6k8
R_{34} = 820 k
P_1 = 1 k preset; 10-turn cermet
P_2 = 5 k preset
P_3 = 2k5 preset
P_4;P_5 = 10 k preset
P_6 = 20 k preset; 10-turn cermet
P_7 = 1 k multiturn potentiometer

Capacitors:

C_1 = 220 n
C_2 = 470 n
C_3 = 220 n MKT
C_4 = 100 p ceramic
C_5 = 100 n
C_6;C_7 = 1 μ; 6V3 tantalum
C8 = 4μ7; 6V3 tantalum

Semiconductors:

D_1 = LM336 (National Semiconductor)
T_1 = BC557B
IC_1;IC_2 = TLC272 or TLC27M2 (Texas Instruments)
IC_3 = ICL7106
IC_4 = pressure sensor

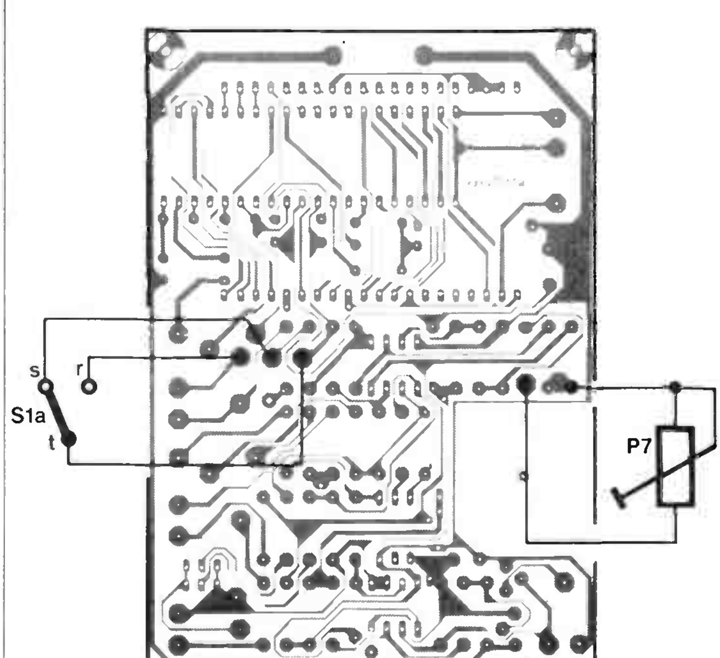
1981. P_1 is used to set the sensitivity as required. As already stated, the maximum display reading is ±1999, which justifies the choice of the metre as the unit of altitude.

Switching to barometer operation involves three simultaneous operations, accomplished by S_1; the zero level compensation should be disabled; the sensitivity should be reduced by a factor 8.3, approximately; and the polarity sign on the LC display must be reversed in accordance with the proportional relation between pressure and readout value.

The first two functions are combined in S_{1a}; P_2 is used to calibrate the pressure indication. Strictly speaking, reversing the display sign requires ICL7106 pins 30 and 31 to be driven with a reversed polarity input signal. However since this would call for a DPDT section on S_1, another solution was found in the suppression of the minus sign by means of S_{1b}; as the sensor measures absolute pressure only, the minus sign is entirely irrelevant anyway.

The LCD reads in millibar, the maximum indication being some 1200 mb as determined by the maximum level that can be handled accurately by the meter electronics.

7b



Construction

Constructing the altimeter/barometer should hardly present problems, as a ready-made PCB is available from our Readers Services. Circuit board Type 86110 (see Fig. 7a) has been made to fit into a hand-held Verobox; it may be necessary, however, to bevel the corners of the board before it can be mounted. P_7 calls for a recess hole to be cut, while its wires, as well as those of S_{1a}, should go to points on the PCB track side, as shown in Fig. 7b.
The sensor should be soldered straight onto the PCB, as a 6-pin DIP socket would cause strain in the IC terminals and thereby possible instability. The LCD should be mounted at a suitable distance above the board surface to enable it to protrude from a clearance in the box. It is a good idea to use two sets of three stacked 20-way socket terminal strips to achieve the correct height; a lengthwise cut 40-way wire-wrap socket is also quite adequate for this purpose.
To improve upon the thermal stability of the meter, the Verobox should be lined internally with small sheets of expandable polystyrene. For optimum screening of the sensitive amplifiers, grounded tin sheet plates were glued onto the top and bottom lining surfaces.
S_1, S_2 and P_7 are external controls; the latter is preferably equipped with a special 10- or 16-turn locking dial.

Setting up and use in practice

As only very few constructors of the present altimeter/barometer would have access to a fully equipped

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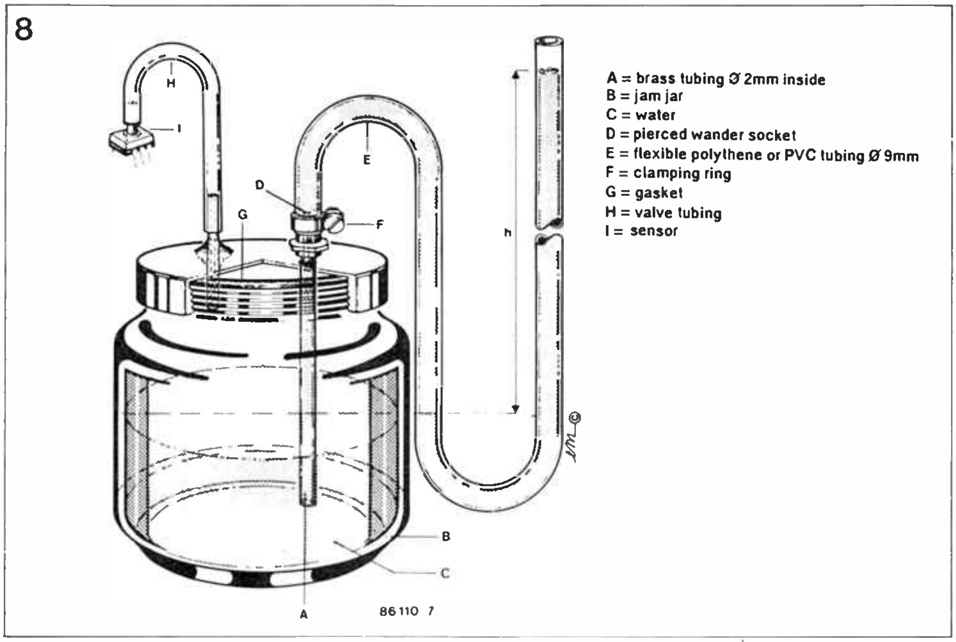

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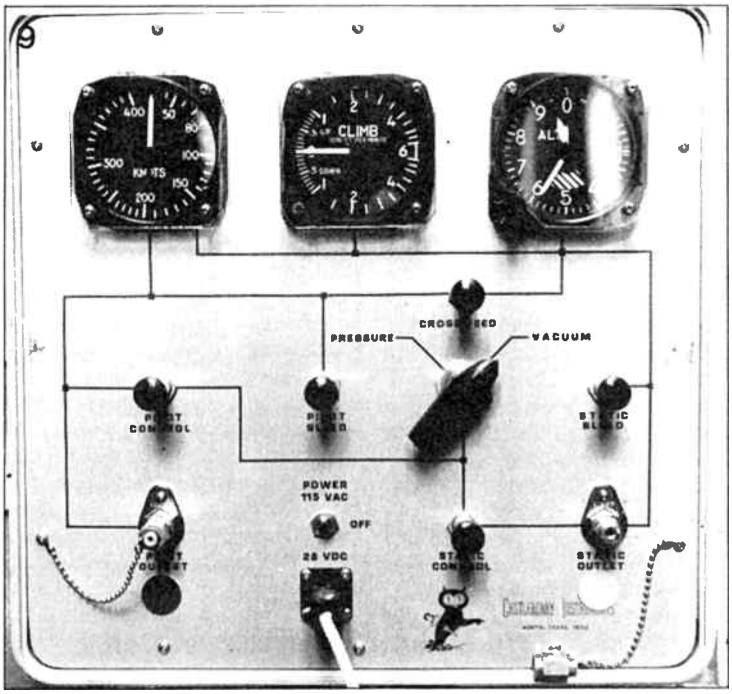


KP101A
(Philips/Mullard).

Miscellaneous:
S_1 = miniature SPDT switch
S_2 = miniature DPDT switch.
LCD = 3½ digit, e.g. Videlec LC513031-300 15/21; Data Modul 43D5R03; Hamlin 3901 or 3902 SE6902.
0.1 inch pitch terminal block 2 rows of 3 contacts.
2 off jumpers for above block.
2 off 8-pin IC sockets; 1 off 40-pin socket.
6 off 20-way socket terminal strip for LCD.
Hand-held box, i.e. BICC VERO Type 65-2996H.
PCB Type 86110

PP3 battery 9 V plus clip.

Table 1
Sensor specifications

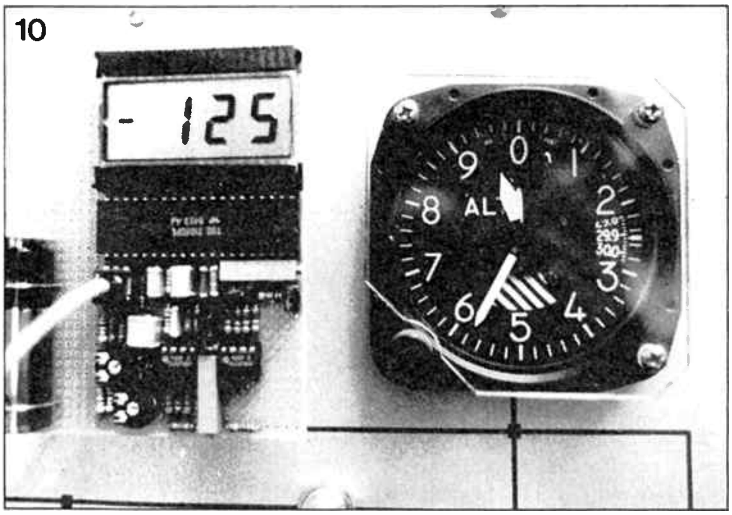
	KP100A	KP100A1	KP101A
bridge supply voltage			
max	12 V	12 V	12 V
typ (optimum temperature compensation)	7,5 V	5 V	5 V
operating pressure range	2 bar	2 bar	1,2 bar
sensitivity (at 25°C)	9 – 17 mV/Vbar	9 – 17 mV/Vbar	14 – 28 mV/Vbar
offset voltage	±5 mV/V	±5 mV/V	±5 mV/V
temperature coefficient of sensitivity			
uncompensated (bridge supply ≦12 V)	–0,2%/K	–0,2%/K	–0,2%/K
compensated	±0,02%/K	±0,02%/K	±0,02%/K
temperature coefficient of offset voltage (full scale)			
uncompensated (bridge supply ≦7,5 V)	±0,04%/K	±0,04%/K	±0,04%/K
compensated	±0,06%/K	±0,06%/K	±0,06%/K
bridge resistance	1,8 kΩ	1,8 kΩ	≈1 – 2 kΩ
pressure hysteresis (full scale)	±0,6%	±0,6%	≈ ±0,6%

Data taken from *Philips Technical Publication 156.*

Fig. 8. A home-made calibration instrument for setting up the barometer/altimeter.

Fig. 9. Probably the envy of many an avionics enthusiast: a professionally specified aircraft instrument calibration unit.

Fig. 10 Setting up an early prototype of the barometer/altimeter



avionics workshop comprising a calibration unit similar to that shown in Fig. 9, adjusting the completed circuit requires a good deal of patience. However with a DMM and a few pressure measurement contrivances, setting up should not present problems.

To begin with, P_5 is adjusted for 5.000 V at the collector of T_1. The measured value should remain stable with a battery voltage down to 7 V. Perform a fast check on the sensor bridge function by measuring the output voltage of A_2; this should be about 1.2 V at 20 °C.

Disable the external temperature compensation by placing two jumpers in positions B and D. Set S_1 to the altimeter function (as shown in the circuit diagram), and set P_1 for a reference voltage of 50 mV between pins 35 and 36 of IC_3. Next, attempt zeroing the display read-out by turning P_7; if this can not be done, the sensor offset compensation is still out of range, and P_6 should be adjusted accordingly.

Fig. 8 shows a suggested set-up for calibration of the altimeter. A pressurized vessel is used to simulate low altitude. Either a small, hand-operated pump plus manometer borrowed from a former student of medicine, or a 2 m high (≈200 mb) Torricellian tube filled with water can be used to set P_1 for an LCD reading in accordance with the manometer indication, or −1832 m when using the tube. Next, measure the previously mentioned reference voltage for IC_3; if this is less than about 35 mV, the sensor is slightly insensitive, and the amplification of A_3 may have to be increased by changing R_5 and R_6 to, for instance, 22 k 1%. Try out the effect and redo all previously mentioned settings.

Switch to barometer operation and adjust P_2 for a reading of 200 mb when using the Torricellian tube. The setting of P_1 should remain unaltered.

Proceed with compensating the sensor offset as detailed below. It should be borne in mind that this compensation serves to ensure a read-out of nought at 0 mb, as well as to enable the span of P_7 to be large enough during altimeter operation.

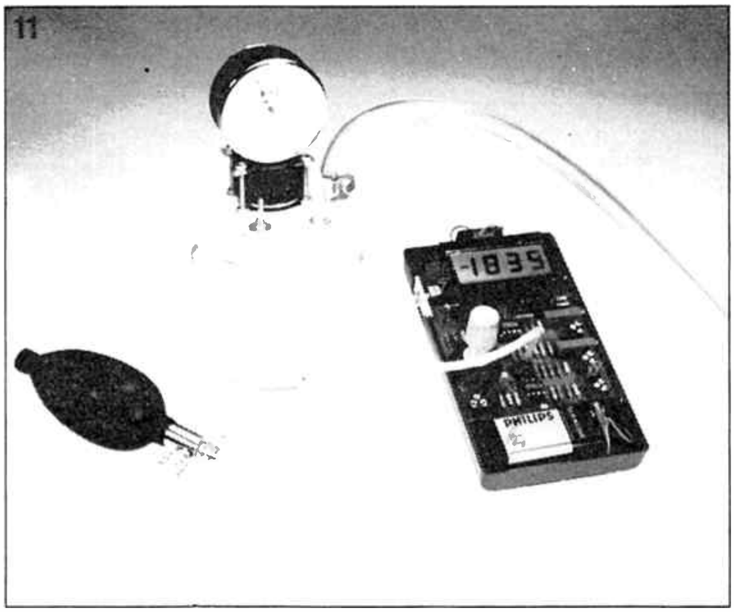
Adjust P_6 to have the read-out tally with the relevant atmospheric pressure at the time of calibration. A glance at the giant displays indicating weather conditions and fitted as a public service by some shopkeepers in possession of a meteorological station may be useful to acquire the instantaneous pressure. A more accurate method, however, involves phoning the meteorological service of the nearest airport and asking for the current atmospheric pressure *and* the associated level at which the measurement was taken. Find out about the relative altitude of your location, and observe a correction factor of 0.12 mb/m.

For the setting of the temperature compensation, the polarity of the temperature coefficient must be established. Leaving the jumpers in positions B and D, allow the meter to stabilize at room temperature (20 °C) and set P_3 for 0 V between its wiper and the output of A_2. Zero the read-out and gradually increase the ambient temperature to, say, 40 °C, whilst observing the LCD indication. Should this go negative, a negative compensation signal is required, and the jumper in position D must be fitted in position C; the B jumper remains where it is. Should the indication increase, B is moved to A while D remains where it is. After positioning the jumpers as required, the meter is zeroed with P_4 (note that the temperature is still at a higher than normal level). Arrange for the temperature to vary gradually between about 20 °C and 40 °C to verify the eventual stability of the zero setting; if necessary, fine adjustment is carried out by turning P_5 for optimum operation of the sensor's internal temperature compensation circuitry (V_{BE} multipliers).

A prototype of the barometer/altimeter, shown in Fig. 10, achieved an 8-hour stability of ±5 m. Although the least significant display can be expected to change at quite frequent intervals, it was nonetheless deemed useful to retain so as to provide a trend indication (rate of climb/descent), rather than any absolute value.

(TW)

Fig. 11 Alternative version of the pressurized vessel calibration method. The instruments shown here are normally included in a portable blood pressure measuring outfit.



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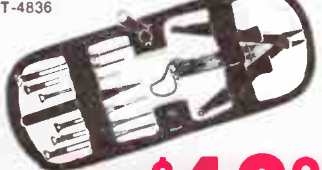

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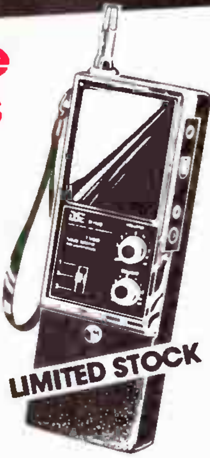

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Pocket Com II. They'll have a ball playing spies and commandos with this fully operational 2-way transceiver. No licence required. Complies with DOC spec. RFME001. Cat D-1101

$15.95 each

Let the kids talk to Santa

With this fantastic 3 channel hand-held it's easy. Bushwalkers, campers and fishermen can ask Santa to get them out of trouble too... what a gift! One channel fitted with CB crystal, two left free for your choice. DOC Approved Cat D-1106

DUE MID DEC

$129

Yo-Ho-Ho.. Budget Mobile CB

Compact to fit Santa's sleigh and today's smaller cars. But full 40 channel power, digital frequency display, RF power meter and more for reliable motoring.

$139

DUE EARLY DEC

DOC Approved. Cat D-1450

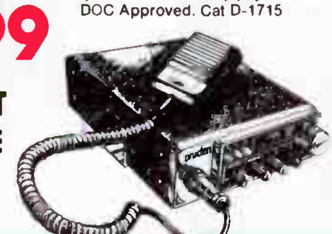
Top range AM/SSB Mobile

Name it and this compact CB has it... all the best Uniden features! Plus SSB band for that extra range when you need it most. Ideal as base station with optional 12V supply.

DOC Approved. Cat D-1715

$299

GREAT VALUE



Hear the clarity of UHF FM

All the most wanted Uniden features to jingle your bells. 40 channel UHF CB has the lot — even repeater capability built-in! Maximum legal power. DOC Approved. Cat D-1806

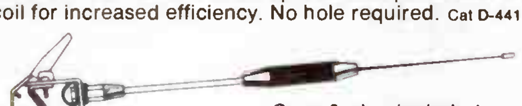
$479

WHAT A GREAT BARGAIN

Get the CB message with our antennas

27MHz gutter mount takes a moment to set up and what performance! Centre loading coil for increased efficiency. No hole required. Cat D-4411

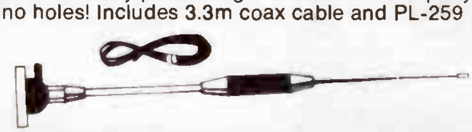
$31.95



Coax & plug included.

27MHz with magnetic base really pulls in signals. Ideal for company cars and hire cars: no holes! Includes 3.3m coax cable and PL-259 plug. Cat D-4412

$29.95



DICK SMITH ELECTRONICS PTY LTD

DICK SMITH ELECTRONICS FOR A GREAT RANGE OF AUSTRALIA'S FINEST TEST EQUIPMENT!

Multimeter Transistor/Diode Checker

NEW!

New multimeter and transistor/diode checker. 33 ranges 200-200M ohms (in 7 ranges). Current 200uA-10A AC/DC. With buzzer continuity. Cat Q-1445

GREAT **$79.95**

Digital Multimeter checks caps & semis too

The latest and the best for Christmas. Imagine: for this low price you get a full 3.5 digit LCD multimeter that also checks capacitors, diodes and transistors! A single AC/DC switch doubles voltage ranges: up to 10 ranges, 200mV-750V AC/DC; doubles current ranges too: 200uA-10A AC/DC. Buzzer continuity included.

Cat Q-1465

NEW! **$115**

Economy 3.5 Digit Multimeter

Economy wide-angled LCD meter with RF shielding and overload protection. Handles 250V or 350V indefinitely.

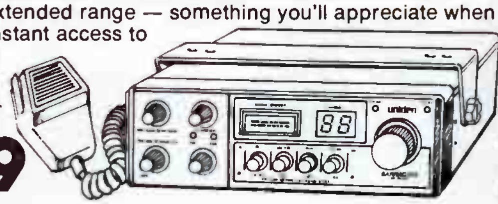
Cat Q-1520

$64.95 FANTASTIC VALUE

Yule tide gifts...
DSE marine safety transceivers

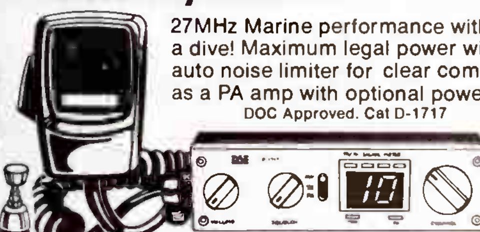
New Barracuda AM/SSB marine

Excellent marine performer! Covers all 10 channels in the 27MHz marine band for extended range — something you'll appreciate when you need it! And instant access to emergency CH.-88 plus many other advanced features.
Cat D-1714



$349

Economy marine



27MHz Marine performance without your budget taking a dive! Maximum legal power with all 10 channels fitted, auto noise limiter for clear communications. Doubles as a PA amp with optional power horn.
DOC Approved. Cat D-1717

ONLY **$139**

Prefer a hand held marine?

Here's our best: goes with you after mooring to prevent theft! Access to full 55 channels in the VHF marine band; reprogrammable 12 channels for coastal cruising. Switchable 0.5/2.5W output.
DOC Approved. Cat D-1404

$399

VHF Marine with Seaphone

Marine luxury at a bargain price. For safety there's access to all 55 international channels and instant CH-16 selection. Make calls — via OTC's Seaphone — from your boat to the land phone network. Ideal gift for any Salt!
DOC Approved Cat D-1400

$449
FANTASTIC

For Santas on a budget...

Our bargain priced 27MHz hand-held is the right choice. Performs with maximum legal power on 6 fitted channels; connects to an external antenna for greater range! Compact for go anywhere action. DOC Approved. Cat D-1125

$199

Anti-corrosion safeguard

Space-age technology protects metals against corrosion for up to 2 years. Small, inexpensive pad emits invisible, odourless vapour to 'coat' components, etc. Place inside marine radio... wherever rust could be a problem.
Cat D-1300

$5.95

Your DSE marine transceiver needs the best antenna

27MHz helical suits most hull types and doesn't require a ground plane. Complete with mounting base, cable and simulated ground plane. Cat D-4070 **$59.95**

Reliable antenna for your VHF marine transceiver. And what value: includes 'any-which-way' base with quick release lever that lowers antenna to prevent damage from tree branches, bridges and those flying fish that get away! Cat D-4016 **$74.50**

Solar panels... free power

Perfect summer gift!
Save $$$ buying new batteries! Use the Sun to recharge cells or power radios, tape players, etc. on the boat, while camping or at home. Have fun with solar experiments.

20V/500mA Solar Panel

SAVE $50

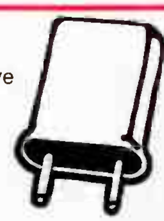
$159 Cat Z-4844

Xtals for hand-helds

Value stocking fillers for the old Salt. Transmit/receive pairs for popular 27MHz marine channels.

27.620 Cat D-6062	
27.860 Cat D-6086	27.910 Cat D-6091
27.880 Cat D-6088	27.940 Cat D-6094
27.900 Cat D-6090	27.960 Cat D-6096

$9.50 PAIR



4.5 Digit Multimeter

Affordable 4.5 digit bench top that's versatile enough to take with you! Extremely accurate with high resolution.

- 10 voltage ranges — accuracy .05% DC
- 6 resistance ranges — accuracy .15%
- 200uA min — 10A max AC/DC
- 6,000 hours battery life

Cat Q-1550

$289

Personal Multimeter

3.5 digit meter only 10mm thick! Features super fast auto ranging, buzzer continuity, polarity indication with minus sign, 2x/second sampling

- 8 auto ranging AC/DC voltage ranges
- 5 auto resistance ranges
- 5M ohm input resistance

WOW! **$59.95**
Cat Q-1555

Turbometer — air speed indicator

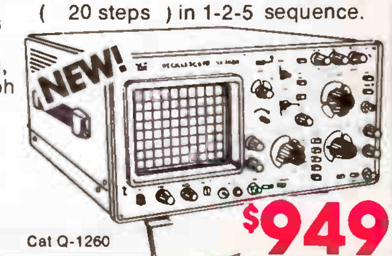
$30 less than anywhere else!

Santa can tell how fast he travels in flight! You can use it to test wind speed: yachting, ballooning, etc. (displays speed in knots, mph and metres per second). Handy tester for experiments and servicemen too! Cat Q-1405

JUST **$159**

Unbeatable value for dual trace 20MHz CRO!

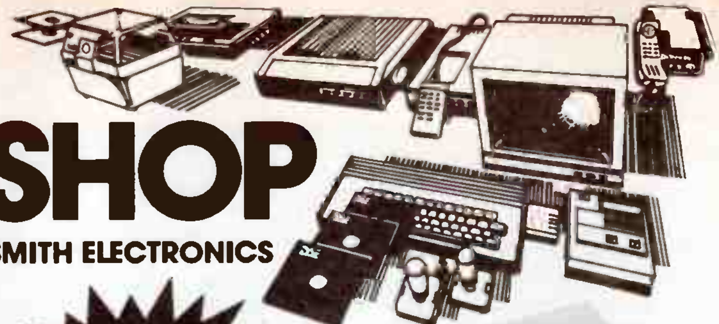
Sensational value! An affordable, professional standard 20MHz oscilloscope that's got the lot: **Bandwidth:** DC to 20MHz (-3dB). **Input impedance:** 1m ohm to 25pF +/-2%. **Algebraic addition:** CHI+CHII, -CHI+CHIII. **Sweep time:** 0.1us/DIV - 0.2s/DIV +/-3% (20 steps) in 1-2-5 sequence.



Cat Q-1260

$949

ONE STOP COMPUTER SHOP



A COMPLETE RANGE OF PERIPHERALS FROM DICK SMITH ELECTRONICS

VZ 300 Family Pack

NEW!

THOUSANDS SOLD!

The best value-for-money in computers today!

The ideal start to home computing. Easy to use, affordable and there's nothing extra to buy for an immediate start — plugs into any standard colour TV.

Includes Data Cassette! Usually an option with other systems, it's part of the ready-to-use VZ 300 pack. Run software cassettes and store programs you've developed on the versatile VZ 300.

We include FREE programs! The first thing the family will want to do is play a game, and you can without spending another cent. The VZ 300 pack includes 2 game AND 2 educational programs... more than enough to keep them going. Cat X-7307

More extras than you thought possible for the price!

ONLY $199

DSE Multitech for Xmas!

With all this power for the low price there really must be a Santa Claus! Features and performance that more than match IBM PC for business or advanced hobbyist applications — at $$$ less. And a choice of systems to suit your budget and needs:

System One: • 256K memory • 360K single built-in floppy disk drive • 3 months warranty.
Cat X-8000

$1395

System Two: • 256K memory • twin 360K built-in floppy disk drives • 6 months warranty and on-site service (Mainland capitals).
Cat X-8001

BONUS! Includes the new integrated progam, **First Choice,** which contains most of your business needs:
• word processing • spreadsheet • data base
• communications. **Worth $420!**

$1995

MONITOR NOT INCLUDED

DICK SMITH ELECTRONICS

Quality disks from only $2.75 each!

Premium double density 5¼″ disks you can trust important data on — made by a leading manufacturer exclusively for us! In library boxes of 10 diskettes.

Single sided
Cat X-3500
$27.50 a box.

Double sided
Cat X-3501
$29.50 a box.

DICK SMITH ELECTRONICS COMPUTERSTOP

• *NSW* • *Brookvale* 93 0441 • *Chullora* 642 8922 • *Gore Hill* 439 5311 • *Miranda* 525 2722 • *Newcastle* 61 1896 • *North Ryde* 88 3855 • *Parramatta* 689 2188 • *Tamworth* 66 1711 • *Wollongong* 28 3800 • *York St* 267 9111 • *ACT* • *Canberra* 80 4944 • *VIC* • *Elizabeth St* 67 9834 • *Richmond* 428 1614 • *Springvale* 547 0522 • *QLD* • *Brisbane City* 229 9377 • *Buranda* 391 6233 • *SA* • *Adelaide* 232 1200 • *WA* • *Perth* 481 3261 • *NT* • *Darwin* 81 1977 • *TAS* • *Hobart* 31 0800

QUALITY IN KITS FROM HEATHKIT

EXCLUSIVE!

Everybody's HERO!

The robot of the future is here today. It's Hero Jr — from Heathkit, of course. More than just a robot, Hero Jr will become a real member of your family. He (she?) is pre-programmed: Hero Jr will wake you up (even listen to make sure you're awake!), remember dates and anniversaries, walk, talk, protect you and your home (even activate your security system* for you!) and much, much more. You can re-program Hero Jr via its own keypad or with your home computer (needs RS232C link, terminal emulator software, cartridge adaptor and basic cartridge). Of course, Hero Jr is battery operated and comes with an AC recharger. Cat G-1005

**With optional Heathkit Security System*

$1395

(Also available built up: Cat G-1000 @ $1995)

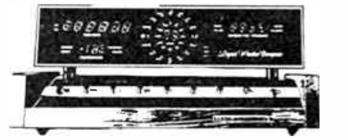
(Includes: R/C, IR Detector, Sonar, Cartridge Adaptor, RS232)

NOW IN STOCK AT DICK SMITH ELECTRONICS

The Ultimate Weather Station

Get better weather information than the weather bureau gives! Famous world-wide, the Heathkit computerised weather station gives wind speed and direction, wind chill factor, temperature, barometric pressure (and whether its rising or falling)... everything! If your business is knowing the weather, the Heathkit weather computer is for you! Everything supplied — including sensors and cable. Cat G-2000

WEATHER STATION **$1100**



Hero Accessories:

Infra Red Motion Detector Cat G-1010
(for security applications) **$399**

RS232 interface Cat G-1030
(re-program Hero from your own computer) **$179**

Cartridge Adaptor Cat G-1050
(for plug-in command cartridges) **$179**

Spare Batteries Cat G-1040
(set 2 rechargeable) **$69**

BASIC Cartridge Cat G-1080
(Robotics Oriented BASIC Language — use when reprogramming with your own computer). **$179**

HEATHKIT ORDER FORM

Terms and conditions of sale:

For items stocked in DSE stores or the DSXpress centre, normal DSE terms and conditions apply.

For items from the Heathkit catalogue other than those normally stocked, DSE will order these for you on the following conditions:

(1) Price must be confirmed via the Heathkit Information Line — Sydney (02) 888 2105.

(2) A 25% non-refundable deposit must be made on any order (this can be done with your credit card as per normal sales).

(3) Normally delivery time from the US via seafreight is 8 to 10 weeks from order. Air freight is available (approx 10% extra) and this reduces the delivery time to approximately 4 weeks.

(4) Items ordered from the US do not qualify for our normal 14 day satisfaction guarantee or for refund: if in doubt about the kit you would like, take advantage of our special assembly manual offer.

(5) Quotations given for Heathkit products, whether written or verbal, are valid for 7 days only. This is because of the volatile nature of international currencies.

(6) Orders may be made by phone (toll free 008 226610), mail, fax, telex or any other of our normal order methods. If using phone, we suggest the order form be filled out to confirm the details of your order and retained by you.

Did you miss out on a Heathkit Catalogue?

Some issues of this magazine did not contain the Heathkit Catalogue (it is in very short supply world-wide!)

Or it may be that some light-fingered larrikin has lifted, purloined or pinched it before you saw it...

Don't panic: send this coupon to The Heathkit Information Service, Dick Smith Electronics, PO Box 321, North Ryde — and we'll send you one free of charge.

Or if you talk nicely to your local DSE store manager he/she might be able to find one for you (just give them this coupon).

Name ....

Address ....

.... Postcode........................

The best value-for-money you'll find this Xmas!

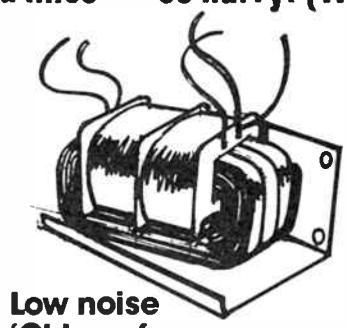
DICK SMITH ELECTRONICS PTY LTD

UTOPIATRONICS

Hobbyists — save $$$! Building a project is even more affordable than ever before. Amp and specialised components now sold individually...
Limited stock on selected lines — so hurry! (Watch January for more.)

240V -37V/17V Transformer
Handy power supply for kits: 240V primary with 37V/17V tappings. Ideal for amplifiers, power supplies, etc. Cat M-1200

$9.95



Low noise 'C' transformer
For that extra oomph — gives 36 volts a side at 2 amps. As used in higher powered amplifiers, power supplies, etc. Cat M-0152

$29.50

Standard SPDT
Toggle switch with legs brought out at 90° for circuit board mounting. Ideal for projects with board mounted controls through the front panel. Cat S-1290

$3.50

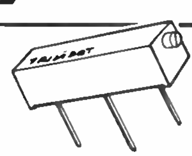
UTOPIATRONICS... SAVINGS & CONVENIENCE

Latch/Decoder/Driver for LCDs
CD4543BM/ CD4543BC. A monolithic CMOS BCD-to-7 segment device used for LCDs and other displays: ideal for computers/ calculators, DVM and various timing projects. Provides 4 bit storage latch and 8421 BCD-to-7 segment decoder/ driver functions. Cat J-1070

$4.50

Great for audio applications
TBA820A 8-pin audio amp IC with a 2 watt output. Two make a great amp. Cat Z-2507

$4.45



For precision calibrating...
Multiturn look trimpot for close-tolerance adjustment. PCB mounting type. Cat R-1910

$1.25

TBA120T IF amp and decoder
Designed specifically for audio detection in TVs and FM receivers... particularly in use with ceramic filters. Features: • 8 stage limiting IF amp and balanced detector • DC operated volume control • sensitivity: 3dB limiting voltage 30uV (typical). Cat Z-2510

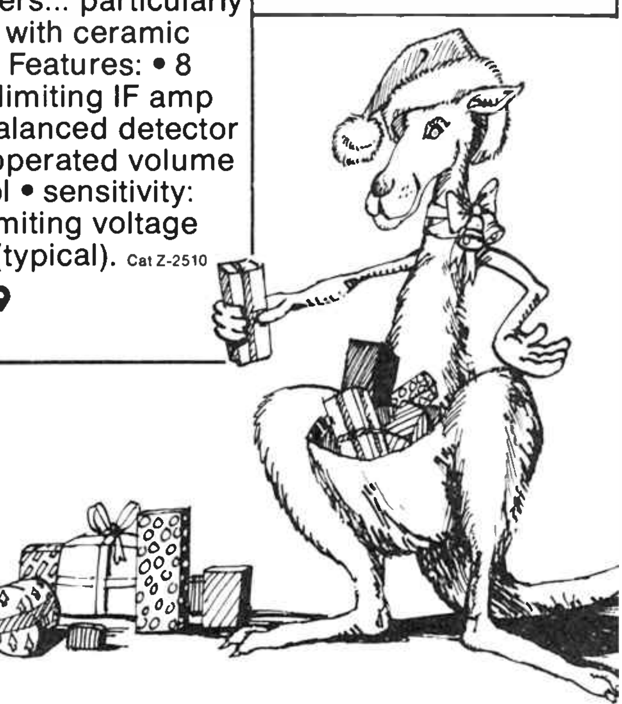
$2.49

2N4427 1W-175W RF transistor
Great all rounder for amplifier, frequency multiplier or oscillator applications. Also suitable for use as an output driver or pre-driver stages in VHF and UHF equipment. • Power output: 1.0W • minimum gain: 10dB • efficiency: 50%. Cat Z-2506

$3.99

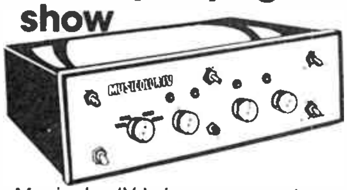
MRF660 RF line transistor
This beauty is perfect for commercial/ industrial VHF/UHF mobile transceiver applications. • Power output: 7.0W • power gain: 5.4dB minimum • efficiency: 60% minimum • load mismatch capability at high line and RF input overdrive. Cat Z-2508

$19.95



DSE — No. 1 for kits
over 320 kits to choose from!
DSE Kits make fantastic presents... they're exciting to use... fun to build!

Xmas party light show



Musicolor IV brings your party alive with dazzling synchronised music-light effects. 4 Chase patterns, auto reverse. Plugs into speakers. Cat K-3143

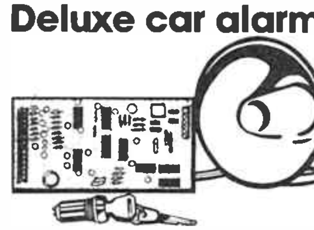
$129 As described in EA Aug '81

Liven up the party

Guests love it! Beat strobe light produces sensational flashes in time with music for professional effects. Cat K-3153

$64.95 As described in AEM July '85

Deluxe car alarm



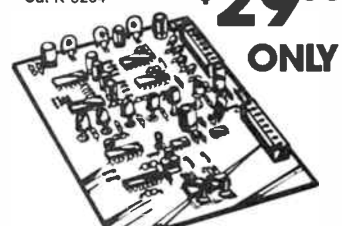
9 of the 10 protection features recommended by the NRMA: • delayed & instant inputs • flashing light • key on/off... and more! Optional ignition killer for 10 out of 10! Cat K-3252

$76.45 As described in EA May '84

Home alarm

Careful! It may not be Santa creeping in at night. 4 Sector alarm provides real security for $$$ less than commercial systems.
Cat K-3254

$29.95 ONLY



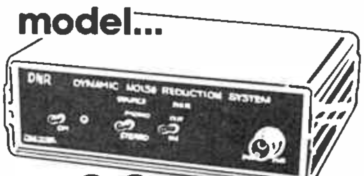
As described in ETI

Merry Stereo Xmas

VCR Sound processor adds sensational stereo-like sound to videos. Graphic equaliser tailors output to suit your tastes.
Cat K-3422

$54.95 As described in EA April '84

Turn your old VCR into the latest model...

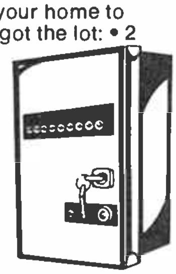


$99 As described in EA Aug '86

VCR DNR reduces annoying 'hiss' — improves signal-to-noise ratio up to 18dB. Adds brilliant simulated stereo too! Cat K-3423

Pro featured alarm — Save $$$!

Don't mortgage your home to protect it! We've got the lot: • 2 instant & 6 delay sectors • battery back up • siren and bell outputs (optional dialler drivers and strobe capabilities).



$139 Cat K-3424

Santa's helper

Infrared remote control turns electrical appliances on/off up to 12m away: TV, stereo, etc. Luxury you can afford! Cat K-3428

$69.95

As described in EA April '86

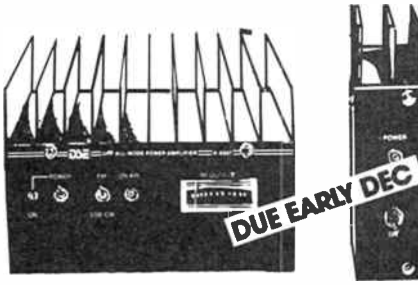
NEW! NEW! NEW! NEW!

UHF Power Amp

Most UHF transceivers are in the 2 to 10W class. Now you can lift them into the "super-rig" class with this 50W linear amplifier. Perfect for hand-helds too! Features: • 14dB gain (typical 50W out from 2W in) • Class AB • Harmonics better than -60dB • 10MHz bandwidth • 12V operated for mobile & base use. Cat K-6307

$279 ONLY

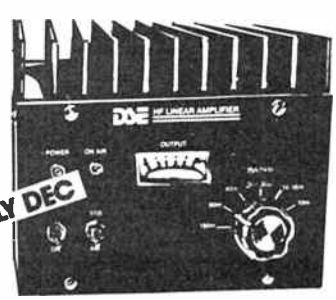
GREAT VALUE!



HF Amplifier

Sick of QRP? This new kit gives your HF transceiver a new lease of life with around 10-14dB gain. That's about 100 watts out from a 4 watt drive — and it covers the full HF spectrum from 2 to 30MHz (about 50W output on 10m). Wide-band ferrites used so no tuning required for band changes (switched low-pass filter covers all amateur bands). 4 to 10W drive required (15W if 2:1 attenuator included).

$249 ONLY Cat K-6331



Play around!

With our Anywhere Amp it's easy! Plug in a guitar, organ or electronic Chistmas bells — ideal portable PA amp. Compact, battery operated for use 'anywhere'. Cat K-3447

$87.95 BARGAIN

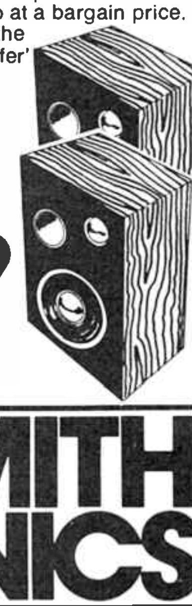
Short form kit — only
Case & hardware not included!

Speaking of value...

40W bookshelf speakers for quality stereo at a bargain price. Ideal gift for the 'do-it-yourselfer' or teenager.

Cat K-4000

As described in EA Nov '85

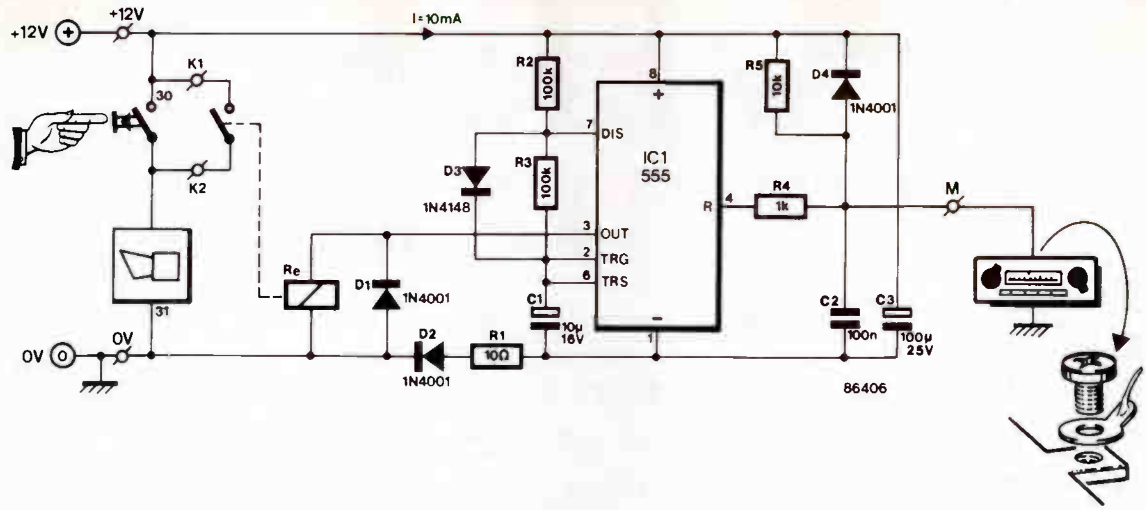


$249 PAIR

DICK SMITH ELECTRONICS
PTY LTD

car radio alarm

1



It is an unfortunate as well as a generally acknowledged fact that the car radio (plus cassette recorder) ranges among the most desirable and often surprisingly easy to steal objects on many a burglar's "shopping list".
This circuit may help to prematurely end the criminal practice by sounding the horn if it is attempted to remove the radio set; cutting or unplugging an additional ground wire, which has been hidden in the cable for connection to the battery and loudspeaker(s), causes the alarm to be set off, since the connection to the car chassis (ground) is interrupted.
The circuit for the car radio alarm is composed of a single timer, the well-known Type 555, surrounded by a few additional odds and ends to make an astable multivibrator, whose on-time is determined with C_1. Horn relay Re should have a coil resistance to enable the timer chip to energize it direct by means of the voltage at output pin 3.
It is seen that the multivibrator is in the reset state as long as point M is connected to earth, i.e. when the set is in the place where it should be. Removing the car radio inevitably causes the voltage at M to rise to nearly 12 V, ending the reset state of IC_1, which responds with activating Re, i.e. the car horn, since this is energized via the relay contacts in parallel with the horn switch in the steering wheel.
Note that Re is a PCB-mount type, e.g. the Siemens Type V23127-A0002-A101; where this is not available, any other type of small changeover relay having a 12 V coil may be wired to the circuit, provided the 555 is capable of handling the coil current; many motorists' and car repair shops can, no doubt, supply you with a suitable relay for the alarm circuit.
The sense wire to point M should be hidden in the multi-wire cable to the radio set, while the circuit itself must be fitted in an out of the way position, somewhere behind the dashboard.
In order that not even an attempt is made to break into your car, it is, as will be readily understood, prudent to stick adhesives to the car side windows, warning of the presence of the radio alarm. *(Sv)*

Parts list

Resistors:

R_1 = 10 Ω
R_2;R_3 = 100 k
R_4 = 1 k
R_5 = 10 k

Capacitors:

C_1 = 10 µ;16 V electrolytic
C_2 = 100 n;MKT
C_3 = 100 µ;25 V electrolytic

Semiconductors:

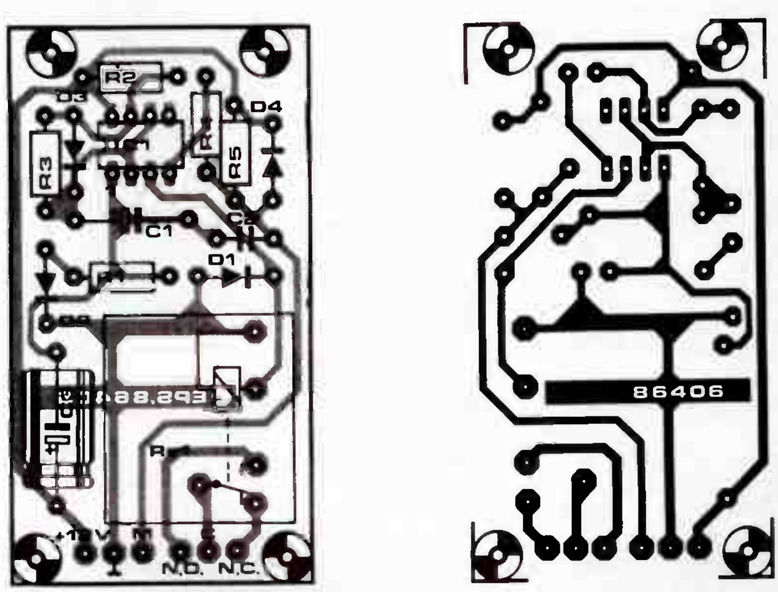
D_1;D_2;D_4 = 1N4001
D_3 = 1N4148
IC_1 = 555

Miscellaneous:

Re_1 = 12 V coil; single changeover*.
PCB 86406
Suitable plastic enclosure.

* see text.

2



SOUND SAMPLING AND DIGITAL SYNTHESIS

by D Doepfer & C Assall

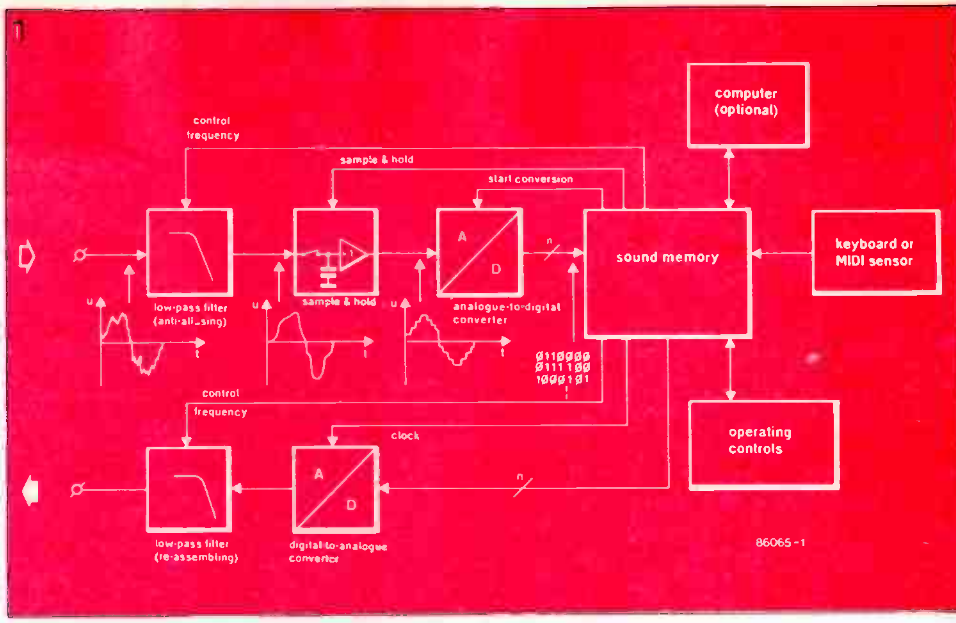
Nowadays, phrases such as sound sampling *and* digital synthesis *crop up more and more often when "insiders" are talking about electronic music or electrophonic instruments. Although on the face of it these two concepts have little in common, this is a false impression as the following article shows.*

A sound sampler is intended to be fed with a random range of sounds, process this if required, and output it as a series of discrete tones. Changing the frequency of the tones is normally effected by means of a keyboard, so that a sound sampler can be played like any other keyboard instrument.

Operation

The AF output signal of a microphone, tape recorder, or record player is stored and then reproduced. To this end, the signal is transformed into a series of (binary) digits in an analogue-to-digital converter (ADC), after which the digits are stored in a digital random-access memory (RAM) or read-only memory (ROM).
The converter is not able to scan the entire audio frequency range of 20 Hz to 20 kHz continuously. Instead, it samples the signal at regular, defined intervals of time, and only these samples are converted and stored.
Research has shown that a band of signals must be sampled at a frequency of not less than twice the highest frequency occurring in the band to prevent loss of information.
For the present purposes, the upper audio frequency will be taken as 16 kHz, which means that the sampling rate must not be less than 32 kHz. Lower sampling frequencies would result in aliasing: the alias signal has a frequency that corresponds to an harmonic of the sampled signal.
Since the bandwidth of the incoming AF signal varies according to the signal source, the input of a sound sampler is invariably provided with an anti-aliasing (low-pass) filter as shown in Fig. 1.
The cut-off frequency of this filter must not be greater than half the sampling rate. It may be variable as, for instance, in an integrated voltage-controlled filter (VCF), so that a variable sample rate can be used. Sampling rates greater than 32 kHz result in improved sound quality (because of the greater scanned bandwidth), but, since more digits then have to be stored during the same time interval, mean that the memory must have a correspondingly larger capacity.
Because the level of the input signal to the ADC must not change during the conversion process (since useless binary digits would result), a sample-and-hold (S&H) circuit is introduced between the ADC and the filter. This circuit derives a sample from the AF signal at fixed time intervals (every 31.25 μs at a sample rate of 32 kHz) and holds the level of this sample steady at its output until the next sample is taken. Basically, a sample-and-hold circuit consists of a switch, a capacitor, and a buffer-amplifier. When the switch is closed, the output of the circuit follows the input; when it is open, the last voltage level at the output is retained. The switch is an electronic type such as a field-effect transistor (FET) or CMOS switch. Sample-and-hold circuits are also available as integrated units.
The conversion of the analogue signal into a digital code must be completed within a slightly shorter time than 31.25 μs (at a sample rate of 32 kHz), because the S&H circuit also needs a finite time to come into operation. At the same time, no distortions must be introduced that would impair the final sound quality.
The resolution (in bits=binary digits) of the ADC stands in direct relation to the signal-to-noise (S/N) ratio and the dynamic range. The dynamic range is the range over which the ADC can produce a suitable output signal in response to an input signal. It is often quoted as the difference in decibels between the noise level of the device and the level at which the ADC is saturated (i.e. the overload level).
In practice, good resolution is taken as 1 bit for a dynamic range of 6 dB: that is, an 8-bit resolution gives a range of 48 dB; 10-bit=60 dB; 12-bit=72 dB; and 16-bit=96 dB. The choice of resolution is largely a matter of cost: on purely technical considerations, 16-bit resolution is, of course, preferable to 10-bit, but unfortunately good-quality 16-bit ADCs cost around

Fig. 1. Block diagram of a typical sound sampler.



£300. Furthermore, 16-bit resolution would put heavy demands on the S&H circuit as well as on the filter, and this would further increase costs. Finally, 16-bit resolution requires double the storage capacity of that for 8-bit resolution.

Fortunately, 8-bit resolution is perfectly satisfactory for most applications, but it requires optimum use of the dynamic range. Problems are only likely to arise with signals that cover a large range, for instance, those that have a large peak value at the onset and a very small one at the end. The *quantization distortion* will be quite audible at the end of such signals. This problem can be cured by higher resolution, e.g. 12-bit, or by an inexpensive *compander*. A compander is a combination of *compressor* and *expander*. A compressor automatically reduces the range of amplitude variations of an AF signal at the input of a system, whereas an expander automatically extends the range of amplitude variations at the output of the system. An 8-bit system with a suitable compander yields results that are comparable to those of a 12-bit system.

The bit stream at the output of the ADC is stored serially in a digital sound memory. The capacity of this memory for a sound of 1 s duration, 8-bit resolution, and 32 kHz sampling rate must be 32 Kbyte [1 Kbyte=1024 (2^{10}) bytes]. The run-off control for writing the data into the memory can be effected by means of the software of a microprocessor system. This software (in machine language) must be fast enough to read the output of the ADC, write the value into the memory, and increase the memory address (high/low byte) by 1 every 31.25 μs. Even simple 8-bit processors with an 8-bit index register are suitable for this.

Writing may be started manually (pressing a key or pushbutton), or automatically as soon as the AF signal exceeds a given threshold level. Manual starting is normally used when from a range of sounds only a particular band needs to be sampled. Automatic starting is preferred for the sampling of the sound from individual instruments.

When the memory is full, writing is stopped, and the sound is available as a series of 32×2^{10} bytes. This series can be further processed with the aid of customer-made software and/or transferred to a main store such as a floppy disk.

To reproduce the stored digital code as an analogue sound, the bits are converted in a digital-to-analogue converter (DAC) at the output. The timing rate resulting from the reconversion process determines the cut-off frequency of the (low-pass) re-assembling filter that follows the DAC. Since the timing frequency varies with the frequency of the reproduced signal, it is important that the cut-off frequency is in tandem with the clock. The re-assembling filter should, therefore, preferably be an integrated, voltage-controlled type, for instance, the CEM3320.

If the data are read from the memory at the same speed as they were written, the output signal is a replica of that at the input. If, however, the reading speed is varied, the frequency of the output signal is altered. If the reading speed is controlled from a keyboard, it is thus possible to play back the original signal at a different pitch.

The run-off control for reading the data from the memory may be provided by a computer or specially designed hardware. This hardware is basically a binary counter the clock of which is fed by a signal whose frequency is determined by whichever key on the keyboard is pressed.

Traditional systems operating with the 1 V/octave standard contain a fast voltage-controlled oscillator (VCO) that converts the voltage from the keyboard into the requisite frequency. The control voltage is also supplied to the frequency-control input of the re-assembling filter, so that the filter operates in tandem with the play-back sampling rate. A gating pulse, also provided by the keyboard, starts the actual play-back.

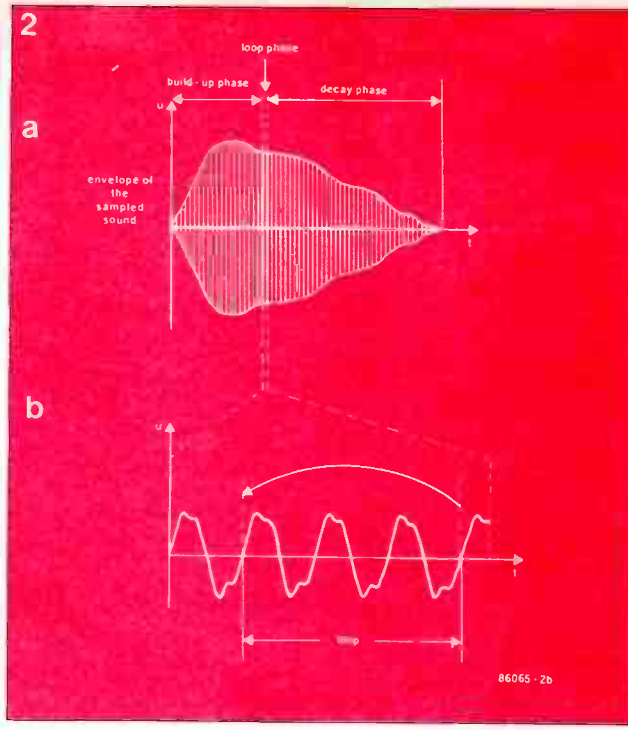
In digital systems operating in accordance with the MIDI standard, the MIDI data are obtained from a suitable peripheral device, such as the 6850. The MIDI data are converted by a computer into a suitable signal to drive a high-speed oscillator whose output is used to read the memory. If the computer is fitted with a fast processor, such as the 68000, a programmable counter, for instance an 8254, may be used instead of the high-speed oscillator, in conjunction with suitable customer-designed software. The memory is then not read with a variable frequency, but at a fixed sample rate with variable increment. In this manner, the output signal will deviate from the input according to the increments. Unfortunately, this mode of operation causes other problems, such as digital aliasing, which can not be discussed here.

Every time a key is pressed, the sound starts afresh, irrespective of whether the previous sound has finished or not. To enable stationary sounds to be generated, loops have been provided in the roll-off control circuit. The sound can then be divided into three phases as shown in Fig. 2: the build-up phase; the stationary or loop phase; and the decay phase. When a key is pressed, the sound builds up (as, for instance, when a violin string is bowed); then remains stationary (like the sound from the violin after it has been bowed) as long as the key is pressed; and finally decays when the key is released.

The instants at which the standing phase begins and ends are under the control of the musician, although a computer can be a very useful tool here, as when, for instance, it is predetermined that only zero crossing of the signal will be used as starting and finishing points. The loop must be a whole multiple of the period of the signal to avoid annoying clicks at the change-over points.

Determining the loop is normally quite straightforward with monophonic (from Greek for "single sound") instruments. Generally, the loop will embrace at least a couple of periods, as this will make the sound rather livelier. Occasionally, beats, frequency fluctuations, and other spurious effects may cause a dimunition of the liveliness; a chorus, phasing, flanging, or delay unit connected at the output may improve matters again.

If the input signal has already been processed with a periodic effect, such as vibrato (=slow frequency modulation); tremolo (=slow amplitude modulation); phasing; or flanging, the effects frequency must be taken into account in the loop, otherwise the effect would be lost in the standing phase, although it is present in the two other phases.



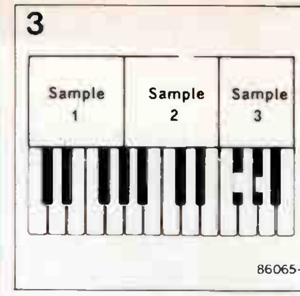


Fig. 2. Division of the sampled sound into three phases: the (central) standing, or stationary, phase is shown with extended time axis in 2b.

Fig. 3. Typical keyboard for use in multi-sampling.

With polyphonic (from Greek "simultaneous sounding of different notes") inputs, such as from a choir or orchestra, determining a properly working loop is at best difficult and often impossible. The difficulty revolves around finding two change-over points that are suitable for all instruments contributing to the polyphonic sound.

It is often possible to arrive at a compromise by taking a very wide loop (up to 100 periods) and negating the ensuing slight distortion by using a chorus unit or delay line at the output. The crucial information of most instruments is contained in the build-up phase, so that the storage allocation for the standing phase can be kept relatively small.

The signal output by the DAC may undergo further analogue processes. It is, for instance, possible to modify the high-frequency content with the aid of a voltage-controlled filter (VCF) and a wave-form (envelope) generator, or the loudness level with a voltage-controlled amplifier (VCA) and a wave-form generator.

Independent of such further analogue processes, the signal may also be digitally modified by a computer while still stored in the memory. In conjunction with a graphics display on the monitor, the sound can be partially erased, shifted, duplicated, or inverted (backwards). Inversion of percussive sounds particularly leads to interesting structures.

The signal may be given a completely new amplitude envelope and be displayed graphically in different forms. If the computer is sufficiently powerful, the sound may also be subject to Fourier analysis, and after appropriate modification be synthesized anew.

As already stated, the computer is also a powerful tool in the determination of the loop start and finish. If, for instance, it has a mass storage device, such as a floppy disk, sounds and associated loop values can be stored indefinitely, which makes it possible to build up a complete sound library. Musicians can interchange all kinds of sound, while manufacturers can produce and market standard sounds on chips.

Making the output signal faster or slower than the input signal gives rise to the so-called Mickey Mouse effect, because the sound becomes more and more unnatural the farther the output speed is from the input speed. The effect is caused by a shift in the resonance frequency or formant structure when the output pitch is changed by varying the reading speed. Each instrument has its own distinct variation of the effect: the less pronounced its formants are, the less noticeable the effect is. The effect is kept in check by multi-sampling, in which in different tone ranges (e.g. each octave) several sounds are sampled (see Fig. 3). During playback, only the input sound nearest in frequency to the required output tone is used. In extreme cases, each semitone is stored at its own address. Since this requires an enormous memory capacity, such extremes are not (yet) encountered in practice.

A not insignificant problem with multi-sampling is the proper matching of the various frequency ranges (as, for instance, 4

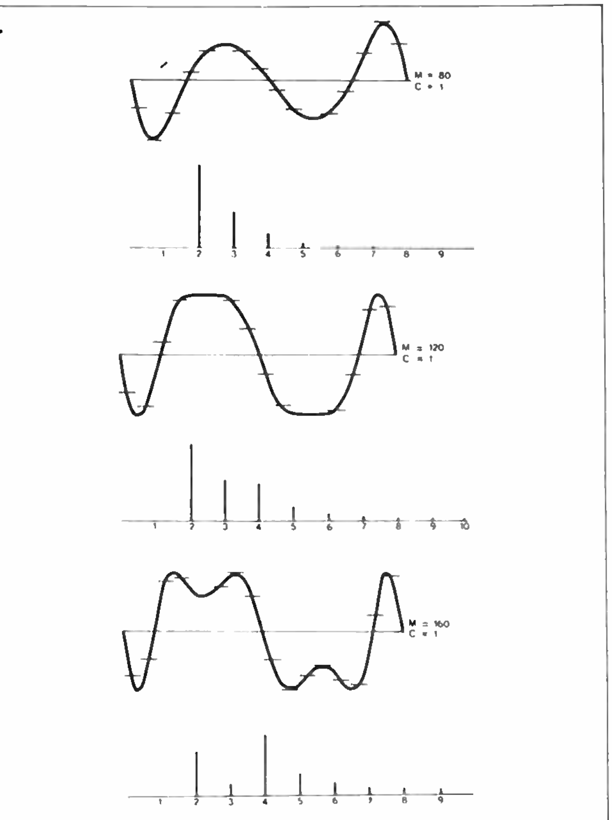


Fig. 4. Sounds generated by the Fourier synthesis technique: M is the percentage modulation and C = 1 indicates that the fundamental and modulating frequencies are equal.

equal loudness level) so that the transition from one range to another is not noticeable.
There is another, not so well-known, method of multi-sampling, which does not depend on the selection of different frequencies, but on the dynamics of the instrument. A lightly struck piano key causes a different sound than when it is struck hard; the same is true for virtually all instruments. It is, therefore, possible to use different memories for different degrees of touch. During playback, it depends on the dynamics of the key, or on the MIDI information as to the dynamics, which memory will be read. Unfortunately, this method of multi-sampling requires very expensive equipment and is, therefore, hardly found in commercially available equipment.
Sound samplers are available as monophonic or polyphonic instruments. Monophonic models can generate only one sound at a time, whereas polyphonic types produce several sounds simultaneously. The latter are sub-divided into models with one common memory for all sounds, and models that have a memory for each different register. In the latter, each register can produce its own distinct sound, which, in conjunction with multi-register sequences, has, of course, the great advantage that each register can be used with a different instrument (MIDI mono mode possible).
Polyphonic equipment with only one sound memory generates the same sound for each register, but can, simultaneously, do so at different pitch.

Digital synthesis

It has been seen that during the recording of a sound a series of data, representing that sound, is stored in a memory. Any computing technique by which a series of significant data could be created in the memory without sampling would afford pure synthetic sounds. In principle, there are many methods by which random series of data can be produced, but for the purposes here the series must be musically acceptable, clearly arranged, and, moreover, there should be a simple relation between the recording characteristics and the sound output. These requirements reduce the available techiques to:

- Fourier synthesis (also called harmonic synthesis);
- frequency-modulation (FM) synthesis;
- waveshaping synthesis;
- phase distortion synthesis.

Since the tones are available in digital code, it is possible to manipulate them in all possible variations. It is, for example, possible to play back a digital sound backwards, or to mix, combine, or modulate it with a second tone. Other effects, including doubling; echo; reverberation; flanging; chorus; harmonizing; ring modulation; imposing on a new envelope; and fast Fourier transform with subsequent re-synthesis are possible with the aid of suitable software. It is noteworthy that all these effects can be realized with hardly any extension of the hardware.
Manipulation of natural sounds, extending beyond mere sampling and storing, belongs to a new technique of sound generation: *digital sound sythesis*. In its pure form, it obviates the need for an analogue input unit. In this technique, a waveform is produced direct by a computer system that is controlled by a mathematical algorithm. The tone is determined by the method which, in the truest sense of the word, synthesizes a waveform. The main difficulty here is to describe the waveform as precisely as possible with only a limited number of parameters. An extreme example would be to read the tone point by point, but, apart from making the reading procedure a very longwinded affair, there is also the difficulty of determining the spectral constitution of any given sound.
Modern synthesis techniques seek a compromise between the number of defining parameters and the specified output. Since each method can only take account of certain aspects, its mathematical structure results in definite characteristics which are clearly identifiable in the final sound.

Fourier synthesis

Since synthesis is the opposite of analysis, and Fourier analysis enables any waveform, no matter how complex, to be represented by a series of simple sine waves that are harmonically related, it is possible to build a complex waveform from a number of sine waves. This mathematical concept does not need a digital synthesizer to put it into practical form, for it has been used for a very long time in the generation of sounds in organs. However, because of technical limitations, only a relatively small number of controlled harmonics can be realized in these instruments.

The modern computer has made it possible, at least in theory, to make a virtually unlimited number of harmonics available, whose amplitude can be controlled very precisely. In practice, however, only thirty-two harmonics are generally used, because the computing time rises with each harmonic. The great benefit of digital Fourier synthesis is that it makes it possible to give each sound its own harmonic spectrum.

To prevent too great an input (writing) complexity, only two reading methods are used in practice. With the first, a separate amplitude envelope is input for each harmonic; the envelope extends over the entire length of the sound to be computed. With the second method, the overall spectrum is written for each separate period; the intermediate values of the as yet undefined periods are then interpolated by the software. The second method has some advantages as well as some disadvantages as compared with the first.

Advantages are:

- the input is strictly analytical and there is, therefore, a direct relation between the input and the final output;
- there is accurate control of tones in each individual period.

Disadvantages are:

- greater input complexity;
- relatively long computing times;
- harmonics that fall outside the proposed frame can not be used;
- the computed waveform does not by itself attain maximum amplitude so that additional and intricate regulation is required before and after the computation.

FM synthesis

In analogue synthesizers, the output of the tone oscillator is modulated by the signal from a second oscillator to give the generated sound more liveliness (vibrato). Such frequency modulation has also been used in radio broadcasting for many years.

In the 1970s, J Chowning, an acoustic engineer searching for an alternative to the complex Fourier synthesis method of tone generation, found that frequency modulation can also be used for the direct generation of sounds. In the ensuing FM synthesis technique, one sine wave is controlled by another. The range of harmonics and, therefore, the colour of the output sound are determined solely by the difference in frequency between the two waves and the depth of modulation.

Although FM synthesis offers a real easing of the writing procedures, it does not provide a direct relation between the input and final output signal. Consequently, it requires much experience and trial and error to produce sounds of a predetermined character. It is not possible to deliberately influence the harmonics in the output signal.

Summarizing, FM synthesis has the following advantages:

- fairly easy writing procedure;
- short computing time;
- depending on the relation between the two sine waves, even non-harmonic frequencies may be generated;
- the waveshape is always computed with maximum amplitude;

and the disadvantage that analytic tone generation is not possible.

Waveshaping synthesis

If a sinusoidal signal is applied to the input of a non-linear network, the output will not be a sine wave, but be distorted to a degree that depends on the characteristics of the network. If this output is analysed, it is found that a number of frequencies has been added to that of the original input signal. This property is the basis of waveshaping synthesis.

It is, however, practically impossible to predict the sound spectrum resulting from the application of a sine wave to a non-linear network. The relation between the non-linearity and the output sound has been analysed mathematically. This analysis has shown that for each harmonic wanted in the output the network requires a separate polynomial characteristic. The individual polynomials are mathematically related and are calculated with the aid of a recursion formula and the ordinal number of the relevant harmonic. The resulting row of polynomials is known as the Chebishev polynomial.

To obtain a number of suitably weighted harmonics in the output spectrum, each relevant non-linear characteristic is calculated with the appropriate weighting factor. The resulting polynomials are added together to arrive at the composite non-linear function from which the network constituents can be computed. A sinusoidal signal applied to the resulting network will give rise to an output sound that contains all the predetermined harmonics in correct proportion. The waveform of the output sound can be varied simply by altering the content of the non-linear function, i.e. by changing the value of one or more components contained in the network.

Summarizing, waveshaping synthesis combines certain aspects of Fourier synthesis, i.e. the analytical sound construction, and FM synthesis, particularly the simple writing procedures and the short computing time required. It has these advantages:

- simple writing procedure;
- analytical input character;
- short computing time;
- the technique of waveshape distortion is modelled on the tone generation by "natural" instruments, so that in many situations it is possible to synthesize simple and natural sounding tones.

Disadvantages of waveshaping synthesis are:

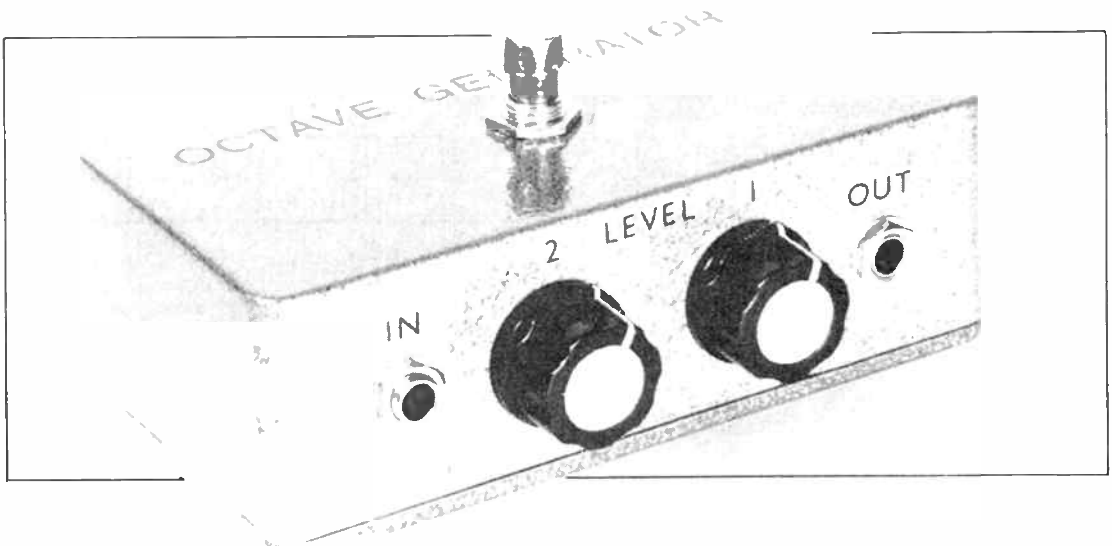
- harmonics can not be controlled as accurately as with Fourier synthesis;
- it is difficult to achieve optimum control of the final waveshape;
- it involves complex mathematical relations and operations.

Phase distortion synthesis

Phase distortion synthesis is, to some extent, a combination of FM synthesis and waveshaping synthesis in that a non-linear network is used to alter the phase angle of the sinusoidal input signal. From a mathematical point of view, this technique is a special case of FM synthesis. Here again, there is no clear relation between the non-linear function that causes the change in phase angle and the resulting sound. None the less, this technique enables a fairly easy simulation of the tone generation of analogue synthesizers operating with the subtractive synthesis method. In practical terms, the non-linear network causes the output sound to have a shape that can be varied between sinusoidal and sawtooth. The resulting sound could be said to vary between "analogue" and "digital".

OCTAVE GENERATOR

by R A Penfold



An octave generator is a guitar effects unit that gives what sounds very much like bass guitar accompaniment. With relatively few people playing the bass guitar these days, this form of effects unit is, understandably, growing in popularity.

The octave generator, or "octaver" as it is sometimes called, is unusual in that it does not use any of the normal types of processing such as filtering or distortion. Instead, a frequency divider system is used that generates outputs at a half and at one quarter of the input frequency, i.e. one and two octaves below the input frequency, and these signals are then mixed with the input signal.

To work well, a unit of this type needs to be rather more complex than might be expected for reasons that will be explored shortly. Although the proposed design has been kept reasonably simple, it gives excellent results. The unit is constructed as a standard pedal type, with a footswitch enabling the effect to be switched in and out as desired. The two signals generated by the unit have separate gain controls so that they can be mixed with the original signal at any desired levels.

System operation

On the face of it, all that is required are a couple of series-connected divide-by-two circuits fed with the input signal that have their outputs mixed with the main output signal. In practice this will not give the required effect for several reasons. Firstly, the input signal must be processed to give a pulse signal that will reliably operate a digital divider circuit. Secondly, the outputs from the divider circuits will be square-wave signals containing strong harmonics and sounding nothing like a bass guitar. Thirdly, the divided signal lacks any envelope shaping, and will simply cut in at the beginning of a note and continue at the same volume until the note decays to the point where it ceases to drive the divider circuit properly. This leaves a fourth and final problem, which is that the divider is unlikely to cut out cleanly, and is almost certain to produce unwanted pulses when the input signal falls to a barely adequate level to drive the divider circuit. This would give loud clicking and buzzing sounds that would clearly stand out above the largely decayed guitar signal.

The unit described is designed to overcome all of these problems, and the way in which it functions is explained with reference to Figure 1.

Block diagram

The input signal is fed to a mixer and to an amplifier; the amplified signal is applied to a trigger circuit. The output of the trigger is logic high if the input signal is above a certain threshold level, and logic low if the input is below the threshold level. The trigger circuit provides a large amount of hysteresis, however, which means that the input voltage at which it provides a logic 1 output is much higher than the input potential that causes it to switch back to a low logic output. This hysteresis helps to avoid problems with spurious output transitions caused by noise on the input signal, or by the slightly irregular output waveform of a guitar. Figure 2 illustrates the way in which the hysteresis does this, and that it is mainly needed when the signal from the guitar has decayed to almost zero. It results in the output from the divider stages cutting off quite abruptly, but it can not guarantee that there will not be a few spurious output pulses as the input signal decays to an inadequate level.

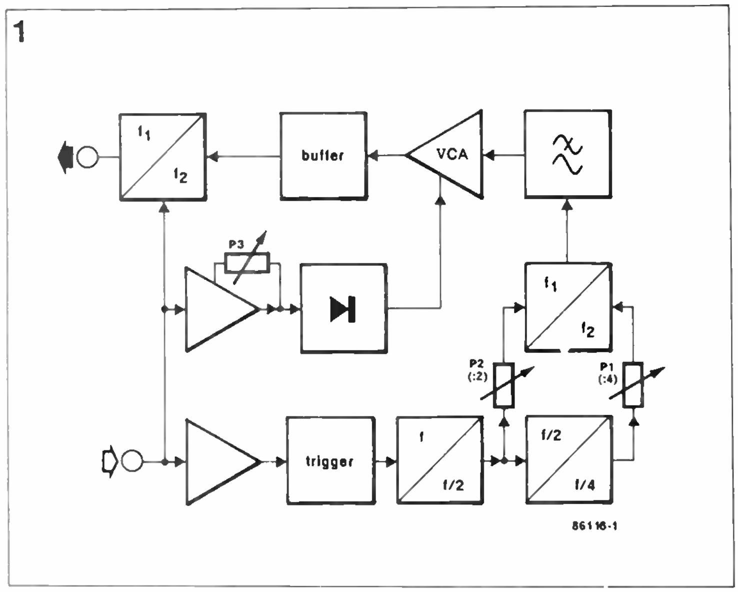


Fig 1 Block diagram of the octave generator

The trigger circuit drives two cascaded divide-by-two stages, and these generate the signals one and two octaves below the fundamental input frequency. The two divided signals are mixed at the required levels, and the combined signal is fed to an active low-pass filter. The cut-off frequency of this filter is a compromise, since setting it too high gives an excessive harmonic content on the output and a rather unconvincing effect, while setting it too low results in severe attenuation of the fundamental output frequencies of the dividers when the guitar is played near the top of its compass. A frequency of 250 Hz is used in the prototype, but this can be varied if desired simply by altering the value of three resistors.

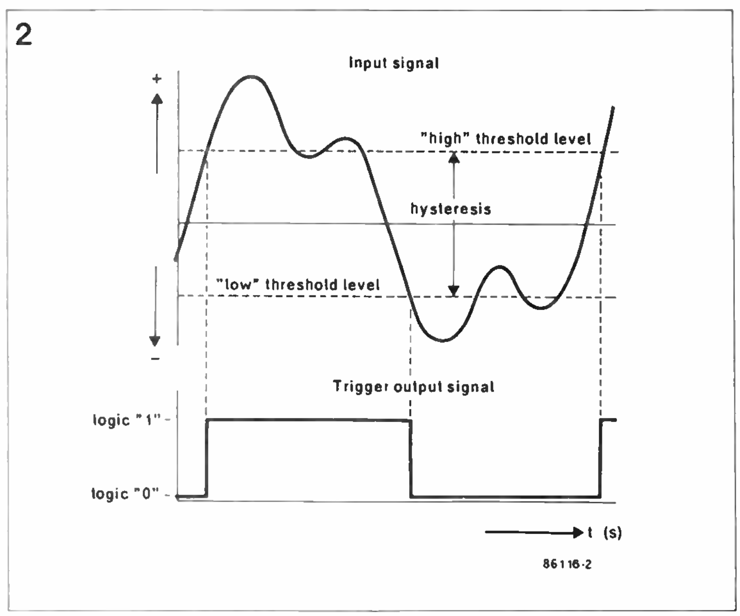


Fig 2 The hysteresis of the trigger circuit results in a glitch free output even with awkward input waveforms

The filtered signal is fed to a voltage-controlled amplifier (VCA). The gain of this is in direct proportion to the control voltage, which varies in sympathy with the amplitude of the signal from the guitar. The VCA therefore provides envelope shaping, and gives a guitar-type (fast attack and slow decay) envelope. The control voltage is obtained by amplifying a part of the input signal and rectifying this to give a direct voltage roughly in proportion to the input signal. In practice, the envelope shape of the divided signal will not precisely match that of the input signal, but this is not really important, and is probably an advantage, as it tends to make the divided signal sound distinct from the input signal. This aids the illusion of the bass signal coming from a separate instrument.

An important effect of the envelope shaping is that it results in the divided signal decaying to an inaudible level by the time the output from the divider stages starts to cut off. If the output of these stages fails to cut off completely, this is, therefore, of no importance since any spurious output pulses will not be audible.

The VCA has a very high output impedance, and it is connected to the second input of the first mixer via a buffer amplifier.

Circuit description

The circuit diagram is shown in Fig. 3.

The input mixer, IC_1, is a standard summing-mode type based on a Type LF351 opamp.

The unit is powered from a single 9-volt supply rather than from a dual balanced one. Resistors R_3 and R_4, decoupled by C_4, form a voltage divider across the supply lines to provide the bias voltage on the non-inverting inputs of IC_1 and A_1.

The input amplifier is built around A_1, which is a simple inverting-mode circuit with a voltage gain of about 40 dB, which is determined by the ratio of R_5 and negative feedback resistor R_6.

Resistor R_5 sets the input impedance of the amplifier to about 100 k which, with R_2 setting the input impedance to the mixer at 100 k, and R_{25} setting the input impedance of the envelope shaper at 56 k, gives the circuit as a whole a suitably high input impedance of about 25 k.

Opamp A_2 operates as a conventional Schmitt trigger, with positive feedback and hysteresis provided by R_8.

The divider stages are provided by IC_3, a Type 4024BE CMOS seven-stage binary counter. Only the first two stages of this IC are used; the other five are simply ignored. It would be possible to use more outputs of IC_3, and to couple these to the mixer via gain controls, but there is little point in doing so since the fundamental output frequency

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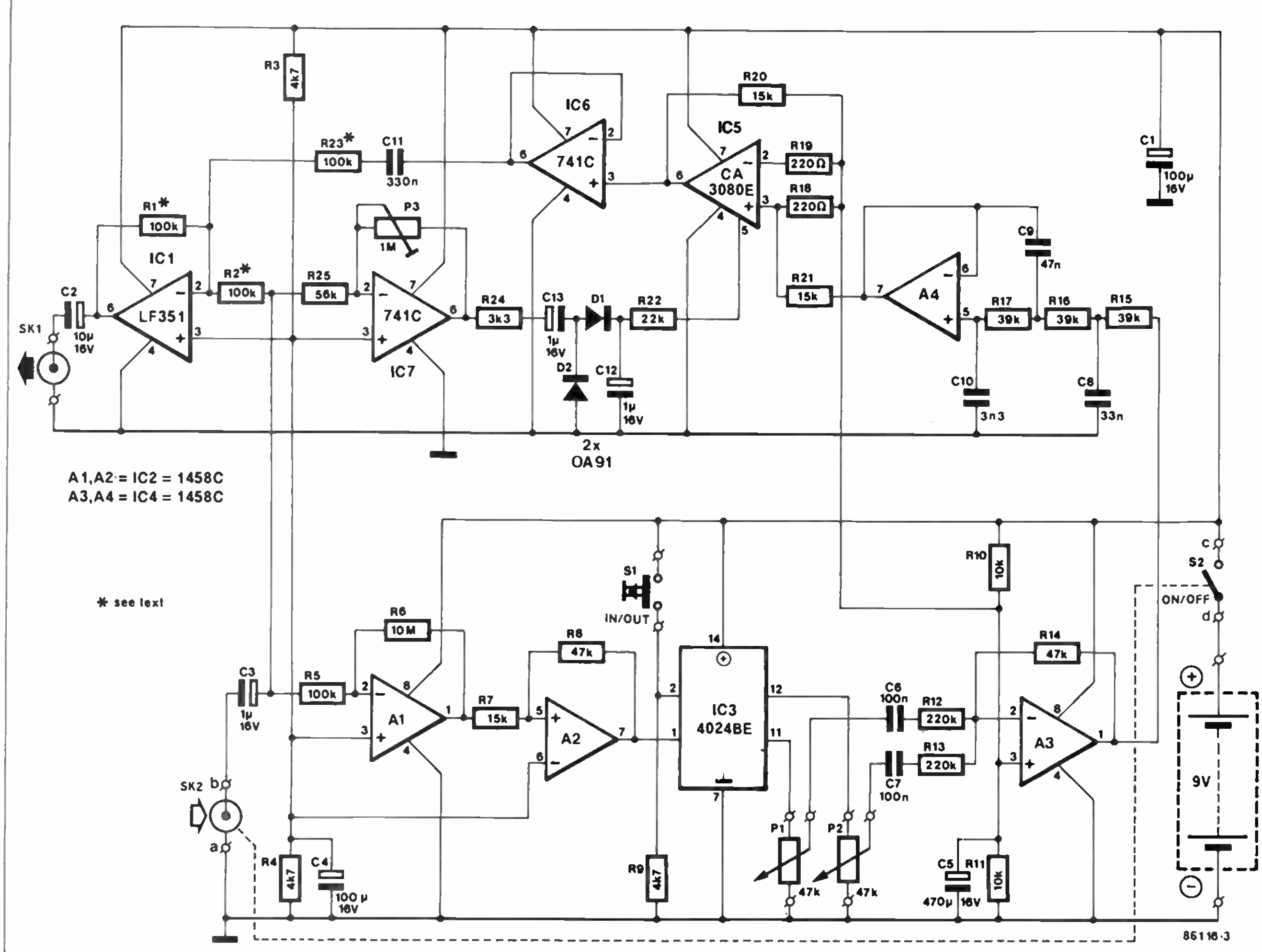

Fig. 3. Main circuit diagram of the octave generator.

of even the third stage is in the sub-audio range, except when the guitar is played quite high up in its compass.

Pin 2 is the reset input of IC_3, and this is normally held low by R_9 to enable the divider circuits to function normally. However, when (foot) switch S_1 is operated, the reset input is taken high, which disables the dividers and thus provides a simple means of switching the effect in and out.

Potentiometers P_1 and P_2 are the gain controls for the signals two and one octave respectively below the fundamental input frequency. They are connected to another summing-mode mixer, A_3, which has a voltage gain of considerably less than unity from each input to the output. This low gain is necessary because each input signal has a higher peak-to-peak voltage level than A_3 is capable of providing.

The low-pass filter, A_4, is a conventional third-order, i.e. 18 dB per octave, type with a cut-off frequency of about 250 Hz. This frequency is eas-

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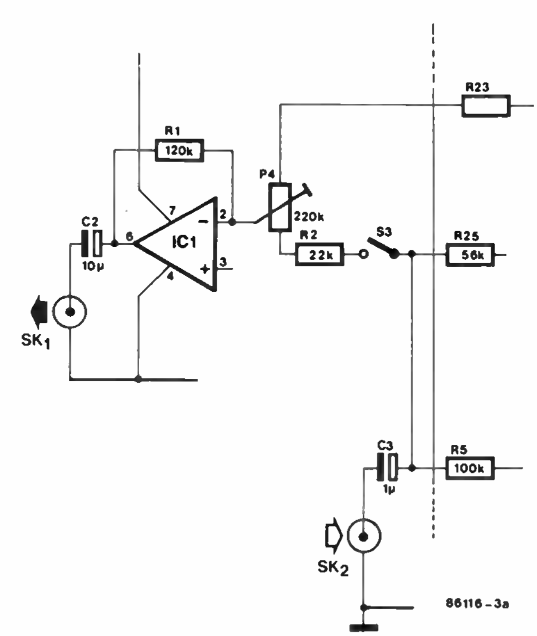


Fig. 3a. Modified circuit arrangement around IC_1 to provide optional balance control and "bass only" selection.

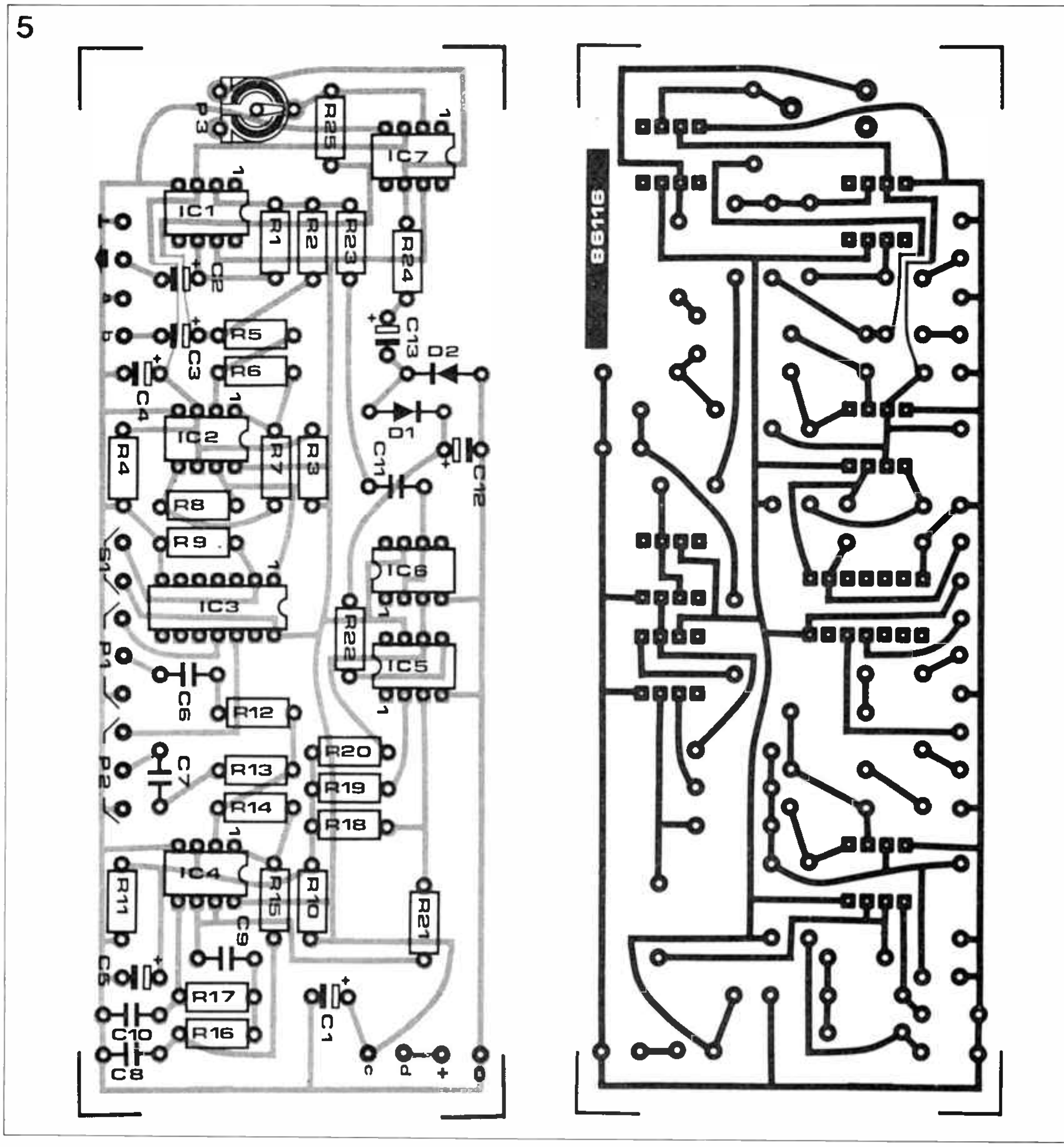


Fig. 5. Printed circuit board of the octave generator.

Parts list

Resistors:

R_1*;R_2*;R_5;R_{23}* = 100 k
R_3;R_4;R_9 = 4k7
R_6 = 10 M
R_7;R_{20};R_{21} = 15 k
R_8;R_{14} = 47 k
R_{10};R_{11} = 10 k
R_{12};R_{13} = 220 k
R_{15};R_{16};R_{17} = 39 k
R_{18};R_{19} = 220 Ω
R_{22} = 22 k
R_{24} = 3k3
R_{25} = 56 k
P_1;P_2 = 47 k log potentiometer
P_3 = 1 M horizontal sub-miniature preset
P_4 + = 220 k lin potentiometer

Capacitors:

C_1;C_4 = 100 μ; 10 V; radial electrolytic
C_2 = 10 μ; 25 V; radial electrolytic
C_3;C_{12};C_{13} = 1 μ; 63 V; radial electrolytic
C_5 = 470 μ; 10 V, radial electrolytic
C_6;C_7 = 100 n carbonate
C_8 = 33 n carbonate
C_9 = 47 n carbonate
C_{10} = 3n3 carbonate
C_{11} = 330 n carbonate

Semiconductors:

IC_1 = LF351
IC_2;IC_4 = 1458C
IC_3 = 4024BE (CMOS)
IC_5 = CA3080E
IC_6;IC_7 = 741C
D_1;D_2 = OA91

Miscellaneous:

SK_1 = standard jack socket
SK_2 = standard jack with DPDT contacts
S_1 = part of SK_2
S_2 = SPST heavy-duty push-button switch
S_3 + = SPST heavy-duty push-button switch or standard SPST toggle switch (see text)
B_1 = 9-volt PP3-size battery
Die-cast aluminium case about 150 × 80 × 50mm (standard unit) or, if optional facilities fitted, about 190 × 110 × 60 mm fitted with PCB mounting guides (Maplin; Verospeed)
PC adaptors (Verospeed)
PCB No. 86116
Battery connector
Two (three if optional facilities fitted) control knobs

ily altered, if desired, by changing the values of R_{15} to R_{17} incl. It is inversely proportional to the value of these resistors: if, for instance, those values are halved, the cut-off frequency is doubled.

IC_7 is a voltage amplifier whose gain can be varied by P_3 from zero at minimum resistance to about 25 dB. This enables the circuit to operate with a wide range of input levels, and it is important that P_3 is set for a suitable voltage gain. Too little gain will result in an inadequate output signal level, while excessive gain would tend to sustain the output too long. Rectification and smoothing are provided by D_1-D_2 and C_4 respectively. Both the attack and the decay times of the circuit have been kept quite short so that the envelope shaper responds readily to the variations in the dynamics of the input signal, but neither time has been made so short that serious distortion is introduced.

The voltage-controlled amplifier, IC_5, is a Type CA3080E operational transconductance amplifier (OTA). Although OTAs have some characteristics in common with ordinary op-amps (including differential inputs), there are several major differences. The main one is that an OTA is current- rather than voltage-operated. It is, therefore, the differential input current that controls the output current. There is also an amplifier bias input (pin 5 in this case), and the gain of an OTA is controlled by the bias current fed to this input. In fact, the gain is in direct proportion to this bias current.

In most applications, including the present one, voltage rather than current operation is far more convenient. Fortunately, the conversion from current to voltage operation can be achieved simply by adding series resistors at the inputs, and a load resistor at the output: in the present circuit R_{21} and R_{22}, and R_{20} respectively. Resistors R_{18} and R_{19} are merely input bias resistors.

An OTA has a very high output impedance, especially when it operates with a low control current, but IC_6 acts as a buffer amplifier which gives the circuit a low output impedance. The output of IC_6 drives the inverting input of mixer IC_1.

Power for the generator is obtained from a 9-volt PP3 battery. This is an economical power source, since the current consumption of the generator is only about 6 mA. On/off switch S_2 is a set of make contacts on input socket SK_2. The generator is, therefore, switched on automatically when the guitar lead is plugged into SK_2, and switched off again when the plug is removed. Actually, SK_2 has DPDT contacts, but the extra contacts are just ignored.

Optional facilities

It is possible to add a balance control and "bass only" switch by modifying the circuit around IC_1 as shown in Fig. 3a. Potentiometer P_4 is the balance control and S_3 is the "bass only" selector. This switch may be a simple toggle type on the front panel, or a foot-operated push-button type similar to S_2. Apart from the changed values of R_1 and R_2 as shown, that of R_{23} must be altered to 22 k. Furthermore, the case needs to be somewhat larger to accommodate the added controls.

Construction

With the exception of the controls, sockets, switches, and battery, the components are mounted on the printed-circuit board shown in Fig. 5. Only IC_3 is a MOS device and should, therefore, be fitted in a 14-pin DIL holder, even if the other devices are soldered direct to the board. The other normal anti-static handling precautions should also be observed, of course, when dealing with IC_3.

Diodes D_1 and D_2 are germanium types, which are also delicate components. It is heat rather than static electricity which is the problem when dealing with these, and the soldering iron should not be applied to each joint for any longer than is really necessary when these components are being fitted.

There is little else to give any problems in the construction of the board, but note that IC_5 and IC_6 have the opposite orientation to the other ICs. At this stage, only pins are fitted to the board at positions where connections to off-board components will eventually be made.

The recommended case is a die-cast type, which, apart from providing screening against mains hum and other electrical noise, is also very tough. This is important in an application such as this where most other cases would be likely to sustain damage when the push-button switch is operated. Die-cast boxes are well able to stand up to a lot of rough treatment. With this project, the removable lid becomes the base panel, and the case is effectively used upside-down. Switch S_1 is mounted on the top panel of the case with the other controls and the sockets fitted in a row along the front panel.

Next, the hard-wiring is added and details of this are included in Fig. 5. None of this wiring requires screened leads: ordinary circuit wire or lengths of ribbon cable are perfectly suitable. Once the wiring has been completed, the board is mounted in the case with the aid of four PCB guide adaptors to ease it into the moulded guide rails. The adaptors need to be trimmed slightly to fit into this particular case. The board is mounted near to the bottom of the case with the component side uppermost. It is advisable to cover the inside of the base panel with a couple of layers of insulation tape to prevent any possibility of connections on the underside of the board short-circuiting through the case.

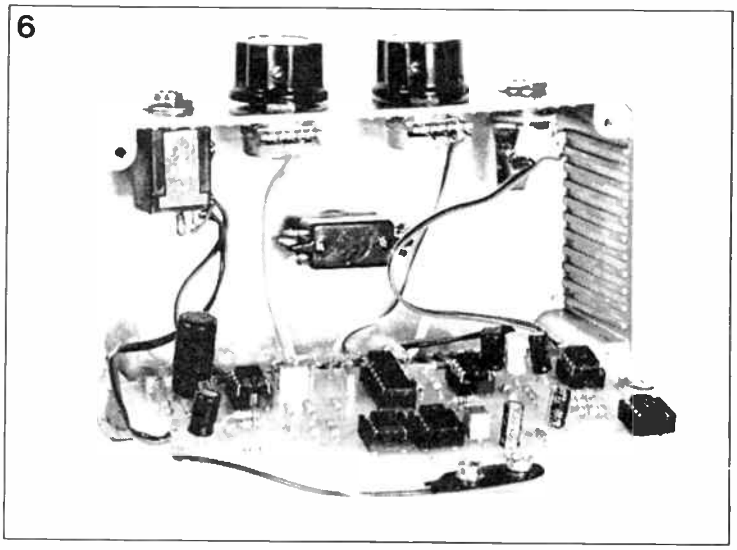


Fig 6 Inside view of the unit from the top.

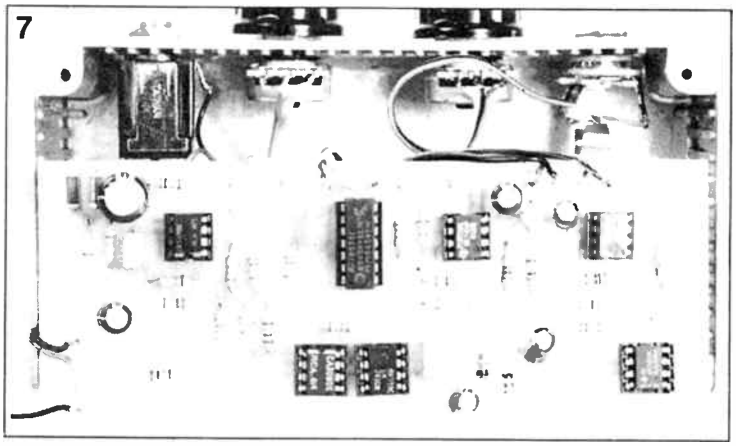


Fig. 7 Inside view of the unit from the underside.

Six 8-pin DIL IC holders
One 14-pin DIL IC holder

Wire, solder, etc.

*If optional balance control and "base only" facilities are fitted, R_1 = 120 k; R_2 and R_{23} = 22 k.

+ Only required if optional facilities fitted: see text.

Adjustment

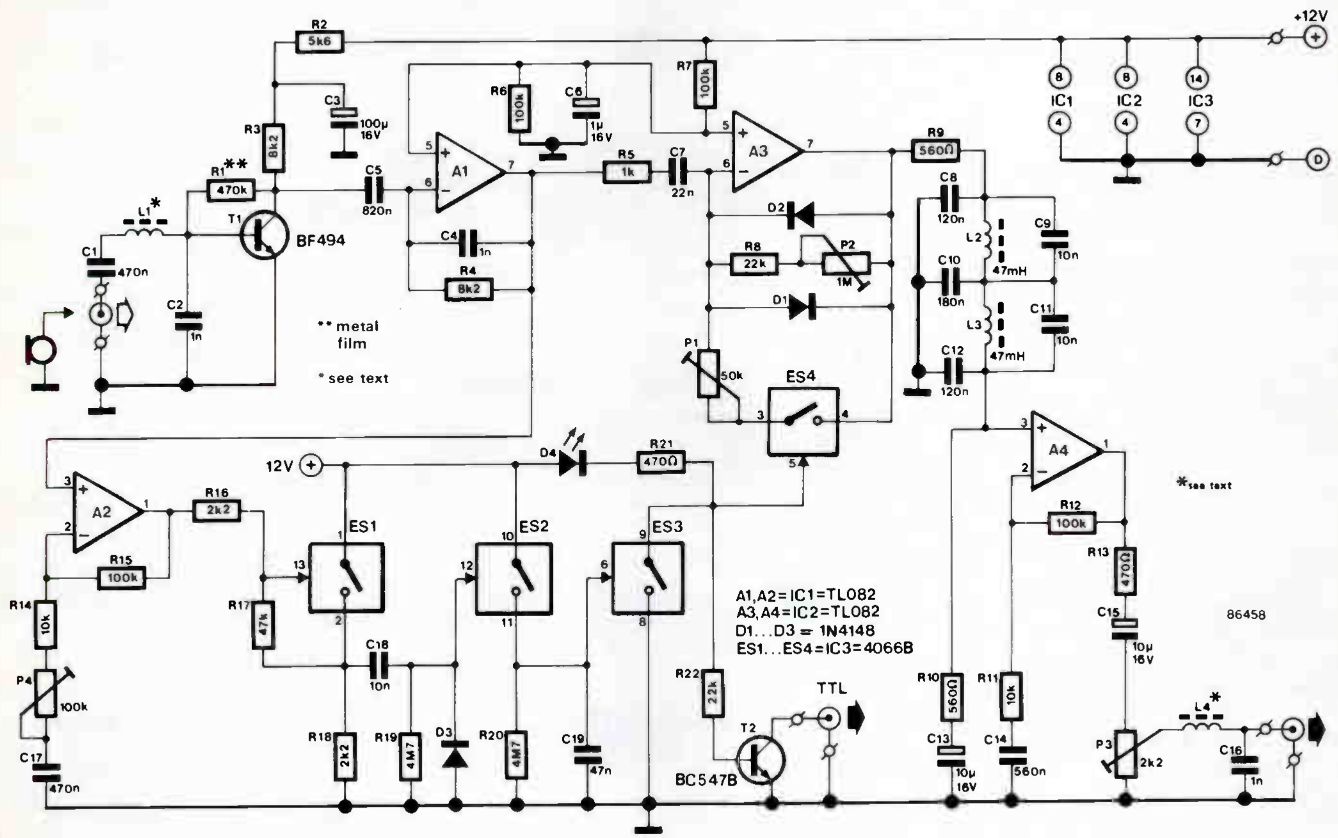
As pointed out under *Circuit Description*, the generator is switched on automatically when the guitar is connected to SK_2 (by a standard screened jack lead). When you have finished using the unit, always disconnect the plug from SK_2 immediately to switch off and conserve the battery.

The output of SK_1 connects to the guitar amplifier via a second screened jack lead. With P_3 set at a roughly mid setting, the unit should function to some degree, with P_1 and P_2 controlling the signal levels of the low frequency signals. A little trial and error should soon locate a suitable setting for P_3. If it is set too far in an anticlockwise direction, the volume of the low-frequency signals will be rather too low even with P_1 and P_2 well advanced. Excessive adjustment in the opposite direction will give too much gain and cause distortion on the low-frequency signals, as well as excessive sustain. Probably the best setting for P_3 will be the most clockwise setting that does not cause the low-frequency signals to become clipped and heavily distorted, but the precise setting is unlikely to be very critical.

The unit will operate properly with most guitar pick-ups, but with very low output types it might be necessary to use a preamplifier to obtain really good results.

The best bass guitar type effect is obtained with P_2 set at minimum and P_1 well advanced, so that only the signal two octaves below the input is mixed with the input signal. The signal one octave below the input does not give a particularly convincing bass guitar effect, but it does provide a much richer sound and it can be used to good effect.

speech processor with background suppression



A speech processor is commonly used in public-address installations and in utility transmitters. It augments the average value of the speech signal, so that in spite of a high level of background noise or, in the case of a radio transmission, a lot of interference, speech recognition remains possible. In many cases it is, however, undesirable that this background noise or interference is enhanced together with the wanted signal. A possible remedy, as outlined here, is to provide an adjustable threshold at which the speech processor becomes active.

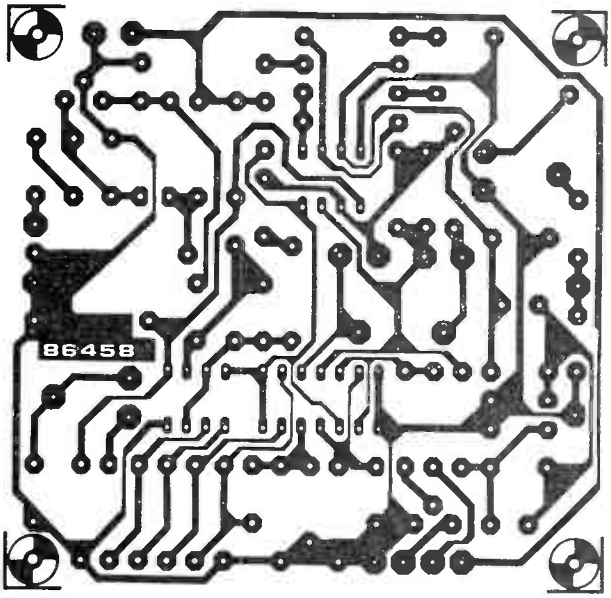
With reference to the diagram, the signal from the microphone is amplified in T_1 (a low-noise amplifier) and in A_1. Limiting (or clipping) of the signal takes place in A_3.

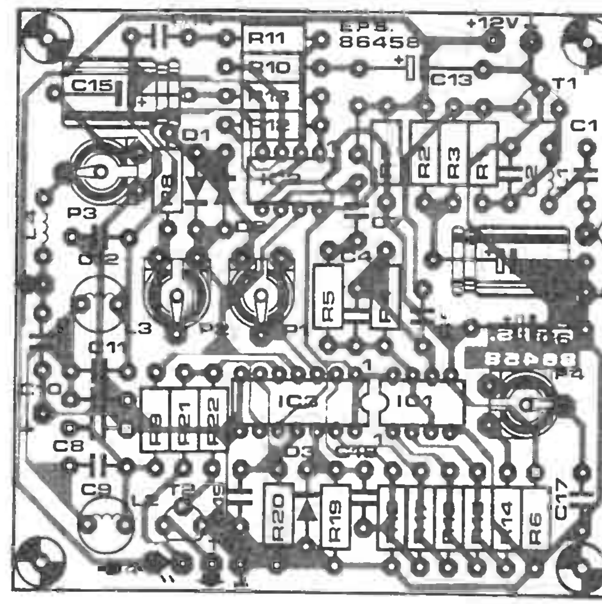
The signal (taken from the output of A_1) is also amplified in A_2. When the output of this opamp reaches a certain level, electronic switch ES_1 is actuated. Consequently, the monostable formed by ES_2 changes state, and this closes ES_3, whereupon ES_4 is opened, which in its turn increases the amplification of A_3. When ES_4 is closed, the amplification of A_3 is determined by the ratio P_1:R_5; when the switch is open, by the ratio (P_2+R_8):R_5.

The mono-time, determined by the time-constant R_{20}-C_{19}, has been chosen such that speech is not clipped. The low-pass filter between A_3 and A_4 ensures that frequencies above 3 kHz are severely attenuated. The required output level is set by P_3.

Calibration is somewhat unorthodox: a signal source with a continuous output of speech by trained speakers is used. The microphone is positioned in front of the loudspeaker at normal speaking distance and the sound level adjusted to roughly the level of the user. Next, connect a pair of headphones to the output of the processor and make sure that only the output of these phones can be heard. Adjust P_4 for maximum resistance, and then set the clipping level with P_2 (which is a matter of personal taste). At maximum clipping level, intelligibility of the speech will remain good in the presence of interference, but it will have a somewhat harsh, metallic character. Then, adjust P_1 for maximum resistance, and P_4 till all background noise disappears. Finally, set the ratio signal: background noise with P_1; this is best done by making a recording of the user's speech via the microphone and the processor. When the processor is active, i.e. clips, D_4 lights.

L_1 and L_4 are 6 turns 36 SWG CuL through 3 mm ferrite beads. *(B)*





guitar fuzz unit

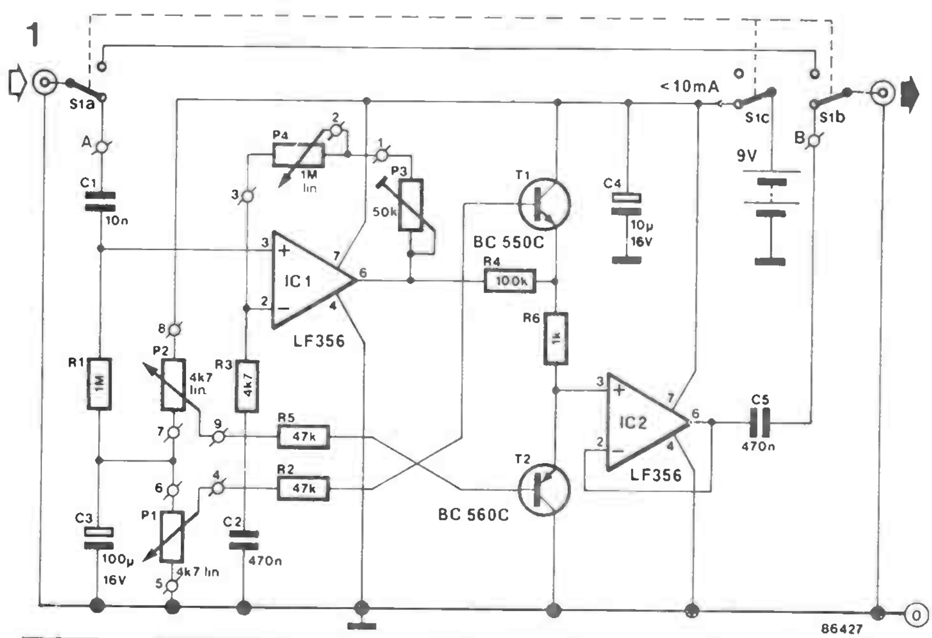
The fuzzbox, fuzzer, tube screamer, or whatever other name there may exist for the controlled guitar sound distortion unit, is a well-known item in the electrophonic field, which is of common interest to both musicians and electronics enthusiasts.

The majority of fuzz units are simply opamp configurations with some form of maximum input level control, which determines the degree of overdrive by the guitar input signal, and, consequently, the amount of audible distortion, generally referred to as the object "sound" the player has in mind as his very own musical visiting card.

This is probably one of the few fuzz units to feature controllable symmetrical clipping facilities, which means that the limit for distortion-free amplification may be separately defined for both the negative and positive portions of the input sinewave(s), the peaks of which may be clipped by means of shunt transistors T_1 and T_2 respectively, each with its own clipping level control potentiometer (P_1; P_2). The transistors, when driven, pass the signal from input opamp IC_1 to the positive supply or to the ground rail, before buffer IC_2 can pass the "fuzzy" guitar sound to the connected amplifier.

Preset P_3 determines the minimum gain of the fuzz unit; the desired level may be set with P_4 turned to its minimum resistance position. Next, P_4 is adjusted to suit the maximum input level that can be expected from the guitar. P_3 and P_4 may then be alternately adjusted to hit the correct compromise between these two signal levels.

1



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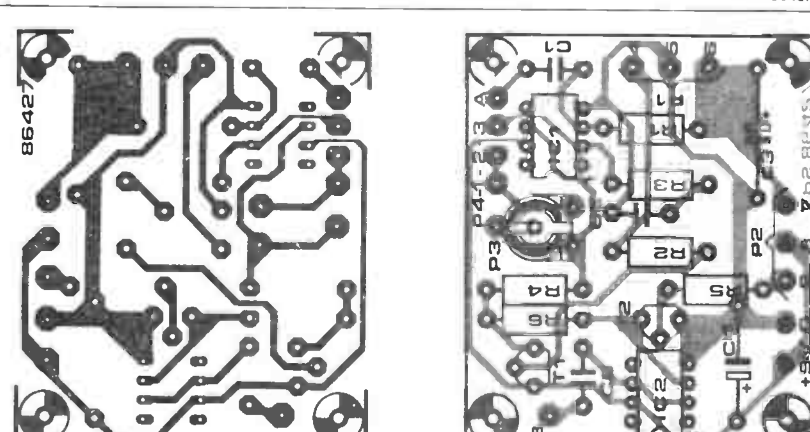
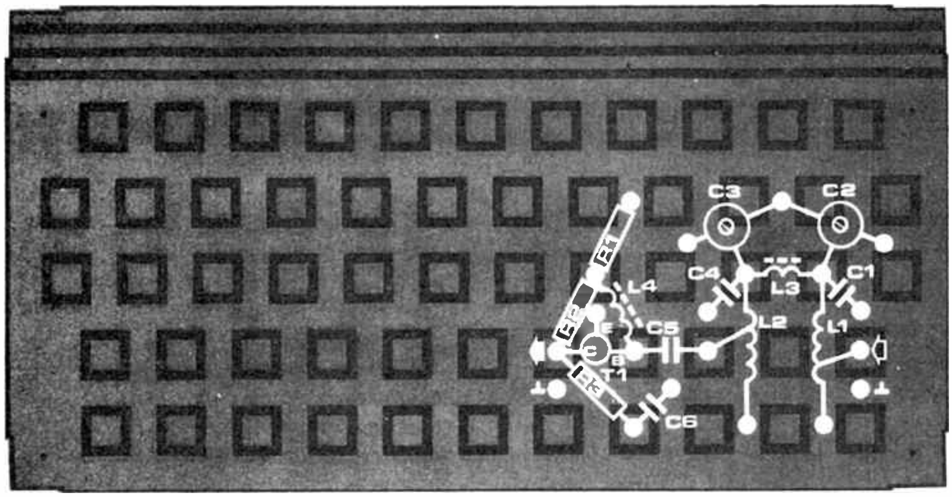


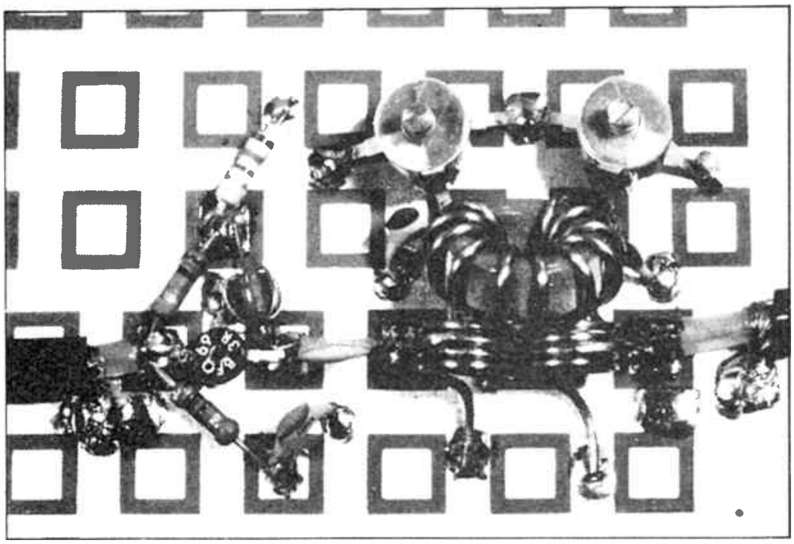
Finally, note the three-pole changeover switch which allows easy bypassing of the fuzzer while simultaneously switching it off to preserve battery power.

JB

Reproduction problems with November?

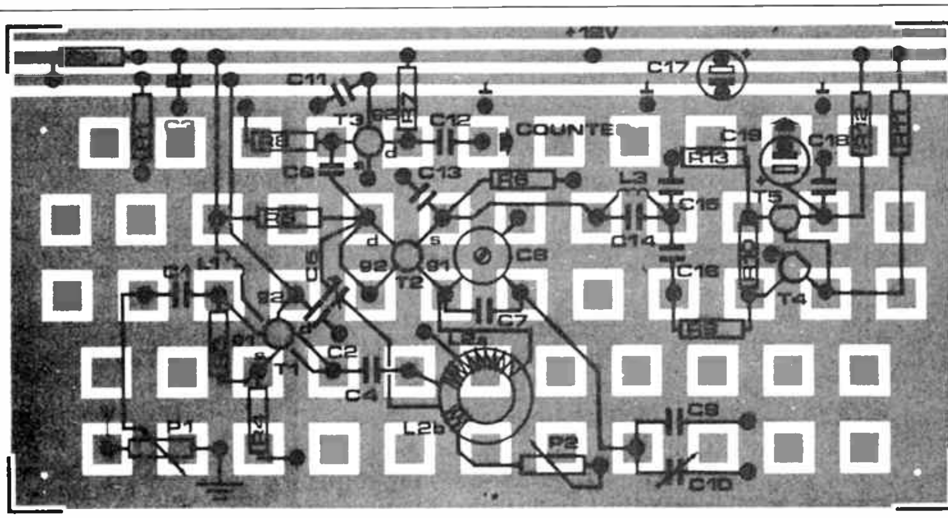
4





Pages 45 and 47 in our November issue suffered from some reproduction problems. Figure 4 on page 45, showing the construction of the VHF Preamplifier, and its accompanying picture, suffered somewhat and they are reproduced above. Figure 3 on page 47, showing construction of the Superregenerative Shortwave Receiver, suffered to some extent also. This is reproduced below.

3



THE BATTLE FOR SUPERTELEVISION

Europe and Japan are waging a technobattle over how best to provide the public with top-quality television pictures in the 1990s. Over the past decade, the Japanese broadcasting authority, NHK, has been perfecting a high-definition television system that uses 1,125 horizontal lines across the screen, instead of the 525 lines they and the Americans use at present. This offers much finer grained pictures—better, in a sense, even than film.

The Japanese, with the Americans and Canadians in tow, have been pushing hard to get their high-definition television (HDTV) system adopted as a world standard. The Europeans are adamant that it should not be. At a recent meeting of the International Radio Consultative Committee in Yugoslavia, they managed to get the issue deferred for another four years of discussion. With better-quality pictures from 625-line television, Europe's broadcasting engineers do not see the NHK proposal as an answer to their own problems.

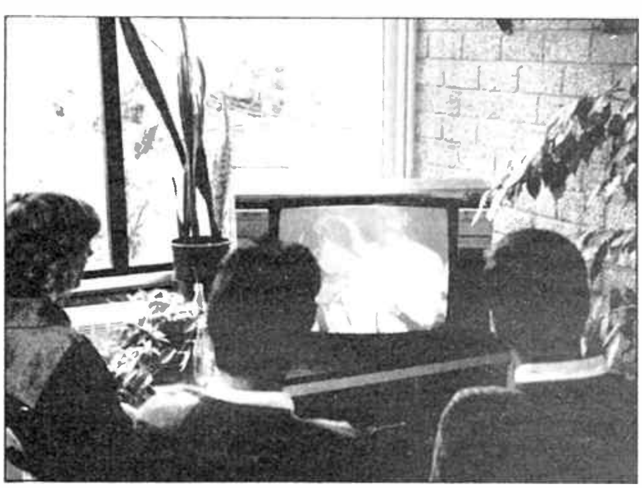
The two sides have so little in common that four years may not be long enough to reach a consensus. For a start, America and Japan both have electricity supplies that alternate at 60 Hertz (cycles per second), while Europe and most other places have 50-Hertz electricity. Television scenes illuminated with light blinking 60 times a second (eg, in America) produce a shuddering effect when displayed on television sets which have their pictures refreshed 50 times a second. Europe's viewers tolerate shudder on the occasional American programme. They would not like it all the time.

Then there is cost. If adopted, the Japanese HDTV system would cost as much as did the switch from black-and-white to colour. HDTV viewers would have to buy a new television set to receive the super-quality pictures. Yet broadcasters would still have to transmit separate pictures for people with conventional colour and monochrome sets.

Hence Europe's preference for a system that is evolutionary rather than revolutionary in design — and capable of being received by existing sets fitted with a cheap add-on box.

The European Broadcasting Union has adopted a new family of television standards called MAC (multiplexed analog components), developed by the Independent Broadcasting Authority in Britain. These aim to provide all sorts of future television features — from widescreen pictures, eight-channel sound and data to direct satellite broadcasting and better definition. The intention is to have MAC pictures compatible with all of Europe's existing television sets.

The motives are not wholly altruistic. European equipment makers have been lobbying their governments hard for fear that if (like the Americans) they accept the Japanese standard, they, too, will kiss their television businesses goodbye — as Sony, Hitachi, Sanyo, Toshiba, Mitsubishi and Matsushita tool up for a global price war in HDTV equipment for studios, transmission and home.



Never mind the quality, see the width

From studio to home

Yet Japan's HDTV and Europe's MAC are not in direct competition. Each represents a set of engineering standards for quite separate things, and serves different sectors of the television industry — which range from programme-making to distribution and display in the home.

HDTV is seen as a studio standard for producers wanting to make features or commercials with the sharpness of 35mm film but taking advantage of the flexibility, faster turn-around and graphic tricks offered by video tape.

Sony, Hitachi and Ikegami are all offering studio equipment based on HDTV standards.

One of the first production companies to buy Sony's $1m HDTV system was Paris-based Captain Video, which has been using it to supply complex "matting" (ie, special optical effects) that would be too expensive using film, and impractical with the video cameras and recorders used in studios today. The equipment promises production savings of 15-20%.

HDTV studio equipment can also offer television stations better "prints" for broadcasting. After a commercial is in the can, successive generations of prints are made of it on 1-inch video tape for distribution — with a loss of quality compounded each time it is re-recorded. An HDTV master tape made to 1,125-line television standards has a definition better than the electronic equivalent of 35mm film, while its conversion to 1-inch distribution tape involves fewer quality-reducing stages.

So distribution tapes emerging from HDTV studios tend to be superior to chose from film laboratories.

But HDTV is not a distribution (ie, transmission) system in a television sense, still less a standard for domestic television sets. True, Japanese officials are proposing a derivative called MUSE for transmitting HDTV pictures — but they have yet to win agreement among equipment makers in Japan, let alone the rest of the world. After that, they will need to develop standards for receiving and displaying HDTV pictures on domestic

television sets.
Europe's television engineers have, in contrast, started in the middle. They argue that it is neither the studio nor the home, but the distribution link between them, which is in the greatest mess and needs to be standardised.
Mess? Broadcasters are finding that their medium no longer has a monopoly over the distribution of pictures to the sitting room. Nowadays it has to compete for viewers' time not only with cable television (and soon with two-way interactive cable), but also with video cassettes, video discs, video games, even home computers. Waiting in the wings are awesome new inventions like the CD-ROM (compact disc read-only memory), which stores encyclopedic volumes of pictures, text, music and commentaries, all capable of being interrogated by typing a few simple questions on the screen of a home computer.

Studio in the sky

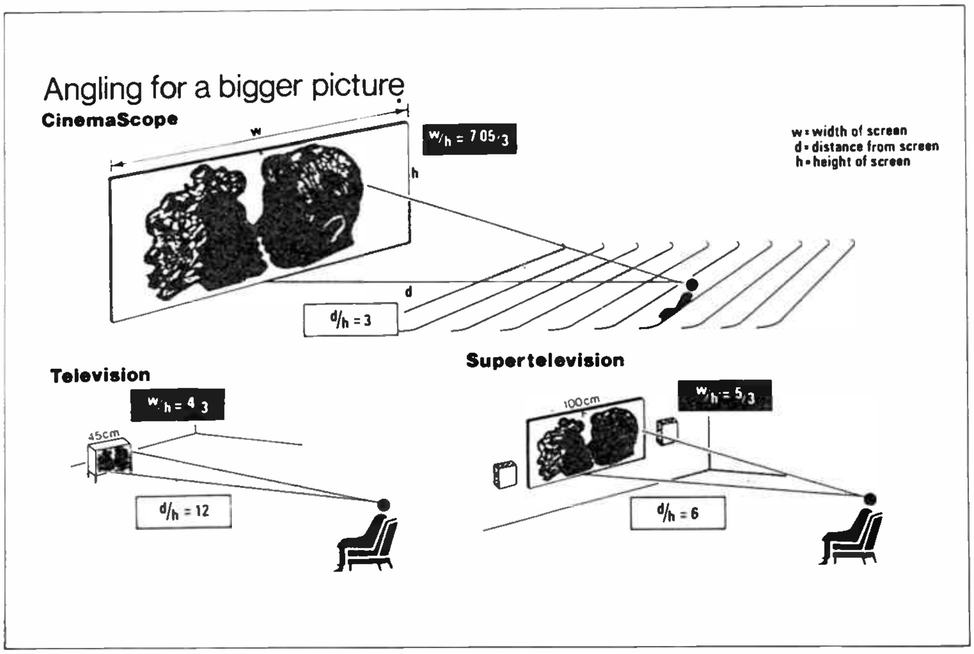
The televison industry everywhere is under the same threat. Its great white hope is DBS — direct broadcasting satellites beaming television programmes and other video delights down to viewers below. In 1977, the World Administrative Radio Conference allocated part of the frequency spectrum above 10 GHz (1 gigahertz is 1,000 megahertz) to satellite broadcasting. Ever since, broadcasters have been waiting impatiently for electronic firms to perfect the special microwave valves — known as travelling wave tubes — that would be powerful enough to transmit pictures direct from space to people's homes.
The most powerful travelling wave tubes for broadcasting satellites look like being the new 200-watt devices being developed by Thomson-CSF in France and AEG-Telefunken in West Germany. The Mitterrand government had hoped to have its TDF-1 DBS satellite with Thomson tubes in orbit by this year. The schedule has slipped by 18 months to two years, following troubles with the Ariane launcher and a change of heart by France's new conservative government. The French 200-watt tubes have nevertheless been flown in two Japanese experimental satellites, BS-2a and BS-2b. One of these has now gone on the blink and nobody is yet sure how reliable the 200-watt transmitters are.
If they can be made to work properly, DBS systems with 200 watts of power ought to be able to deliver pictures to dishes less than a tenth the size of the ground stations used for telecoms today.
Unfortunately, even a 1.8 metre dish perched on a rooftop would be unwieldy in a high wind. Mounted on the ground, it would need about half a ton of concrete to keep it steady. In Britain, it would also need to have planning permission.
Hence the pressure to develop ever more sensitive receivers — so that domestic dishes can be reduced to 90cm or even 60cm in diameter. These could be mounted in the loft. Their price would drop from $1,000 or so for a 1.8-metre dish and its decoder box to around $350.
At the 1977 conference, five channels plus "parking places" in geosynchronous orbit were allocated to each country in Europe. Britain and West Germany still say they hope to have their DBS services working by 1990.
In April, the IBA in Britain started advertising franchises for three (out of Britain's five) DBS channels. The offer closes on August 29th.
But the satellites still have to be built and launched. With the setback to America's shuttle programme and problems stacking up for Europe's own Ariane launcher, few are now putting money on getting DBS services up and running in Europe (or anywhere) by the end of the decade.

Overhaul for telly

Europe's route to high-definition television — and other technological improvements — is via DBS. The reasons are threefold:

- Money. Most broadcasting authorities in Europe have already had to replace or upgrade much of their existing equipment for terrestrial transmission. They cannot justify upgrading it again for a decade or more.
- Improvements. Though developed later than America's 525-line NTSC colour system (adopted by Japan), both of Europe's 625-line systems, PAL and SECAM, are beginning to show their ages. Television engineers everywhere want to get rid of inherent problems in first-generation colour equipment — like the "edge" and "moiré" effects caused by highcontrast colours on captions and closely-striped patterns.
- New features. In their battle for the viewers' attention, broadcasters want to be able to market technological refinements that give television an edge over its new video rivals. Top of the list are stereo sound, additional commentary and data channels, wider pictures and higher resolution.

The MAC family of standards has been designed to provide all these and more. The principal standard, C-MAC, has been optimised for satellite transmission. The version for cable television is D-MAC. A narrower-band derivative called D2-MAC,



carrying only half the number of sound channels, has been added for early community-wide cable systems.

Television engineers in Europe and Japan differ fundamentally on how they see the television set of the 1990s. Where Japanese engineers expect it to be a bulky box built round a high-resolution cathode ray tube, the Europeans see flat-panel displays more than twice the size of today's largest television screens.

The IBA in Britain argues that television tomorrow will be more cinema-like. People are not going to change their sitting rooms, but they will get wider and bigger pictures. The old 4×3 proportions of the cathode ray tube were designed to match the cinema screen of the pre-television era. But in response to competition, film went wider — to the extremes of CinemaScope's 7.05×3 proportions before settling down to between 5×3 and 5.5×3 (not far from the 4.85×3 "golden mean" favoured by artists). The new metre-wide flat-panel displays are being developed with heights of 60cm to give cinemalike proportions.

Another visual effect which television engineers are cribbing from film is image size. The best seats in a cinema are at 3-3.5 times the screen height from the front (see chart). Viewers at home tend to sit around 10-12 times the screen height from the television set. Given a screen 60cm high, and keeping their seats in the same position, they would be sitting at six to eight times the screen height — close enough in proportional terms to start picking up some of the "towering" effects produced by cinema's larger images.

Will such a television screen need more than 625 lines? No, say Europe's television planners. HDTV, they argue, is fine for making high-quality videos for big cinema-sized screens. But its 1,125 line resolution is overkill for broadcasting to the home. Displaying even a 35mm film in an "electronic cinema" would need only 800 lines or so. Besides, they say, there are some technological tricks that allow C-MAC to offer the closest thing to HDTV — and still be viewed on existing television sets.

So-called "enhanced C-MAC" uses digital tricks and microchips borrowed from the computer industry to get a sharper and bigger picture. To provide the wider 5×3 picture, engineers have borrowed six of C-MAC's eight sound and data channels. Wide-picture viewers would still be able to get stereo sound, but everybody would have to give up optional foreign language commentaries.

On each television line, the sound signals would be sent not as the usual analog waves, but as a morse-like stream of "digital packets" (akin to a packetswitched data network) transmitting 3m bits of computer data a second. The colour signals would be transmitted separately, one after another, instead of simultaneously but separated slightly in frequency.

All colour television systems (NTSC, PAL or SECAM as well as MAC) use three separate signals to transmit the full range and brightness of the colours. A mixture of red, blue and green (in the proportions 30%, 11% and 59%) is transmitted as the "luminance" signal. This provides the compatibility for black-and-white sets and carries the information used by the eye's monochrome receptors ("rods"). The two additional signals needed to supply the colour are sent as the blue component minus the luminance, and the red minus the luminance. Both trigger the eye's colour sensors ("cones") which have lower resolving power.

The trick adopted in the so-called C-MAC/Packets approach is to give the resolution-supplying luminance signal as much room as possible to do its job, while squeezing the colour components slightly — and, by separating them in time, ensuring they do not get in each other's way.

As an optional extra, a "frame store" can be used to dispense with the conventional interlacing process and all its problems. To reduce flickering, alternate lines of the picture have been sent since the beginning of television in the first cycle, followed by the alternate set in the next cycle, and so on. In Europe, that means interlacing 312.5 lines 50 times a second; in America and Japan. 262.5 lines 60 times a second. So the net result is only 25 full frames a second in Europe and 30 frames in America and Japan.

However, future television sets could display their full complement of lines (525 or 625) every cycle if they had a frame store to hold, juggle and derive their video signals — and would do so without flicker or any of the side-effects of interlacing. Used in conjunction with enhanced C-MAC, this would be equivalent to 50 full frames being painted on the screen every second. Enough, say its proponents, to give C-MAC more than sufficient picture sharpness to cope with the most demanding of transmissions — while allowing viewers to use their existing sets by buying only a small add-on box.

CORRECTIONS

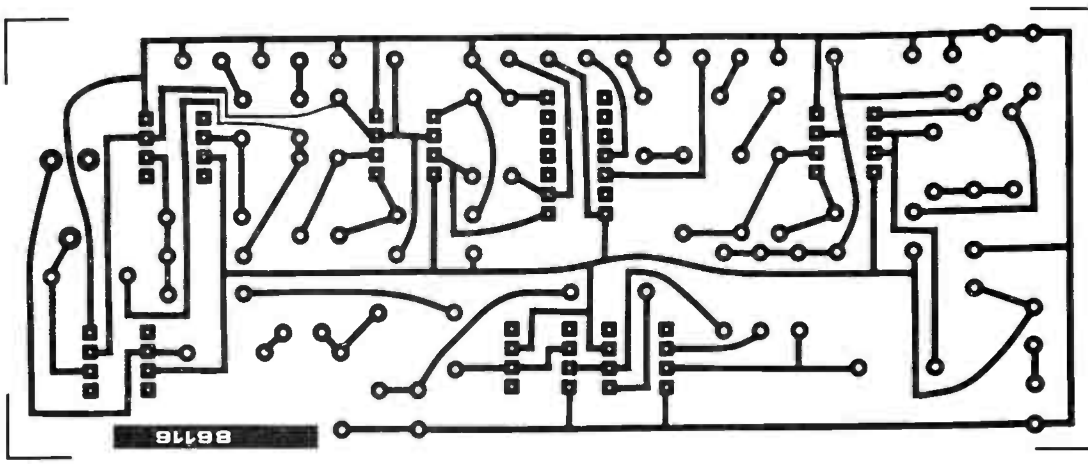
Colour video interface for Atari ST

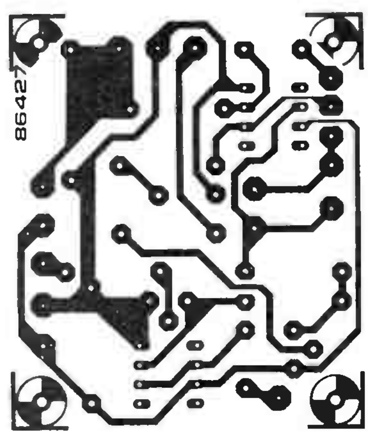
Should the interface fail to reliably produce coloured images, R_7 may have to be changed to 1K0.

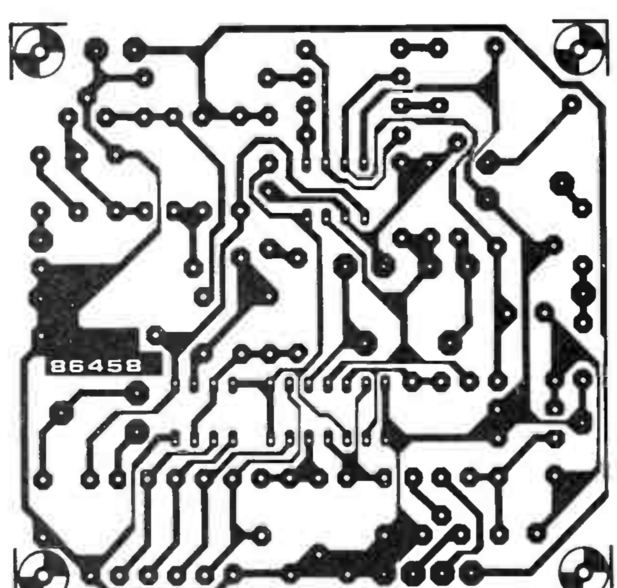
Serial digitizer

On circuit board 86090-1, pin 10 of ADC IC_1 is erroneously connected to pin 15 of IC_3. Please remove the relevant wire jumper and connect pin 10 of IC_1 to pin 7 of IC_3, as shown in the circuit diagram.

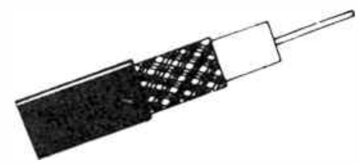
Elektor Electronics PCBs







Low-loss coax cable bargain



Jaycar currently has a bargain in low-loss RG-178 coaxial cable. This is a professional quality 50 ohm cable which is just 2 mm outside diameter and ideal for RF wiring in instruments, receivers, transmitters, tuners and other RF devices.

RG-178 features a Teflon dielectric which exhibits low loss in short lengths to 1 GHz. In addition, Teflon is a high temperature plastic which does not melt at ordinary soldering temperatures so that you can solder the cable to pc boards and connectors without fear of 'meltdown' as so commonly occurs with other common coaxial cables.

Where RG178 is normally around $4/metre, this month Jaycar has a 4 m pack for $10, a 10m pack for $20 and a 50 m pack for $1.50/metre.

Jaycar has five stores in Sydney and one in Brisbane. Head office 'phone is **(02) 747 2022.**

BF981 MOSFETs

Those high performance FETs oft-used in Elektor RF projects, the Philips BF981, are available off-the-shelf from Ian Truscott's Electronic World at Croydon in Melbourne, just a few blocks from the Croydon Railway station.

The data books describe the BF981 as a depletion-type FET intended for VHF applications in TV and FM tuners, and professional communications equipment. It is a dual-gate type (tetrode), protected against excessive input voltage surges by back-to-back diodes between gates and source.

It features a typical noise figure of 0.7 dB at 200 MHz with a 10 mA drain current. Transfer admittance is quoted as 14 mA/V and maximum drain-source voltage as 20 V. It comes in a plastic X-package.

Contact **Electronic World, 30 Lacey St, Croydon Vic. (03) 723 3860.**

10 GHz radar alarm RF head

A bargain in 10 GHz 'radar' burglar alarm modules is currently available from All Electronic Components in Melbourne.

They have a batch of the Philips CL 8963 'RF heads' with installed Tx and Rx diodes, ready to roll.

These are quality units and unused. Ideal for motion detection in a confined space using the Doppler detection method, it provides a simple, sensitive motion sensor. Any motion within the unit's field of view produces an audio output which can be readily detected, 'Squared-up' and used to latch a relay in an alarm circuit.

Check them out at **All Electronic Components, 118-122 Lonsdale St, Melbourne 3000 Vic. (03) 662 3606.**

PROJECT BUYERS' GUIDE

This month's Star Project is from **Dick Smith Electronics** who supply a complete kit for $179. It is available from DSE stores across the land. Now you have to admit that, at that price, it's damn good value for money.

A kit for the **AEM9503 Rapid 12 Vdc NiCad Charger** we understand will be stocked by **Eagle Electronics** in Adelaide, priced under $50. The components are all bog standard off-the-shelf items from the vast majority of retailers, so constructors should experience no difficulty in obtaining any required component. The box in which it is housed is a standard zippy box with aluminium front panel.

The **AEM9504 Flash-triggered Slave Strobe** will likely be stocked as a kit by **Dick Smith Electronics.** Enquire at your nearest/favourite DSE store or dealer. Components for this unit are widely available. The FPT100 is a widely stocked phototransistor. The 6.5 μ/250 Vac paper capcitors are stocked by **Dick Smith Electronics** throughout Australia and New Zealand, **Jaycar** in Sydney and **Altronics** in Perth. Also try **Eagle Electronics** in Adelaide, **All Electronic Components** and **Active Electronics,** both in Melbourne. The transformer is a commonly stocked item.

The **AEM4506 Computer Frequency Counter Interface** is such a simple project! For a kit, try **Eagle Electronics** in Adelaide who will be stocking it for something less than $10 we understand! Otherwise, if you're assembling it all yourself, the IC is a widely stocked component, DIL headers likewise and there's nothing else that can't be obtained literally everywhere.

Printed circuit boards for this month's projects will be available through our Printed Circuit Service, as usual. Ring for pricing. We're on 487 2700.

Our **Elektor Section** this month features an electronic **Barometer/Altimeter** that should prove popular and useful to glider pilots, hot-air balloonists, weather watchers and a host of others. We understand **Hi-Com Unitronics** in Sydney will be stocking a kit for this project, so check them out. The 3.5-digit liquid crystal display employed in this project is not widely stocked, but check anyway with your favourite or local component supplier before looking further afield. The Philips barometric pressure sensor chip is not an item that Philips Elcoma, the distributors, normally keeps as a stock line. If you've got most or all of the other components, then this device could possibly be sourced from **Hi-Com Unitronics.** The LM336 'precision zener' may be obtained through any National Semiconductors stockist. Try **Geoff Wood Electronics** in Sydney.

The Intersil ICL70106 counter display driver is sourced in Australia by R&D Electronics and second-sourced by Thomson-CSF whose distributor is Promark Electronics (offices in Sydney and Melbourne). The op-amps are TLC272s from Texas Instruments. Try **All Electronic Components** or **Radio Parts** in Melbourne, **Geoff Wood Electronics** and **Hi-Com Unitronics** in Sydney.

The **Car Radio Alarm** is a simple device using the popular and ubiquitous 555 timer IC. The Siemens relay specified might be obtained through the distributors, **Promark Electronics** who have offices in Sydney and Melbourne. However, a variety of relays will do the job, provided they have sufficient sensitivity. They may not mechanically fit, and may be mounted in any reasonable position in close proximity to the electronics (to reduce interference).

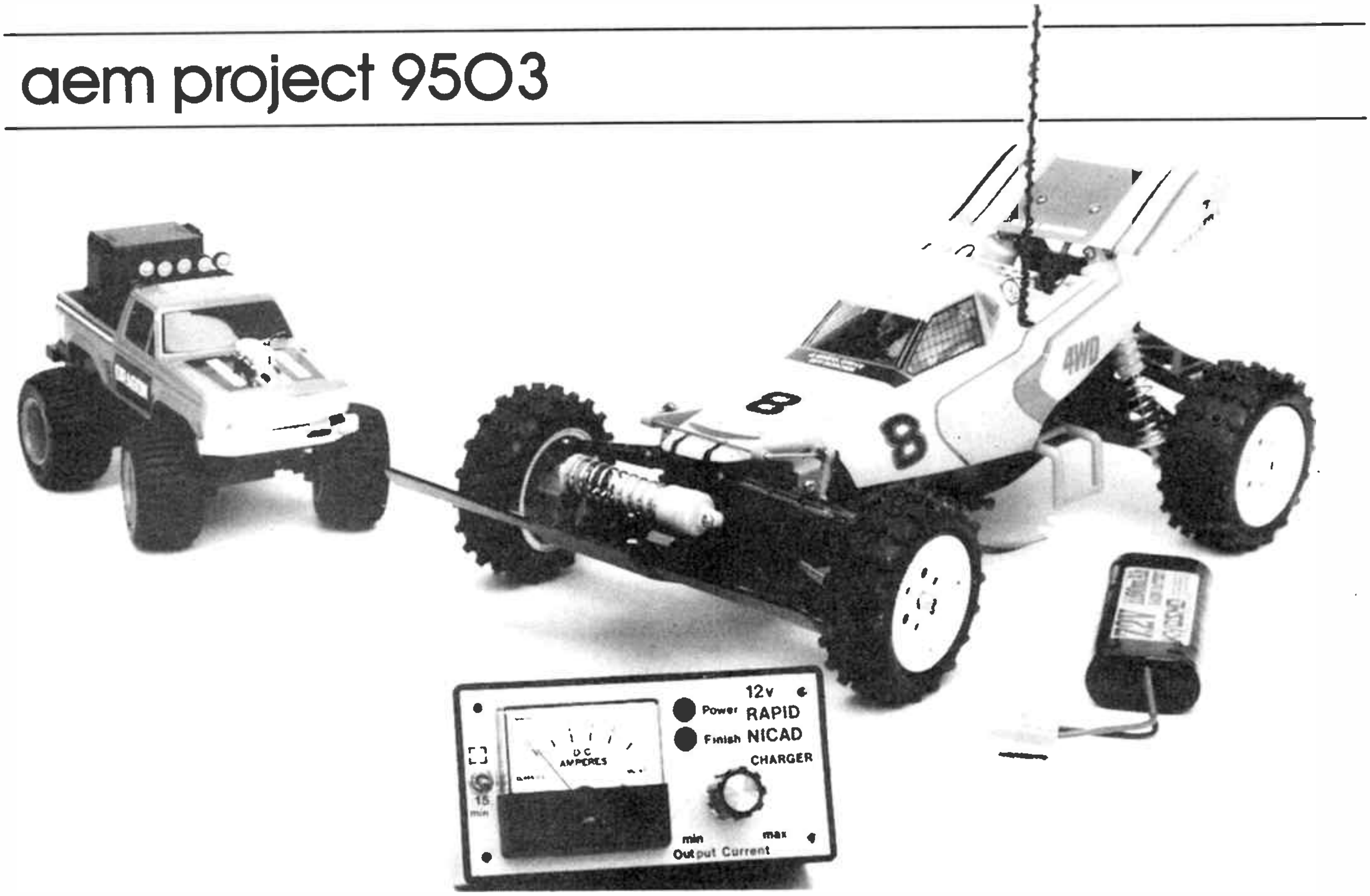
R. A. Penfold's **Octave Generator** on pages 55 to 59 will undoubtedly prove popular among guitar-playing enthusiasts. The components are generally common items, with the exception perhaps of the National Semiconductor LF351 op-amp. This may be obtained from National stockists. Try **Geoff Wood Electronics** as well as **Hi-Com Unitronics** in Sydney, **All Electronic Components** and possibly **Radio Parts** in Melbourne.

There's little unusual in components in the **SPeech Processor** on page 60. You may have to go hunting for the RF chokes L2 and L3, both 47 mH. Try **Geoff Wood Electronics** in Sydney, **Truscott's Electronic World** in Croydon in Melbourne, plus **All Electronic Components** and **Radio Parts** in Melbourne. The 3 mm ferrite beads are widely stocked by many retailers.

In the **Guitar Fuzz Unit** presented on page 61, the semiconductors are a little unusual, but obtainable. The LF356 op-amps may be obtained through National Semiconductor stockists. **Geoff Wood Electronics** in Sydney specialises in National Semiconductors, so give him a whirl. The BC550 is a relatively widely stocked item, but its complement, the BC560, is not so common. However, lean on your favourite retailer's counter and see what can be done. If that fails, try retailers such as **Stewart Electronics** and **All Electronic Components** in Melbourne or, once again, **Geoff Wood Electronics** in Sydney.

Last Month's **Guitar Equaliser** pages 34-37, is being stocked as a kit by Hi-Com Unitronics who is providing good support for our Elektor section by way of components and kits for the projects.

If you're after printed circuit boards for any of these projects, 'phone our Printed Circuit Service.



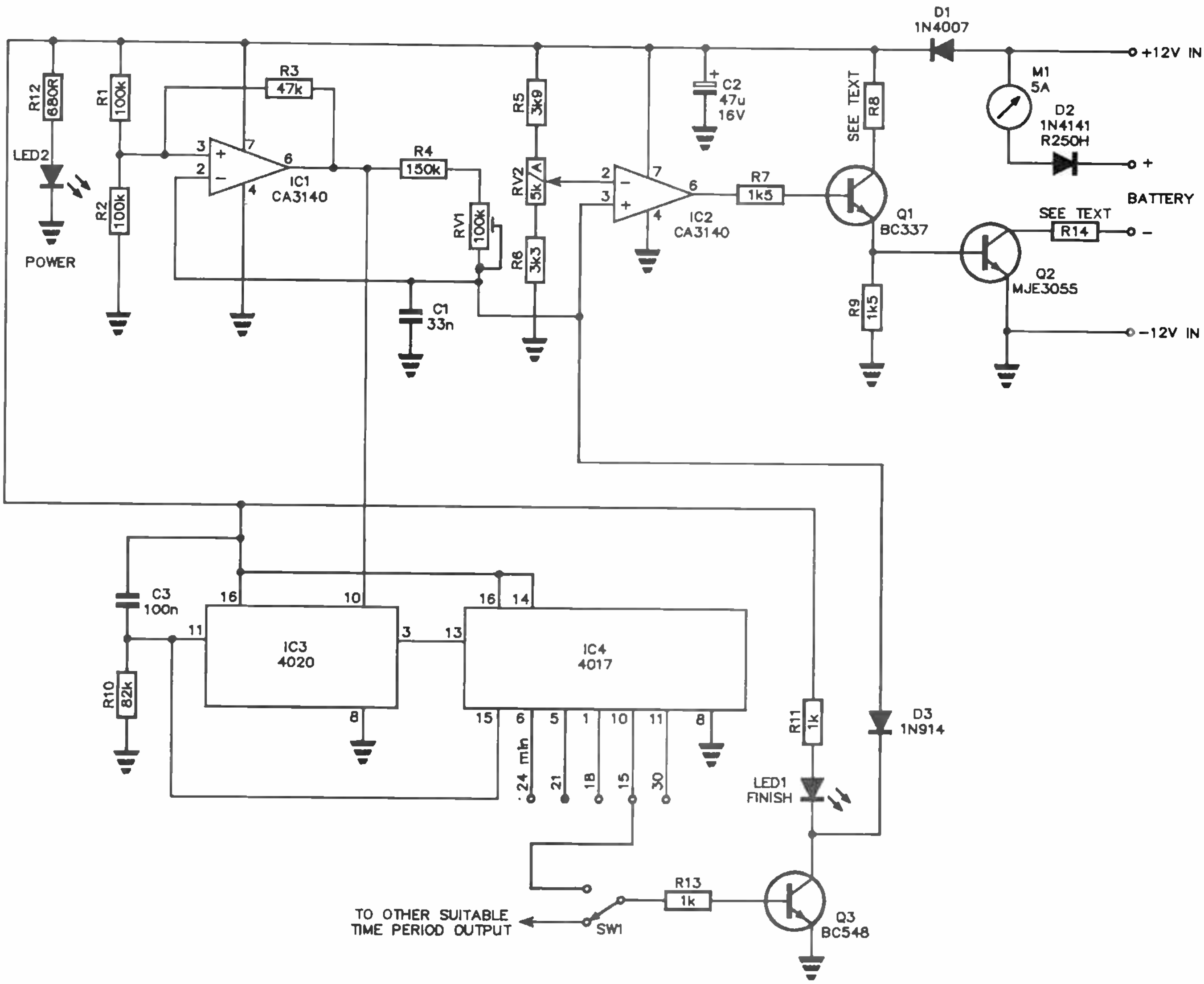
This rapid NiCad battery charger works from 12 Vdc supply

Graeme Teesdale

Battery-powered radio control models sure run out of 'juice' fast in a dynamic action session. Nickel-cadmium rechargeable batteries are popular for obvious reasons, but many commercial 'fast' chargers that work from 12 Vdc (e.g: your car battery) are crude and dangerous to your batteries, comprising just a switch, meter and a dropping resistor. If you're distracted, or forget, you can literally 'cook' your expensive NiCads by leaving them on-charge too long. Not with this project, though!

RADIO-CONTROLLED models, cars in particular, currently enjoy considerable popularity. The models have sophisticated construction and controls, are spectacular in operation and just plain *fun* to play with! Many makes can take either standard dry batteries or the 'equivalent' rechargeable nickel-cadmium cells, while some come with a rechargeable 'battery pack'. They're great fun to use, especially outdoors. But that presents a dilemma. Half an hour of heavy driving — or less — and your batteries are dead! Solution? A portable charger that operates from a 12 V car battery and two sets of rechargeable batteries — one set for driving while the other is on-charge. However, nobody wants to wait around for the 'normal' battery charging time of 10-14 hours, so the charger needs to be able to *fast* charge the batteries in 10-15 minutes. This is done by forcing a current of between two and five amps into the battery. A "time-out" feature is essential to protect the battery from overcharging damage due to excessive heat build-up in the cells.

▶



CIRCUIT OPERATION

The op-amp ICl is connected as a relaxation oscillator. The charging voltage of C1 is applied to the non-inverting input of op-amp IC2. The waveform here is approximately sawtooth in shape, while the output on pin 6 of ICl is a pulse, providing a suitable logic clocking signal for the input of a 4020 counter, IC3. The preset RV1 provides some control over the oscillation frequency.

IC2 is connected as an open-loop comparator. The output on pin 6 swings towards the +12 V rail when pin 3 exceeds the set-point voltage on pin 2. This provides a pulse-width modulated output at pin 6. The PWM range is from zero to 100%. Resistors R5 and R6 set the range of RV2 to achieve this. This provides output current control and keeps dissipation in Q2 down.

The output from IC2 switches Q1 on and off, driving the base of Q2. Resistor R8 can be varied in value to achieve maximum saturation of Q2 to provide for the typically widely varying current gains encountered. The 'normal' value of R8 is between 47 and 100 ohms. When the lower values are necessary, R8 must be made up of two 1 W resistors in parallel.

Resistor R14 is included to shift the burden of power dissipation away from Q2 and to limit Q2's collector current.

Diode D2 prevents the battery under charge from discharging when the +12 V supply is removed. Resistor R1 provides protection against the unit having the 12 V input connected in reverse.

IC3, the 4020, is a ripple counter, dividing the pulses from ICl by 16 384. This provides an output at three minute intervals. Adjusting RV1 permits variation of this interval. IC4 is a counter that provides decimal outputs. A selected output drives the base of Q3 which turns off IC2 and the charging current. As the output of IC3 is set at three minute intervals, you can select any charging period from three to 30 minutes. Outputs from IC4 at 15, 18, 21, 24 and 30 minutes are brought out to pads for hard wiring alternate periods to be selected by SW1.

When the selected output of IC4 goes high, Q3 is switched on, providing current for LED3, the FINISH LED. The collector of Q3 clamps pin 3 of IC2 low via D3, stopping output from IC2, thus removing drive from Q1 and Q2 and cutting off the charging current. The circuit is 'reset' when the 12 Vdc input is removed and reconnected as IC3 and IC4 are reset on power-up by the CR network C3 and R10.

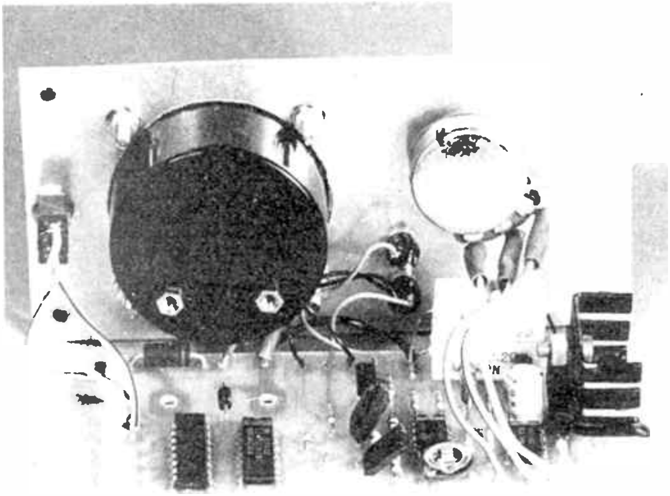
To indicate that power is applied to the unit, LED2 has been included, current being supplied via R12 from the 12 Vdc input rail.

Circuit details

Current is supplied to the battery being charged in pulses. The width of the pulses (that is, the time the pulses permit current to flow) is varied by a potentiometer to vary the average current after a preselected time. Two times can be selected by a toggle switch. The most commonly used period is 15 minutes and one position of the toggle switch is always set to this period. For the other, a period can be selected by connecting the switch contact to one of the on-board period outputs. Apart from 15 minutes as mentioned, periods of 18, 21, 24 and 30 minutes are provided.

A low-cost 5 A full-scale panel meter is used to indicate charging current and two LEDs indicate 12 Vdc power is applied and that charging has finished.

All the components employed were chosen for their ready availability at many electronics retailers. So, constructors should have little difficulty sourcing components for the project.



The guts! The pc board has been unbolted from the panel meter to show the components. Note the 'flag' heatsink on Q3. Note that R14 comprises two power resistors in parallel. A TO3 style transistor could be used for Q3, mounted off the board. In this case wire a 5 A fuse in place of R14.

Construction

It was decided to house the unit in a small, low-cost plastic 'zippy' box, of the type which has an aluminium 'front panel'. Scotchcal labelling was used to dress it up. The charging current meter bolts to the front panel, the printed circuit board containing the electronics being supported by the meter terminal screws. This makes for simple, tidy construction with a minimum of "chassis bashing."

The first place to start is with the zippy box's front panel. As it's aluminium, it is quite 'soft' and easily worked. With a soft lead pencil, measure up and mark out the hole centres for the switch, panel meter, the two LEDs and the potentiometer. The panel meter may be supplied with a template for marking hole centres. Use it. Centre-punch all hole centres when you're finished.

Drill a small pilot hole in each hole position before drilling the holes to their final diameter. A small jigsaw may be used to cut out the meter hole. Alternatively, drill a series of holes just inside the edge of the marked meter hole, each one just overlapping the next. The centre should be easily removed when you've finished. Use a half-round file to smooth the edges of the hole. Don't overdo it. The meter should just comfortably fit.

When the panel drilling is finished, you can apply your Scotchcal. You can make your own from the artwork repordUced elsewhere in this article, or if you have purchased a kit, no doubt one will be supplied. Take your Scotchcal label and soak it in a saucer of water. Wet the front panel with a sponge, peel off the Scotchcal backing and position the label on the panel. The water will permit you to slide it around for exact positioning. If you do it 'dry' you only get one chance to get it correct. Smooth the Scothcal in place with a sponge, making sure you get rid of any bubbles by working them towards the panel edge.

When it's dry, the switch, meter, potentiometer and LEDs may be mounted to the panel. Put it aside when you're finished.

Now tackle the printed circuit board. Whether you've made your own or purchased a ready-made board, give it a thorough visual check. See that all the holes are drilled and of the correct diameter. Check that there are no small 'bridges' between closely-spaced tracks or pads, particuiarly around the ICs. Correct anything that needs it.

The board is best assembled by starting with the smaller components, the low power resistors, the capacitors and the diodes. Leave the power resistors and trimpot until later. Watch the orientation of the diodes. Mount all components right down on the board, else it won't fit behind the meter. Solder the ICs in place next, taking care that they're placed the right way round. IC3 and IC4 are CMOS devices, so take the appropriate precautions. Handle them only by their ends, avoid touching the pins during insertion. Solder the common and supply pins first (pins 8 and 16 in each case).

The two transistors, the trimpot and the power resistors are assembled last of all. Note that Q2 stands straight up from the board and requires a small heatsink which is bolted directly to it. Check you put them in the right way round.

Now attach the wires that run from the board to the components mounted on the panel. Colour coding helps here. Now give it all a thorough check.

Complete the wiring to the front panel components checking as you go, with one final check at the end. Now bolt the board to the meter, with the components facing the panel.

Power-up and adjustments

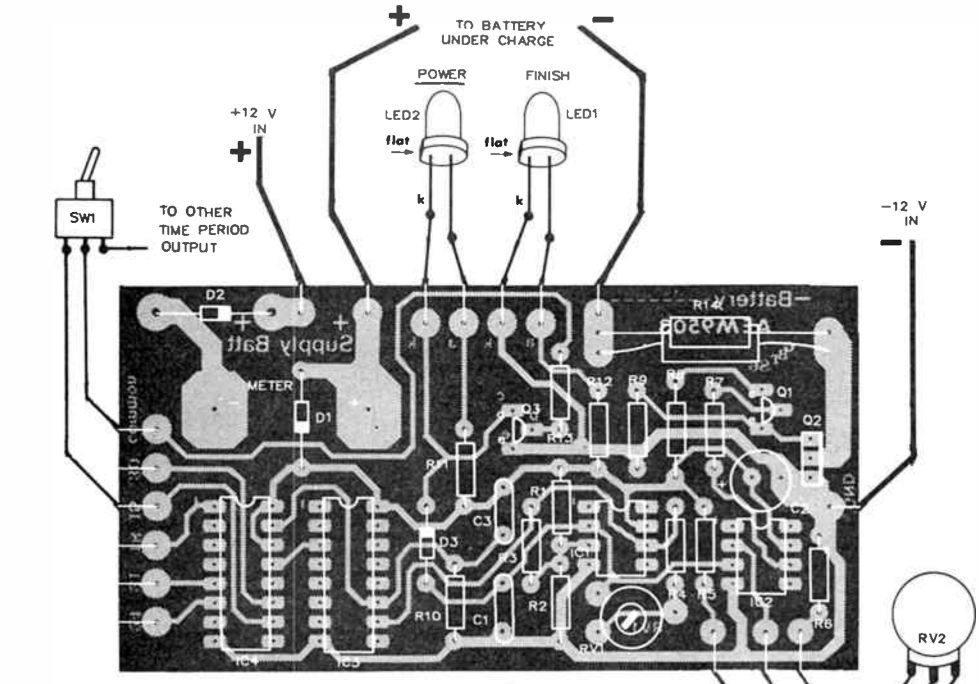
Connect a 12 Vdc source (preferably fused and switched) and a suitably discharged battery. Set SW1 to 15 minutes and the current control at minimum. Turn on the 12 V source and see that the power LED lights and that no current shows on the meter. Slowly increase the current control. The meter reading should rise. Exactly how far depends on how 'dead' the battery is. If you don't get sensible indications, switch off and check your wiring and board assembly. Correct any faults.

Assuming all's well at this stage, you can now adjust RV1 (the trimpot) so that you get three minute pulses at pin 3 of IC3. Be patient!

With a truly dud battery connected, see that you can vary the charging current from zero through the maximum of 5 A.

The trip action of the maximum time period can be checked by shorting the collector and emitter of Q3 with a jumper lead. The FINISH LED should light and the output current should fall to zero.

Well, there you go. Keep those racers on the road!



Component overlay and wiring diagram.

AEM9503 PARTS LIST

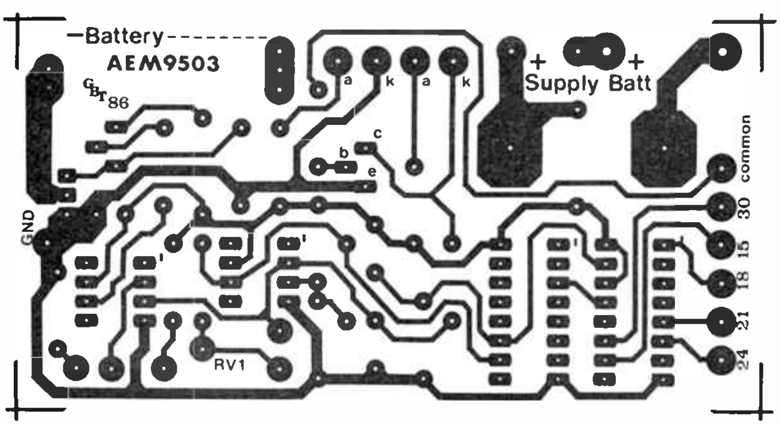
Semiconductors
IC1, IC2 . . . CA3140, LM3140
IC3 . . . . CD4020
IC4 . . . . CD4017
D1 . . . . 1N4002, 1N4007
D2 . . . . 1N4141, R250H
LED 1, LED 2 TIL220R red LED
Q1 . . . . BC337
Q2 . . . . MJE3055

Resistors
R1, R2 . . . . 100k
R3 . . . . 47k
R4 . . . . 159k
R5 . . . . 3k9
R6 . . . . 3k3
R7 . . . . 1k5
R8 . . 47-100R, 1 W (see text)
R9 . . . . 1k5
R10 . . . . 82k
R11 . . . . 1k
R12 . . . . 680R
R13 . . . . 1k
R14 . . . . . . 1R5 and 2R2, 5 W in parallel
RV1 . . . . 100k preset
RV2 . . . . 5k/A pot

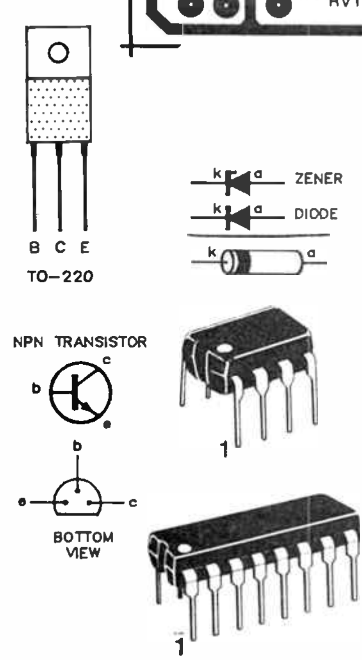
Capacitors
C1 . . . . 33n greencap
C2 . . . . 47μu RB electro
C3 . . . . 100n greencap

Miscellaneous
M1 . . . . 0-5 A panel meter, MU45 or similar
SW1 . . . . . . SPDT min. toggle switch
AEM9503 pc board; jiffy box 40 x 68 x 130 mm; Scotchcal front panel; TO-220 heatsink; knob; two LED mounts; one to two metres of heavy duty hookup wire; one to two metres of medium duty hookup wire.

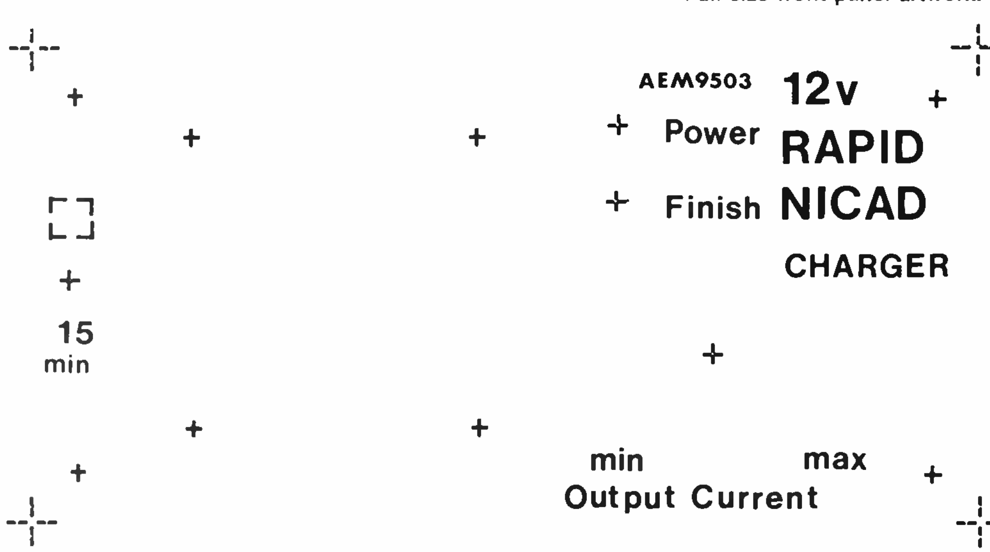
Estimated cost: $44-$50



Full-size pc board artwork.



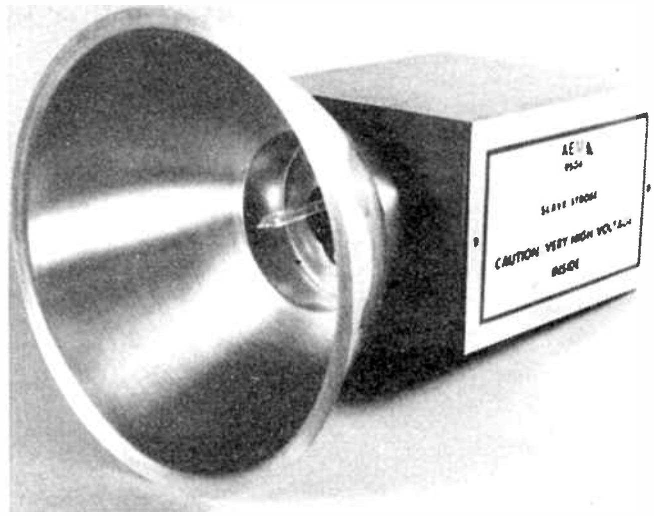
Full-size front panel artwork.



A flash-triggered 'slave' strobe

David Tilbrook
Technical Systems Australia Pty Ltd

This project was designed to team with our Beat-triggered strobe, the AEM9500, or any other strobe. It triggers from the main strobe's flash to provide an additional flash in sychronism with the main strobe without having any interconnection between them. You can have one main strobe and as many 'slaves' as you wish!



The Slave Strobe employs the same hardware as our Beat-Triggered Strobe. The optical flash sensor is located at the bottom of the reflector, so in use you face the slave unit(s) into the area the main strobe covers.

THE AEM9500 Beat-triggered Strobe was published in the July 1985 issue and has proved to be an enormously popular project. The most common readers request in relation to that project has been for additional strobes which can be triggered by the main strobe to increase the intensity of the light pulse. The AEM9504 Slave Strobe has been designed especially for this purpose and is triggered by the light pulse of the main strobe. In this way a number of slave strobes can be used in conjunction with a single main strobe without the necessity of any interconnecting wires. This not only increases the intensity of the strobe flash but overcomes the problem of shadows which often dramatically decreases the effectiveness of the strobe effect.

Design consideration

The main problem with the design of an optically triggered strobe unit is to ensure that the strobe triggers reliably. It must fire every time the main strobe fires while at the same time ensuring that it will not false trigger as a result of other light effects which may be in operation at the same time. The slave strobe must be able to function in a wide variety of background light levels yet remain sensitive enough to ensure detection of the main strobe pulse.

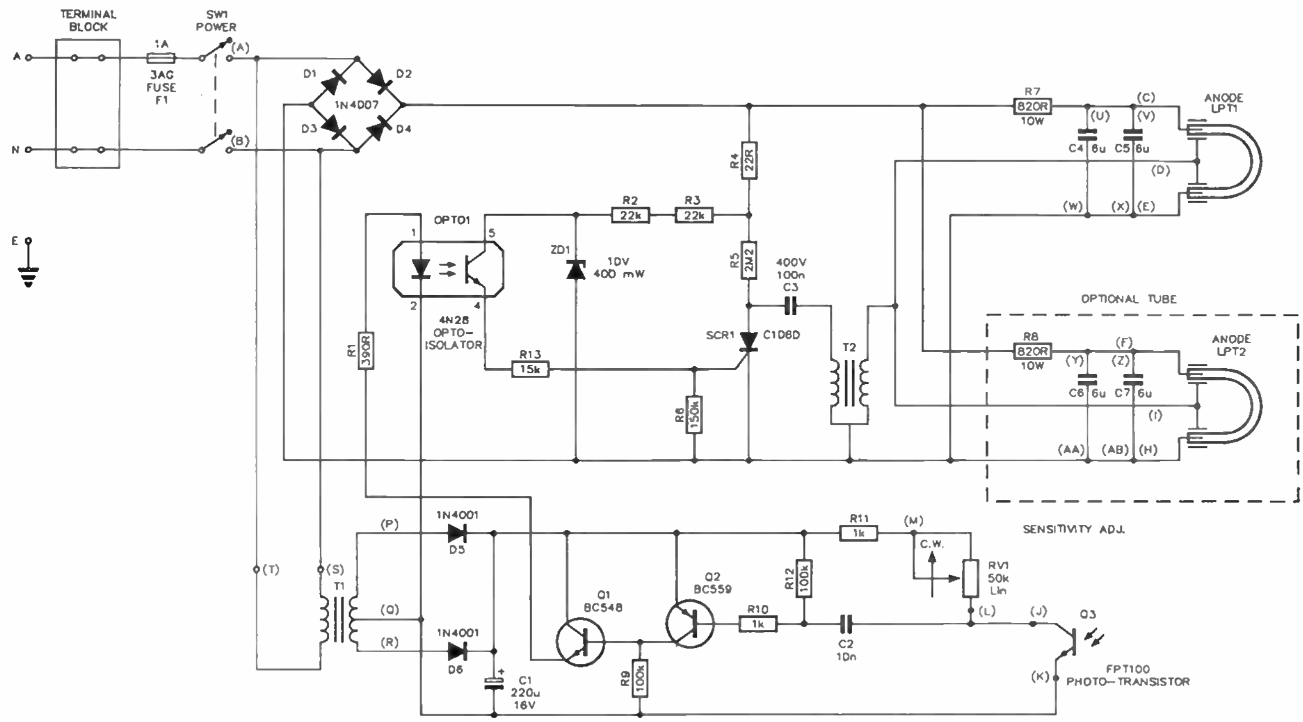
The first step in the design of the slave strobe, therefore, was to choose an appropriate optical detector. A light dependent resistor can not be used for this application since its response time is too long. Instead we chose the FPT100 photo-transistor which has a good response time and is both inexpensive and readily available. A photo-transistor functions like an ordinary transistor except that the base is controlled by the light intensity incident upon its photo-active area. If the device is placed in a dark environment then the base is effectively unbiased and the resistance from its collector to its emitter will be high. As the light intensity is increased the effective bias is increased and the emitter to collector resistance is decreased.

In this circuit the emitter of the photo-transistor is connected to 0 V while the collector is connected via a potentiometer to the positive supply line. Light pulses detected by the transistor will result in the device being biased on more heavily, resulting in a drop in signal voltage on its collector. The potentiometer allows the resistance from the collector to the positive rail to be varied and hence allows adjustment for different ambient light levels. If, for example, the strobe is used in an environment with high ambient light levels the resistance from the photo-transistor's emitter to its collector will be low. If a fixed large value resistor were to be used from the device's collector to the positive rail the voltage on the collector would be pulled down to 0 V making it unable to detect light flashes from the main strobe unit.

The solution, in this case, is to use a relatively small value resistor in this position so that more current flows in the photo-transistor increasing the voltage drop across the device. In a dark environment however, this will decrease the sensitivity of the strobe requiring an unnecessarily bright pulse before triggering will occur. In this situation a large value resistance is required. The use of the potentiometer overcomes these problems by allowing the value of this resistance to be varied and hence the sensitivity to be varied.

The key to making the slave strobe trigger reliably when the main strobe fires was to design the detector circuitry so that it responds to a rapid change rather than to the magnitude of the light levels. The potentiometer discussed above ensures simply that the photo-transistor is in a reasonable operating range, so that its correct adjustment is extremely easy to do. In fact, in most operating environments the strobe will fire reliably regardless of the adjustment of the potentiometer.

Since the voltage on the collector of the photo-transistor is inversely proportional to light intensity the magnitude of this voltage will change for different ambient light levels. The 50 Hz mains causes conventional lighting to flicker at 100 Hz so this will also be present on the collector of the phototransistor. To decouple these unwanted stimuli from the narrow pulse that results when the main strobe fires, the col-



CIRCUIT OPERATION

The 240 volt mains supply is connected via a terminal block, 1 A fuse and power switch to the power transformer T1 and to a full-wave rectifier formed from the four diodes D1, D2, D3 and D4. The rectifier produces a dc voltage of around 340 volts which is applied to the anode of the Xenon strobe tube via resistor R7. This resistor is necessary so that once the tube has fired the voltage drop across the tube will fall below that required to sustain conduction. The tube then goes open-circuit, allowing the main discharge capacitors C4 and C5 to recharge.

The 340 volt supply is also applied to the input of a potential divider formed from resistors R2, R3, R4 and zener diode ZD1. The 10 volt drop produced across ZD1 is applied to the collector of the transistor within the opto-isolator the emitter of which is connected to the gate of the SCR via current limiting resistor R13. R6 is included to decrease the sensitivity of the gate to external noise pulses.

A second output from the potential divider is connected to the 2M2 resistor R5 which in turn connects to both the anode of the SCR and to capacitor C3 in series with the primary of the trigger transformer. When the LED within the opto-isolator is turned on, its transistor conducts applying a current to the gate of the SCR. The SCR turns on, representing a very low resistance between its anode and its cathode which completes the circuit between C3 and the primary of the trigger transformer. Since C3 has previously been charged by resistor R5 it discharges through the primary producing a trigger voltage of several thousands volts on the secondary of T2. This voltage causes some of the gas within the Xenon strobe tube to ionise and the tube resistance breaks down. The resulting rush of current flowing from the main discharge capacitors C4 and C5 causes the bright Xenon flash.

The circuitry used to detect the trigger flash is based around the FPT100 photo-transistor Q3. The collector of Q3 is connected via a 50k linear potentiometer in series with R11 to a low-voltage positive supply line formed from a simple full-wave rectifier and capacitor across the secondary of the mains transformer T1. The collector is connected to the input of an RC high-pass filter formed from R12 and C2 with a time constant of around 1ms. This decouples slowly changing light levels and produces significant output only for quickly changing light levels such as those produced when the main strobe unit fires.

Fast changing light levels will produce negative-going pulses at the base of Q2. If these pulses are greater than around 0.6 volts then transistor Q2 will be turned on, producing positive-going amplified pulses on the collector of Q2. These pulses are current amplified by Q1 and fed to the LED within the opto-isolator to trigger the strobe tube.

lector voltage is ac-coupled by a first-order RC high-pass filter formed by capacitor C2 and resistor R12. The time constant for this RC filter is set at approximately one millisecond, so slowly changing voltages will be rejected by the filter. The output of this filter is fed to the base of transistor Q2 via the current limiting resistor R10. This provides a 0.6 V threshold which must be exceeded by the signal voltage before the strobe will fire, since the signal voltage on the output of the filter must drop by more than 0.6 V approximately before the emitter — base junction of the transistor will be forward biased.

The combination of the RC filter and 0.6 V threshold makes the detector very reliable yet insensitive to false triggering. The prototype unit triggers reliably when the main strobe triggers even in bright ambient light environments. It is not necessary to point the main strobe directly at the slave strobe in order to ensure reliable triggering. In fact, the two strobes can be pointed in completely opposite directions within the same room. Turning the main room lights on and off however should not cause the strobe to false trigger. ▶

Construction

This strobe, like all strobes, employs high voltage to operate the Xenon flash tubes. Here, this voltage is obtained by rectifying the 240 V mains supply voltage producing a potentially lethal supply voltage around 340 volts. BE CAREFUL during the construction and during any subsequent servicing fo the unit to be sure that it is OFF before going near any of the high-voltage wiring.

The use of the AEM9504 pc board is strongly recommended for this project since it has been designed to provide the necessary isolation between the high- and low-voltage sections. If you choose to make your own pc board be sure to use only fibreglass pc board material.

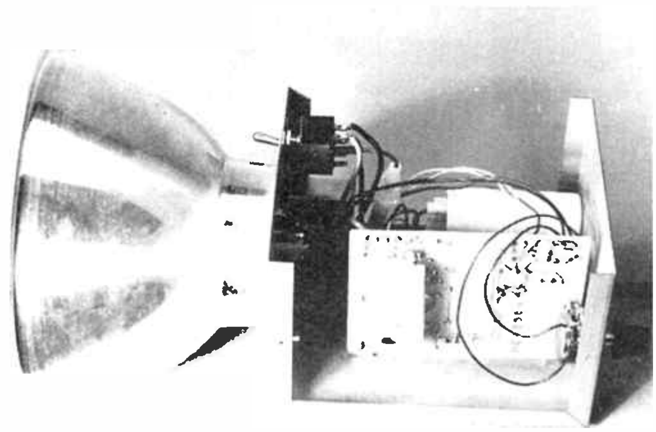
The component overlay included with this article shows the positions of the components on the pc board. Start the construction of the pc board by soldering the resistors in place first. Leave the large 10 watt resistor R7 (and R8 if the optional second tube is used) until last. These resistors solder to the rear (tracks) side of the pc board and tend to be a nuisance when soldering other components. Next, solder the capacitors to the pc board being careful to insert C1 with the correct orientation. The body of the capacitor is marked indicating the positive and negative leads. The component overlay shows which of the two holes the positive lead should be inserted.

Next mount the semiconductors starting with the diodes D1, D2, D3 and D4. Note that these are 1N4007 1000 V types. Do not confuse these with the 1N4001 and 1N4002 types which are specified for use as D5 and D6. Solder the transistors in place on the pc board, again being careful not to confuse the BC559 and BC548 types. Finally the SCR can be mounted on the board. The component overlay shows the correct orientation. A diagram showing the pinout of the SCR has been included with the circuit diagram. Note that the lead closest to the chamfered edge is the gate.

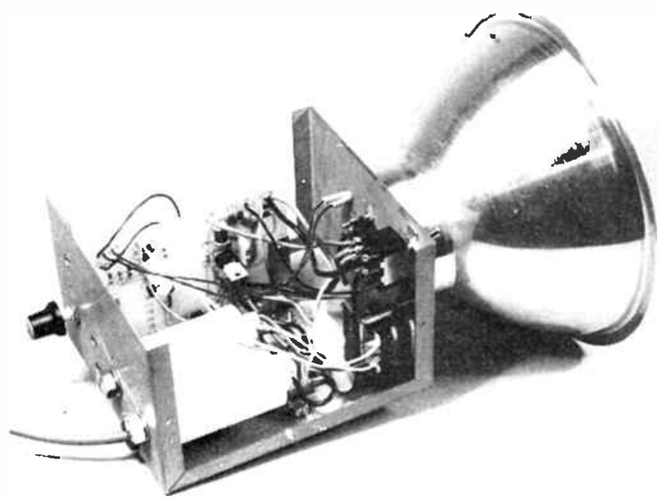
Solder the trigger transformer and opto-isolator into position and then bolt the two mounting brackets into position. The final step in the construction of the board is to mount the 10 watt resistors to its rear. Before doing this, however, wrap the leads around the shaft of a small screwdriver about two times as shown in the accompanying diagram. This lengthens the thermal path between the resistor and the pc board and provides a small heatsink which decreases the amount of the heat transferred to the pc board from the resistor.

The next stage in the construction is to assemble the chassis mounted components. The prototype chassis was the same size as that used for the beat-triggered strobe measuring 150 × 130 × 100 mm. The chassis used was an all-metal box which provides good electrical shielding and insensitivity to heat generated by the 10 watt resistors inside. A photographic type aluminium reflector is fitted to the front of the chassis into which the Xenon flash tube and the photo-transistor are fitted. The Xenon flash tube is soldered to an octal plug using any three consecutive pins. The plug cover is discarded. The accompanying assembly diagram shows the tube mounting arrangement. The tube leads are inserted into the pins of the octal socket and then soldered where they exit the other end of the pin. Place the plug upside down, so that the Xenon tube is pointing down, and then apply a little solder at a time to the tube leads protruding from the plug pins. In this way the solder can be made to flow down the leads and into the plug pins. Try not to get solder on the outside of the plug pins since this will impede insertion of the plug into its socket.

The aluminium reflector mentioned above is mounted to

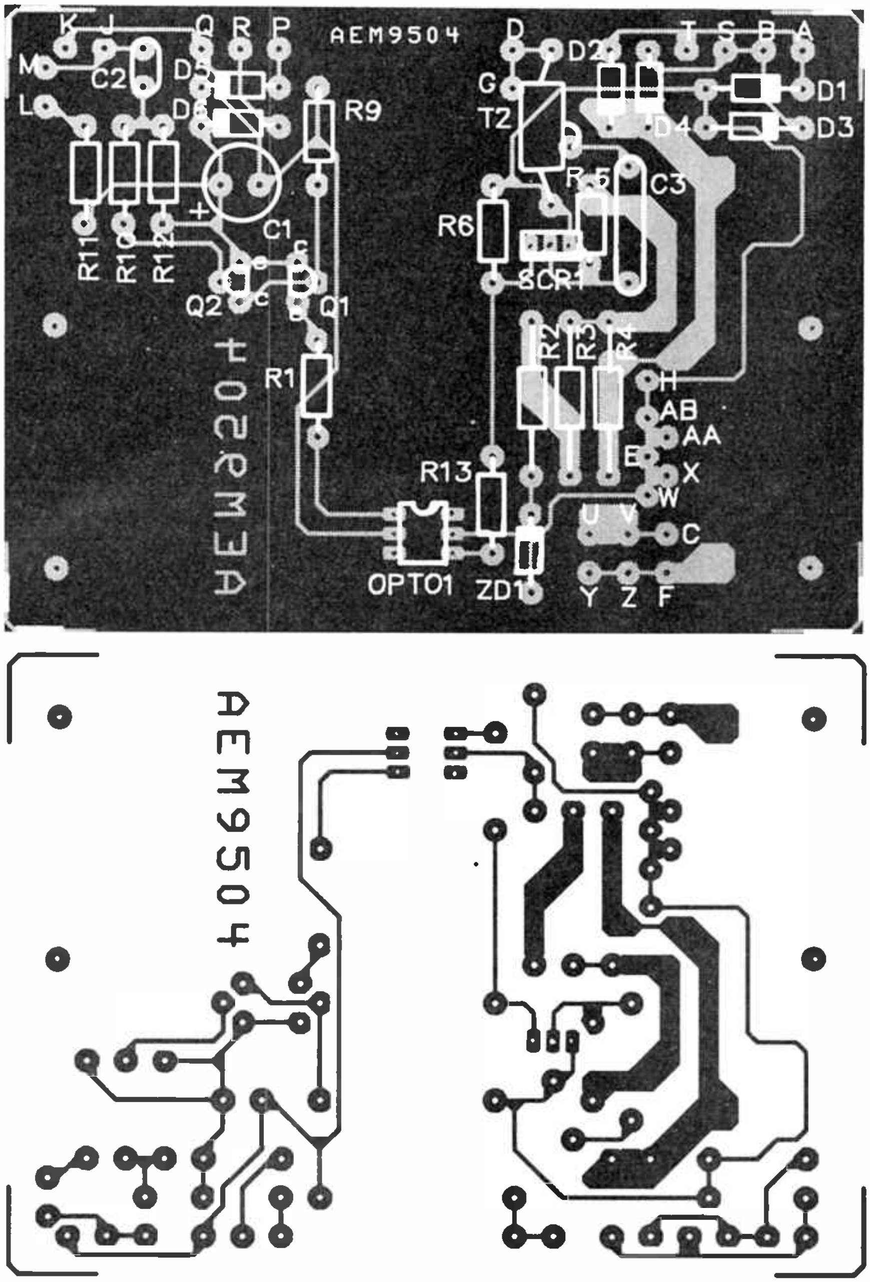


Internal viewing showing the rear of the board. Note the 10 W wirewound resistor, R7. The sensitivity potentiometer is mounted on the rear panel (right).

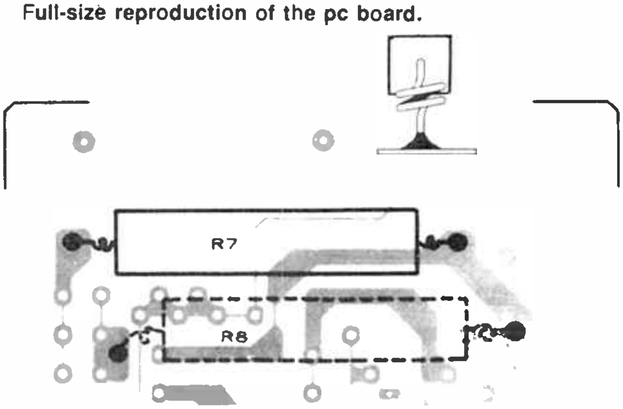


Internal view showing general layout. Note the positioning of the small transformer and the wires leading to the phototransistor.

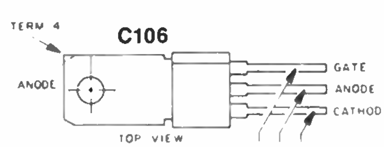
View inside the reflector showing positioning of the phototransistor.

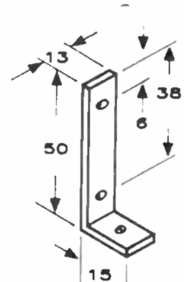


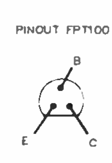
Full-size reproduction of the pc board.



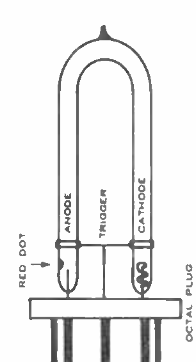
The 10 W resistors mount on the copper side of the board.







ALL DIMENSIONS ARE IN MILLIMETRES
ALL HOLES ARE 4mm DIAMETER



Strobe tube mounting on the octal plug.

AEM9504 PARTS LIST

Semiconductors

Q1 .... BC548 or equiv.
Q2 .... BC559 or equiv.
Q3 ... FPT100 photo-transistor
D1-D4 ...... 1N4007 or equiv.
D5, D6...... 1N4001 or equiv.
ZD1 .... C106D SCR
OPTO1 .... 4N28 opto-isolator

Resistors All ¼W unless shown

R1 .... 390R
R2-R4 .... 22k
R5 .... 2M2
R6 .... 150k
R7 .... 820R, 10W
R8 .... see optional list
R9 .... 100k
R10, R11 .... 1k
R12 .... 100k
RV1 .... 50k lin pot.

Capacitors

C1 .... 220u/16V electro
C2 .... 10n MKT
C3 .... 100n/400V MPC
C4, C5 .. 6µ/6µ5 250V AC MKP Rifa type PHN453
C6, C7 ...... See optional list

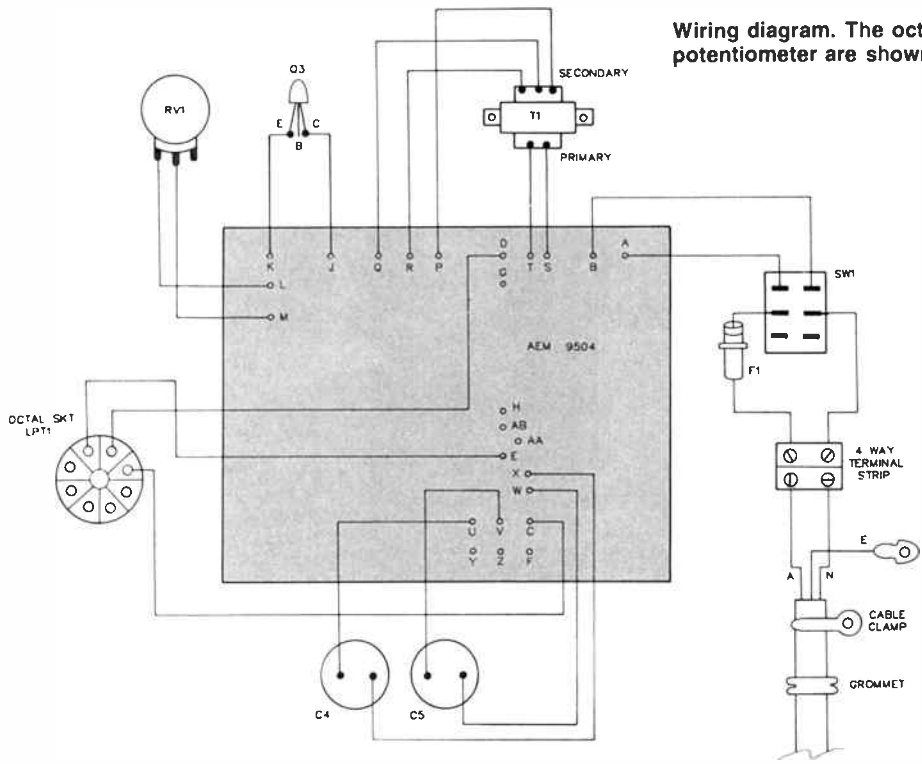
Miscellaneous

T1...... 12.6V CT transformer type 2851
T2 .. TR4KN pulse transformer
LP1 .... Xenon tube MFT1210
SW1 ...... DPDT 240V toggle
F1 .... 1 A, 3AG fuse with in-line fuseholder
2-way terminal strip; strobe reflector; octal chassis socket; octal plug; 1 × all-metal box to suit, 150 × 130 × 100 mm; 1 × perspex cover; 2 × right angle brackets, see drawing; 1 × knob; 4 × rubber feet; 1 × cable clamp; 1 × solder lug; hookup wire, nuts, bolts, mains lead and plug.

Optional Components (for second tube)

R8 .... 820R 10W resistor
C6, C7 .. 6µ/6µ5 250 Vac MKP Rifa type PHN453
LPT2 ... MFT1210 Xenon tube

Estimated Cost: $28-$34



Wiring diagram. The octal socket, the switch and the potentiometer are shown looking from the rear.

the front of the chassis by four bolts, two of which are also used to mount the octal socket in place. Before doing this, however, a small hole should be drilled through both the chassis front and the flat section of the reflector so that the photo-transistor can be mounted. Drill this hole away from the Xenon flash tube to minimise the possibility of a short between any of the tube leads and the photo-transistor.

The photographs show the position of the major components within the chassis. The mains power switch and power transformer mount to the front of the chassis. The discharge capacitors C4 and C5 (and C6, C7 if the optional tube is fitted), and the sensitivity adjustment potentiometer are mounted to the rear of the chassis while the pc board and a two-way terminal strip are mounted to the bottom of the chassis.

Start this phase of the construction by mounting the power switch, two-way terminal block and power transformer to the chassis. Mount the mains cable by passing it through the rear of the chassis using a grommet and a cable clamp bolted to the bottom of the box. Terminate the active (brown) and neutral (blue) wires using one side of the terminal block, checking with a multimeter to ensure that an open circuit exists between the two wires and between both wires and the chassis. Terminate the earth lead (green or green with a yellow trace) from the mains cable by soldering it to a solder lug and bolting this to the bottom of the chassis using a nut and bolt especially for this purpose. Make sure that the earth lead is a little longer than the active and neutral leads so that if the cable clamp failed the earth lead would be the last lead to break.

Next make the wiring between the other side of the terminal strip and the mains switch. Use 240 V rated cable only. The connection between the active side of the terminal strip is done via a 3AG in-line fuse holder. Insulate the solder joints to the switch using spaghetti or plastic heat-shrink tubing.

The large discharge capacitors can now be mounted into position on the rear panel after first inserting the specially provided connecting wires into the push-lock terminals on the tops of the capacitors. Check that the wires have been pushed fully into the terminals and that the wires will not pull out easily.

The pc board and sensitivity adjustment pot can now be bolted into place within the chassis and the remaining wiring carried out. A wiring diagram has been provided which shows all of the wiring to the pc board and between the various off-board components. The photo-transistor is mounted using the hole discussed above by insulating the wires leding to it using spaghetti and then gluing it into position on the front panel.

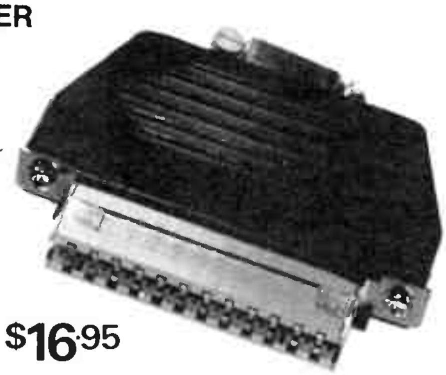
Carry out a thorough check of all wiring before applying power. Pay particular attention to the 240 V wiring using a multimeter to carry out a final test. Check that with the mains switch in the off position the resistance between the active and neutral pins on the mains plug is open circuit. Check that an open circuit exists between both of these pins and the earth pin and that a short exists between the earth pin and the chassis. When the mains switch is turned on, the resistance from the active pin to the neutral pin should decrease to the resistance of the primary of the power transformer.

Powering up

If all is well with the wiring and components, bolt the top of the box into position. First power up the beat-triggered strobe setting it to the continuous mode and face it towards the slave strobe. With the beat-triggered strobe firing, turn on the slave strobe which should immediately start firing in synchronisation. If all is well turn the strobe off and glue a perspex cover over the front of the reflector so that it is impossible to make accidental contact with the strobe tube(s) which carry a potentially lethal voltage.

The slave strobe greatly improves the effectiveness and the visual impact of the AEM9500 Beat-triggered Strobe or any other main strobe unit. A single main strobe can be used with as many slave strobes as required which can be located virtually anywhere within reasonable distance of the main unit.

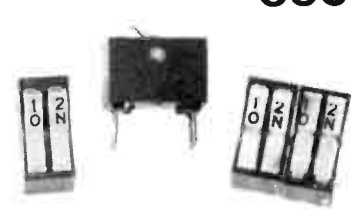
COMMODORE COMPUTER EDGE CONNECTOR



Geoff is actually putting these connectors together himself because no one can supply a proper connector for the Commodore expansion port. Yes this connector has the two polarising keys so you can't plug it in the wrong way round and blow things up!! Also has a posh U.S. made back shell. Needless to say the two rows of 12 contacts are gold plated and of the correct pitch. The polarizing feature alone makes it well worth $16.95.

$16.95

MODULAR DIP-SWITCH SUPER SPECIAL 60c



What would you expect to pay for quality EECO rocker DIP switches? Would you believe 30cents per actuator? We've secured a quantity of two pole switches which can be stacked to get any even number of switches you like on the same PCB pitch - yes a 20 SPST gang or more if you like.

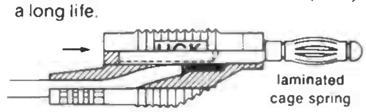
They're rated at 1Amp. 28V non-switching or 125mA switching. Gold over copper alloy switch contacts and tin-lead over copper alloy terminals. Rugged sealed construction. Actuators can be locked against accidental actuation. 60 cents each (twin actuators blocks) but hurry.

NEW RANGE OF HIGH QUALITY TEST LEADS

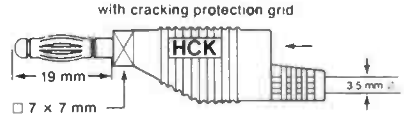
Sick of those stiff plastic test leads that come with most multimeters? You know the ones that kink and produce pungent smoke when you touch them with a soldering iron? Well we've done something about it and proudly introduce the HCK range of quality silicone leads.

It's impossible to describe how flexible they are. You wouldn't believe that a 1000V/16Amp rating cable could be so er, floppy (?). Cable has soldering-iron proof silicon rubber insulation with 512 strands of copper inside. -100 C to 300 C temperature range. Plugs are stackable, extremely hard-wearing. Choice of black, red, blue, yellow, green and violet.

We will also be stocking the cable cut to length. Not cheap but an investment in real quality and a long life.



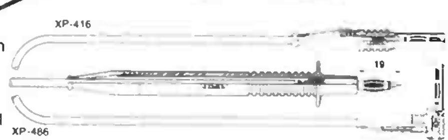
16 A Universal Test Lead
with cracking protection grid



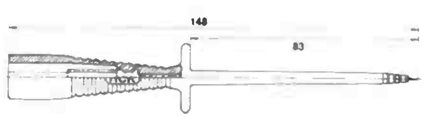
4mm Test Leads
Stackable with special cracking protection grid. Laminated cage spring contact with virtually no contact resistance. Available in three lengths - 500mm **$5.66**, 1.0m **$7.21** and 1.5m **$8.66** with exposed plug on each end.

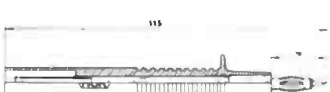
4mm Safety Shrouded Leads
Available with straight or 90 plugs. Available in 1 metre length only. Straight **$9.43** 90 **$9.99**

4mm Safety Prod Leads
Available with straight or 90 plug. Available in 1 metre length only. Straight **$10.15** 90 **$10.60**



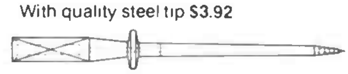
4mm Plug-On Test Prods





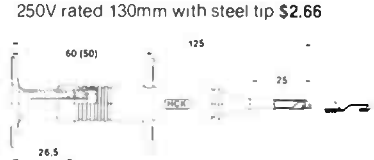
With 4mm plug tip **$3.05**

With quality steel tip $3.92

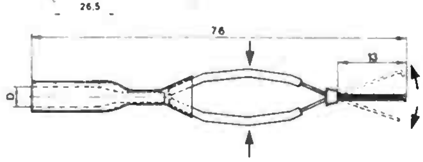


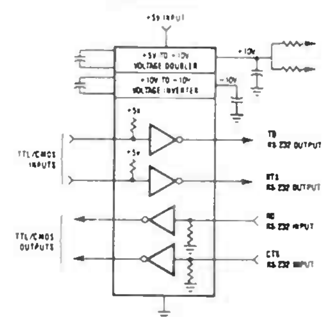
250V rated 130mm with steel tip $2.66

4mm Safety Hook Grip
Accepts 4mm plug and features quality steel hook **$9.43**



4mm Plug-On Clip Test Tweezers
No exposed parts. Fully epoxy-resin insulated. Grips down to 1mm and won't fall off **$10.54**.





5V POWERED DUAL RS232 TRANSMITTER/RECEIVER MAX232

Yes it meets all RS232C specs but only needs a 5V supply because it has built-in converters for the +10V and -10V power supplies. Can also be used as a voltage quadrupler for input voltages up to 5.5V.

Also contains 2 drivers and receivers. Uses low power CMOS. Handles 30V input level and provides a ±9V output swing. Ideal for battery powered systems. **$12.96**

OPEN FRAME LOW PROFILE IC SOCKETS

Highest quality glass filled polyester with MACHINED contacts. Four finger GOLD PLATED contact. Terminals are tin plated for easy soldering. Open frame ensures good cooling, easy cleaning and checking. Available in 8 to 40 pin configurations.
8 pin **56c**, 14 pin **98c**, 16 in **$1.12**, 18 pin **$1.26**, 20 pin **$1.40**, 24 pin **$1.68**, 28 pin $1.96, 40 pin **$2.80**.

8.30 to 5 Monday to Friday, 8.30 to 12 Sat.
Mail Orders add $5.00 to cover postal charges.

All prices INCLUDE sales tax.

Tax exemption certificates accepted if line value exceeds $10.00.

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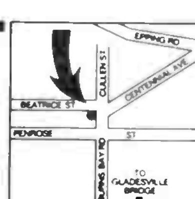

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specialising in electronic components for the professional and hobbyist.

Pocket-size RS232/V24 tester boasts unique features

Comtest is a complete, inline RS232/V24 interface communications tester. Equipped with 25 pairs of LEDs, 25 dual-in-line switches and 25 pairs of DTE-DCE interface pins, the unit can ● monitor all 23 signals, ● break and redirect all 25 lines, ● cross-patch all 25 lines using a set of seven single and one double jumper cables.

Besides those extended breakout and monitoring features, Comtest provides two-level test (>2V and >25V) of the open circuit voltage which typically occurs when DCE and DTE are connected to power lines with different ground potential; four-level (10, 20, 40 and 60 mA) bi-directional current loop test for RS232 contact, short haul modems or any other current loop.

Clear layout and marking of elements on the front panel and simple instructions with a guide to all signals and their CCITT and EIA symbols, printed on the back panel, make using the Comtest easy, even for a beginner, the makers claim.

The unit measures 102 × 79 × 18 mm, weighs 110 grams and requires no batteries. It comes in a robust ABS moulded plastic case that should withstand all the knocks typical of field service environments.

The manufacturers say the Comtest is ideal for engineers, computer salesmen, communications consultants, college and university lecturers.

For more information, contact: **Motivation Plus, 12 Fetherstone St., Bankstown 2200 NSW. (02) 707 1126.**

Terminal/ workstation features inbuilt autodial modem

A new low-cost desktop workstation which combines an easy-to-use word processor with an intelligent data communications terminal was released recently by Microbee Systems.

Designed and manufactured in Australia, the new Microbee "TeleTerm" is a compact package which performs most of the information processing and communications functions required in the modern office — at a much lower price than previously possible, Microbee says.

In addition to the word processor and data terminal functions, the TeleTerm also features "Offsider" — a set of pop-up desk utilities including a 'phone number index, a clock/calendar and an electronic notepad.

Physically, the TeleTerm is a compact keyboard unit incorporating an inbuilt modem and pushbutton telephone. Its keyboard is ergonomically sculpted and provides 92 keys, including 12 programmable function keys and a numeric keypad. All that is needed apart from the TeleTerm itself is an external video monitor and optional printer.

All basic functions of the TeleTerm are controlled by internal software resident in ROM chips. This means that these functions are instantly available at any time, with the touch of a key.

The TeleTerm includes a newly-written wordprocessor, "TeleWord", which features pull-down menus for full user guidance at every step.

Total file storage capacity is 30 000 characters, or approximately 15 typical A4 pages. This may be used for preparation and storage of a single long document, or a number of smaller letters and memos.

In data terminal mode the TeleTerm has two different options: Telcom for conventional ASCII communications, or Videotex for text-and-graphics communications. Each is available at the touch of a key. Both offer automatic dialling and log-on facilities for remote database accessing and electronic mail services like Viatel or TeleMemo, using a few keystrokes.

Both the word processing and terminal functions operate in colour, requiring the use of an RGB colour monitor. However, they are also designed to give acceptable results with a lower-cost monochrome monitor, for applications where colour is not necessary.

The automatic dialling facilities are available through the TeleTerm's inbuilt autodialling data modem. This is of the direct-connect type for best performance, and operates at either of two data communication rates: 300/300 bps or 1200/75 bps. The modem is also auto-answering, and is Telecom approved.

Along with the modem, the TeleTerm provides a pushbutton telephone for "old-fashioned" voice communication.

The basic TeleTerm unit itself sells for only $828.00, (rrp, including sales tax) — a particularly aggressive price when you consider that the unit includes an autodial modem and telephone.

Microbee can provide compatible monochrome video monitors from only $149.00, colour monitors from $448.00 and printers from $449.00.

Demonstrations of the TeleTerm are available at any Microbee Computer Centre, along with further information. For Computer Centre locations, ring **Sydney (02) 886 4444** or **Melbourne (03) 817 1371.**

Multicom II — for complete PC communications

Avtek Electronics commissioned software engineer Barrie Hall to write a PC communications package for their modem line up. The result, MultiCom II, is best described as a communications "superprogram", combining a conventional ASCII comms program with a Viatel (videotex) package, plus a terminal emulator and even a fully screen-mapped "remote" facility. To buy all these separately would currently set you back over $1100 dollars says Barry, so it's pretty good value at $149.50 complete, Avtek claim.

The program is very easy to drive, with an initial "beginners" menu which requires only one keystroke to autodial and log onto Viatel, Minerva etc. In "expert" mode you get all the normal options in either easy-to-use menu or command-driven formats.

Here are a few of its features:

- Complete terminal emulation, including ADM3A, 5A, 31, Televideo, IBM 3101 etc — over 30 terminals plus customisation.
- The ability to run programs remotely, even those which access the screen, e.g: Lotus. The CTTY remote mode on programs such as Crosstalk are a failure — they do not work with Graphics programs or any programs that access the screen — much of IBM software, claims Avtek.
- MultiCom provides full autodialling and redialling. It will even dial numbers in rotation.
- Autodialling on both Hayes (smart modems) and DTR (manual modems). Manual modems such as the Avtek Multimodem can be autodialled via the DTR line. Most comms software can only autodial with intelligent modems.

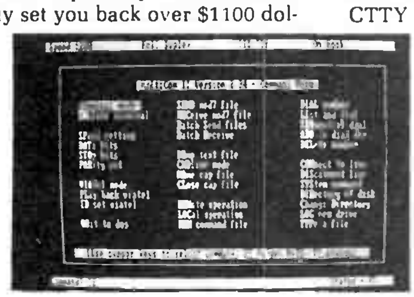
For further information, contact: **Avtek Electronics, PO Box 651 Lane Cove 2066 NSW. (02) 427 6688.**

Computer accessories

If you are looking for an extensive range of computer accessories such as leads, connectors and patch boxes, contact Arista Electronics Pty Ltd. Leads available include all the standard 9-, 15- and 25-pin D-type leads, plus IBM, Tandy, Centronics and Apple leads.

All the plugs and sockets in the range have gold plated pins and all the necessary hardware, both inline and chassis mounting types.

For further information, contact: **Arista Electronics, 57 Vore St, Silverwater 2141 NSW. (02) 648 3488.**



Computer frequency counter interface unit

Roger Graham VK2AIV

Here is a simple to build, low-cost little plug-in board which allows you to use your computer as an audio frequency counter. This article shows how to use it with your Apple II, other computers to follow.

THIS EASY do-it-yourself project enables your computer to read audio frequencies from dc up to approx 14 kHz. The readout (digital, of course!) appears in large-sized text on-screen, easily visible from a distance. Originally made up as a teaching aid for use with science classes studying sound, the project and program could be of interest to others who have a computer but no frequency meter.

Hardware requirements

The little printed circuit board for this unit is about as big as two postage stamps . . . just 60 x 25 millimetres. It carries a two-dollar op-amp, four diodes, three resistors and three capacitors. The whole board is glued upright on the back of a 16-pin DIL plug ready to insert in the Apple games socket. For use with other computers, it may simply be wired to an appropriate connector. A metre of shielded wire terminating in two small alligator clips enables you to take audio frequency readings direct from the voice coil terminals of a speaker or other source.

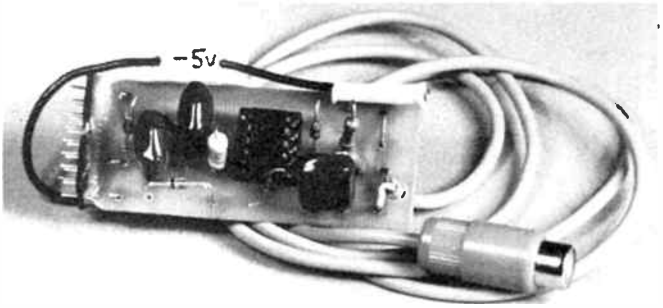
The circuit is basically a "squarer-upper", to convert sine wave audio signals into neat square wave pulses which the computer can count. Audio waveforms with an amplitude of up to a volt or two are applied to one input of the op-amp via the 100n capacitor. Two silicon diodes, D1 and D2, limit the maximum voltage swing at this input, to prevent damage to the op-amp if an excessively large signal is applied.

The printed circuit board is very simple. You may choose to make your own from the design reproduced here, or purchase a readymade board. Some electronics retailers may present the project as a kit. (See 'Retail Roundup' this issue).

The first thing you should do before assembly is to examine the tracks on your pc board. See that all holes are drilled and the correct diameter. Check there are no tiny 'bridges' between the IC pads. If all's well, the components may now be assembled or the board.

Even with a board as simple as this, it's possible to make mistakes in assembly. There is no special order but watch the orientation of the four diodes and be sure that the op-amp is not inserted back to front. Three short pieces of tinned copper wire connect the board to pins 1, 2 and 8 of the 16-pin DIL plug. Later, when you are sure everything is in order, these three wires will also hold things together mechanically while a fillet of Araldite glue is added.

Note that some kinds of DIL plug are moulded from thermo-

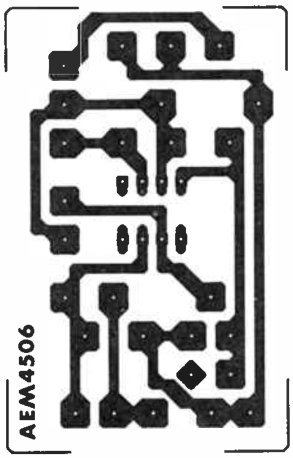


The completed prototype, with cables. As you can see, it's quite a simple project.

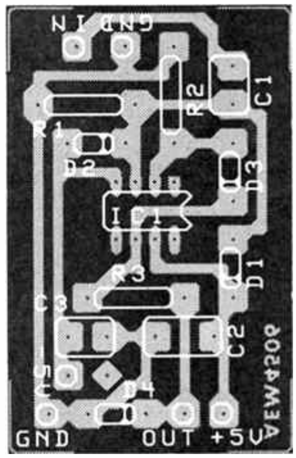
softening plastic, so the pins may droop out of line when heated during soldering. To avoid this disaster, insert the plug into a spare 16-pin socket before soldering. This keeps the pins in line. When soldering, use a fine-pointed bit to melt a tiny dab of fresh solder directly onto the head of the pin, and keep the iron there just long enough to make the solder flow onto the metal. Now tin the end of the wire, again keeping the iron in contact just long enough to make the solder flow. The idea is to make the beginnings of a good joint, while still leaving some active un-burned flux on the surfaces. Now rest the tinned wire against the top of the pin and dab it quickly with the hot, clean bit. Use just enough heat to flow the solder cleanly together, without prolonged dabbling about.

The long length of shielded wire for the input needs to be anchored securely where it joins the board. That's what the larger hole at the top of the board is for . . . just pass the end of the shielded wire through the hole from the non-copper side, before soldering down. The idea is for the outer plastic coat of the wire to be wedged securely in the hole, rather than tugging on the solder pads every time the wire is wiggled.

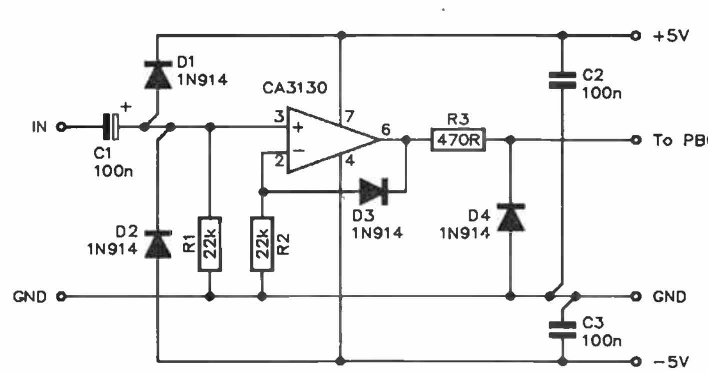
The -5 volt supply for the board enters via a flying lead with a small push-on connector on the end, to fit one of the four square pins of the auxiliary video connector. I used a springy brass contact removed from an old 7-pin miniature valve socket, and sleeved it securely with a generous length of spaghetti. Be careful here, so that the flying lead is not able to make accidental contact with the +12 volt pin adjacent to the -5 volt pin on the mother board. Diagram 3 shows how the unit should look when all complete. ▶



Full-size pc board artwork.

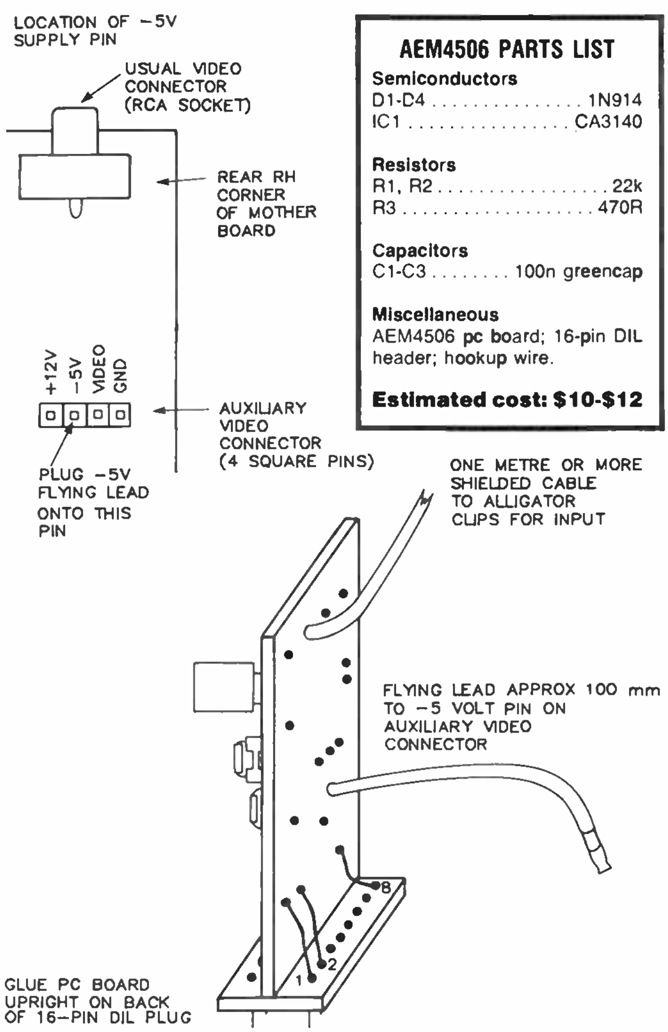


Component overlay



CIRCUIT OPERATION

The op-amp is connected as a Schmitt trigger. That is, its output flips cleanly from full-on to full-off as the input signal worms its wiggly way from a positive amplitude towards negative. The input signal passes to the op-amp's input via C1. Diodes D1 and D2 'clamp' the peak amplitude to under 1 V. the output from the op-amp is a TTL-compatible square wave (i.e: it swings between approx +5 V and zero). This square wave is fed into the computer input port via the 'PB0' line. From this point, the computer takes over, counting how many pulses arrive via PB0 every second.



AEM4506 PARTS LIST

Semiconductors
D1-D4 .... 1N914
IC1 .... CA3140

Resistors
R1, R2 .... 22k
R3 .... 470R

Capacitors
C1-C3 .... 100n greencap

Miscellaneous
AEM4506 pc board; 16-pin DIL header; hookup wire.

Estimated cost: $10-$12

LEVEL

We expect that hobbyists who are

BEGINNERS

in electronics construction should be able to successfully complete this project.

The software

The Apple can read the status of PB0 (high or low) at address $C061. A machine-code program keeps reading this address, looping back to read again and again until the value goes low, then looping until it goes high again. This marks the completion of one cycle of the input wave. The computer tallies up how many times this happens in one second, storing the answer at locations $08-09 (in hexadecimal of course, low byte first). At the end of each second, the computer reads the stored value from $08-09, converts it to decimal, and displays the result on screen. The result is left on view while the program goes round again, to count pulses for a further second. Then the previous value is erased and a new value displayed. i.e: the screen is updated after each new one-second count.

While all this pulse-counting is going on, the computer still has to keep track of the passage of real time. How is it to know when the necessary one-second interval has elapsed? To do this, it keeps count of how many times the program has looped back to check the status of location $C061. Each loop takes just 36 machine cycles (the program has been padded with NOPs where necessary so that every such loop is the same length, whether it involves incrementing one byte or two bytes or none at all).

Now each machine cycle takes just under one microsecond (0.978 µs according to my textbooks). So a 36-cycle loop takes approx 35 microseconds, and a quick division (1 000 000/35 = 28 500 approx) gives the number of loops which must take place to measure out one second of time.

A "time counter" in the program is set to an initial value of $9020 (which is approx 28 500 counts short of $FFFF) then incremented once for every 36-cycle loop. After 28 500 such loops the counter overflows to $0000, and it is this even which signals the end of a one-second timing interval. It follows that, once you have the frequency counter built and running, you can fine-tune it by comparison with another instrument (say a digital frequency meter) simply by altering the two bytes which set the initial value into the "time counter" in the program.

Installation in your Apple

Switch off the computer before attempting to plug the unit in. Remove the top cover and identify the Game Connector socket towards the rear right-hand corner (board location J 14). Note that pin 1 of this socket is at the end nearest to the keyboard. Plug the AEM4506 board into this socket. If you have it pointing the right way, the component side of the board will be towards the power supply of the Apple, i.e: on your left as you sit at the keyboard.

The flying lead for the -5 volt supply is plugged over one of the four protruding pins of the Auxiliary Video connector, which is at the back right-hand corner of the mother board (location K 14). The diagram here shows the four pins of this connector. Be sure you locate the correct pin.

Now you can switch the power on again.

Entering the program

We'll assume you have a disk drive connected to your Apple. Boot any suitable disk with a copy of the Disk Operating System so you can save your programs to disk when entered. The NEW to clear out any Applesoft BASIC program from the memory. Now type in the short BASIC program and save it to disk under the name FREQUENCY METER. (i.e: type SAVE FREQUENCY METER). There's no point in running it yet, until the machine code program is entered.

Now leave Applesoft and get the Monitor (type CALL-151 then Return). The prompt symbol should now be an asterisk *. Enter the starting address of the program, 6000, followed by a colon sign (:) which is the memory-alteration command. Now type in the machine-code program one byte at a time, entering a space between each byte and the next. The monitor will allow you to enter approximately 80 bytes at a time before you hit Return; less if you wish, of course.

There are over 1500 bytes to be entered, so be patient and check as you go. Be sure to SAVE the program to disk before you attempt to RUN anything (if you've made a mistake, the program may crash and destroy all your data . . . no harm done, but you'll have to enter it all again!).

Assuming you have all the program entered inthe memory, and no mistakes found, then SAVE it under the title FREQUENCY METER MACHINE CODE (i.e: type BSAVE FREQUENCY METER MACHINE CODE, A$6000,L$4C3). Note that if you attempt to list the machine-code program (6000L, then return) the listing will make sense only as far as address $6161. Beyond this point there are 25 bytes of data for letters and numerals on screen, then a hi-res shape table of 24 shapes for the same letters and numerals for the next several hundred bytes.

Now at last the frequency meter is ready to go. From the disk, RUN FREQUENCY METER and you should receive what the program is about. Press any key to continue . . . the disk drive should start up again, and load in the machine code program. On screen should appear in large letters:

FREQUENCY METER
0 Hz

If the zero digit flashes on and off every one second, you probably have the program entered without error. Connect the alligator clips to the voice coil of a loudspeaker, and feed in some kind of audio signal, and you should be rewarded with a digital readout on screen.

Calibration

Calibration should not be necessary at all if your Apple clock frequency is the same as mine. But just in case you would like to adjust things, this is what to do:

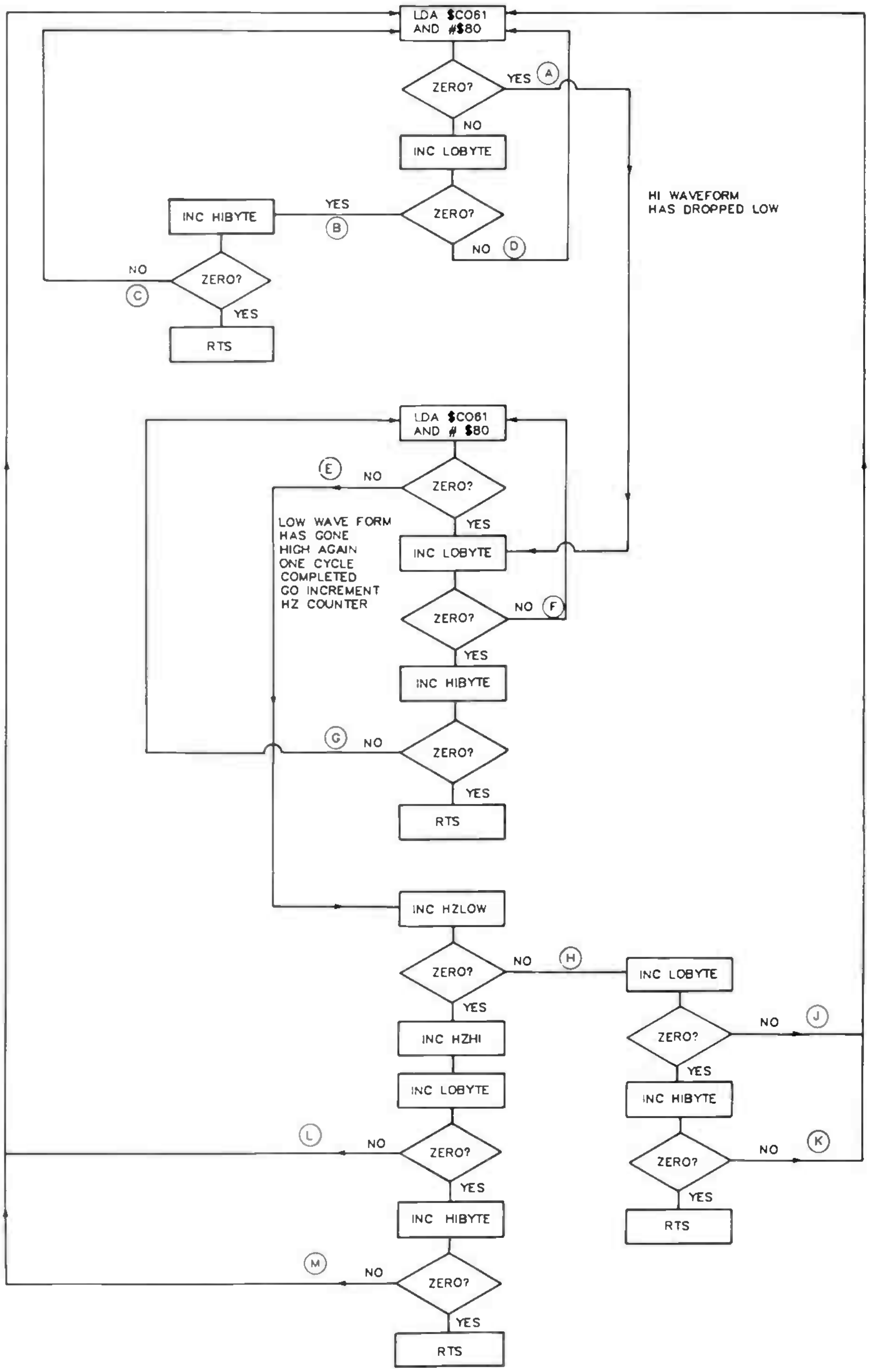
Enter the Monitor and examine the contents of memory locations $6085 and $6089. At present these should read 20 and 90 respectively, being the two bytes loaded into the time-counter to initialise it to $9020 as each new one-second count commences.

This counter is incremented after each loop in the program, and the "second" time interval is concluded on the next loop after the counter reaches $FFFF. By adjusting the initial value in the counter, you can fine-tune the timing interval to your own satisfaction. A digital frequency meter of some kind is necessary, of course, so you can check the actual frequency being measured.

The prototype frequency meter program gave results accurate within 1% from dc up to about 14 kHz (the so-far unexplained error being a tendency to read up to 1% high towards the higher frequencies).

```
                    INTRODUCTION PROGRAM FOR FREQUENCY METER.
10  HOME
30  PRINT "       ***************************
40  PRINT "       * AUDIO FREQUENCY METER *
60  PRINT "       ***************************
70  PRINT
100  PRINT "  REQUIRES SMALL  INTERFACE BOARD PLUGGED INTO GAMES CONNECTO
     R SOCKET."
110  PRINT
120  PRINT "  PROGRAM ACCEPTS AUDIO INPUT E.G. FROM VOICE COIL OF LOUDSP
     EAKER, AND DISPLAYS FREQUENCY ON SCREEN. UPDATES RESULT      AT 1 SE
     COND INTERVALS."
125  PRINT
130  PRINT "  UPPER FREQUENCY LIMIT IS APPROX 14 KHZ"
135  PRINT
140  PRINT
150  PRINT "  FOR DETAILS OF PC BOARD SEE AUSTRALIAN ELECTRONICS MONTHLY
      WHATEVER DATE"
155  PRINT
170  PRINT : HTAB 10
180  INVERSE : PRINT "ANY KEY TO CONTINUE";: NORMAL
190  GET Z$
200  D$ =  CHR$ (13) +  CHR$ (4): REM  RETURN + CTRL D
210  PRINT D$"BRUN FREQUENCY METER MACHINE CODE"
```

FLOW CHART FOR FREQUENCY COUNTER / PULSE COUNTER.



ASSUMES SQUARE-WAVE TTL INPUT TO APPLE PB0 ($C061) PIN 2 OF GAMES CONNECTOR.
PADDED SO ALL PATHS THROUGH THE NET TAKE THE SAME TIME (36 MACHINE CYCLES) NO MATTER WHETHER ONE BYTE OR BOTH BYTES INCREMENTED IN EITHER COUNTER.

```
* APPLE II+ FREQUENCY METER

6000- A9 70 85 E8 A9 61 85 E9
6008- AD 81 C0 20 D8 F3 A2 03
6010- 20 F0 F6 A9 01 85 E7 A9
6018- 32 85 FF A2 18 A0 00 20
6020- 11 F4 A2 00 20 47 60 A9
6028- 64 85 FF A2 A0 A0 00 20
6030- 11 F4 A2 10 20 47 60 20
6038- 3D 60 4C 84 60 A5 FF A2
6040- 48 A0 00 20 11 F4 60 8A
6048- 48 BD 53 61 C9 00 F0 09
6050- 20 5B 60 68 AA E8 4C 47
6058- 60 68 60 86 1E 38 E9 2F
6060- AA 20 30 F7 A9 00 A6 1A
6068- A4 1B 20 01 F6 18 A9 10
6070- 65 E0 85 E0 90 02 E6 E1
6078- A5 FF A6 E0 A4 E1 20 11
6080- F4 A6 1E 60 A9 20 85 1C
6088- A9 90 85 1D A9 00 85 08
6090- 85 09 EA EA EA EA EA EA
6098- EA EA EA AD 61 C0 29 80
60A0- F0 1D E6 1C F0 03 4C 92
60A8- 60 E6 1D D0 E8 4C F2 60
60B0- 48 68 EA EA EA EA EA EA
60B8- AD 61 C0 29 80 D0 0B E6
60C0- 1C D0 ED E6 1D D0 EB 4C
60C8- F2 60 E6 08 D0 12 E6 09
60D0- E6 1C D0 07 E6 1D D0 C3
60D8- 4C F2 60 EA EA 4C 9B 60
60E0- EA EA E6 1C D0 07 E6 1D
60E8- D0 B1 4C F2 60 EA EA 4C
60F0- 9B 60 A2 00 20 F0 F6 20
60F8- 3D 60 A2 13 20 47 60 A2
6100- 03 20 F0 F6 20 3D 60 48
6108- 8A 48 A2 04 A9 00 85 06
6110- A9 30 85 07 38 A5 08 FD
6118- 49 61 48 A5 09 FD 4E 61
6120- 90 0A 85 09 68 85 08 E6
6128- 07 4C 14 61 68 A5 07 E0
6130- 00 F0 0A C9 30 F0 02 85
6138- 06 24 06 F0 03 20 5B 60
6140- CA 10 CD 68 AA 68 4C 84
6148- 60 01 0A 64 E8 10 00 00
6150- 00 03 27 3A 3B 3C 3D 3E
6158- 3C 3F 40 41 46 42 3C 43
6160- 3C 3B 00 44 45 00 47 47
```
▶

```
6168- 47 47 47 00 00 00 00 00
6170- 18 00 32 00 5D 00 75 00
6178- 97 00 B6 00 D6 00 FA 00
6180- 1E 01 36 01 5B 01 81 01
6188- 9E 01 C7 01 EC 01 13 02
6190- 33 02 58 02 75 02 8C 02
6198- B2 02 C9 02 EC 02 0A 03
61A0- 0C 03 12 35 37 35 37 35
61A8- 37 2D 35 3F 37 35 77 31
61B0- 25 35 25 35 25 0C 25 27
61B8- 25 67 FF 3B 2C 4D 25 3F
61C0- 27 2D 25 27 E5 3B 3F 3F
61C8- 2C 2D 2D 05 00 49 29 3E
61D0- 15 3F 37 2D 35 37 35 37
61D8- 35 37 35 37 75 39 3F 3F
61E0- 2E 2D 2D 05 00 12 2E 64
61E8- 2C 2E 2C 2E 2C AE 35 37
61F0- 35 F7 3E 3C 3E BC 32 27
61F8- 97 37 35 37 2D 2D 2D 2D
6200- 25 3F 3F 3F 3F 00 00 2E
6208- 2C 2E 2C 2E 2C 2E 2C 35
6210- 37 35 F7 37 35 3F 37 2D
6218- 75 35 37 35 F7 3E 3C 3E
6220- 3C 3E E4 27 25 00 89 92
6228- 35 FF 2A 3E 36 25 35 25
6230- 35 25 35 36 36 25 24 2C
6238- 25 3F 3C 2C 3C 2C 3C 3F
6240- 2C 2D 3C 2C 05 00 2D 2D
6248- 2D 2D 35 3F 3F 3F 3F 37
6250- 35 37 2E 2C 2E 2C 2E 2C
6258- 2E AC 2A 3E 2E 3E 2E 3E
6260- 1E 3E 3C 3E 3C 3E E4 27
6268- 2D 00 49 29 2D 2D 3E 3F
6270- 3F 1E 37 F5 3B 2E 3E 2E
6278- 3E 2E 3E 2E 0E 2E 2C 2E
6280- 2C 2E 2C 25 27 25 E7 3F
6288- 3F 27 2D 2D 2D 00 2E 2C
6290- 2E 2C 2E 2C 2E 2C 35 37
6298- 35 F7 37 F5 3B 2E DE 37
62A0- 35 37 35 37 2D 00 12 35
62A8- 37 35 B7 2A 3E 2E 3E 4E
62B0- 2E 2C 2E 2C 2E 64 25 27
62B8- 25 E7 3F 3F 27 2D 2D 65
62C0- 25 27 25 E7 3F 3F 27 2D
62C8- 2D 2D 00 12 35 37 35 B7
62D0- 92 12 2E 2C 2E 2C 2E 64
62D8- 25 67 29 3C 0C 3F 3F 3F
62E0- 27 2D 2D 2D 25 27 25 27
62E8- E5 3B 3F 3F 2C 2D 2D 05
62F0- 00 2D 2D 2D 2D 35 3F 3F
62F8- 3F 3F 37 35 37 35 37 2D
6300- 2D 2D 35 3F 3F 3F 37 35
6308- 37 35 37 35 27 00 2E 2C
6310- 2E 2C 2E 2C 2E AC 2A 3E
6318- 2E 3E 17 3E 3C 3F 37 2D
6320- 35 37 75 35 77 29 3E DF
6328- DB 23 24 24 24 24 24 37
6330- 36 36 36 36 36 05 00 2D
6338- 2D 2D 2D 35 3F 3F 3F 3F
6340- 37 35 37 35 37 2D 2D 2D
6348- 35 3F 3F 3F 37 35 37 35
6350- 37 2D 2D 2D 2D 35 3F 3F
6358- 3F 3F 27 00 09 2E 2C 2E
6360- 2C 2E AC 2A 3E 2E 3E 2E
6368- 3E 2E 3E DF 3C 76 29 3E
6370- 4E 35 FF 23 37 27 37 E4
6378- 24 24 24 24 3C 36 36 36
6380- 36 36 00 35 37 35 37 35
6388- 37 35 37 35 37 35 77 31
6390- 25 35 25 35 25 0C 25 27
6398- 25 27 25 27 25 27 25 27
63A0- 25 3F 00 35 37 35 37 36
63A8- 36 36 36 2E 24 24 24 24
63B0- 2C 35 77 29 3E 4E 35 77
63B8- 31 36 25 24 24 24 24 24
63C0- 24 37 36 36 36 36 06 00
63C8- 09 2D 2D AD 0A 3E E4 3F
63D0- 3F BF 37 35 37 35 37 35
63D8- 37 35 37 75 2E 2C 2E 2C
63E0- 2E 64 25 27 00 35 37 35
63E8- 77 29 3E 4E 36 36 36 2E
63F0- 24 24 24 64 25 67 29 3C
63F8- 2C 3C 07 00 35 37 36 36
6400- 36 36 36 2E 24 24 24 24
6408- 24 2C 35 6F 32 36 25 24
6410- 0C 2C 2E 36 36 36 36 36
6418- 25 24 24 24 24 24 24 37
6420- 36 00 2D 2D 2D 2D 35 3F
6428- 3F 36 36 36 36 36 36 27
6430- 24 24 24 24 24 3C 3F 37
6438- 00 36 36 36 36 36 36 2E
6440- 24 24 24 2D 2D 2D 35 36
6448- 36 2E 24 24 24 24 24 24
6450- 3C 36 36 36 3F 3F 3F 27
6458- 24 24 2C 00 92 32 25 35
6460- 25 35 25 35 25 2D 3E 1E
6468- 37 F5 3B 2E DE 37 35 3F
6470- 37 2D 2D 2D 2D 25 3F 3F
6478- 3F 00 01 00 2D 2D 2D 2D
6480- 35 3F 3F 3F 3F 37 2D 2D
6488- 2D 2D 35 3F 3F 3F 3F 37
6490- 2D 2D 2D 2D 35 3F 3F 3F
6498- 3F 37 2D 2D 2D 2D 35 3F
64A0- 3F 3F 3F 37 2D 2D 2D 2D
64A8- 35 3F 3F 3F 3F 37 2D 2D
64B0- 2D 2D 35 3F 3F 3F 3F 37
64B8- 2D 2D 2D 2D 35 3F 3F 3F
64C0- 3F 27 00
```

— from page 19.

It's a bit like your local council threatening to burn your house down if you don't pay your rates.

So Viatel, while it is claimed to be the most successful launch of videotext in the world, is failing to reach the people in the street simply because it is too complicated, expensive and has lost even people like me who could use it because it gets cluttered up with electronic junk mail.

Imagine what owning a facsimile is going to be like when it becomes a popular installation base? The junk mail perpetrators will leap on it using the addresses so openly supplied by Telecom to one and all. How they can get away with it when one should argue invasion of privacy is the question? So what could become a worthwhile service will end up lost because of the clutter of junk in the desperation so many entrepreneurs to make quick bucks?

The same situation happened in Japan when home facsimiles were promoted and installed widely, people came home to pornographic pictures and abusive mail, as well as the endless retail crap. Yet the argument for electronic mail is massive. Instant communication, saving for the nation on transport (trucks, planes, bicycles), fuel and manpower. Australia Post has a bigger army to deliver mail than the defence department has to defend the country.

So there is an argument for fax. But only in business which has now got well used to the fact that in the modern world you have to have a staff of humans pro rata to the sophistication of the company's communication system to process the junk mail from the real mail.

Facsimile machines are expected to exceed the number of telexes installed in Australia within two years. And travelling salespersons will be carrying telephones, facsimiles, computers and God only knows what with them wherever they go.

That anyway is what the electronics industry envisages in the next decade. But can they play the same games with switched-on executives they have with switched-on consumers? Let's look at the next decade next month, and I promise I won't be so negative. We will look at where the manufacturers see things going, and the possible alternatives to their enthusiastic view of life in the new electronic age.

A fax machine in every home? Maybe. But the junk mail is likely to kill the goose before it gets too far under way.

LIVING MEOIA — NEW CONCEPT IN AUDIO/VISUAL HOME ENTERTAINMENT

Len Wallis, of Len Wallis Audio in Sydney, ha launched a new concept in "electronic lifestyle". Wallis explains that, "Living Media is the concept of taking the conventional audio system from its fixed position in the household and adapting it so that it becomes much more versatile in its operation."

The very basic installations would entail running a remote pair of speakers to a second area of the house with a separate volume control. The most complex of installations would include the A.V.D. "Brain" which allows you to turn the system on, control the volume and select the input from any area within the house. As systems such as Luxman, etc gravitate towards remote control infrared repeaters can be incorporated into the house wall panels allowing complete control over the system from various areas of the house via handheld remote controls. The main feature of the Brain, however, is that it provides the ability to listen to two or more sources of input throughout the house at the one time. For instance, you can listen to FM in the bedroom while other members of the family are listening to compact discs in the living room. The volume can be adjusted independantly from each room.

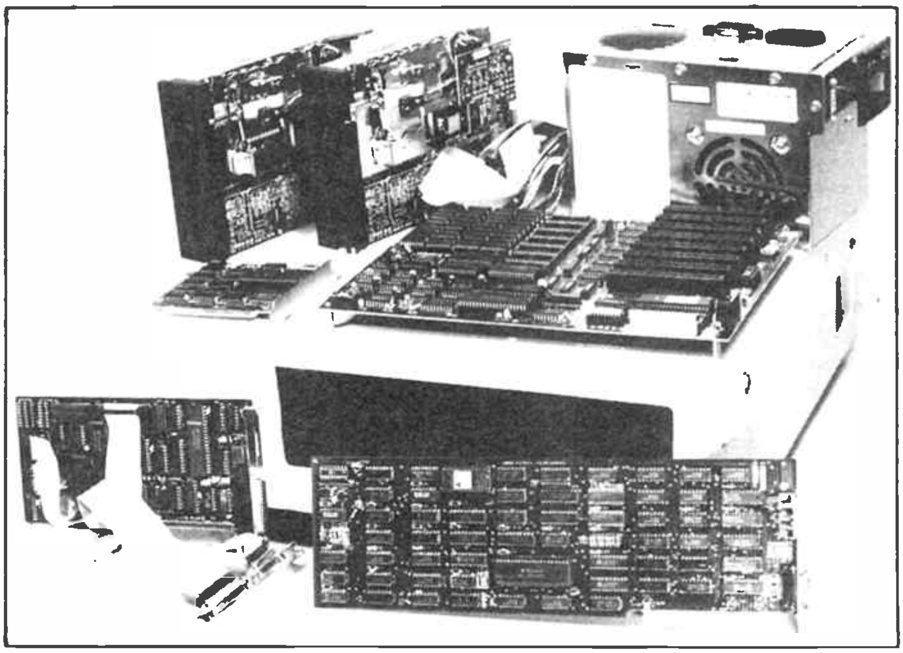
Unlike the B & O system, which at the moment is the only one offering this flexibility, there is no limit to the number of rooms it can be used in, says Len. The system can also be extended to visual mediums with remote monitors being used from a central video unit.

While this concept of a "multi function" audio system is appealing, it is also expensive. The Brain will sell for around $3000, the wall panels around $350 each, and each room will require separate amplification. Len feels that the biggest potential is for the simple location of remote sensors in each listening room which operate off the main remotely controlled audio system.

An important aspect of the Living Media concept, says Len, is the integration of audio and video, a marriage flaunted for many years but one which has not really come to fruition yet. Len is looking at integrating systems with Sony Profeel monitors or good wall projection TV systems currently popular in the US, creating a home cinema with surround sound decoders such as the locally made Raidek or the new Yamaha DSP1.

And the concept is not limited to the home, Len tells us. "There is a big potential in retail stores, particularly fashion, restaurants and coffee lounges through to offices."

If you want to know more about this fascinating idea, contact **Len Wallis Audio, Living Media Division, Shop 9, "The Village", 43-45 Burns Bay Rd, Lane Cove 2066 NSW. (02) 427 1204.**



Start here! The assembly of system component boards, power supply, disk drives and case. The keyboard wouldn't fit in the picture.

Assembling a PC-compatible

With a plethora of motherboards, cards, power supplies and other system components for PC-compatible computers around at present, we wondered just how easy (or how hard!) it would be to assemble one for yourself. Well, Tony Hui from Hi-Com Unitronics offered to show us how, and with the aid of our old photography mate from way back, Ron Farley, here we show you how it's done.

IF YOU WANT to get into some 'serious' computing, then no doubt you've looked around from some hardware that is well supported with a popular software base, offers the power of 16-bit processing and flexibility for later expansion. Specifically, for most people that translates into an IBM PC or close compatible. The problem then arises of matching the cash with the want. By far the lowest-cost route is to assemble you own. While there are many configurations possible, what we're looking at here is a basic system. This comprises the following:

i) a motherboard with eight expansion slots and 640k of RAM fitted,

ii) a high resolution monochrome video card with printer port,

iii) a disk drive controller card (for two drives),

iv) one or two 5.25" floppy disk drives,

v) a power supply,

vi) a keyboard,

vii) a case to suit,

and perhaps a monitor if you haven't already got a suitable one. This gives you a good basic system with hi-res monochrome graphics, a printer port for hard copy output (essential) and plenty of expansion capability. While you might consider going with just a single disk drive, software backup and copying is a tedious process with only one drive and some software depends on having at least two drives. It's worth the extra (and it only makes about 10% difference in the overall price).

Optional extras might include a multi I/O card, a colour graphics card, an 8087 co-processor, a serial/parallel/games port card, a (hi-res) 'EGA' colour card or Hercules video card, a hard disk instead of (or additional to) one of the floppy drives, etc. There are literally dozens of options.

Depending on the mix of system components and peripherals you choose, you'll pay somewhere between about $1300 and $2000 or so for you basic system, not counting a monitor. Now, there's one thing you must consider above all else, and that's the power supply you choose. There are several power supply models, each with different ratings: 130 watt, 150 watt and 200 watt. The latter is for AT-compatibles, which we aren't considering here. The 130 watt supply will handle the demands of your basic system with a number of additional expansion cards (depending on the supply loading of the cards) plugged into the motherboard plus two disk drives, but that's it. If you're considering really loading up the slots with cards and perhaps adding more drives, then get the 150 watt supply.

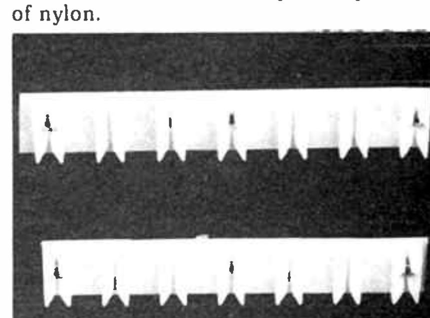
Where to start

Having unbundled your wallet and bundled your goodies home, unpack it all and set the bits and pieces out for easy identification. Clear a good workspace for yourself, you'll need it. The only tools you wil need are a small (2.5 mm shaft) Phillips head screwdriver, preferably with a springloaded head grip for getting screws into awkward places, a pair of needle-nosed pliers and sidecutters, or a decent pair of scissors and perhaps a soldering iron.

The case comes with a lid hinged at the rear and caught by two press-button catches at each side, just behind the front panel. Open the lid, lay the case on one side and remove the disk drive frame. It is held by four screws underneath the cabinet. Put the screws safely aside so they don't get mixed up with others. If you want to install a System Reset switch (which saves turning the power off to effect a reset), now is the time to do it. It is just a momentary action, normally-open pushbutton and may be located on a side or rear panel, but make sure it clears anything that may be mounted in the case now or in the future. Centre punch the hole position, then drill the case to suit the switch you have.

You will have a loudspeaker included with the case. It may come loose or already mounted. If loose, mount it in the case using a sealant/cement such as 'Silastic'. It may be mounted in either of two positions: beneath the disk drive frame, where there are a group of sound holes, or behind the slotted portion at the left hand side of the front panel.

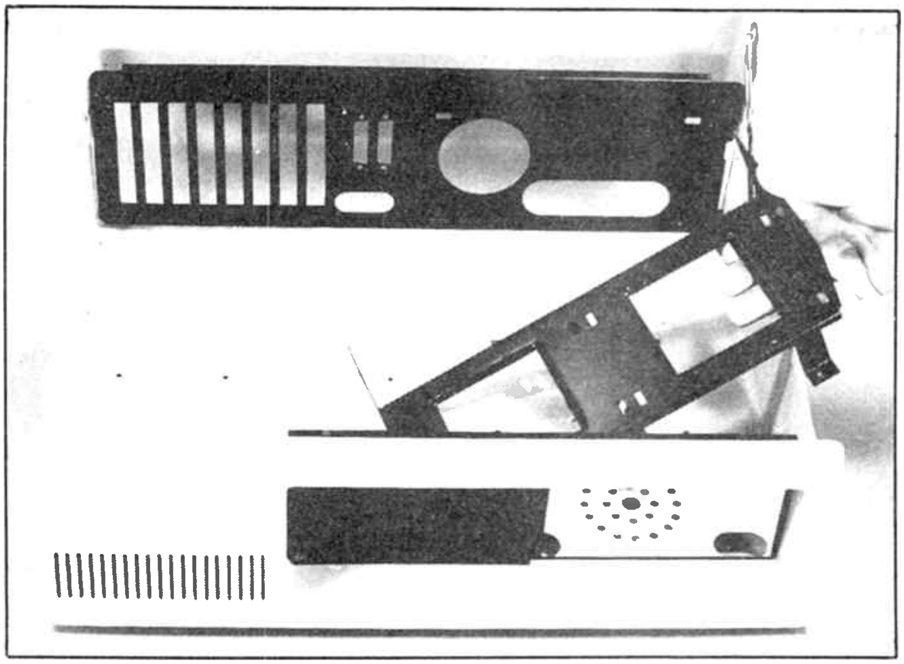
The next step is to install the stick-on feet for the case. Close the lid, turn the case over and stick them in place near the corners, but not so that they obscure any holes. The two plastic card guides can be installed now. These screw to the panel inside the case behind the left hand end of the front panel. Use countersunkhead screws. If the card guides are too long, simply cut them short with sidecutters or scissors. It's easy as they're mad of nylon.



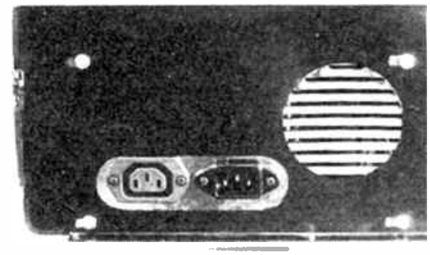
The card guides. Three countersunkhead screws secure each one. See the text for their location.

Power supply

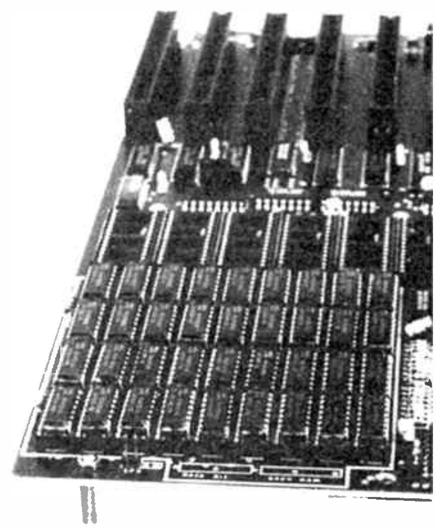
Now for the power supply. It goes in the right hand rear corner of the case and is secured by four large screws thorugh the rear apron. Close the lid and put the case aside for the present.



Removing the disk drive frame.



The power supply is secured by four screws through the rear apron.



Metal standoff pillars are fitted on the motherboard prior to installing it in the case.

Motherboard

Take the motherboard (it's the BIG one!) and assemble the nine standoffs to it. The standoffs are threaded at one end and tapped at the ohter. The threaded end goes up through the board, with a fibre washer between the standoff's shoulder and the bottom of the board. Just secure the nuts finger-tight on the top side for the moment.

Locate the 8-way DIP switch on the motherboard. You'll find it adjacent to the 8237A, a large 40-pin chip, an 8255. The setting of these switches determines the system configuration. Instructions are supplied with your system components. Now you can bolt the motherboard in place. Open the lid and turn the cabinet on its left hand side. Hold the motherboard in place with your left hand and put the screws in from the bottom with your right hand. Note that these screws are all small countersunk types. The finger-tight nuts securing the standoffs to the board allow some movement to take hole tolerances. Tighten the bottom-side bolts first, then the nuts on the top side of the motherboard.

If you've installed a System Reset switch, now is the time to wire it to the motherboard. The documentation that comes with your components shows where this connects.

Now you can put the disk drive frame back and screw it in place. Plug the connector plug into the motherboard. The two-pin connector is located at the front left hand side of the board, in front of the bank of RAM chips.

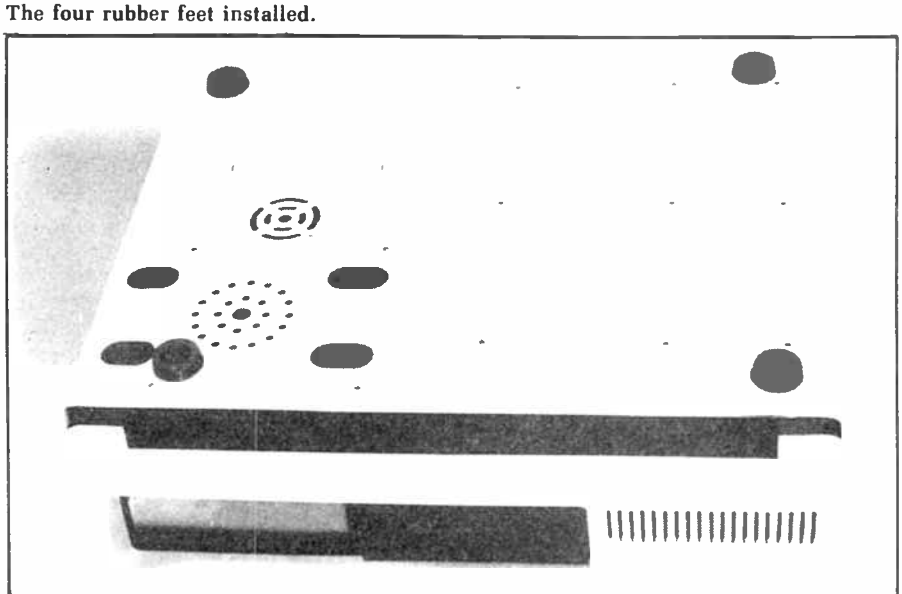
Disk drives

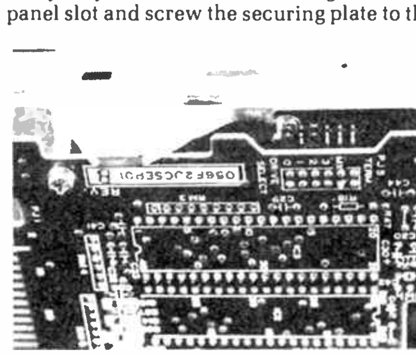
Before installing the disk drives, the first thing to do is locate the jumper pins which configure the drive for your system. Generally, you'll find the jumpers located on the edge of the drive's pc board, on one side. Documentation with your system components will indicate how to set the jumpers.

To install the drives, first determine whether you'll mount them one above the other, or side by side. The latter is probably easiest. Open the lid of the case and turn it on its left hand side with the drive frame uppermost. Pass one of the drives through the upper front panel slot and hold it in place on the drive frame. It is bolted to the frame from beneath with four bolts. You'll find large access holes in the bottom of the cabinet for this purpose. Now pass the other drive through the adjacent front panel slot and secure it with two bolts through the bottom of the frame, adjacent to the first drive, again accessed from beneath the cabinet. Lay the cabinet back down and secure the second drive with two screws on the left hand side, passed thorugh the upturned end of the drive frame. The vacant panel slots above the two drives are 'filled' with snap-in plastic filler panels.

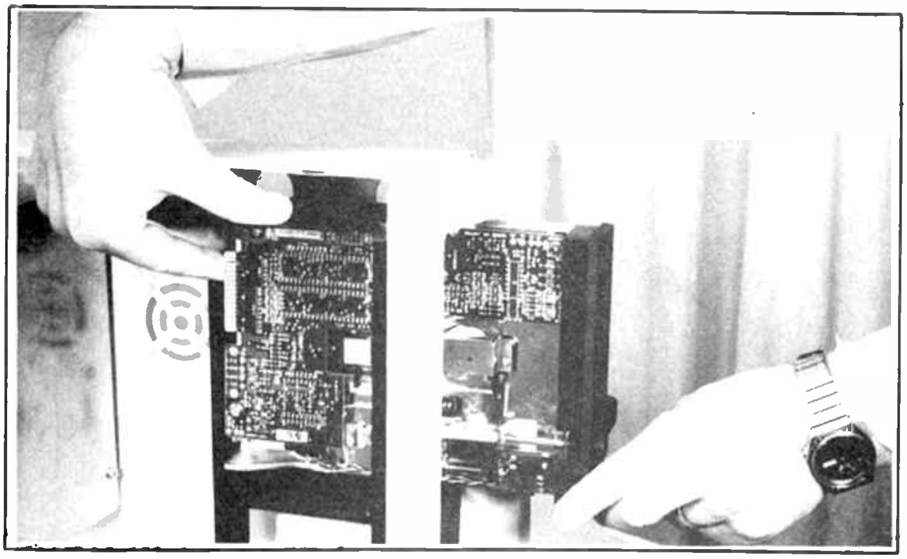
If mounting them one above the other, you'll find a securing plate with one of the drives. With the cabient sitting flat and the lid open, pass the first drive through the front panel slot and screw the securing plate to the ▶

The four rubber feet installed.





Locating the jumpers on the disk drive.



The disk drives install through the slots in the front panel.

drive's left hand side. It can only go one way, as you'll quickly discover. Now tip the cabinet up on its left hand side, holding the drive in place, and screw the drive in via the access holes in the cabinet bottom. To put the top drive in, lay the cabinet back down again, put the drive through the front panel and secure it with screws through the drive frame on the right and the securing plate on the left. Fill the two panel slots to the left of the drives with the snap-in plastic filler panels.

No matter how you arrange your drives, when doing up the screws, DO NOT TIGHTEN THEM UNTIL ALL ARE IN PLACE.

Power to the motherboard

Now plug power supply plugs P8 and P9 into the motherboard. They are keyed and can only go in one way. The two connectors are located at the rear right hand edge of the board, adjacent to the power supply box. P8 goes to the rear connector. You will notice it has one wire less than P9.

The other cables are for powering the disk drives. Don't plug them in just yet.

Cards

Firstly, it should be pointed out that, while the motherboard has eight slots, slot 8 (right hand side) can only take a short card because the disk drive frame overhangs the motherboard in front of it. Slots 1 and 2 should only be used for the monochrome and colour video cards. Slots 3 to 7 are 'general purpose'.

Inspect all your cards before installing them. See that the discrete components are standing up straight and not in danger of fouling card guides, etc. If components foul the card guide, use a sharp knife to cut back the card guide where necessary.

If you have a multifunction card or a port card, it will have some DB sockets on a card bracket attached via ribbon cable to the card. Check and set configuration jumpers according to the manufacturer's instructon. Install the card and then the card bracket containing the DB sockets. Use the rear slots adjacent to the power supply for this.

Install the disk drive card and the ribbon cable to the disk drives. The red wire marks pin 1 on the chained edge connectors. Pin 1 on the disk drive card is uppermost. On the drives, pin 1 is the on the end of the edge connector nearest the keyway slot. Drive A connects to the edge connector on the end of the ribbon cable.

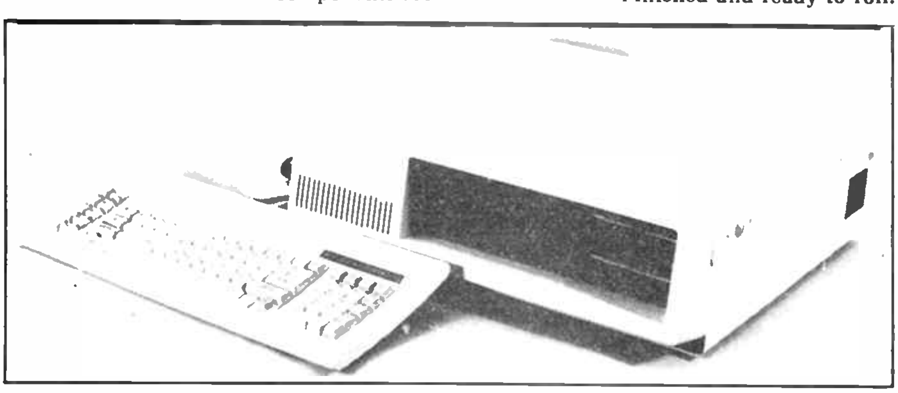
Finishing steps

Plug in the power supply connectors to the disk drives, they are keyed and can only go in one way. Tie down all cables with nylon zip ties. Fill the vacant rear slots with spare card brackets.

All OK? Check everything thoroughly. Close the lid, take the cardboard protectors out of the disk drives, plug in the keyboard, a monitor and your power cable. Bravely, switch on!

If functioning correctly, the unit will go through a memory check procedure and end up with the prompt: A>. Now you're ready to roll!

Finished and ready to roll!



Any likely faults can be easily isolated. Always switch off between checks. Check all cables. Start troubleshooting with the power supply. Unplug all its cables, power-up and see that you can get sensible voltages on one of the connectors. Plug it back together and test step by step; power-up with the motherboard and video card only — see that you get video display. Isolate the problem component in this way. If you have any difficulties, check ALL your documentation. If that fails, call your supplier.

As you can see, it's not difficult. We did it inside two hours — it takes longer to describe it than it does to do it.

— from page 97.

Using the 800 in FX100 emulation mode, we tried outputting a pc board design to it from Smartwork running on our IBM-PC XT. It handled small Smartwork designs OK, but it needs more storage capacity in order to handle Smartwork properly. That aside, the checkplot result on the laser printer was of remarkably good quality, certainly perfectly usable for prototyping or limited quantity in-house production runs. We also tried it hooked up to a Microbee running BeeArtistic. Results were excellent!

It would have been nice to have had the ability to take AutoCad output, which would make the unit ideal for technical documentation applications. We understand Impact are considering something along those lines but we have no information as to when — or if — something might come of it.

The facility to draw rules and boxes, and to fill areas with tone and/or geometric patterns allows you to "dress up" a page or an entire document. However, to use it effectively means sitting down and becoming thoroughly familiar with the commands. It's great for drawing histograms or similar graphs, highlighting bodies of text, creating headings and the like.

The "forms overlay" facility would come in very handy in a technical documentation operation. This enables a complete page of information — text or mixed text and graphics — to be created, then sent to the printer and stored rather than being printed. This stored page can then be superimposed on as many subsequent pages as you wish — as if pre-printed forms were being used. Great for data sheets or tables which have a standard format.

In operation, the unit is extremely quiet. It made for some anxious moments on occasion! That 18 second first print delay positively had us chewing our fingernails there before we got used to it.

The small cassette capacity we found a bit of a limitation in some circumstances. It would be much more practical and convenient to be able to load a whole ream of paper.

The Impact Laser 800 Model II is a well-made unit supported with well-produced documentation. I would not hesitate in recommending it for serious consideration if you're in technical documentation and in the market for a suitable printer, for it's more than "just a fancy printer".

Review Unit kindly supplied by Impact Systems Pty Ltd, 7 Gibbes St, Chatswood NSW 2067. (02) 406 6199. Contact Impact for pricing and details of your nearest sales outlet.

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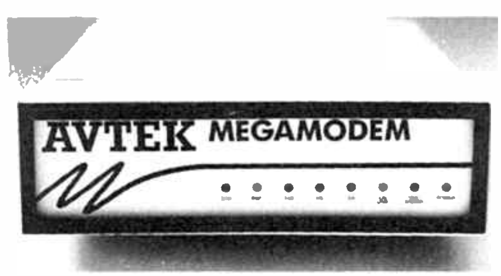

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Memory mapping and computer number systems — using the VZ200/300

Bob Kitch

This contribution will hopefully stimulate users of the VZ200/300 (or perhaps other small micros) to think about *what* actually lies behind the keyboard or monitor. Therein resides, not simply a collection of electronic components, but a truly creative, near-art form; only restricted by the users' ingenuity. I also hope to provide a firm foundation for users to understand how they should visualise or conceive the internals of their computer. This will lead to more imaginative and rewarding use of their somewhat meagre hardware resources.

THE COMPUTER can be conceptualised (thought of) on two distinct planes: **(i)** the tangible, mechanical or physical level; and **(ii)** the intractable, esoteric or conceptual level. These two "states" are often synonymously associated with the hardware and software aspects of computing but they are not quite analogous as a brief consideration should reveal.

The realisation that the computer can in reality adopt any position between these two end-states sheds some insight into how useful a computer can be as a problem solving tool or as a creative device.

The computer is a *virtual* machine. It is incapable of doing mechanical work such as that done by an internal combustion engine. Furthermore, a computer can be *configured* via suitable programming to carry out any function that we may envisage for it. Again the analogy with a tool, for instance a spanner, is instructive. A shifting spanner has only one use — it is dedicated to that job (although I have seen some tradesmen use it as a hammer!). The important notion in computing is that our imagination is the limiting factor in determining the usefulness of the computer. We may wish to use it to monitor the security of our home or to create fantasies of our mind in intellectual and role-playing games, to carry out tedious and repetitive number crunching, or to correct text for us — etc. The spectrum of jobs is vast, and increasing almost daily.

Transformation

Somewhere between the conception of an idea and the translation of this into a computer-based chore, lies the fundamental task of the programmer. The use of the operation called "transformation" is vital to the succes of this translation. The transformation procedure takes a particular notion in our minds (the "object") and produces a "model" of this in the computer. The model may be termed the "image". A good computer image is a skilful combination of the joint hardware and software aspects of the particular computing configuration.

Often a number of step-wise transformations are required to reach the desired goal or end-point. The distribution of tasks proportioned between hardware and software depends upon

i) the resources available, and
ii) the particular talents of the person undertaking the implementation.

Electrical engineers tend to solve problems with hardware intensive solutions, whilst programmers often develop elaborate algorithmic software solutions.

Not surprisingly, *transformation* has a well developed and rigorous expression in mathematics where the somewhat allied ideas of *correspondence* (between similar objects) and *function* (connecting objects) have relevance. The box entitled "Transformation Concepts" accompanying this article futher elaborates upon some of the powerful transformation concepts — in layman's language.

The way in which "correspondence" occurs in computer science and with which perhaps most programmers are familiar, lies in the various types of codes and coding principles which are employed to connect the diversity of ideas under software control. Note that in transformations from object to image the direction of the conceptual movement may be in either direction or sense.

Thus *encoding* represents transforming the object into the image and *decoding* represents returning the object from the image. Also, multiple levels of coding are often used, depending upon where we are positioned in the hardware-software spectrum.

Codes

Consider the following code types:

i) Codes used by electronic circuits to perform digital operations e.g: binary codes.
ii) Codes used to convert decimal numbers into binary form e.g: binary coded decimal (BCD) and gray scale.
iii) Codes used to convert decimal numbers and alphabetic symbols into digital form e.g: ASCII, EBCDIC and Baudot code.
iv) Codes used by computers to perform a prescribed series of operations e.g: Z-80 instruction code and PDP8/E. ▶

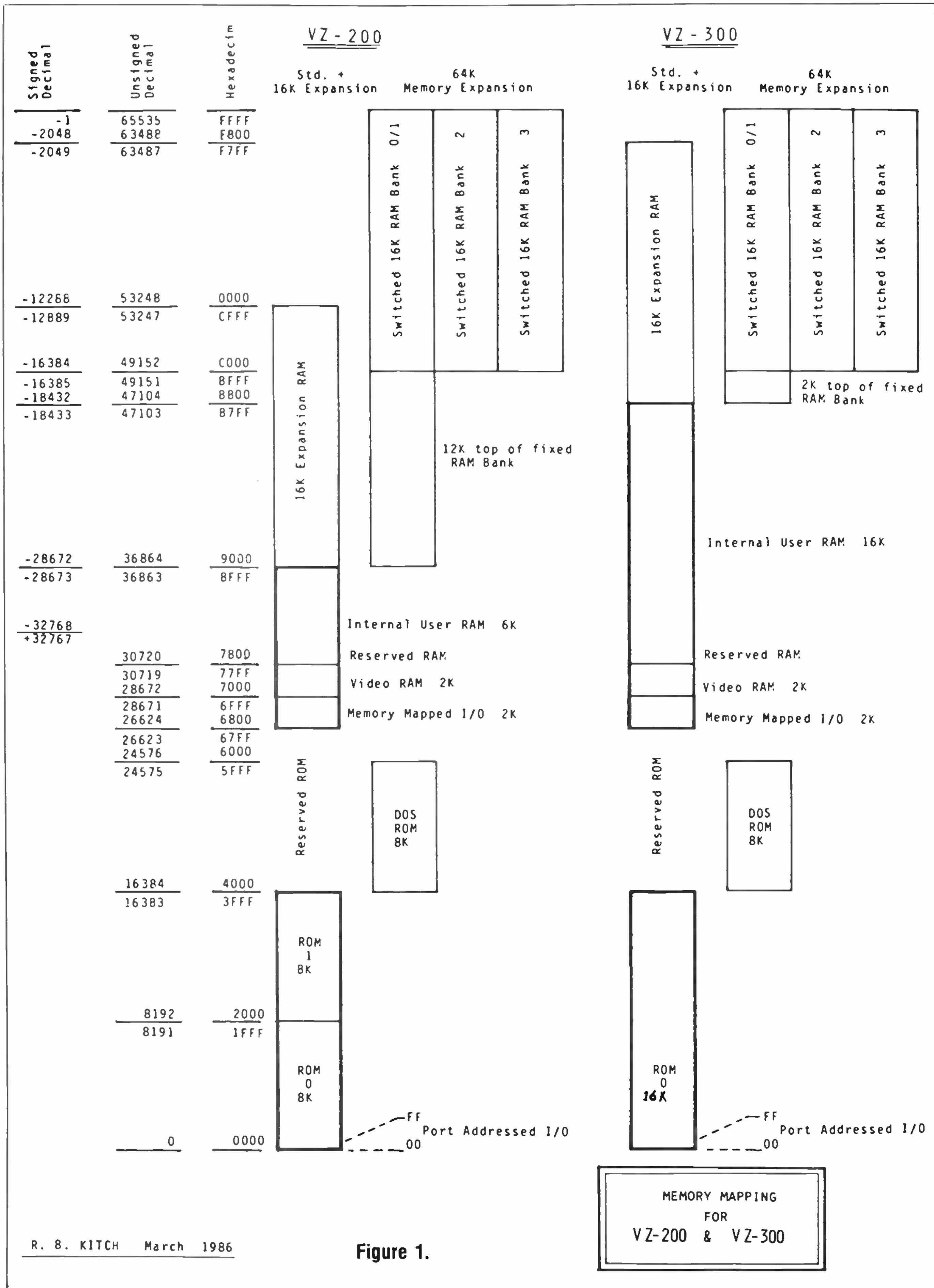

Signed Decimal
Unsigned Decimal
Hexadecim
VZ-200
Std. + 16K Expansion
64K Memory Expansion
VZ-300
Std. + 16K Expansion
64K Memory Expansion
-1 65535 FFFF
-2048 63488 F800
-2049 63487 F7FF
-12288 53248 D000
-12289 53247 CFFF
-16384 49152 C000
-16385 49151 BFFF
-18432 47104 B800
-18433 47103 B7FF
-28672 36864 9000
-28673 36863 8FFF
-32768
+32767
30720 7800
30719 77FF
28672 7000
28671 6FFF
26624 6800
26623 67FF
24576 6000
24575 5FFF
16384 4000
16383 3FFF
8192 2000
8191 1FFF
0 0000
Switched 16K RAM Bank 0/1
Switched 16K RAM Bank 2
Switched 16K RAM Bank 3
16K Expansion RAM
12K top of fixed RAM Bank
2K top of fixed RAM Bank
Internal User RAM 6K
Internal User RAM 16K
Reserved RAM
Video RAM 2K
Memory Mapped I/O 2K
Reserved ROM
DOS ROM 8K
ROM 1 8K
ROM 0 8K
ROM 0 16K
FF
Port Addressed I/O
00
MEMORY MAPPING FOR VZ-200 & VZ-300
R. B. KITCH March 1986

Figure 1.

NUMBER BASE CONVERSION & MEMORY MAPPING

In the accompanying article the need to be able to change number representations, according to differing bases, becomes apparent.

Three bases are usually cited and often freely interchanged. These are:

base 10 — decimal (dec./D) uses symbols 0-9
base 16 — hexadecimal (hex./H) uses symbols 0-9, A-F
base 2 — binary (bin./B) uses symbols 0 and 1

The first system is the most familiar to us. The last is the number system of digital computers. The hex system is a convenient intermediate form between decimal and binary systems. (A fourth system to base 8, or octal — using symbols 0-7 — is sometimes employed and is also a convenient intermediate form — see later).

The accompanying table is an indispensable reference for converting base numbers. I always have this chart alongside me when programming — although some people may be fortunate enough to have an electronic calculator with base conversion functions.

Because there are three base numbers, it follows that there are six possible types of conversion. At the conclusion of this box you should be familiar with each conversion and be able to manipulate the resulting numbers.

DESCRIPTION OF TABLE

Table 1 is composed of six columns.

Column 1 (left-hand most) represents single hex digit ranging from OH to FH.

Columns 2 to 5 are labelled Most Significant 3-0 for decimal numbers.

MSO corresponds with 16**0*N (1*N)
MS1 " " " 16**1*N (16*N)
MS2 " " " 16**2*N (256*N)
MS3 " " " 16**3*N (4096*N)

Column 6 is the four-bit binary number corresponding to the hex digit in column 1.

One hex digit can represent half-a-byte (one-*nibble*) of binary information. Hence the close relationship between hex and binary representations. A 16-bit (two-byte) binary number maps onto four hex digits. A single byte maps onto two hex digits. (Octal or base-8 numbers map onto three bits of binary hence an eight-bit binary number can be represented by three octal digits.)

CONVERSION PROCEDURE

A. We will start converting a hex address value into its corresponding decimal and binary values.

1. Converting hex to dec. We will do this using an example. For instance, what is the decimal mapping of address 345CH? Note that the Most Significant Byte (MSB) is 34H and the Least Significant Byte (LSB) is 5CH.

The corresponding decimal for 3H (actually 3000H) appears in column MS3 and maps as 12288D. Similarly, the 4H (400H) in position MS2 maps as 1024D; 5H or 50H maps as 80D in MS1 and finally, CH corresponds to 12D from MSO.

Thus,

```
  3000H ───► 12288D
   400H ───►  1024D
    50H ───►    80D
 +  CH  ───► +  12D
 345CH  ───► 13404D
```

So 345CH maps as 13404D. A little involved, but easy with the table.

2. Converting hex to bin. Remember I said that hex and binary systems are closely related. Again, what is the binary mapping of address 345CH?

```
 3     4     5     C    H — from column 1
 |     |     |     |
0011  0100  0101  1100 B — from column 6
```

So the binary address for 345Ch would be —

MSB 00110100B LSB 01011100B

It could hardly be simpler!

See how difficult it would be to remember binary, but hex is much more concise and memorable?

B. Let us now take a decimal number and convert it into hex and then binary.

3. Converting dec to hex. What is the hex mapping of 22010D? This involves a little scanning of MS3-MSO of the table.

First scan down MS3 for a decimal number which is equal to, or just less than, 22010D. This is seen to be 20480D which maps as 5000H. Subtract this value from 22010D and look for the number just lower than this is MS2. For example 22010D — 20480D = 1530D. The number just lower than this in MS2 is 1280D which maps as 500H. The remainder from this operation is 250D which corresponds to 240D or FOH in MS1. The final remainder is 10D which maps as AH in MSO.

Thus:

```
  22010D
 -20480D ───► 5000H
 - 1280D ───►  500H
 -  240D ───►  FOH
 -   10D ───► + AH
      0D ───► 55FAH
```

It should be easy to convert this hex number into binary equivalent.

55FAH maps as 01010101 11111010 B

C. Let's now start with a binary number and convert it to hex and then to decimal (as previously done).

4. Converting bin to hex. By now you should be getting the idea. Simple isn't it? For example, convert the two-byte address 10011111 11010011B (looks horrible doesn't it?) into its hex value and then decimal value.

```
1001  1111  1101  0011 B — from column 6
  9     F     D     3  H — from column 1
```

Furthermore,

```
 9000H ───► 36864D
  F00H ───►  3840D
   D0H ───►   208D
 +  3H ───► +   3D
 9FD3H ───► 40915D
```

For those that have been following closely, 40915D is an unsigned decimal and mapped as a signed decimal it is

40915 — 65536 = -24621D
(see later in main article if unsure)

So in summary, we now have four ways of mapping the same address:

hex	9FD3H
unsigned decimal	40915D
signed decimal	-24621D
binary	MSB 10011111B LSB 11010011B

As a final comment and for completeness, it should be said that all the examples given herein are for unsigned decimal numbers in the range of 0 to 65535D. These map onto two-byte numbers ranging from 0000H to FFFFH in hex and 00000000 00000000 to 11111111 11111111 in binary.

The same principles apply for single-byte numbers except that the range of unsigned decimals is reduced to 0 to 255D and 00H to FFH in hex. Only MS1 and MS0 need be used in converting single-byte numbers.

Given this background then, it should be easy to calculate the appropriate values to POKE into addresses 30862D (788EH) and 30863D (788FH) to initialise the USR() command on the VZ. But more of that next time.

If you want some practice in number base conversion and require some additional confidence in following the procedures set out herein then take some addresses from the memory map and practise converting them. (I hope I get them right!)

v) Codes used by programmers to describe a problem to the computer e.g: BASIC, FORTRAN, and SAS.

vi) Codes used by the populace to have work done by a computer which is often transparent to the user. Everyday-type language is often used to communicate to the computer. (i.e: no special skills are required) e.g: POS ('Point-of-sale') terminals or pushbutton data entry panels on microwave ovens etc.

All of these forms of transformation (or coding) describe a relation or function between any object (the notion) and its corresponding image (the programme). Flowcharting is often an intermediate coding step in the transformation process.

The memory image

Towards the hardware end of the spectrum previously alluded to lies the memory or storage system of the computer. Both the programme (or driver) and data are stored in memory which is sequentially addressed in the present generation of Von Neumann machines. Often a successful programmer "needs to get close" to this physical device — particularly in a small microcomputer environment where the memory resource is usually limited. 4K of memory usually requires some smart coding to get a worthwhile programme running — and often in machine code. Larger machines sometimes use a virtual or paged memory system so that the programmer does not need to get close to the hardware limitations. Such things as programme and storage overlaying can be done to make the memory system appear larger than it actually is. The new generation of 16- and 32-bit microprocessors include on-chip memory management functions (e.g: the 80286) to handle memory paging.

The usual way of describing the memory system of a particular computer is via the "Memory Map". This is a transformation of the actual (object) memory chips contained in the computer. This conceptual diagram (image) is an aid for the programmer. It is not a map in the same sense as a geographic (or road) map, but rather it has a one-to-one correspondence with the actual memory system. It does not actually point up any directions in the memory, in the way that a road map does. The memory map is simply a useful programmers' image of the storage which can be accessed by the CPU and the way it is organised.

VZ memory maps

(You thought I was never going to get to it!) Figure 1 is a *Universal Memory Map)* for all the VZ-200 and VZ-300 compluters. These are expandable machines in that additional memory modules, disc systems and various other peripherals can be added onto the standard system. Eight distinct types of machine are detailed:

a) standard "8K" VZ-200 and
b) standard "18K" VZ-300 (both shown in the dark outline)

In the standard machine an area of 10K is reserved for plug-in ROM cartridges. To each of the types can be added:

i) a 16K memory expansion module or
ii) a 64K memory expansion module, and additionally
iii) a disc system containing an 8K DOS can be added which utilises portion of the reserved ROM area.

Thereby eight types of VZ configuration are possible and shown in Figure 1.

A study of the range of memory expansion modules added to the VZ-200 or VZ-300 indicates that they occupy different areas of memory. This clearly shows why expansion modules are not interchangeable between models. Fortunately all of the "system areas" are compatible across models — otherwise software would not be transportable. All memory addresses below the reserved RAM (communications area) are the same on either system. This includes video RAM, memory mapped I/O, port addressed I/O and DOS ROM. As most of the peripherals are mapped into the I/O areas, these devices are also compatible between models.

Numbering systems for memory mapping

The three columns extending down the left-hand side of the map are the memory address ranges in the computer that are handled by the Z-80 microprocessor. Again the concept of "mapping" is worth noting — because the CPU uses none of the techniques shown in the columns to actually address memory! The actual (object) addressing method is a 16-bit wide binary sytem which, with suitable decoding, can resolve all the addressing functions necessary. A binary view of the addressing is unnecessarily complicated to obtaining a clear image of the VZ's address space.

An explanation of the three numbering systems used on the memory map follows.

Two forms of decimal (base 10) notation and one of hexadecimal (base 16) are shown. These are image numbering systems of the actual (object) 16-bit binary (base 2) method used by the Z-80 (Port addressed I/O uses only eight-bits of the Least Significant Byte of the address, to uniquely identify the 256 I/O ports).

If you are not particulary familiar with converting or dealing with numbers derived from differing bases, then read the boxes called "Number Base Conversion" accompanying this article.

Unsigned decimal addressing

This number system is shown in the central column of the memory map. It is perhaps the easiest to understand and explain. With a 16-bit binary number as used on the address bus, it is possible to uniquely map 2**16 or 65536 memory locations. These addresses may furthermore be mapped into a one-dimensional vector with memory location OD (2**1-1) mapped at the bottom and memory location 65535D (2**16-1) mapped at the top. This convention of "top" and "bottom" may be inverted — but top of memory is conventionally referred to as the bigger decimal number — so it makes little logical sense to have "top" at the bottom! (Note that some memory maps are drawn in this inverted sense).

Another sense of mapping is apparent and worth mentioning here. This type of map is a byte-mapped transformation as each address is actually eight-bits wide. Most data processing programming deals with bytes as the fundamental units of information. However, the Z-80 can be addressed down to bit level and hence another bit-mapped image containing 524288 (65536*8) bits could be conceived. Some controller applications make use of bit mapping because often the available RAM for programme use is rather restricted and usually the definition or resolution of the process is two-state and can be aptly modelled by a single-bit.

In the unsigned decimal mapping methods, magnitude or size of the address number uniquely defines the location of the address in memory. Relational operators such as "greater than" and "less than" work correctly. This image of addressing is most easily visualised but it bears a difficult relationship to the 16-bit object addressing.

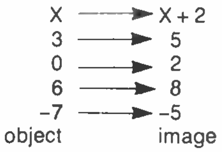
Hexadecimal addressing

This system is shown in the third column and has a stronger relationship to the two-byte wide addressing used by the CPU ▶

TRANSFORMATION CONCEPTS

In a *transformation*, the point being transformed is called the *object*. A transformation *maps* an object onto its' image according to some relation.

An *image* is the result when an object is transformed. e.g:



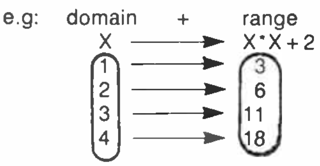
"the image of 3 is 5"

Relations are a way of connecting sets of numbers — a mapping is a special relation.

In a *mapping*, any number in the set being mapped is an object, but the entire set being mapped is usually called the *domain*.

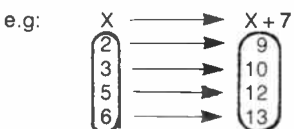
The *domain* of a *function* is a set of numbers mapped by the function.

The domain is the object set.

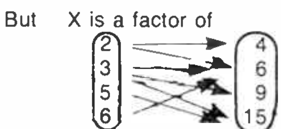


"the set (1, 2, 3, 4) is the domain"

A mapping is a *relation* in which, for every object mapped, there is one, and only one, image.

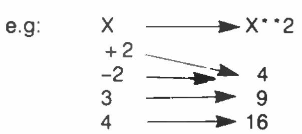


is a *valid* mapping.

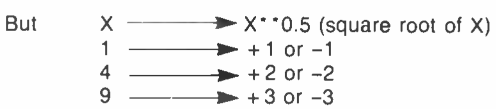


is NOT a mapping.

Functions are special relations in which each object is uniquely mapped onto one image.



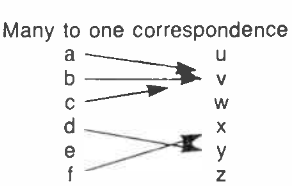
is a *valid* function.

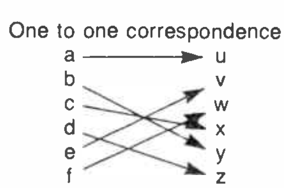


is NOT a valid function.

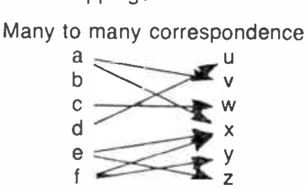
Correspondence has four types:

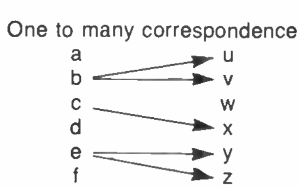
Mappings are:





NOT mappings are:





bus system. Each nibble (half-a-byte or four-bits) of the address is mapped onto one hexadecimal digit.

Whilst this system may appear a little unfamiliar, it has magnitude and sense — the same as the unsigned decimal notation. Therefore, similar connotations apply to the hexadecimal system as to the unsigned decimal system.

The correspondence between "top of memory" in an unexpanded VZ-200 as being 36863D or 8FFFH should be obvious from the memory map. It is simply a different way (by virtue of the number base difference) of image-mapping the same object.

In certain applications it is more convenient to use decimal notation — and in others it is clearer to use hexadecimal. If it is necessary to get close to the hardware, such as when designing the address decoding for a peripheral expansion, then hexadecimal, with its closer relationship to bus addressing, is better. Alternatively, when a programmer is wanting to locate a routine in memory, there is less need to get close to the machine, (e.g: when PEEKing or POKEing), and the more familiar decimal system is easier. In reality, experienced programmers or engineers readily flip from one to the other — particularly if they have a "smart" electronic calculator with base conversion functions.

Up to this point, all should appear to be logical, orderly and comprehensible. Unfortunately, the people who wrote the Microsoft version of the BASIC interpreter resident in the VZ (and previously used in the TRS-80 Level II, System-80 and PET) must have thought that unsigned decimal and hexadecimal were too logical and easily understood! If you try to PEEK into an address higher than 32767D or 7FFFH you will obtain an "OVERFLOW ERROR" message during run time. A look at the Reference Manual informs you that the valid address range is from -32768D to +32767D. Fair enough, but can one now assme that "top of memory" is +32767D and "bottom of memory" is -32768D. A reasonable deduction, but unfortunately, entirely incorrect! Is our faith in mathematics and logic (relational operators) misplaced?

Signed decimal addressing

The culprit is the signed decimal numbering system shown in the left hand column of the memory map. This number system is closely derived from the 16-bit binary system. The signed decimal numbering is developed from the two's complement binary system which is a method that facilitates the ▶

TABLE 1.

CONVERSION DECIMAL — HEXADECIMAL — BINARY

	Dec.				
	MSB		LSB		
	4096	256	16	1	
Hex.	**MS3**	**MS2**	**MS1**	**MS0**	**Bin.**
0	0	0	0	0	**0000**
1	4096	256	16	1	**0001**
2	8192	512	32	2	**0010**
3	12288	768	48	3	**0011**
4	16384	1024	64	4	**0100**
5	20480	1280	80	5	**0101**
6	24576	1536	96	6	**0110**
7	28672	1792	112	7	**0111**
8	32768	2048	128	8	**1000**
9	36864	2304	144	9	**1001**
A	40960	2560	160	10	**1010**
B	45056	2816	176	11	**1011**
C	49152	3072	192	12	**1100**
D	53348	3328	208	13	**1101**
E	57344	3584	224	14	**1110**
F	61440	3840	240	15	**1111**

manipulation of negative numbers. Do not be *overwhelmed if the terms are unfamiliar as it is not essential to understand their derivation.* There exists a simple relationship between the familiar unsigned decimal and the signed decimal systems.

The simplest way of expressing the relationship is that if the unsigned decimal address is greater than 32767D then subtract 65536D from the unsigned decimal value — thereby obtaining a (negative) signed decimal. If the unsigned decimal is less than or equal to 32767D then the signed decimal value maps directly. Expressing this in BASIC is as follows:

UD = unsigned decimal value
SD = signed decimal value

To convert UD to SD:

```
15 IF UD > 32767 THEN SD = UD — 65536
                 ELSE  SD = UD
```

To convert SD to UD

```
25 IF SD < 0 THEN UD = SD + 65536
             ELSE  UD = SD
```

Refer to the mapping in the extreme left hand column of the memory map where the signed decimal system is detailed. Bottom of memory is still OD but top of memory is –1D. A very important discontinuity occurs in the numbering system at mid-memory, where adjacent bytes are numbered 32767D and –32768D. Relational operators do not work in this mapping system.

Suppose one wanted to PEEK into each consecutive memory address over the entire range of memory from OD to –1D (note!). As remarked previously, it is necessary to use signed decimals when PEEKing.

The loop written in BASIC —

```
10 FOR SD = –32768 TO +32767
20 V = PEEK (SD)
30 PRINT SD, V
40 NEXT SD
```

will not provide a consecutive listing of memory. It will commence at the base of the upper half of memory (SD = 32768D) and proceed to the top of memory (SD = –1). It will then leap to the bottom of memory (SD = OD) and proceed to the mid memory (SD = +32767D) position. Not quite what was intended!

To achieve the desired result, the following loop could be written:

```
10 FOR UD = 0 TO 65535
20 SD = UD: IF UD > 32767 THEN SD = UD — 65536
30 V = PEEK (SD)
40 PRINT SD, UD, V
50 NEXT UD
```

This will correctly step-up through memory consecutively from bottom to top (but slowly!)

Uses of the memory map

Having worked thus far through this exposition, what are some of the uses to which the memory map can be put? The first use is when it provides the programmer with a clear image (that word again) of how the addressable memory of the computer is *organised*. A number of advanced programming techniques for the BASIC interpreter also become available. For example, the *utilisation* of the memory by a BASIC programme can be determined. Overlaying of the Programme Statement Table by another routine but with retention of the Variable List Table, becomes possible. Also Assembly Language routines can be loaded into Free Space and called by the USR statement. Overwriting and corruption of programmes (images) can be avoided by reference to the map during loading. If, however, this does inadvertently occur, then the memory map becomes an important load map for debugging purposes.

A more detailed description of the I/O area (including the video RAM) mapping for the peripheral devices, and the communications area would provide more information for advanced programming techniques. Perhaps, with the Editor's indulgence, we may be able to explore these interesting areas at a future date? Meanwhile, get to *understand* your VZ'd, practise number base conversions and let your imagination run with applications for the VZ.

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The Impact Laser 800 printer Model II

Roger Harrison

One technological 'niche' in which Australia is offering competition against the multinationals – and winning – is laser printers. Impact Systems of Chatswood NSW make a range of laser printers which are sold on the local market as well as overseas against products from giants such as Hewlett Packard, Apple, Canon and Ricoh. Here we review their current top-line unit, the Laser 800 Model II.

I THOUGHT the term "desktop publishing" was a misnomer until I met a fellow in my neighbourhood who actually was a desktop publisher. He ran a one-man business consultancy and had to produce limited quantities of lengthy, high quality reports comprising text with graphics illustrations. His office was the small study in his house. His work 'tools' comprised a microcomputer and a desktop laser printer.

All his report preparation was done on the computer — text, illustrations and the 'cutting and pasting' of them to form an integrated document. His laser printer was used to produce a single document or a limited number of multiple copies as required.

From time to time I have been involved in what can best be described as "benchtop publishing". Copy is prepared on a typewriter (or these days, a wordprocessor and printer) and drawings on a draughting board. A document, manual or newsletter is then assembled from cut-out pieces of text and drawings pasted onto 'page masters' using cow gum (a sort of glue that never really sets so you can shift the glued pieces around for alignment, etc). The page masters are then reproduced by photocopying or a small offset press (so-called 'instant' printing) where large-ish numbers are involved.

The advantages and efficiency of my neighbour's system and the quality of the result were dramatically brought home to me. In addition, he pointed out that the pages produced from the printer could readily be used as masters for a small offset press.

I next saw a laser printer at the launch of Impact System's new Laser 800 printer models earlier this year. I was impressed to find that, apart from the laser 'engine', they were actually designed and manufactured here in Australia. In fact, the press crew attending the launch were taken for a tour of the design and manufacturing plant areas at Impact's head office where the function was held. I decided to try one for myself and arranged one of their new printers for review.

The laser printer

The laser printer is a remarkably powerful tool with many, and widely varying, applications. It is a marriage of three technologies: Xerography (photocopying), optical scanning and microcomputing. (See *Laser printers — writing with light*, AEM November 1986). As a relatively low-cost, high quality hard copy output device for a computer system, it is unsurpassed. As such, laser printers have 'taken off' in a big way in many market areas.

A laser printer comprises a "printing engine" which is controlled by what is virtually a complete microcomputer with an 'intelligent' interface. The printing engine is rather like a photocopier, consisting of a rotating drum with a photoconductive surface which is charged and then a pattern of the required image formed. Light impinging on the photoconductive surface will dissipate the charge where it falls. The required image is formed by scanning a narrow, well-focused beam of light from a laser across the drum surface, turning off the beam where charge is to remain to form the image. A "toner" powder is applied to the drum which adheres to the charged area and is then transferred to blank copy paper as the drum rotates. The image is subsequently 'fixed' on the copy paper by heat and pressure.

The optical scanning process is controlled by what is virtually a complete microprocessor within the printer. Because the system employs a narrow beam of laser light, modulated at a rate of about 3 MHz to produce the 'dots' horizontally across the drum, very high resolution is possible, typically 300 x 300 dots per square inch (imperial measure reigns, yet!). Characters are generated in a manner similar to the way characters are formed on a VDU screen or dot matrix printer. However, the higher resolution afforded permits much improved quality compared to dot matrix printer characters, as well as a wide variety of character sizes and other variations (e.g: italics, reverse italics, shadowing, shade patterns etc). Horizontal scan time is about 1.5 milliseconds and its takes about five seconds to create a whole page.

Type 'fonts' stored in ROM may be called up from simple escape commands in text sent to the printer, allowing a mixture of the available fonts on a page of text. Plug-in ROM cartridges can provide further selection of typefaces or even special graphics characters. A font may even be created on your own computer and downloaded to the printer. The technology of laser printers also offers the ability to draw lines (of varying width!) and boxes using simple commands embedded in text, to 'fill' a areas with selected patterns and to mix text and graphics on the page.

What these features allow you to do is to compose complex pages of text or text and graphics, using a range of fonts and font variations for a document entirely on your wordprocessing system, and to print the entire document without having to stop the printer to change font wheels (as with a daisywheel printer) or to subsequently 'cut and paste' text and diagrams or graphics.

But this calls for some considerable 'power' in the microprocessor system that drives the laser printer. An A4 page measures about 8" x 11" so to store a full bit image and transfer it to the drum as a video signal requires almost one megabyte of storage (memory) capacity! And to keep the printer operating at full speed, you need to be able to store one whole page while the previous one is printing, calling for two megabytes of storage.

Applications for a laser printer will be immediately obvious to those currently using a printer to prepare text for cut and paste copy in manuals, newsletters, circulars and other documents of a similar nature. Indeed, our review of the Impact Laser 800 printer was conducted from that standpoint as there are many areas in the electronics and computing industries which require such facilities.

The Impact Laser 800

Impact Systems makes two version of the Laser 800 printer, Model I and Model II. They are essentially the same machine with Model II having enhanced facilities. The accompanying table shows the general hardware specifications. From Impact's manual, the features and facilities provided are summarised as follows:

- Provides high resolution (300 x 300 dots per square inch)
- Operates at high speed (up to eight A4 sheets per minute)
- Is quiet in operation (less than 55 dB(A)

ABRIDGED SPECIFICATIONS
IMPACT LASER 800 MODEL II

Size:	475(w) × 293(h) × 415(d) mm
Weight:	34 kg
Power Supply:	220/240 Vac, 50 Hz; 120 Vac, 60 Hz (optional)
Consumption:	900 W operating, 230 W standby (220/240 Vac)
Noise Level:	<55 dBa printing <45 dBA standby
Paper:	plain (manufacturer approved); 60 to 80 gsm cassette, 40-128 gsm single sided manual feed, 60-128 gsm double-sided manual feed.
Paper Sizes:	cassette — A4 (210 × 297 mm) B5 (182 × 257 mm) legal (216 × 356 mm) American Quarto (216 × 297 mm) Manual feed — from 100 × 140 mm to 216 × 356 mm.
Cassette Capacity:	app. 100 sheets 80 gsm.
Print Speed:	cassette — 8.1 sheets/min. A4 6.9 sheets/min. legal manual: 5.1 sheets/min.
Warm-up Time:	<2 mins from power-on.
1st Print Delay:	cassette — 16 secs manual — 22 secs
Process Speed:	47.1 mm/sec.
Interface:	Centronics and RS232; others available on-order.

while printing)

- Provides an intelligent operator control panel with 16-character liquid crystal display and interactive menu-based configuration parameter input routines.
- Is provided with four (six on Model II) library character fonts. These fonts can be chosen from a large selection. Storage space is provided for up to 10 fonts in both models.
- Provides cartridge loading facilities for both fonts and graphics cells on Model II. A large variety of cartridges are available. Cartridges can also be programmed to order from user's data.
- Provides for up to seven (optionally 15) on-line fonts to be made available for immediate access during printing of a single sheet. These fonts can originate from the library storage, from cartridge (Model II only) or from the host computer.
- Enables font variation (italic, bold, rotate, shade, double-height, double-width) during transfer to on-line storage.
- Enables areas of print to be treated as "graphics cells". This provides logo and signature capabilities.
- Provides line and box drawing commands.
- Provides a form overlay capability.
- Provides single command on-line landscape/portrait selection on a page-for-page basis. All fonts and graphics used in portrait orientation can be used without change in landscape mode.

We elected to review the Model II.

The Laser 800 handles printing in quite a different way to conventional computer printers. Conventional printers treat text in one of two basic ways: (a) they print each character as it's received, progressing across the page until a line is completed and then roll the page up one line and return the carriage to the left hand edge, or (b) store each line of text in a buffer before printing — allowing text to be printed on the carriage's return journey — bi-directional printing. In such printers, the data sent is assembled in reverse order each alternate line. Some printers have substantial buffers added, capable of storing many lines of text, but such buffers are fundamentally not part of the character printing process.

In printing characters, the Laser 800 takes image data from the font ROM and puts it into a temporary storage area called a "scan buffer" where the image is stored in its expected position. If overlapping of characters is required, then the image of both is OR'ed at the point of overlap. The 800 has two scan buffers, one being used for printer output while the other is busy with image generation. They are each 2500 dots by eight scan lines capacity.

The two processors perform different tasks. One is known as the "command processor", the other as the "font processor". The first provides the interfaces to the host computer (the serial RS232 interface, Centronics interface or whatever), looks after the front panel, the cartridge port and command of the laser engine. The command processor interprets "escape" command sequences sent with the text from the host computer and builds up "task buffers" in its associated RAM for the font processor. The task buffers describe the character, font type, size and positioning, etc in the scan buffer.

The font processor reads the task buffers directly from the command processor RAM. Fonts which are to be used on a page are transferred into this memory area from either on-board EPROM (internal library), a cartridge or the host computer. Up to 15 fonts may be stored here. The font processor then controls the transfer of font image data into the scan buffers.

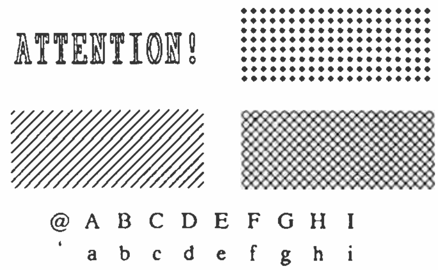
There are several significant advantages to this arrangement, according to Impact. Firstly, the font image is moved quickly into the scan buffers for printing. Secondly, it may be rotated from the horizontal (normal, or "portrait", printing) position, as it is stored, to vertical ("landscape") "on the fly". Further, it allows for variable line spacing and subscripting/superscripting without the necessity of special fonts. Just for the record, 68000-10 microprocessors are used for the command and font processors.

The Laser 800 assembles the entire page before printing. The inherently high operating speed of the laser printing engine makes this necessary. By manipulation of the "cursor" (the current print position pointer), the printed image can be sent first and then the text, effectively superimposing the text over the graphics image prior to printing. Blocks of text can be placed anywhere on the page in any order."

Full page bit-mapping is supported for the printing of complex graphics and an additional memory board can be attached for the storage and generation of large graphic images.

The Laser 800 is able to emulate daisy wheel, conventional dot-matrix printers and other laser printers. The on-board microprocessor power is used to keep the total chip count low, requiring little hard logic. From a peek inside, you'd hardly thing they'd achieved the goal as it's packed with electronics, but I'd hate to think of what it would take to obtain the same features by other means!

Three emulations are available on the Model 1: line printer, Diablo 630 extended character set, and HP Laser Jet. Five emulations are available on the Model II: Qume



Some font and graphics print examples.

daisywheel and Epson FX100, in addition to the three just mentioned, which makes it pretty versatile. When you select an emulation mode, other than line printer, the machine will respond to the commands of *both* the selected emulation *and* the machine's own command set. Commands from the 800's own set are called up with a specified non-printing character, usually a little-used character, such as {, placed before the command, called the "lead-in code". A typical command might be "{cf4." This says "change to font 4".

Trying it out

After a quick run-down on features and functions from the suppliers, who delivered and installed the machine, we were left at its mercy. Supplied with each Laser 800 is a quick reference card and a User's Manual. I must say both are extremely well produced and show the hallmarks of being well thought-out. Each is well-organised and easy to use. Curiously, neither has been set on a laser printer! No additional font cartridges or other options were supplied, we got just the Model II "as she comes".

During warm-up after turning the power on, the liquid crystal display on the operator control panel (seen at top left in the picture on the opposite page) shows a kangaroo hopping across from left to right. Aussie kitsch, maybe — but a nice touch. There are five buttons on this panel: "on line", "prog", "test (menu)", "FF (item)" and "man fd (sel)". There are two modes of operation — *operational* mode and *program* mode. The first is the normal or default mode. The display always shows the current status. In program mode, you can specify all the configuration and emulation parameters. You get menus on the display from which you choose the required parameters. With the aid of the quick reference card, one quickly becomes familiar with the unit's basic operation. For the more sophisticated functions, reference to the User's Manual sets things straight.

We tried driving it from a variety of computers — our IBM-PC XT, a Microbee and an Apple II+, via both the Centronics and the RS232 interfaces. Each time it was simply a "plug-in and go" exercise.

All the fonts were given a thorough "exercise". The ability to vary the font style — bold, italics, shadow, outline, condensed, etc — without having to have special or extra font ROMs is a powerful and very useful feature. The larger point size type is noticeably "ragged" — but not unacceptably so — an artefact of the raster scanning process, but the characters in the more conventional sizes are of quite high quality. Overall print quality is excellent, certainly superior to dot-matrix NLQ printers and easily rivalling daisywheels.

to page 88.▶

Memo to telecom

ONE OF the most important items to discuss this month is the subject of Te'ecom approval for modems. As most readers will be aware, this magazine has presented three modem kits as projects over the last twelve months and the total of available kit-type modems is well into double figures. However, as we point out in great detail in each of our projects, anyone who builds these kits is NOT PERMITTED to connect it to the Telecom line without first obtaining an approval certificate from Telecom. This might seem a fairly trivial exercise to the uninitiated. However, the application must be accompanied by the appropriate fee (currently $600) and the approval may not be granted for up to six months. Then, if you modify or upgrade your modem you must re-apply for approval, and so it goes . . .

We have, on several occasions, been phoned by enthusiasts who have built the AEM4610 Supermodem project who wish to obtain the necessary approval to use their modems on Telecom lines. When they are informed of the above details, the ensuing silence on the phone is quite dramatic. I also have been informed by a reliable source inside Telecom that their certification laboratory is stretched to breaking point with modem applications.

It would appear that some reasonable alternative is urgently needed to overcome the problems being encountered. The argument that Telecom advance in the cause of certification requirements is quite a reasonable one. They are justifiably worried that a kit constructor may inadvertently connect the Telecom side of the modem to the mains (i.e: 240 volts ac), or that a fault in construction or use may eventually bring about the same result. Telecom would be singularly unimpressed if one of their linespersons were caused to sizzle and fry due to the negligence of a kit constructor.

On the other hand, total prohibition will not work either because, regardless of the illegality of their actions, a number of constructors of modem kits will probably connect their modems to the 'phone and use them anyway. In addition, just because certification has been granted to a device does not mean that the device will never be altered from its original specification. Hackers (a hacker) NEVER leave any item of computer equipment in its original state; there is always just ONE MORE improvement that can be made. This means that the original certification document is now worthless, and who is going to fork out another $600? As a further point for consideration, the AEM4610 Supermodem is shortly going to have a V.22 expansion board available. If I choose to build this additional board as a kit to save a little cash, do I then need to fork out another $600?

I would like to propose the following compromise. Telecom should amend their regulations to allow for the approval of a *line isolation unit* to be used in conjunction with ANY modem kit that has an approved plugpack power supply as its sole source of power. This would then allow kit suppliers to supply fully built and certified line isolation devices with their kits. Telecom would not have to worry about mains voltages appearing on the 'phone line, because the kits would all be powered by plugpacks. Let's hear your comments (or alternative suggestions).

If anyone from Telecom is interested in contributing to the discussion, we would be glad to hear from you.

Letters

We have received our first batch of letters and they are a very mixed bag indeed. There are several important corrections to the Supermodem circuit, which have been brought to our attention by **Mr N. Nicola** of Victoria and **Mr G. Boyce** of South Australia — thank you both for your letters.

1. The anode and cathode of the LED are shown reversed on the overlay.
2. Voltage levels on any of the connection points could have any value from 0 to 14 volts (plus or minus), depending on the state of the communications lines.
3. Any persons experiencing problems with the operation of the modem at 1200/75 should check R9, as described in the last issue. This should be 470 ohms, not 100R as shown in the parts list.

One very interesting letter came from **Steve Hyde** in Brisbane. Steve is obviously a newcomer to the world of modems and we would like to encourage him, and others like him, to become involved in communications. Essentially Steve's question is "If I build a Supermodem, do I need some sort of software driver program to run it?" The answer, very simply, is Yes! Because any modem is usually designed to run with a large variety of computers and/or terminals, the manner in which the host computer communicates with the modem is determined by an appropriate software package specifically designed for that computer or terminal.

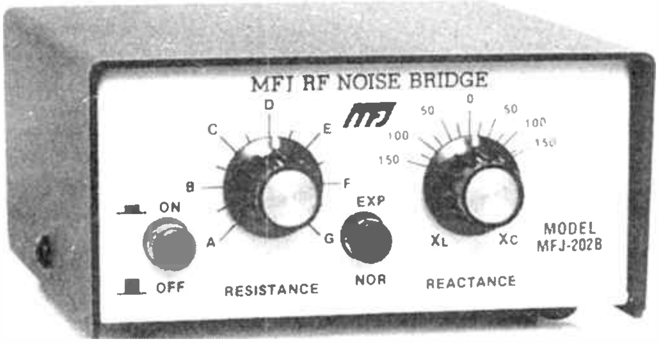
These packages handle such mundane tasks as initialising the host serial port, determining the correct communications protocol (start/stop/data bits, parity etc.) and handling the transfer of data between the host and the modem, and hence the remote terminal/computer or bulletin board etc. The design and programming of such a package is a fairly complex task and usually beyond the ability of the average enthusaist. However, some very dedicated programmers have written such programs and placed them in the public domain. PC-TALK (for the IBM PC and clones) is a typical public domain program and programs such as this are usually available for a very modest cost from a local user group specialising in particular computer varieties.

One other very useful feature of most communications programs is the ability to store all the input data to a disk file (the Viatel package supplied as an option with the Supermodem is a typical example). The manner in which this is accomplished depends upon the individual package and therefore I don't propose to attempt a discussion on any single package. Most simple packages store ALL input as an ASCII file. This file must then be edited using a standard editor to strip off all the unnecessary dialogue material such as sing-on messages etc. Note also, that BASIC programs transferred as ASCII files must be "converted" back to standard BASIC (i.e: tokenised) form before they can be run. The routine to do this is usually a part of the BASIC interpreter supplied with most systems.

That's all for this issue, next issue I hope to give a brief discussion on the RS232 interfacing requirements of modems and computers. Keep the letters rolling in.

Antenna noise bridge covers wide impedance range

Most noise bridges allow only measurements in the tens or at most, hundreds of ohms which generally becomes inconvenient, particularly when working with wire array type antennas. MFJ Enterprises' new MFJ-202B noise bridge incorporates a specially designed 'range expander' which allows it to read up to 3800 ohms resistance and using the range expander, capacitive and inductive reactances of up to 1900 ohms.



MFJ has assured the noise bridges have a very high accuracy by individually factory calibrating each unit before despatch from their plant in Starkville, Mississippi USA.

Using the MFJ-202B, in conjunction with an appropriate receiver, over its operating frequency range of 1 to 100 MHz opens up a whole new world of tuned circuit measurements, claim GFS.

Many useful tasks can be performed, using MFJ's bridge. They include: finding antenna resonant frequency, cutting a half wave dipole to frequency, tuned circuit alignment, measurement of RF amplifier impedances, RF transformers and baluns, as well as capacitance and inductance measurement.

The MFJ-202B's small neat size and in-built power source make it ideal for use both indoors or outdoors. GFS advise at the time of writing the MFJ-202B was priced at $299 plus $10 p&p. For more information or a brochure, contact **GFS Electronic Imports, 17 McKeon Road, Mitcham 3132 Vic. (03) 873 3777.**

Wagga: wackiest wadio woundup inna west!

Wagga Amateur Radio Club's annual convention, held this year over the last weekend of October, attracted a goodly crowd of participants from VK2 and VK3, and as far afield as VK4. The almost-constant round of hidden transmitter hunts, on-air 'scrambles' and other contests kept the enthusiastic contestants occupied much of the time, vying for an amazing array of prizes. In-between times, trade displays and eyeballing were the order.

Your Editor, VK2ZTB, was a guest of the club for the convention and addressed the Saturday night dinner crowd with his current hobbyhorse harangue — aspects of the Linton/Harrison Paper on licence restructuring and the future of amateur radio.

Being on the team that won the 'AEM Foxhunt' was somewhat of an embarrassment, but all's fair in love and foxhunts! The transmitter was hidden in a nettle patch — just to add a little 'sting' to the exercise, one assumes?

The trade and hobby displays brought some interesting equipment to the fore — both old and new. It was good to renew old acquaintances, make many new ones and suss-out a wide range of ideas and opinions on many topics of amateur interest. The general consensus was — a good time was had by all. WARC sure seems to know how to run an imaginative convention.

Packet repeater software

The Sydney Amateur Digital Communications Group has announced the release of their SADCG Digital Repeater software, version 2.1, for amateur packet radio. This release features full implementation of AX25 digipeating, making it the first 'multi-protocol' packet repeater.

The first amateur packet repeater in Australia used the original version 1.3, supplied by John Vandenberg, VE3DVV, which at that stage only supported Vancouver V1 protocol and provided functions for V1 users. The D.R. software progressed to version 1.5, where it was superceded by version 2.0, to coincide with the release of Vancouver V2 protocol.

With version 2.1, it is now possible for both Vancouver and AX25 users to operate on the same channel simultaneously without interference. The explanation behind this is that with Vancouver protocol all frames are repeated by the DR unless the user supplies a LOGOFF command, which allows the user to send packets without going via the DR.

The concept with AX25 protocol is the reverse, the AX25 user is not repeated via the DR unless the AX25 user specifically puts the DR's callsign into the user's AX25 address field. This means a SADCG D.R. can be installed as part of an AX25 digipeating chain.

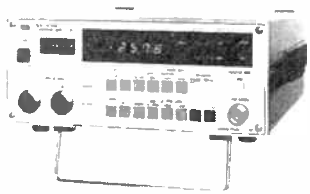
The SADCG DR does provide user commanded functions, which can be called by Vancouver protocol users, while in the unconnected mode, (that is when a packet node is not connected/linked with anyone) the functions include: TIME, STATUS, LOG, LOGON, LOGOFF, CLEAR, SAVE, DUMP and HELP.

Other features provided for Vancouver protocol users are automatic DR identification messages, which display TIME, CALLSIGN and LOCATION. This occurs every five minutes while the DR is in use, otherwise it is in quiescent mode when there is no channel activity.

These DR command functions are not provided to AX25 protocol users, as none of these features are used in TAPR AX25 digipeating.

The SADCG DR software is only supplied to amateur radio groups who operate; or intend operating, a licensed packet digital repeater and is presently only available for use on CADCG (Vancouver) Terminal Node Controllers (TNC).

Contact the **SADCG, PO Box 231, French's Forest 2086 NSW.**



Portable RF power meter

A microprocessor based programmable portable RF power meter from JRC, the model NJL-70W, has just been released by ACL Special Instruments of Melbourne.

It can measure a wide range of power from -70 dbm to +20 dbm in the bands from 10 MHz to 26.5 GHz in conjunction with the NJL-71 series power sensors.

This multi-functional power meter is designed for automatic zeroing and calibration, compensation for loss and gain, comparitive measurement for any reference, and storage and recall of setting data by the use of a back-up memory.

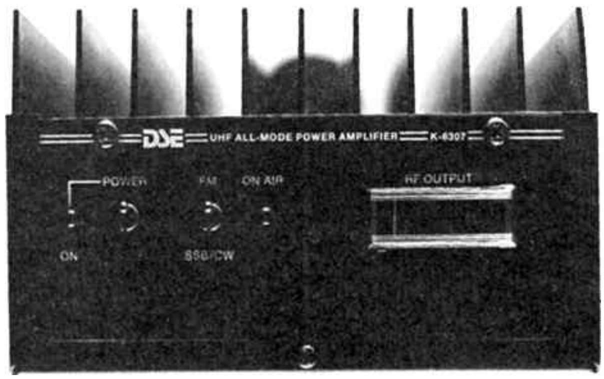
All the functions are available by simple pushbutton operation and the meter is portable, for use with an external 12 volt dc source.

Contact **ACL Special Instruments**, a division of Associated Calibration Laboratories, **27 Rosella St., East Doncaster 3109 Vic. (03) 842 8822.**

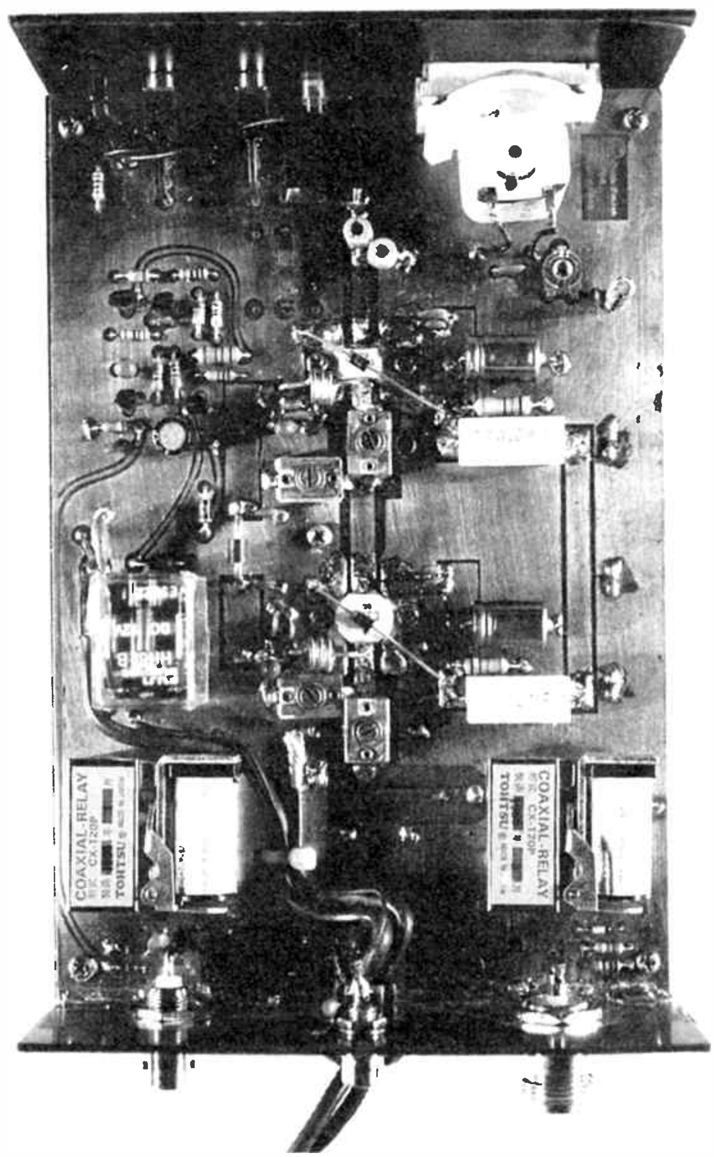
A 70 cm 50 watt all-mode booster amp.

Dick Smith Electronics
Technical Products Division

Many UHF transceivers have an output in the 2 W to 10 W range. This amplifier will lift a 2 W output rig to the 50 W level and may be used with CW, FM and SSB modes. It features a 10 MHz bandwidth, harmonics better than 60 dB down and 12 Vdc operation for mobile or home use.



View of the front panel (above) and internal view of the completed project (below). Input socket is on the left, output on the right. Note the RF output meter at top right.



OPERATION on the 70 cm amateur band (420-450 MHz) has grown considerably in popularity over the past decade, with the principal activity lying between 432 MHz and 440 MHz; SSB (and a little CW) operation between 432 and 433 MHz, and FM operation (much of it mobile using repeaters) above that.

One thing you learn very quickly about working on 70 cm and that is there's no substitute for power — whether it be plain old brute force RF or effective radiated power from a gain antenna. With mobile operation, there's a physical limit to the size of antenna you can mount on a vehicle, so your range is effectively governed by the amount of RF watts you put 'up the stick'. Hence this project.

Design features

The project provides a typical output of 50 watts for a two watt input drive in the 430-440 MHz portion of the 70 cm UHF amateur band. It is intended for boosting the output of exciters or transceivers ranging from low-powered hand-held units to 10 W transceivers. Performance tests on the prototype indicate a 10 MHz bandwidth at the 0.5 dB points and an overall efficiency of 40%. All harmonics and spurii measured a minimum of 60 dB below the fundamental, while third-order intermodulation (imd) products measured below −35 dB.

Two Mitsubishi RF power devices, a 2SC1968A and a 2SC3102, are cascaded to provide a gain of 14 dB. Both devices are biased in class AB to ensure suitable linearity for SSB operation. A simple diode-drop scheme was chosen to simplify the circuitry and construction. Circuit board transmission line matching techniques were selected for their inherent low loss and ease of reproduction. The output device is capable of withstanding load mismatches of 20:1. Input VSWR is typically less than 1.2:1 and the insertion loss in the bypass mode measured less than 0.9 dB.

The front panel incorporates a power switch, a switchable between-syllable delay for SSB operation and a relative RF output power meter. Two LEDs provide power on and on-air indication. The input and output sockets are mounted on the back panel and an RCA socket provides a switched +12 V output for a masthead preamp. ▶

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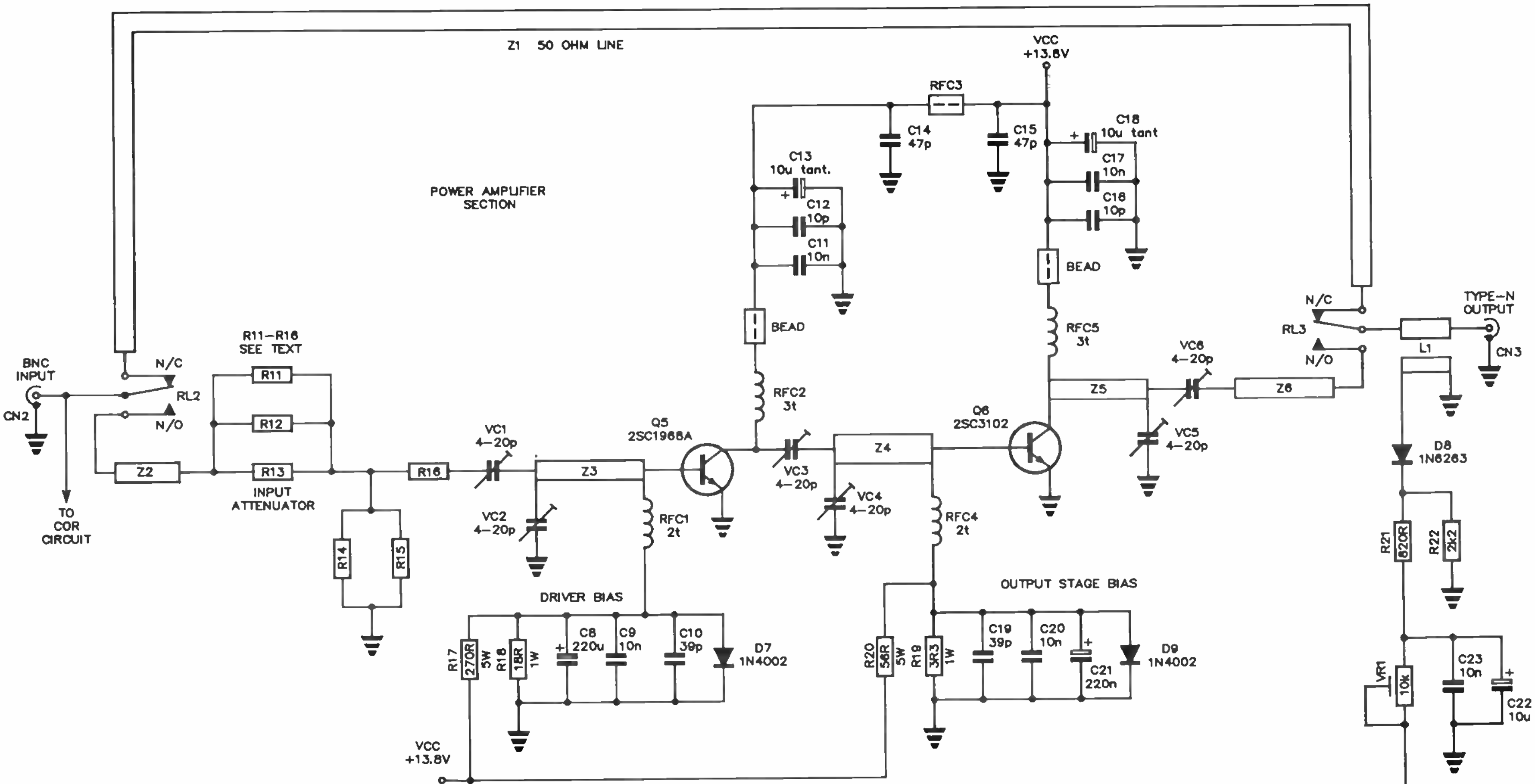


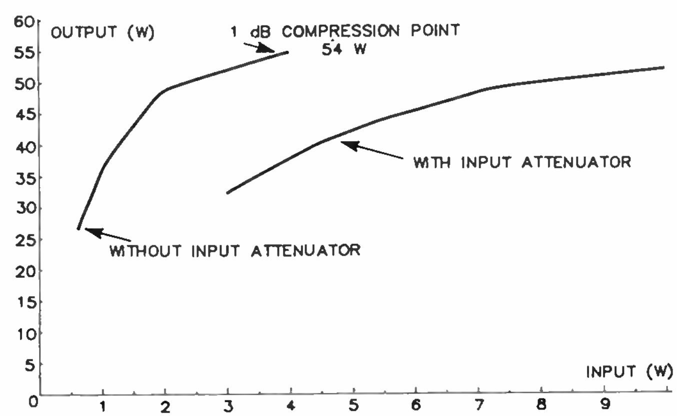
CIRCUIT OPERATION

There are two separate sections to the project's circuitry, the amplifier and the "carrier detect" change-over and protection ('cor')circuit.

THE AMPLIFIER

When the unit is switched off, a transmit signal applied to the input socket is routed to the output via the normally-closed (N/C) contacts of the coaxial relays K2 and K3, and the 50 ohm transmission line Z1. This is the "bypass" condition. On reception, signals from the antenna are passed to the receiver in the opposite direction.

When the unit is switched on, it is in the "standby" mode. An applied input signal is sensed by the carrier detect circuit which energises relays K1 to K3, routing the transmit RF signal to the input of the driver stage, Q5. A length of 50 ohm transmission line on the pc board, Z2, completes the path from the K2 contacts (RL2) to the amplifier input.



The 2SC1968A device has a power gain of about 7.0 dB at 435 MHz when powered from a 13.8 V supply. Assuming a 0.2 dB insertion loss in the matching networks, the second (output) stage will be driven with about 9 W for a 2 W input drive. A typical power gain figure for the 2SC3102 device is 7.5 dB. Again, assuming 0.2 dB losses each in the matching networks and the contacts of K3 (RL3), output will be about 47 W.

On the output, L1 (tracks on the pc board) along with D8, R21, R22, C22 and C23 form a directional coupler to indicate relative power output, driving the front panel metering circuit M1, VR1 and C24.

CARRIER DETECT & CHANGE-OVER

When the unit is turned on, C3 charges to the supply voltage via R2. When you press the microphone button on your transceiver, a small portion of the input RF signal is coupled off via C1 and rectified by diodes D1 and D2. These diodes were selected for their fast switching times. The positive going pulses turn on Q1, discharging C3 and allowing Q3 to conduct. When the current through the potential divider comprised of R7 and R8 exceeds approximately 60 μA Q4 will also turn on, energising relay K1 which supplies dc power to the main amp and the coils of the RF switching relays, K2 and K3. This is the "on-air" mode.

When you release the microphone button, Q1 is biased off by R1 allowing C3 to charge up via R2 when the front panel mode switch is selected for SSB/CW operation (long delay). C3 will be charged up by both R2 and R3 when the mode switch is set for FM operation (short delay). The required SSB delay with these components is about 1.5 seconds. This time can be reduced or lengthened if desired by changing the value of R2.

The turn-off threshold for Q3 is about 9.3 volts for a 13.8 volt rail. So when C103 charges up to about 63% of its final value Q3 and Q4 will turn off releasing the relays K1-K3. The unit is now in the standby condition.

Q2, ZD1, R5 and R6 form an overvoltage sense and shut down circuit. When a supply rail in excess of 17 volts is applied and SW2 is turned on, ZD1 will conduct turning on Q2 and holding Q3 off. Dangerous supply potentials which would have otherwise destroyed Q1 and Q2 from over-dissipation are thus prevented from being switched to these devices.

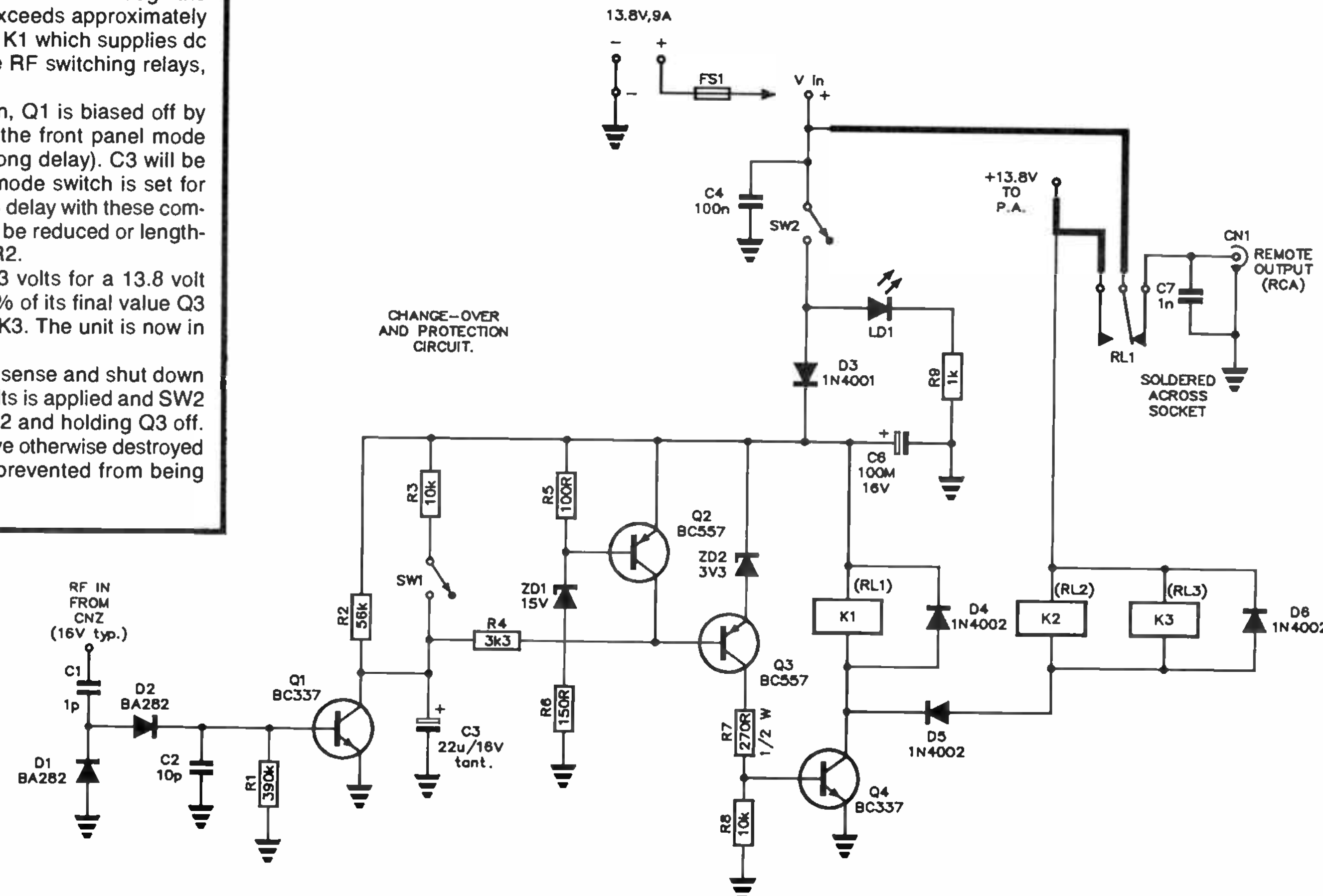
Output power versus input power, with and without an input attenuator. The linear scale exaggerates small non-linearities.

LEVEL

We expect that constructors of an

INTERMEDIATE

level, between beginners and experienced persons, should be able to successfully complete this project.



CHANGE-OVER AND PROTECTION CIRCUIT.

The unit requires a nominal 12-13.8 Vdc supply capable of delivering 10 amps. Thus, it can be readily powered from a vehicle battery for mobile operation or from a common dc 'battery eliminator' bench supply.

Circuit board transmission line matching techniques were used for their inherent low loss and ease of reproduction. In fact, some comment about the matching networks is in order here. If you look at the circuit and the construction, you'll see that 'T-network' matching was used. This method was chosen for several reasons. Firstly, it allows control over the circuit Q which the simpler L-network (commonly seen) does not. Secondly, practical component values are easily realised which means an economical choice of components may be made. A further major advantage is the circuit's ability to match over a wide range of complex impedances, thus providing allowance for normal production variations in transistor parameters and other nominal circuit tolerances.

Construction

All components are mounted on a double-sided pc board measuring 199 mm by 134 mm. This is mounted on a black-anodised finned heatsink measuring 200 mm by 136 mm. The front and rear panels bolt onto the heatsink and an aluminium wrap-around lid completes the assembly.

Before the mounting of components can begin, copper shims are first installed onto the board. Prepare eight pieces of shim so that they are slightly smaller than the rectangular outlines on the pc board overlay and fold them around the Q5 and Q6 transistor cut-outs in the positions indicated on the overlay. The undersides of the shims and the surface of the board should both be lightly tinned to ensure a good low impedance connection.

The holes marked with an X on the component overlay locate the positions where pcb pins are inserted. Solder to both sides of the board and cut the pins flush on both sides of the board. This improves the groundplane connections where large RF currents are present. Insert the other pcb pins at the locations marked with a circle. These are for wiring terminations.

Placement of the components can now begin. Install and solder all resistors. If an attenuator is required, refer to the ATTENUATORS box to calculate the desired resistor values. If an attenuator is not required, prepare two lengths of copper strips as per Diagram 2 and insert in place of the attenuators in the positions marked on the component overlay. Use 1.7 mm diameter tinned copper wire if you feel these are too difficult to construct. This will result in only a slight degradation of the input VSWR.

Note that R1 has to be soldered to both sides of the board and one end of R7 is soldered to the pad on the component side. Resistors R17 to R20 are bent into a U-shape and soldered to the top of the pcb. Leave a 2 mm air gap between the bottom of R17 and R20 and the top of the board to allow for air flow. R21 and R22 are conventionally mounted. Now install VR1.

With the exception of C1-C3, C5-C6, and C22-C24, (which are installed in the conventional manner) all capacitors are mounted on the top-side tracks of the board. Refer to Diagram 1 for the correct preparation and installation method for the disc ceramic capacitors.

The semiconductors can be mounted next. The anode of D1 should be soldered to both sides of the groundplane. The cathode of D3 and the anode of D4 are soldered to both sides of the board. This also applies to the collectors of Q3 and Q4. Diodes D7 and D9 are not installed at this stage. Mount the two front panel switches and the LEDs. The LEDs should ▶

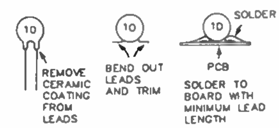


Diagram 1. How the disc ceramic capacitors are prepared and installed.

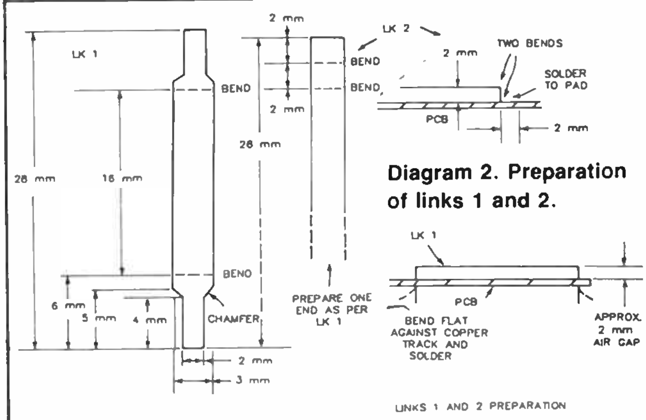


Diagram 2. Preparation of links 1 and 2.

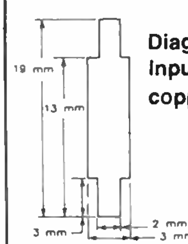


Diagram 3. Input/output copper strip.

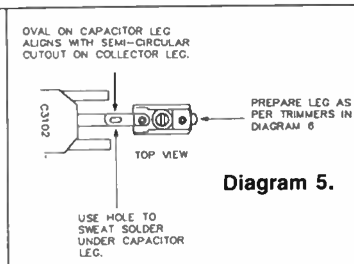


Diagram 5.

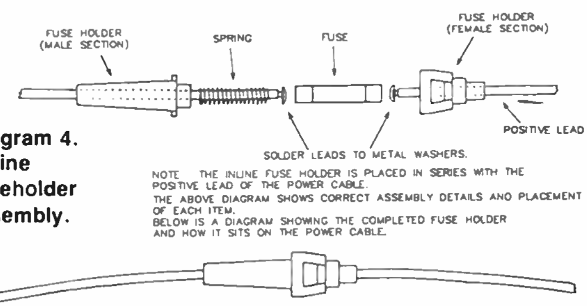
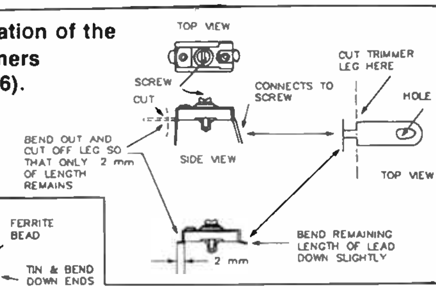


Diagram 4. In-line fuseholder assembly.

Diagram 6. Preparation of the compression trimmers VC3-VC5 (NOT VC6).



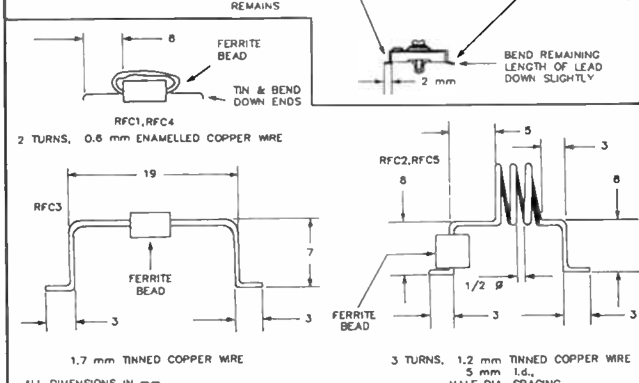


Diagram 8. Coil winding details (RF chokes RFC1-5).

UHF 50 WATT P.A. PARTS LIST

Semiconductors

D1 .... BA282, BA243, BA244
D2-D7 .... 1N4002s
D8 .... 1N6263
D9 .... 1N4002
ZD1 ..... 15 V, 400 mW zener
ZD2 .... 3V3, 1 W zener
LD1 ... TL4213, 5 mm red LED
LD2 . TL4233, 5 mm green LED
Q1 .... BC337
Q2, Q3 .... BC557
Q4 .... BC337
Q5 .... 2SC1968A
Q6 .... 2SC3102

Resistors all 1/4 W, 5% unless noted

R1 .... 390k
R2 .... 56k
R3 .... 10k
R4 .... 3k3
R5 .... 100R
R6 .... 150R
R7 .... 270R, 1/2 W
R8 .... 10k
R9, R10 .... 1k
R11-16 .... see text
R17 .... 270R, 5 W
R18 .... 18R, 1 W
R19 .... 3R3, 1 W
R20 .... 56R, 5 W
R21 .... 820R
R22 .... 2k2

VR1 .... 10k horiz. trimpot

Capacitors

C1 .... 1p disc
C2 .... 10p disc
C3 .... 22µ/16 V tant.
C4 .... 100n disc
C5 .... 1n disc
C6 ..... 100µ/25 V RB electro.
C7 .... 1n disc
C8 ..... 220µ/16 V RT electro.
C9 .... 10n disc
C10 .... 39p disc
C11 .... 10n disc
C12 .... 10p disc
C13 .... 10µ/25 V tant.
C14, C15 .... 47p disc
C16 .... 10p disc
C17 .... 10n disc
C18 .... 10µ/25 V tant.
C19 .... 39p disc
C20 .... 10n disc
C21 .... 220µ/16 V electro.
C22 ..... 10µ/25 V RB electro.
C23 .... 1n disc
C24 .... 10n disc

VC1, VC2 .... 4-20p Murata film trimmers
VC3-VC6 .... 4-20p mica compression trimmers (Sprague GMA-20-200)

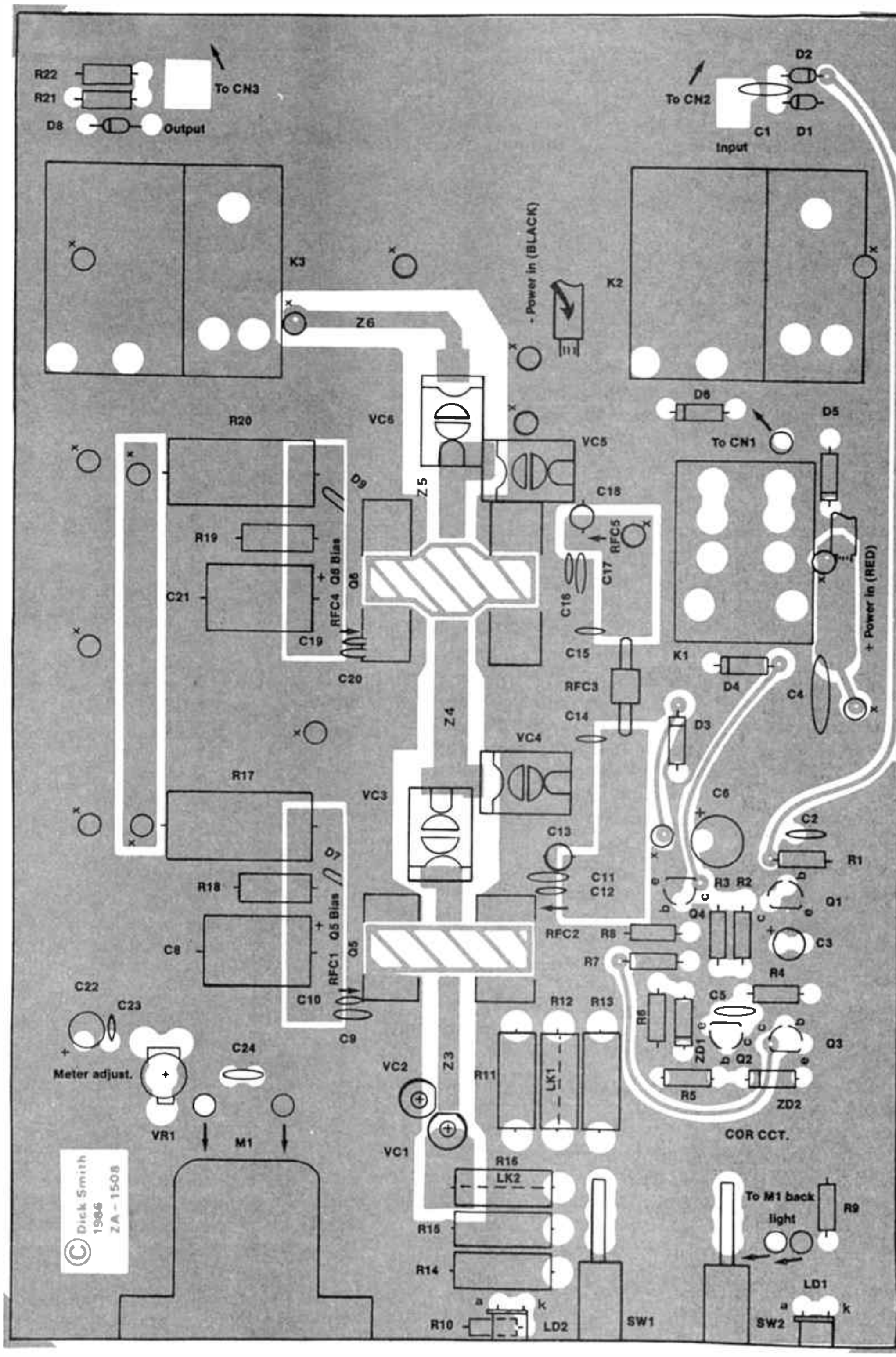


Diagram 7. Component overlay.

Miscellaneous

CN1 .... RCA panel socket
CN2 .... BNC panel socket
CN3 .... Type-N panel socket
FS1 ...... 15 A, 3AD fuse with in-line fuseholder
K1 .... DPDT relay, 10 A contacts, 12 V coil
K2, K3 ... SPDT coaxial relays, 12 V coil
M1 .... 500 µA signal strength meter with backlight
RFC1-5 .... see text

ZA-1508 double-sided pc board; 136 × 200 mm flat-sided heatsink; folded aluminium enclosure with front and rear panels; 50 pc stakes; small piece of copper sheet; four rubber feet; five FX115 ferrite beads; nuts, bolts, washers and screws; coil wire (all tinned copper) — 30 cm of 0.6 mm dia., 1 m of 1.2 mm dia. and 10 cm of 1.7 mm dia.; one metre each of red and black 4 mm dia. power cable; captive-type cable grommet; one cable tie.

Kit price: $279

protrude about 8 mm from the top of the board and are bent at a right-angle to the same centre line as the switches.

Next the power and two coaxial relays can be assembled to the board.

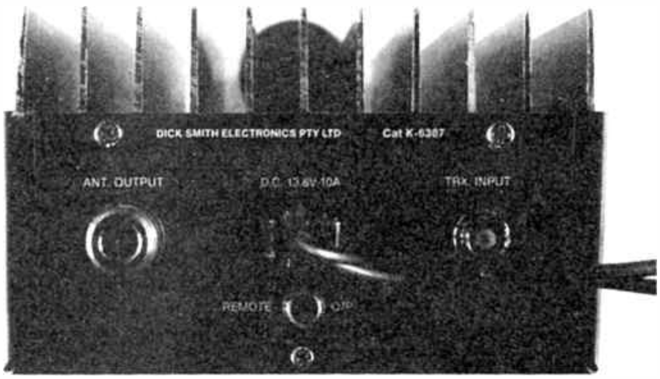
The two Mitsubishi RF devices can be installed next. Particular care and attention must be paid to this next step as these transistors can be mechanically weakened if installed incorrectly. *Lightly* tin the underside of the transistor leads and the area of contact on the pcb. This includes the track which runs from VC6 to the collector of Q6. Place the devices into their respective positions as shown on the component overlay, but do **not** solder them in at this point in time. Put the pcb aside for the moment.

Using only a thin film of thermal compound, coat the two supplied aluminium plates at the areas of contact to the heatsink and transistor bases. Referring to Diagram 9, align the large aluminium plate to the pre-tapped holes on the heatsink. The smaller pre-drilled aluminium plate, 8 mm by 24 mm, is then aligned to the previously positioned plate as per the diagram. The larger plate allows a reasonable spacing between the bottom of the pcb and the top of the heatsink, thus preventing shorts and reducing proximity effects. The smaller rectangular piece offsets Q5 to allow for the difference in thickness (1 mm) between the mounting bases of the two RF devices. Referring to the positions on Diagram 9, locate the four 4BA brass nuts and the washers on the heatsink. There are two flat washers and one shakeproof washer on each of the two hole locations on the aluminium plate. The shakeproof washer goes toward the aluminium, not the pcb.

Carefully place the pcb onto the heatsink-aluminium plate assembly and insert 3 mm machine screws into the 10 hole locations. Screw them in, but do not tighten down down just yet. The board should run parallel to the edge of the heatsink with about 1 mm clearance around the sides and the front. The back of the pcb should be flush with the back of the heatsink. If the board overhangs due to a production tolerance it may be necessary to file the edge until it is flush. Bolt on the front panel and locate the meter on its marked position. The two switches and LEDs should then protrude through their respective holes. If everything is aligned, apply some contact adhesive to the top of the meter and glue in place with the flange of the meter butted against the back of the front panel. Terminate the four wires from the meter to their respective pcb pins.

With everything thus aligned, tighten-down the 10 previously inserted screws, ensuring first that the base and collector leads of Q5 and Q6 are aligned *exactly* to the striplines. The two power transistors should always be bolted down last and slackened off first. This is so that the devices never have to take the full support of the pc board. The transistor connections should lie reasonably flat to the plane of the pcb and not bend up or down. This is important as even a little stress on these devices can lead to their eventual destruction. Note that the emitter connection leads for Q5 clears the copper shims and solder directly to the board while the connections for Q6 solder to the tops of the shims. With a soldering iron, run some solder around the edges of the transistor leads and 'sweat' the connections so that the solder on the underside melts.

The Q6 collector lead and the lead in connection for VC6 (not yet installed) form the transmission line for the output matching network. The copper track which runs from the collector of the output device (Q6) to compression trimmer VC6 is there to give the leads on the transistor and the trimmer something to bond to. Tin this track and sweat the col-



View of the rear panel. Note the "remote" output socket. this provides dc to a masthead preamp if required.

lector lead to the copper surface while avoiding running excessive solder to the actual transistor lead if possible.

The trimmer capacitors are mounted next. Bend the leads out on VC1 and VC2 so that they are flush with the bottom surface and trim about 1.5 mm from the leads. Orientate as per the component overlay and solder in place. Bend and cut the lead connections in three only of the compression trimmers as per Diagram 6. Lightly tin the copper contact areas where the trimmers are to be positioned and solder them in place. The output compression trimmer (VC6) can now be installed. Firstly, prepare the trimmer as per Diagram 5 and tin the pad areas where it is to make contact. Insert the trimmer into the pre-drilled holes. Align the trimmer so that the hole in the uncut leg overlaps the semi-circular cutout on the transistor lead forming an oval. Use this hole to sweat the solder under the capacitor leg, thus avoiding running excessive solder onto the transmission line. Solder the other side of the capacitor to its copper pad.

Coat the tops of Q5 and Q6 with a thin film of silicone grease. Bend D7 and D9 into a U-shape and solder in place across the two transistors. There must be a tight physical connection between the bodies of the diodes and the transistors to ensure good temperature tracking when the unit is in operation.

Prepare the five RF chokes as per Diagram 8 and solder in place. The ferrite beads for RFC1 and RFC4 should be suspended slightly above the groundplane. Use only enough solder to make contact to the transistor connections.

Bolt the three sockets to the back panel. The input and output sockets should be tight enough so that they will not work loose when screwing connection cables on and off. Bolt to the heatsink using 4 mm machine screws.

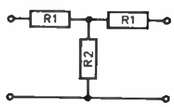
With the pc board and back panel bolted to the heatsink, solder the two boards where they meet at a right angle, ensuring first that the main pcb is properly aligned. If there is a gap between the two boards it may not be possible to do this. If this situation occurs, run a length of tinned copper wire along the gap and bend over at both ends so that it is seated in place, parallel to both boards. It should be easier now to solder the two boards together. The underside of the pcb is also to be soldered to the rear panel, but this will be done at a later stage. Cut off the excess lengths of wire if necessary.

Next, prepare two lengths of 3 mm wide copper shims as per Diagram 3 and bend over at one end. Insert the bent ends into the holes of the input and output sockets and solder in place. Insert the other ends of the copper strips into their respective holes on the main pcb.

INPUT ATTENUATOR

For single sideband operation, the power input to the amplifier should be confined to 1-2 watts to ensure the amplifier maintains linearity. (On-air tests proved however that this could be exceeded somewhat without any reports of noticeable clipping.) This input level is compatible with most handheld/portable transceivers on the market, but the larger base/mobile rigs generally have an output somewhere between four and 10 watts. Six watts was considered a mean figure, so an attenuator to reduce 6 W to 1.5 W was required, a drop of 6 dB.

A "T" configuration was chosen:



Referring to the *ITT Reference Data for Radio Engineers*, the following formulas apply:

$$R1 = Z[1 - 2/(K + 1)]$$

Where Z is the input/output impedance (50 ohms in this case),

$$K = \sqrt{(Pout/Pin)} = \sqrt{(6/1.5)} = \sqrt{4} = 2$$

therefore,

$$R1 = 50[1 - 2/(2 + 1)] = 50[1 - 2/3] = 50/3 = 16.6 \text{ ohms}$$

and,

$$R2 = 2ZK/(K^2 - 1) = 2 \times 50 \times 2/(4 - 1) = 200/3 = 66.6 \text{ ohms}$$

This gave the basis for some good ballpark figures and after some trial and error, the following values were chosen:

R11 to R13 = 39 ohms each (13 ohms results)
R14, R15 = 150 ohms (75 ohms results)
R16 = 12 ohms

Standard 1 W resistors are quite unsuitable at this frequency owing to their high self inductance and stray resonance effects. Thus, Allen-Bradley hot-moulded carbon composition resistors were chosen for their inherent low self-reactance.

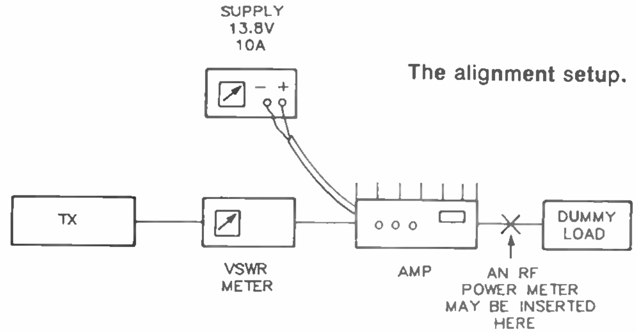
As can be seen from the foregoing, the actual values come reasonably close to the calculated values.

Strip 10 mm of insulation from the ends of the red and black power cables then cut in the in-line fuseholder. (Refer to Diagram 4 for the correct preparation of the fuse holder assembly). Solder the leads to their indicated locations. Feed the power cables through the remaining hole in the back panel and retain using the captive grommet. Run a length of small gauge cable parallel to the red power cable. Terminate the ends of the smaller gauge cable to the RCA socket and the pcb pin. Solder C7 across the back of the RCA socket.

Remove the pcb/back panel from the heatsink and tie the three cables to the pc board with a cable tie.

Looking at the board from the bottom this time, solder to the back panel as previously outlined for the top of the board. The lugs which protrude through the pcb on VC4 and VC5 can also be soldered to the board, as well as the copper strip connections for the input/output sockets. This would be a good time to give the pcb a final inspection.

Reinstall the pcb to the heatsink, tightening down the transistor screws last. Bolt the front panel on and the unit is ready for powering up and alignment.



The alignment setup.

Power-up and alignment

The following equipment is required to align the power amplifier:

- 12-13.8 Vdc 10 A power supply with current metering,
- UHF power/SWR meter, rated to 50 W or greater,
- 430 MHz-440 MHz exciter, adjustable from 0.5 W to 3 W,
- A 50 ohm dummy load,
- A multimeter, and
- A non-ferrous alignment tool.

Connect the amplifier to a supply voltage that will eventually be used to power the unit. The supply range is between +12 V and +13.8 V. Switch on. The relays should pull in momentarily and the current drain should be about 50 mA. The idle current of the two RF devices will be checked first. With an alligator clip, short the anode of D4 to ground so that the relays pull in. The amplifier should draw 500 mA. Remove power.

Desolder and lift one end of the two dc feed chokes, RFC2 and RFC5, and insert a current meter in series with Q5's collector and its choke. The optimum quiescent collector current for the 2SC1968A operating in class AB is nominally 20 mA. Owing to h_{FE} variations of the transistors, this may not be the reading obtained. In this situation it may be necessary to adjust the ratio of R17 to R18. R17 may be increased or decreased to optimise the idle current. If the power dissipation of the PW5 resistor is exceeded it will be necessary to parallel values by "stacking" resistors on top of each other. The optimum collector idle current for the 2SC3102 device (Q6) is nominally 150–200 mA. Adjust idle current as previously outlined for Q5.

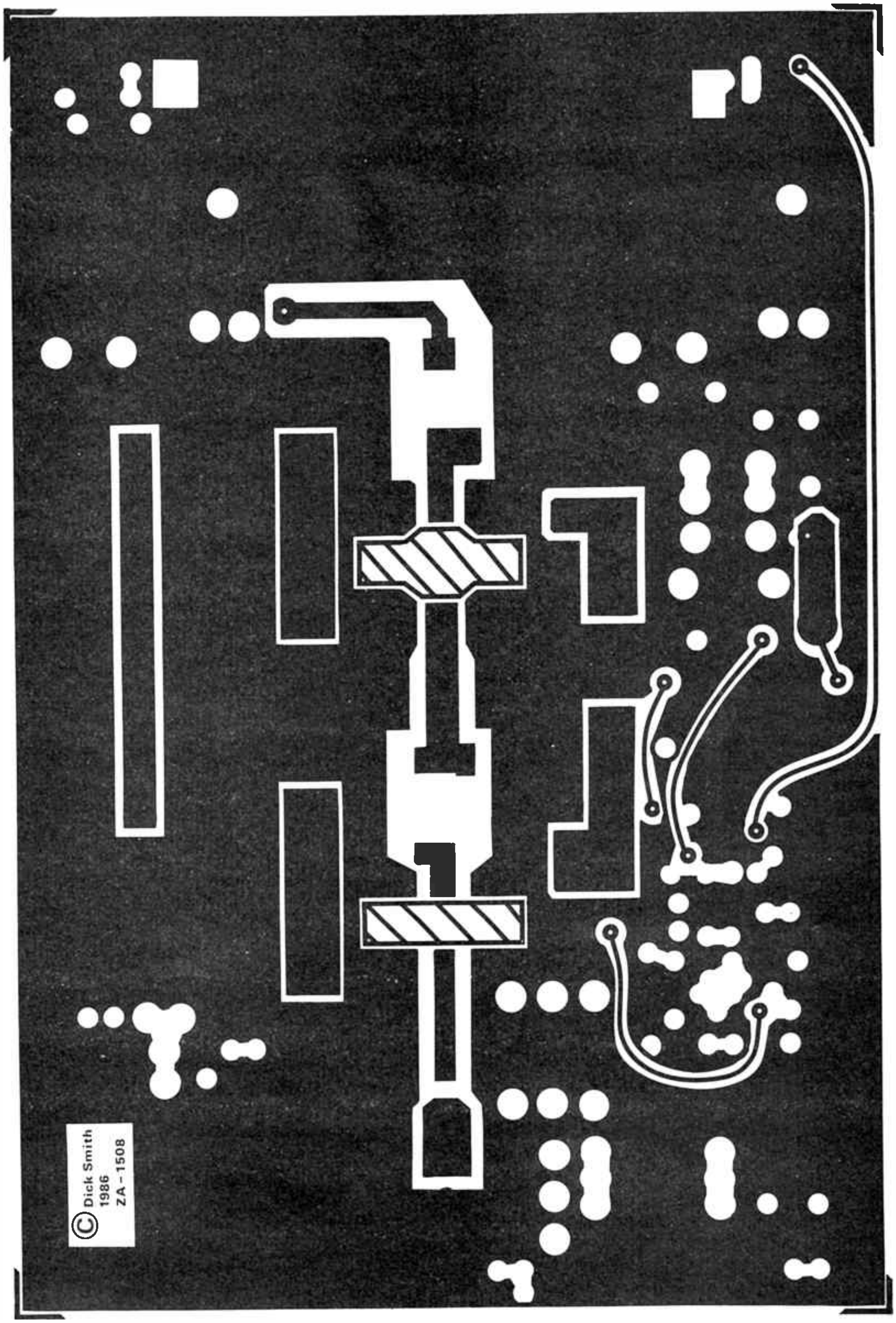
Reconnect the two feed chokes and alignment can begin.

It is desirable to begin tuning the amplifier with as low an input drive as possible and with reduced supply voltage. This is to reduce the possibility of damaging the transistors by operating at high power levels into a mis-matched load.

Connect a dummy load and power meter (if obtainable) to the output. If obtaining a suitable power meter is not practical, the RF power meter incorporated on the front panel is perfectly suitable for tuning the output power. Connect a suitable exciter and a VSWR meter to the input. Adjust VC1 and VC2 to mid-position and the four compression trimmers to about a quarter turn from tight. Apply an input drive level of between 0.5 W to 1 W and observe the input current. If the relays do not trip with this low level of input, enable the COR circuit by shorting the anode of D4 to ground. Adjust VC1 and VC2 for minimum input SWR. The unit should begin to draw some current at this stage. Peak VC5 and VC6 for maximum output power. VC3 and VC4 can now be adjusted for peak output power. The unit should now draw several amps. ▶

Because admittances are reflected back to the input circuit when tuning it will be necessary to re-align the trimmers a few times for maximum output power and minimum input SWR, tuning VC1 and VC2 first and the output trimmers last. Assuming an input drive of about 1 W, the unit should draw about 7-8 amps and the output should be about 35 W.

Apply the desired drive level (2-3 W max. on SSB, 5 W max. on FM) and again peak the trimmers for maximum output and minimum input SWR. The amp should now output 50 W and draw 9 A. VC5 and VC6 are the critical components for obtaining maximum efficiency. Maximum efficiency is achieved by tuning for maximum RF output and minimum input current and is typically 40%. This can be calculated from the following formula:

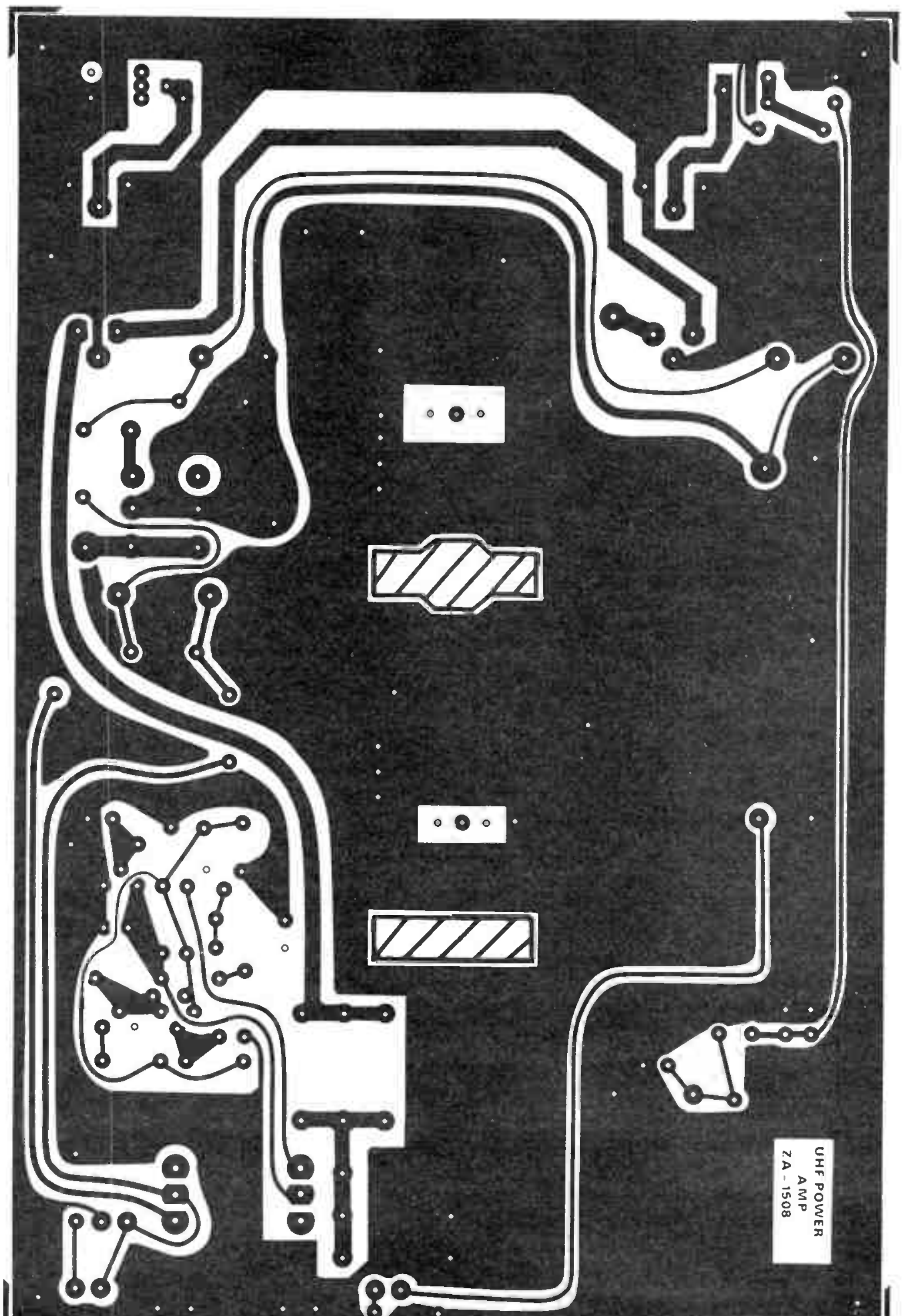


$$\text{eff. (\%)} = \frac{P_{out}}{(V_{CC} \times I) + P_{in}\,(\text{drive})} \times 100$$

The temperature of the two input trimmers, VC1 and VC2 should be checked by feeling their cases to ensure the input is not being over driven. Very little heat should be felt. Another indication of over-dissipation is that the trimmer tuning screws will begin to stiffen after a short period.

This completes the alignment procedure. Bolt the cover to the heatsink, attach the four rubber feet and the amplifier is ready for on-air testing. **DIAGRAM 9 is on page 110**

This month's ★ Star Project ★ is from Dick Smith Electronics who will be marketing kits through their stores and dealers; cat. no. K6307, $179. Mail order enquiries to PO Box 321, North Ryde 2113 NSW. (02) 888 3200.



WINNERS OF OUR 1ST BIRTHDAY CONTESTS

Our five 1st Birthday Contests, run over the July, August and September issues, proved quite popular and it was no mean task in most instances sorting out the winners. Thanks one and all for your efforts, it's a pity we couldn't actually award extra prizes for some of the efforts submitted that didn't win. Don't lose hope, though. We've more super contests planned for 1987!

CONTEST NO.1

Prize: –A fabulous Philips 54 cm colour stereo TV, model CH 285.

The winner: Michael Springett of Lower Mitcham, SA.

Congratulations Michael, from *AEM* and Philips Consumer Products. May you enjoy the delights of this Australian designed and manufactured stereo TV for years to come.

And the answers were:

Q1: A. A. Campbell-Swinton, V. K. Zworykin and Alan Blumlein were instrumental in the development of TV with stereo sound.

Q2: Dual-sound channel TV for Australia was announced in December 1983.

Q3: The first stereo TV set designed and manufactured in Australia was the Philips KS683.

Q4: Philips' promotional theme for their stereo TV revolves around the word "imagine."

CONTEST NO. 2

Prize: The new Philips microprocessor-controlled 50 MHz dual-trace CRO, model PM3050.

The winner: Bruno Celotto, Carlton Vic.

Bruno, congratulations from *AEM* and Philips Scientific & Industrial Division. Undoubtedly you'll be able to make great use of this fantastic instrument for many years.

The answers were:

Q1: Karl Ferdinand Braun described the basic oscilloscope system in 1897.

Q2: O. S. Puckle developed the hard valve timebase in 1933.

Q3: The worst-case rise time PM3050's vertical amps is >10 ns/div.

Q4: The significan option that allows use of the PM3050 in an automated system is the IEEE-488 interface.

CONTEST NO. 3

Prize: A Multitech Popular 500 System 1 computer from Dick Smith Electronics and a 1200 bps Racal-Vadic Maxwell Modem.

The winner: Catherine Foley, St Ives NSW.

Congratulations on a great entry Catherine, from AEM, Dick Smith Electronics and Racal.

The answers were:

Q1: Lord Byron and Lady Ada Lovelace were the poet and the princess of parallellograms.

Q2: Lady Lovelace wrote programs for Babbage's computing machine and the ADA langauge was named after her.

Q3: Modem is a contraction of modulator/demodulator.

Q4: The System 1 Multitech is supplied with MS-DOS 2.11.

Q5: Racal is an active participant in the International Telegraph and Telephone Consultative Committee (CCITT).

CONTEST NO. 4

Prize: An Ersa Temperature-controlled soldering station with two irons, model MS1500 from Meltec Pty Ltd.

The winner: Alan Denby, Epping NSW.

Congratulations Alan, from *AEM* and Meltec. You were the only contestant to get Q2 correct!

The answers:

Q1: Ersa, in 1921, first applied for a patent on an electrically-heated soldering iron.

Q2: 60/40 solder is NOT a eutectic alloy! Thus, it doesn't have a eutectic point temperature.

Q3: Zero-crossing power control avoids switching spike problems.

CONTEST NO. 5

Prize: Regency HX1000 handheld scanner from Emtronics.

The winner: Marek Kujat VK4ZKM, Herston Qld.

Congratulations to you Marek, from *AEM* and Emtronics, on an imaginative entry.

The answers:

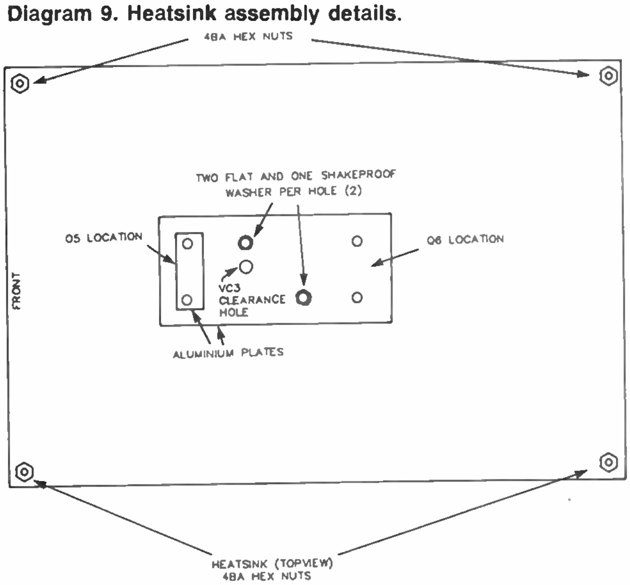
Q1: The frequency limits of the UHF CRS band are 476.425 MHz and 477.400 MHz.

Q2: The search frequency increments of the HX1000 on VHF and UHF are 5 kHz and 12.5 kHz, respectively.

Q3: SINAD stands for "signal, noise and distortion."

aem star project

Diagram 9. Heatsink assembly details.



— from page 32

Setting up

Set all presets to mid-point. Set the Resonance control and Input Mix to minimum. Set Tune to half-way. Mode switches SW1 and SW2 are set to highpass, and with the Slope switch set to 24 dB/octave and no signal plugged in; the voltage at pin 7 of IC2/A is set to approximately +6.9 volts with RV9. Check the voltage on pin 6 of IC1 and reset RV9 to the same. Fine tuning this offset is made easier by setting the voltmeter to the lowest dc range, and setting for zero volts between pin 7 of IC2/A and pin 6 of IC1.

Now listen to the output of the VCF and plug a high frequency sine tone from a VCO into the Freq. CV Input, with no attenuation. It should be more or less audible. Now simply adjust RV7 to minimise this tone. Switch SW1 and SW2 to lowpass mode, plug the VCO signal into the Resonance CV Input, and turn up the Resonance to half-way. Turn up the Tune control until the VCO tone is clearly audible. Adjust RVS to minimise the tone. This completes the VCF setting-up for now, as the scale adjustment RV6 can be set for 1 V/octave when the VCOs are set from the completed keyboard. It will be close enough for now. Check that the VCF actually operates as a lowpass and highpass filter, and that the various other facilities work as described previously.

Except for checking the overload function, there is little to go wrong in the mixer. Connect +15 volts to one of the inputs, set the Master Gain to maximum, and slowly advance the input gain until the Overload LED lights. This should happen with about +5.4 volts on pin 7 of IC1/B.

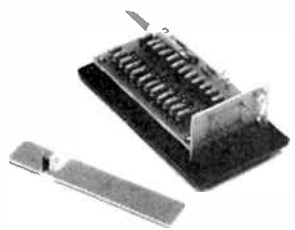
Check the noise source by listening to the White Noise output. You will not hear anything for 10-15 seconds until the dc levels are established in the circuit. This is quite normal. Having ascertained the presence of white and red noise, and a low rumble at the Random Voltage output, (with the Random Tune at maximum), check the ac level at the White Noise output. It should vary between about 0.5-0.7 volts RMS. If it is less than 0.5 volts at any time, try a lower value for Rx, which should be 1M before any testing. Do no try a higher value for Rx unless the output goes significantly higher than 0.8 volts.

With these modules working correctly, you can now begin to explore a great range of timbres and textures, enough to keep you going until the next part of this series at least!

Curtis Electromusic Specialties ICs are available in Australia through Chris Short of NRG Keyboards & Computers. 135 Rae St, North Fitzroy 3058 Vic. (03) 481 8995.

AEM PRINTED CIRCUIT SERVICE

Our printed circuit boards are all manufactured on quality fibreglass substrate and feature rolled-tin over copper tracks and silk-screened component overlays.



5501 NEG-ION GENERATOR
Clear the air! Our negative ion generator provides around 8 kV output Simple and low-cost. (Sept. '85)
$18.35

AEM1500 METRONOME
A simple, low-cost project with variable beat from 'presto' to 'largo'. Operates from 9 V battery. (Aug. '85)
$4.70

AEM3500 LISTENING POST
Our most popular project, by far! It decodes the audio from a SW receiver and, with software, allows your computer (Apple II/BBC/C64/Microbee) to decode RTTY, FAX and Morse. (July '85)
$12.20

AEM6500 MOSFET AMP MODULE
A 'universal' amp module using the Hitachi MOSFETs and able to deliver 60 W with one pair or 120 W with two, into 8 ohms. (July '85)
$9.70

6504 POWER AMP STATUS MON.
This project prevents dc fault conditions or excessive clipping from exterminating amps and speakers alike. Handles amps up to 300 W and powers from the amp's supply rails (Aug. '86)
$19.40

5505 MAINS FILTER
This project, dubbed the "Hash Harrier", is a truly effective mains filter that copes with both common mode and differential mode noise, including spikes. It is rated for loads totalling up to 5 A. (April '86)
$26.00

2600 PEAK RF POWER METER
This simple, low-cost project features a 10-LED bar display and can be made for power ranges from 5 W peak to 400 W peak. (April '86)
$10.50

2500 AUDIO OSCILLATOR
A simple sine/square signal generator for the bench. It covers to 100 kHz and has output amplitude ranges from 30 mV to 3 V, fully variable. Separate sine and square outputs. (Dec. '85)
$9.65

6010 ULTRA-FIDELITY PREAMP
The 'digital era' preamp, featuring low-level cartridge input, CD input, two tuner inputs and one aux. input. There are four boards in the set — 6010LL (cartridge pre-preamp), 6010f, 6010r and 6010ma — the front, rear and main boards. (Oct-Nov-Dec. '85).
6010LL — $19.10
6010f — $16.40
6010r — $16.40
6010ma — $23.10
Set of four $74.90

5502 MICROWAVE OVEN LEAKAGE DETECTOR
Anyone who owns a microwave oven needs one of these! Simple to build and low cost. (Dec. '85)
$9.15

6503 ACTIVE CROSSOVER
Here's a high performance four channel (use as many as you need) active crossover that's just right for that active speaker project! (Feb. '86)
$34.40

5504 ELECTROMYOGRAM
This is a 'muscle activity' monitor, sensitive enough to detect muscle activity that cannot be detected by eye. Can be used for relaxation training, biofeedback, migraine relief etc. (Mar. '86)
$15.90

4600 DUAL-SPEED MODEM
A great little modem that provides 300/300 baud full duplex and 1200/75 half duplex operating modes at the flick of a switch. It features simple RS232 interfacing. (Dec. '85, 7910 data sheet, same issue)
$33.70, or $15.00 (faulty tracks, no overlay)

6102 2-WAY CROSSOVER
Crossover board for our popular 2-ways using the Vifa drivers. (Aug. '85)
$21.75

5503 BED-WET-ECTOR
This is a simple, safe battery-operated alarm that may be used to help overcome bed-wetting problems. (Mar. '86)
$9.20

4610 SUPERMODEM
An intelligent modem with Hayes-compatible command set, for any computer with a serial port. It is capable of all V.21 and V.23 modes and features an expansion bus for later add-ons. Price includes necessary EPROM with resident software. (Apr-Aug. '86)
$139.00

4505 CODE-TO-SPEECH SYNTH.
Taking ASCII text input from a serial port, Centronics port or IBM slot, this versatile project will 'speak' text files. Double-sided, thru-hole plated board (June-July '86)
$55.00

4504 LOW-COST SPEECH SYNTHESISER
This simple to build project employs the GI speech chip SPO256-AL2 which allows you to put together 'word parts' to make electronic speech. It employs 8-bit parallel interfacing. ('Bee interface — Feb. '86, with data sheet; C64 interface — July '86)
$17.30

3502 SIGNAL-OPERATED CASSETTE CONTROLLER
Just the thing for taping signals picked up on your SW receiver or scanner while you can't attend. Simple to build, powers from 10-15 V. (Mar. '86)
$9.20

4501 8-CHANNEL RELAY INTERFACE FOR COMPUTERS
Get your comptuter to control something! Hooks up to 8-bit parallel port or data bus. ('Bee — Oct. '85, C64 — Sept. '86).
$13.00

6501 4-INPUT MIXER
A versatile mixer/preamp for a guitar amp or stage amp. Select resistors to select the input impedance of the channels (Sept. '85)
$20.40

4502 REAL TIME CLOCK
This project plugs into the Microbee's parallel port and gives accurate date/time etc. Battery-backed. (Nov. '85)
$10.50

8500 VEHICLE COURTESY LIGHT EXTENDER
Don't get caught in the dark! This project 'holds' your vehicle's courtesy light on for some 30 seconds after you leave or enter it. (Nov. '85)
$9.90

4500 MICROTRAINER
Take the mystery out of micros. A great project for learning the 'guts' of microprocessing, without having to build a microcomputer. (Sept. '85)
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6000 ULTRA-FIDELITY POWER AMP
A low-distortion amp module that delivers over 200 W into 8 ohms, featuring the high power 2SK176/2SJ56 Hitachi MOSFET output devices. (June-July '86, data sheet in June).
$31.20

9501 DUAL-RAIL SUPPLY
A utility power supply module that can deliver dual rails from 2.6 V to 26 V at currents up to 560 mA — depending on choice of 5 VA pc-mount power tranny. (Aug. '86)
$19.30

9500 BEAT-TRIGGERED STROBE
Just the thing for discos and parties! Project can act as a manually variable strobe or, coupled to an audio source, flash in time with the beat. (July '85)
$11.30

ELEKTOR BOARDS

86090 SERIAL DIGITISER
The project can attach to any computer sporting an RS232 port and features one to eight multiplexed analogue input channels, conversion time less than half ms, variable ref. voltage to 4 V and modular construction. The main board is 86090-1, input boards (up to four) are 86090-2. (Oct. '86)
$21.10 — 86090-1
$6.40 — 86090-2 each

86086 HEADPHONE AMP
Featuring the TEA2025 stereo amp chip, this project has ample output for headphones from 30 to 600 ohms. Uses a 12 V supply. (Oct. '86)
$15.50

86016 SATELLITE SPEAKERS
This is the crossover board for a set of two-ways featuring the Dynaudio 17W75 and D-28AF drivers. (Oct. '86)
$8.35

86041 SPEAKER Z-METER
This simple instrument measures the resistance and inductive reactance of woofers and 'wide-range' drivers with a range to 18 ohms resistive and 5 ohms reactive. (Oct. '86)
$17.60

86002 BATTERY CHARGER
This dc-operated battery charger is designed to charge 9, 12 or 15 volt NiCads from a 12 V car battery. (Oct. '86)
$15.75

86462 RMS-TO-DC CONVERTER
A great add-on for your multimeter. It features a response to 100 kHz above 1 V input, 6 kHz at levels below 100 mV. A x1 and x10 attenuator is included. Needs supply of 5-15 V. (Oct. '86)
$3.25

86490 RODENT DETERRENT
An ultrasonic 'screamer' to annoy rats, mice and maybe even cockroaches. Simple, cheap. (Oct. '86)
$4.65

85000 RF BOARD
A 'universal' RF board employed in the "RF Circuit Design" series. It has an array of pads, a set of three supply rails and a large groundplane. (Oct. '86)
$8.00

86453 HEART MONITOR
This low-cost project senses heart beat by placing your finger on an optosensor, providing an audible 'pip' output. (Oct. '86)
$5.40

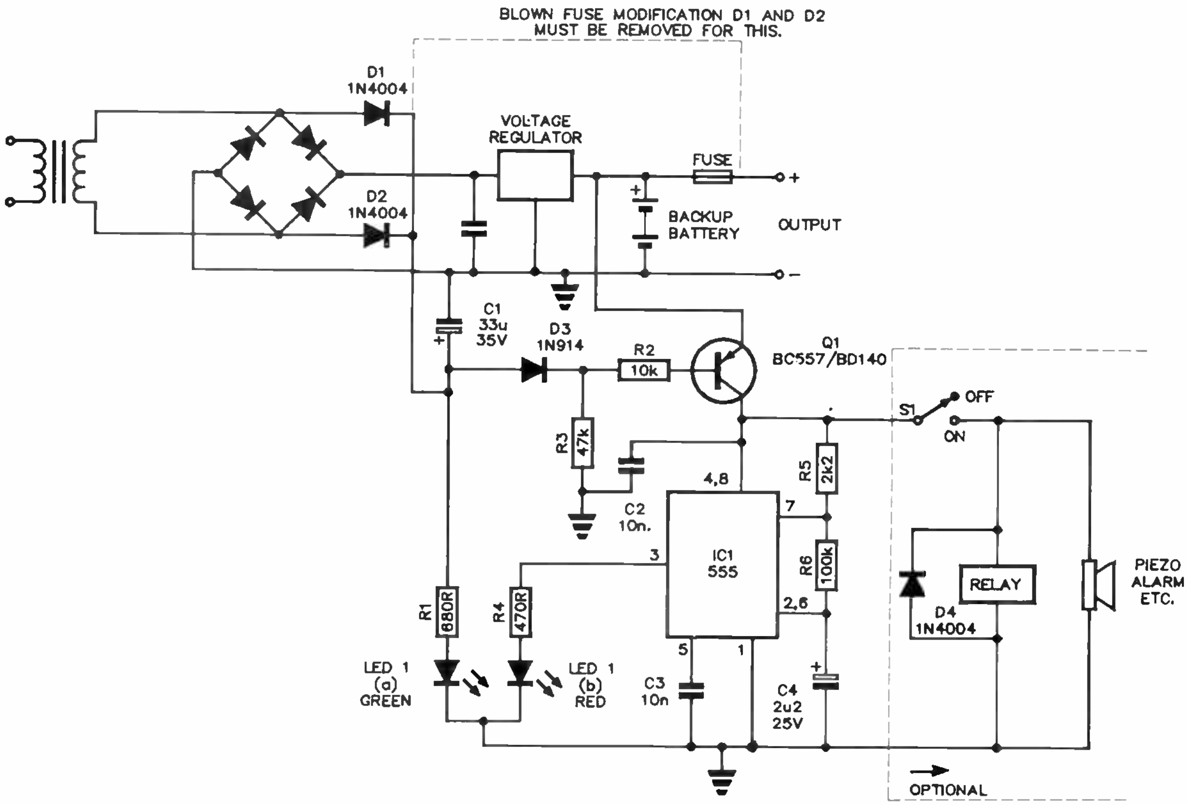
HOW TO ORDER

Order pc boards by the project number and title • All prices include post and handling • New Zealand purchasers add $1.00 to these prices • Photostats of the pertinent articles cost $4.00 each, post paid • With out-of-stock boards there may be a delay in delivery.

All cheques or money orders should be made payable to Australian Electronics Monthly.

Australian Electronics Monthly, PO Box 289 WAHROONGA, 2076 NSW (02) 487 2700.

You can buy the boards at our offices if you wish, at any time during business hours. We're located at the Fox Valley Centre, Cnr Fox Valley Rd and Kiogle St, Wahroonga NSW. The entrance is in Kiogle St.



Mains failure indicator for battery-backed supply

The circuit shown here has numerous applications where an ac power supply is used in conjunction with a storage battery to provide a constant dc source such as for alarms, communication equipment etc.

It is very important that any disruption to the supply is brought to the operator's attention as quickly as possible. The ac supply may be interrupted by something as simple as the accidental turning off of a switch, knocking out of plugs etc, which may pass unnoticed while the backup operates.

LEDs have become the universal indicating device but can easily be overlooked even when showing a fault condition as both green and red LEDs are used to indicate normal operation. If, under fault conditions the LED flashes, the attention of the operator is immediatelv attracted.

For some time now dual-colour LEDs have been available but have not been extensively used. Two LEDs are housed in a single bezel which occupies no more panel space than a single LED. The circuitry described here is arranged so that under normal operation the green LED glows continuously but when the ac source fails the green LED is extinguished and replaced by a flashing red LED.

The circuit works as follows: D1, D2 and C1 provide a filtered supply (which is isolated from the main input filter capacitor) to operated LED 1(a) via R1. This supply also feeds a positive voltage to the base of Q1 via D3 and R2 and prevents Q1 from conducting.

If the ac supply fails, C1 discharges almost immediately and the base of Q1 is then grounded through R3 allowing Q1 to conduct and IC1 to operate. D3 prevents the base of Q1 grounding through R1 and LED1(a). IC1 is arranged in a very basic astable circuit to flash LED1(b) from its output via R4. The flash rate is controlled by R6 and C4 which may be varied if desired.

Provision has been made for additional devices to be operated via Q1 and S1 in case audible indication (e.g: piezo devices), relay-operated alarms etc are required. Q1 should be changed to a BD140 for this operation as the BC557 may not be able to carry the required current.

Capacitors C2 and C3 should be included as noise generated by IC1 may interfere with associated equipmment. If a relay is used to switch external equipment, D4 must be included to suppress back-EMF. The values for R1 and R2 should be calculated to suit the actual voltage as measured at C1 and pin 3 of IC1, respectively. The formula for this is (r = [E-1.5 × 1000]/25).

Do not use the CMOS version of the 555 timer for this application as the output current is limited to 10 mA, which is inadequate. Any supply voltage between 5 and 15 Volts may be used with suitable recalculation of the values for R1 and R4.

Much simpler circuits were tried using a flashing LED in series with LED 1(b), but proved unsatisfactory. Flashing LEDs are quite good devices but require protective circuitry in case of over voltage and are easily damaged. The 555 flashing circuit is much more rugged and has the advantage of being able to vary the flash rate easily if needed.

The same circuit can be used as a blown fuse indicator by deleting D1 and D2 and connecting the junction of C1 and D3 to the output side of the fuse. While the fuse remains intact LED 1(a) is on and Q1 is held off. When the fuse blows the positive base voltage to Q1 is removed and Q1 conducts in the normal manner.

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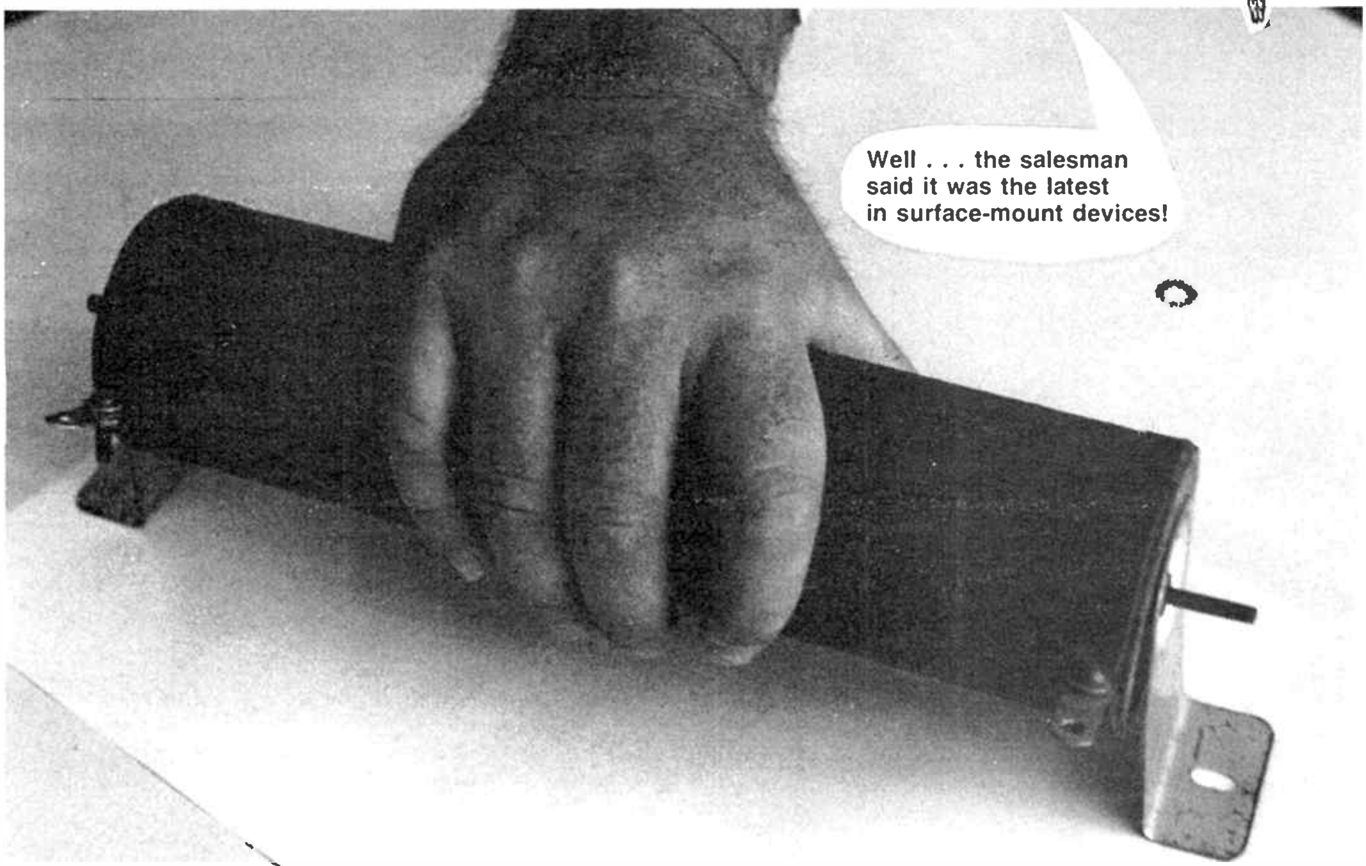
The Last Laugh



INVENTORS lead a precarious existence. Many wait for that 'one good idea' to take off and make a fortune, meanwhile tinkering with prototype after prototype of ever-new, ever-bright ideas, never finishing one project before moving onto the next three — after the methodology of Edison.

We learned recently, via a story in an obscure journal, of a certain Japanese inventor, a prolific fellow who had to invent at least one thing each day or feel wholly unsatisfied. He had achieved some moderate success as an inventor, having licensed the production of some 20 or so of his inventions, the royalties from which kept him in a manner all inventors dream of achieving, but rarely do.

This fellow's latest invention had gained him a litle notoriety. It was a device to keep drivers awake on long, tiring journeys. It consisted of a headband in which was embedded some sophisticated miniature electronics. Using a special switch sensor, it detected when the driver 'nodded-off' and sounded a small beeper to re-awaken them, the beeper turning off when the driver's head assumed the vertical position again.

Initial tests showed it to work quite effectively and so a quantity were manufactured and released on the market through retail stores, specialist car accessory retailers and petrol stations. Sales were keen and users enthusiastic. However, after a period a strange psycho-acoustic phenomena showed up that pretty well rendered the gadget useless.

People 'got used to' the beeper and ignored it when they nodded off — with the occasional dire consequences. It's rather like getting used to the sound of your alarm clock. The manufacturer prudently withdrew the product from the market and the inventor was sent back to the drawing board.

This was the point where our obscure journal came onto the scene. They found the inventor had just devised a new 'wake-up' for his anti-nod-off device. This time, when the wearer nodded-off it applied a small electrical jolt to the nerves at the base of the skull where the neck joins it. The effect, apart from jolting the person awake — not too violently, mind you, but enought to make one fully alert — is one that you never get used to, hence you can't learn to ignore it.

The inventor had not sent the now refined device back to the manufacturer, as he'd thought of a new refinement — an infrared remote control unit for it.

Now wait just a minute! Before you scoff too hard, just consider the huge variety of applications our inventor foretold.

University lectures. The faculty would make it mandatory to wear anti-nod-off headbands. The lecturers would be issued with infrared remote control handsets. Once a certain percentage of the class had nodded-off, the lecturer could call the whole theatre to attention by simply pressing a button!

Press conferences. It would be madatory for journalists to wear one to gain entry (otherwise, no story). As the product presenter droned on and on about the interminable and most unique virtues and features of the product, the chairman could awake the throng from their boozy stupor with one press of that diabolical button. We believe the Australian Journalists Association is negotiating a special award rate for journalists who must attend press conferences.

In parliament. The speaker has a button installed on the arm of the speaker's chair for the remote control handset! Also useful for calling quoroms.

I must say, we liked the last one the most!

Picture and hairy paw courtesy of Andrew Frolley of All Electronic Components.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