★ Build EA's new high energy electric fence ★

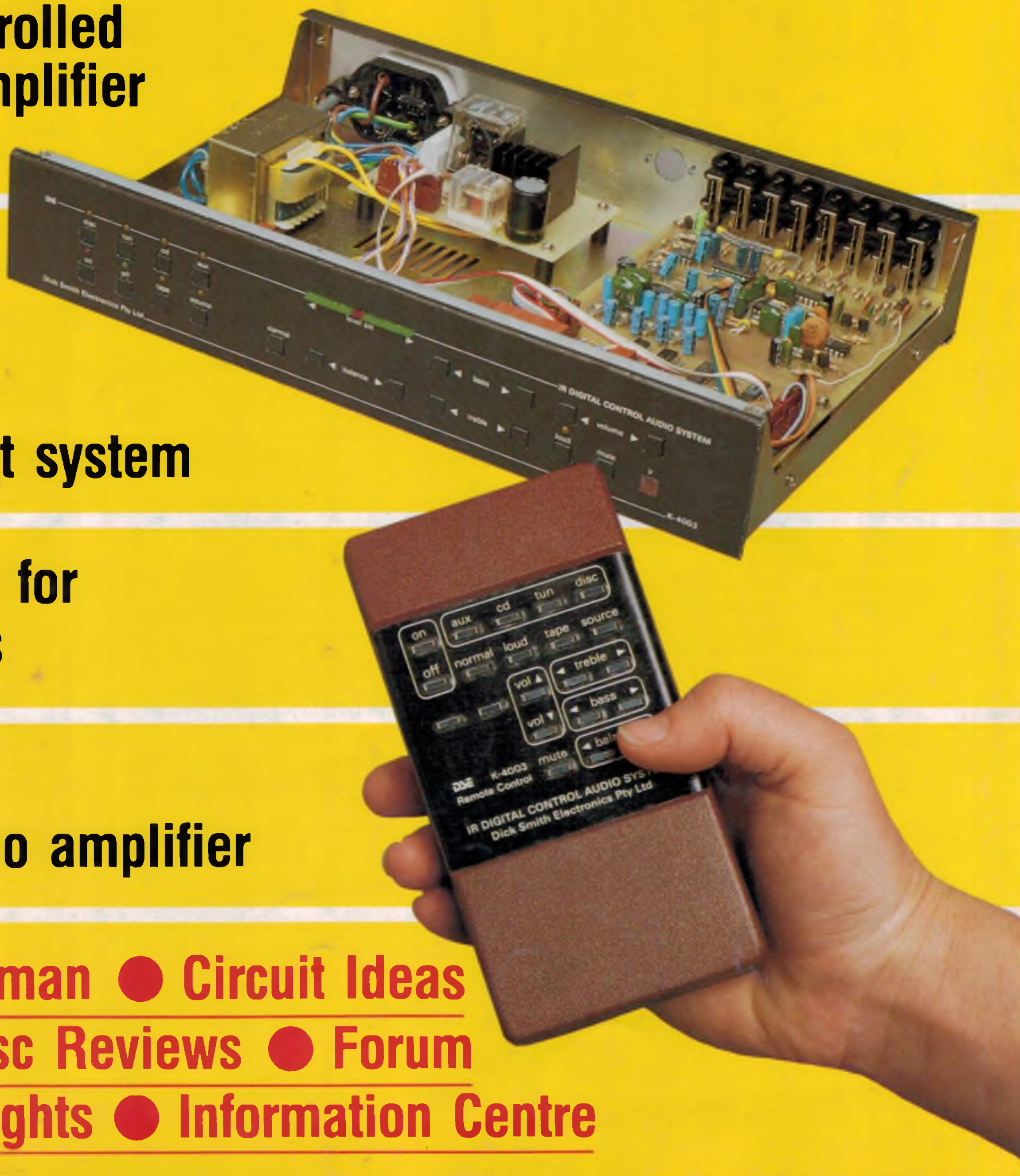
Registered by Australia Post — publication No. NBP 0240

Australia's Top Selling Electronics Magazine

Electronics Australia

OCTOBER 1986
Aust* $2.95
NZ $3.95 incl. GST

★ **Build this remote-controlled audio preamplifier**



★ **Win a $10,000 TI computer development system**

★ **Bright ideas for solar panels**

★ **Review: Denon stereo amplifier**

● The Serviceman ● Circuit Ideas
● Compact Disc Reviews ● Forum
● News Highlights ● Information Centre

New IC-R7000

Introducing a Professional Scanning Receiver at an Affordable Price.

25-1000 MHz Plus! frequency coverage

(no additional module required for coverage to approx. 2.0 GHz.)

ICOM announce a scanning receiver that offers professional performance with IC-R7000 advanced technology – 25-1000MHz coverage, multimode operation and a sophisticated scanning and recall system.
IC-R7000 covers aircraft, marine, business, FM/AM broadcast, amateur radio, emergency services, government and television bands.

ICOM IC-R7000 has many outstanding features.

- **99 MEMORIES:** You can store up to 99 of your favourite frequencies for instant recall. Memory channels can be called up by simply pressing the memory channel knob or direct through the keyboard.
- **KEYBOARD:** Tuning can be quickly achieved by selecting precise frequencies directly through the IC-R7000 keyboard or by turning the main tuning knob.
- **SCANNING:** Instant access is provided to commonly used frequencies through the scanning system. The Auto-M switch enables signal frequencies to be memorized while the IC-R7000 is in the scanning mode. Frequencies that were in use can be recalled at the operator's convenience.
  An optional voice synthesizer automatically announces the scanned signal frequency to ease problems with logging.
- **MULTI MODE:** Push button selection enables FM wide/FM narrow/AM/SSB upper and lower modes to be received.
- **6 TUNING SPEEDS:** 0.1, 1.0, 5, 10, 12.5 and 25 kHz through knob selection.
- **ADVANCED TECHNOLOGY CONSTRUCTION:** The IC-R7000 has dual colour fluorescent display with memory channel readout and dimmer switch.
  Dial lock, noise blanker, combined S-meter and centre meter.
  Optional RC-12 infra red remote control operation. All the above professional features are produced in a convenient, compact unit of size:

Height	282 mm
Width	286 mm
Depth	276 mm

- Specifications guaranteed from 25-1000 MHz and 1260-1300 MHz.
  No additional module is required for coverage to approximately 2000 MHz. No coverage is available from 1000-1025 MHz.

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☐ IC-R7000 ☐ ICOM's full range of communications equipment.

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All stated specifications are approximate and subject to change without notice or obligation.
ICOM customers should be aware of equipment not purchased at authorized ICOM Australia Agents
This equipment is not covered by our parts and labour warranty.

ICOM

The Frequency of Ideas.

THIS MONTH'S COVER

Sit back, relax and enjoy total control over your hifi system. But first, you have to build our new Infrared Remote Control Preamplifier. See page 36.

Electronics Australia

Volume 48, No.10

October 1986

Features

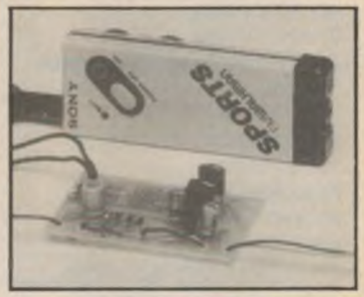
Entertainment Electronics

Projects and Technical

News and Comment

Departments

Power & antenna for a Walkman



Here's the other half of the FM wireless link. Just add this simple circuit to a Walkman-style receiver and you're in business. See page 50.

What's coming

Next month, we intend to describe a 180W HF linear amplifier for radio amateurs, a digital audio storage device and an automatic bilge pump.

High-energy electric fence

This new high-energy electric fence controller has been specially designed to power long fence runs. It's easy to build and runs off a 12V car battery. Details page 24.

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Letters to the editor

Specialised parts should be catalogued

I have been following the discussion concerning parts in the Forum pages of your magazine with much interest.

I would like to add my voice to all those crying out to the parts suppliers to cater for those of us who prefer to make our projects in sections when the money and time are available.

Also I would like to point out that many country people buy by mail order and rely heavily on the catalogs and advertisements to determine parts availability.

So come on parts suppliers — catalog these special parts and we will buy them.

L. Ralph,
Bundaberg, Qld.

Parts for modified projects

Following recent correspondence in your Forum column on the subject of how parts for your projects are made available to would be constructors, I would like to add my weight to the argument that says that individual components should be more readily obtainable.

I've been involved in electronics as a career for 20 years and, at the hobby level, I consider myself an 'advanced experimenter'.

I rarely find myself wishing to build one of your projects down to the last nut and bolt, but rather, I use your published designs as a source of ideas and circuit configurations.

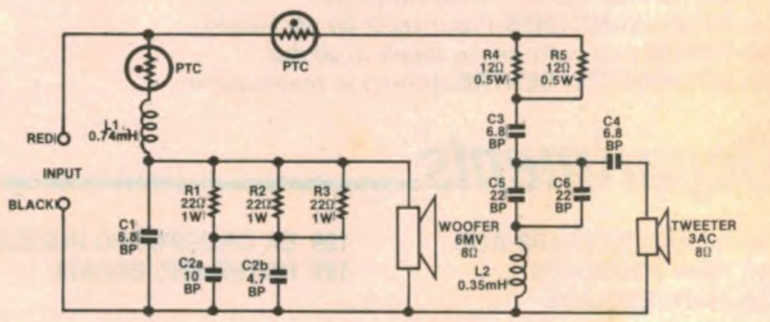
For instance, my last major project was a UHF receiver and although I can-

Don't blow your amplifier

I read with interest your article in the July issue under the title "Foolproof Loudspeaker Protection". Although the PTC devices concerned are no doubt capable of protecting loudspeaker drivers from damage they may, if not installed correctly, help to destroy the amplifier instead.

How? The problem is caused by the passive crossover networks used in most two and 3-way systems. If the load impedance on the output of a typical high or low pass filter is made much higher than its design value then the input drops dangerously low at and near the crossover frequency and, in the case of no load, the filter is simply a series tuned circuit across the amplifier.

Also as the input impedance drops the output response peaks at the series resonant frequency, sending a PTC even higher in resistance.



L1 = 119T, 1.25mm ENAMELLED COPPER WIRE ON A 43mm DIA. × 18mm WIDE FORMER.
L2 = 83T, 1.25mm ENAMELLED COPPER WIRE ON A 43mm DIA. × 18mm WIDE FORMER.

not recall you ever publishing a design for such a project, I gained some useful ideas and circuit sections from the amateur UHF transceiver project published a couple of years ago.

I usually find I only want to build a section or a somewhat modified version of a particular project. This is where sourcing the more exotic components becomes difficult especially when the kit supplier has a 'buy the whole kit or nothing at all' attitude.

Working in the trade is sometimes an advantage as the components can often be tracked down via 'real' suppliers (ie the ones who supply the industry). This is now always successful, however.

Some of my aquaintances have even resorted to the dishonest practice of going to the kit supplier, saying that they bought the kit (when they haven't) and that some of the parts have been damaged or are missing, in order to obtain 'replacements'.

So I strongly support the contention that as well as complete kits, suppliers should make all individual parts available separately.

Thank you for a readable and entertaining electronics magazine.

R. Chapman,
Narra Warren, Vic.

In circumstances where the PTC has gone high, the output stage of the amplifier itself may already be close to overheating. The unusually low and reactive load presented suddenly to the amplifier could be the last straw. Of course, well-designed and electronically protected output stages can take this abuse but many others might fail due to thermal and second breakdown limits being exceeded.

The solution is simple: connect the PTCs in series with any filter circuit feeding the driver to be protected. The high source impedance will slightly alter the frequency under overdrive conditions but neither the drivers nor amplifier will be damaged. I have used this idea many times, not with PTCs but with low voltage bulbs to protect horn tweeters. The principle is exactly the same as with PTCs.

P. Allison,
Summer Hill, NSW.

Comment: This is an excellent analysis of audio networks. As an example of how PTCs should be connected we have reproduced the crossover circuit for the Vifa 60-60s published in last month's issue. The PTCs are in series with each filter section.

Editorial Viewpoint

Satellite TV for city people

The recent announcement of Alan Bond's and Holmes à Court's ventures into satellite broadcasting is an interesting new development which may yet put some life into this medium as far as city dwellers are concerned. Up till now, the whole thrust of satellite broadcasting has been the provision of TV and radio programs to remote areas of Australia. In other words, it has only been of interest to those living "beyond the black stump". For the city dweller who is looking for programs other than those served up by the big three networks, the ABC or SBS, the existing material on satellite feeds would be just more of the same.

Now with these ventures to provide sports programming for clubs and hotels, we have a possibility of quite different video entertainment but for the moment, it won't be available in the home. Why not?

The Bond Corporation envisages that it will have 3000 clients in the first year or so of operation with a potential 10,000 hotels and clubs around the country to be signed up. This will no doubt be just what the clubs and hotels want to increase patronage and probably will be a successful operation. But why not extend it to the man in the street? Perhaps initially the hotels may want this new service to be exclusive, to ensure that they do get the desired increase in patronage but there must be many ordinary citizens who would consider paying a few thousand dollars for the equipment necessary to receive this new service.

If it is not eventually made available to the public, there is a considerable risk that a backyard industry will start up to supply the necessary gear and the satellite backers will be the losers.

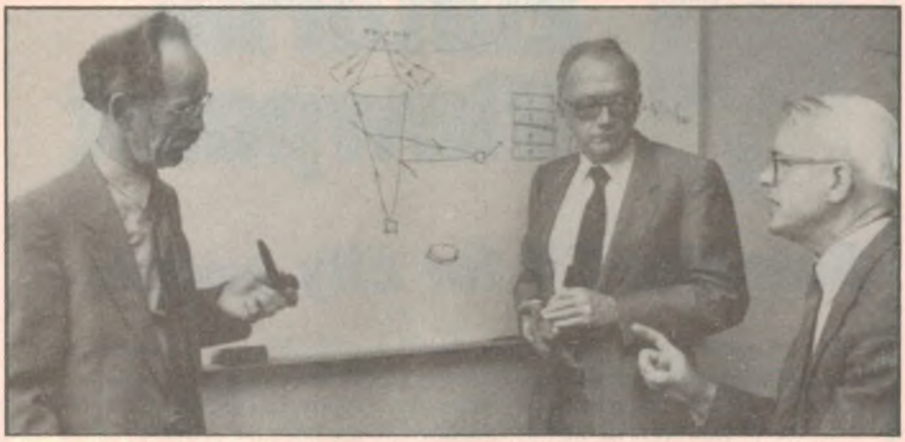
Just as an aside, it looks as though these new ventures could be the end of many bands that play in hotels and clubs, which will be a pity. One of the reasons people presently go to hotels and clubs must be the attraction of a live band. And if many of the bands disappear, this will mean lean times for those companies that supply the electrical and electronic equipment. It is a case of new technology displacing old and disrupting employment in the process.

And while on the subject of television, it will be a great pity if the Government goes through with its decision to merge the Special Broadcasting Service into the Australian Broadcasting Corporation. The projected saving of $2 million over the first year is laughable — the removal expenses will probably amount to more than that!

The ABC will have to do much better with its existing TV stations before it can justify having a second network. It could start by ceasing the weekly feedback program, "Backchat". This program is solid evidence that the ABC ignores the wishes and comments of its viewers and has little intention of providing better programming. To make it worse, they put the same "Backchat" on several times a week. SBS doesn't do that.

Leo Simpson

News Highlights



International recognition for Philips researchers

Three Philips researchers, whose work during the 1970s led to the development of the Compact Disc, the LaserVision videodisc and optical data storage, have received the English Rank Award.

Dr P. Kramer, senior managing director of Philips Research; Mr G. Bouwhuis, senior scientist at the Philips Research Laboratories; and Mr K. Compaan, now retired, were presented with Rank Prize Fund awards at a ceremony at the Royal Institute in London.

Established in 1972 by the late Lord Rank, the Rank Awards are presented to individual scientists who have achieved significant breakthroughs in the fields of opto-electronics and human and animal nutrition.

Business Briefs

• **Scientific Devices** has been appointed the sole Australian representative for Castle Associates, UK.

Located in Scarborough, North Yorkshire, Castle manufacture sound level meters for noise and vibration measurements, together with such accessories as microphones and accelerometers. In addition, they also market audiometric equipment, industrial vibration meters, seismographs, dosimeters and stroboscopes.

For further information contact Scientific Devices Australia Pty Ltd, 2 Jacks Road, South Oakleigh, Vic 3167. Telephone (03) 579 3622.

• **Amtron Tyree changes hands:** Mr Dieter Monch, formerly Managing Director of Nixdorf Computer, has purchased local electronics company, Amtron Tyree Pty Ltd.

Established in 1972, Amtron Tyree has grown to become the largest locally owned electronics connector company in Australia. It's manufacturing facility in the Sydney suburb of Alexandria was first established in 1977. Almost half the company's products are exported to the USA and markets have also been found in Singapore, New Zealand, Hong Kong, West Germany, Sweden and Austria.

The company's address is 176 Cope St, Waterloo, NSW 2017. Phone (02) 698 9666.

• **Changes at Hewlett Packard:** Ms Glen Taylor has moved from Sydney to Perth to take up the Branch Business Manager's role for Hewlett Packard. Grant Freeland (on 03-895 2895) or Geoff Stewart, the Australian Regional Marketing Communications Manager, are the new contacts.

HP also recently opened its second NSW office at 1 Rosebery Avenue, Rosebery. This new office houses HP's Australasian Board Test Centre and the Information Systems Sales and Support group.

Robots in the flour

A contract for an automated manufacturing system for a new flour mill in Melbourne has been awarded to Fisher Controls.

The mill is being built for the Defiance Milling Company Pty Ltd by Henry Simon Australia. An associate company, Simon Carves Australia, is providing consulting services for the design and engineering aspects of the control system.

The system is a computer-based Distributed Control System and allows plant operation via CRT consoles, which link with a powerful batch controller and programmable logic controller.

One of the challenges facing Fisher Controls' engineers in designing the system was the need to maintain flexibility of the production lines to allow for the many special blends of flour used by Defiance. By using a batch control system to track the flow through the plant, reductions in inventory can be achieved together with increases in productivity.

The Fisher Provox system was selected for its ability to handle batch oriented operations and its overall flexibility in meeting changing operational requirements. An alarm system is included to monitor batch operations, production scheduling, bin levels and equipment loads.

Britain plans coal-to-oil conversion

Britain's enormous supplies of coal could be used in the near future to produce liquid fuels such as petrol and gas.

Both ideas have been tried before. Indeed, motor fuel was produced from coal in Germany during wartime, but the process is expensive and no such process has been used commercially in Britain. However, oil is a rapidly diminishing natural resource and the aim now is to discover a method which produces vehicle fuel at less cost.

British Coal believes it already has a suitable process, called liquification it is said to be almost twice as efficient as other petrol-from-coal processes. By the year 2000, says the National Coal Board, more than 10 million tonnes of coal could be used every year in the United Kingdom for the production of motor fuel.

Cards move into the mating game

Forget Bankcard and American Express — they won't find you true love. But despair not. New "smart" cards and optical card technologies are hastening the arrival of a 'dating card' — or so says a recent study produced by International Resource Development Inc in the US.

Market researchers are predicting that, by 1990, singles bars around the world will be equipped with computerised card readers to assist their customers in meeting that special person (oh, shucks).

The love-lost will carry special cards and the terminal/readers in the bars will read this data into a small computer. The computer will then compare the results with those obtained from other customers and indicate who else in the bar might have compatible interests.

On a more serious note, computer terminals could also be used to record detailed medical histories on optical cards, which patients will carry around with them. The 'Lifecard' can then be read by all doctors and hospitals equipped with terminals, giving an accurate medical profile of the patient.

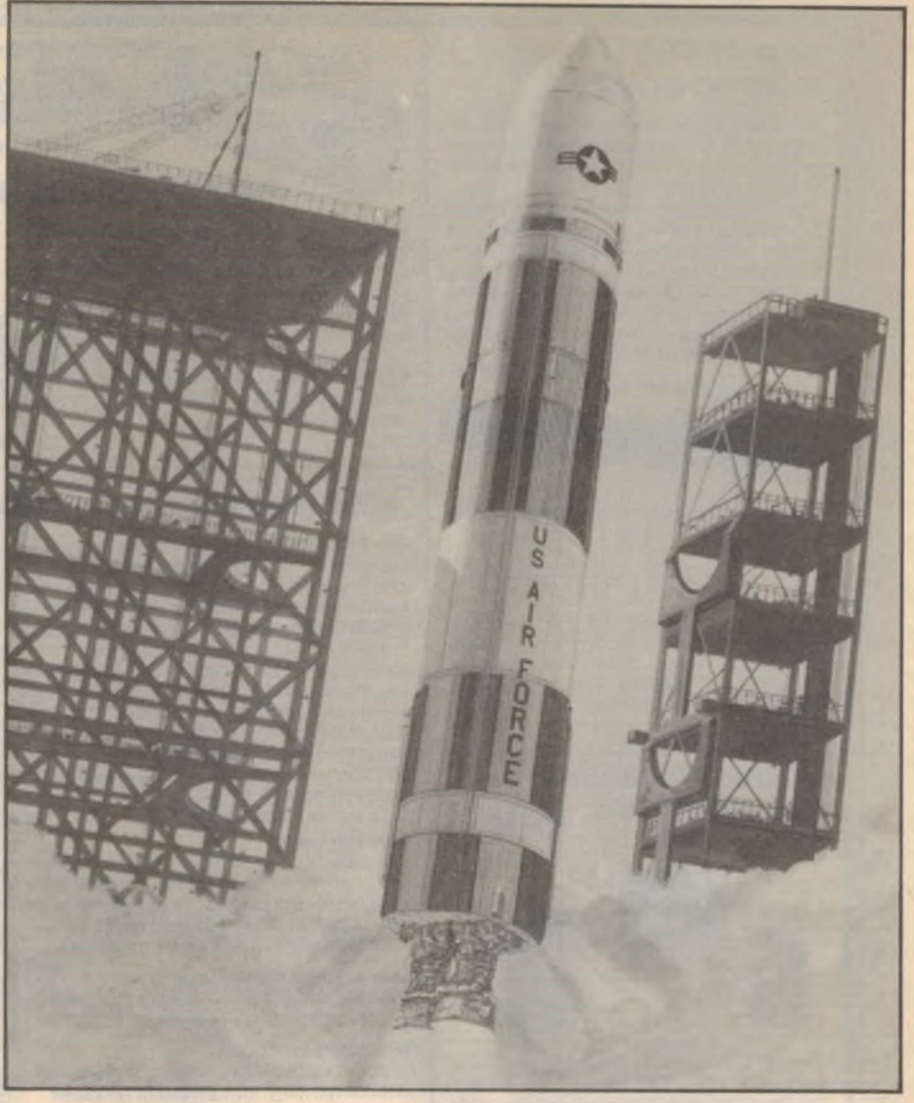
In addition, Kuwait and several other nations are actively investigating the use of the same technology to produce tamperproof identity cards for their entire citizenry. One optimistic vendor hopes to sell 600 million optical cards to the Peoples Republic of China.

Billion bit telephone system

Not content with a 400 megabit/sec data rate for optical fibres, Nippon Telegraph & Telephone has just announced a system with four times the data capacity (ie, 1.6 billion bits per second).

To achieve this rate, Nippon's engineers developed a way of multiplexing four data streams onto the same optical fibre. This has been made possible by improvements to the laser that sends the signal, and to the photodiode which translates it back to an electrical signal.

The company is currently testing a 700km long system by sending high-definition TV signals down the line, before looking to commercial applications.



Hughes to develop new satellite launch vehicle

The Hughes Aircraft Company, manufacturer of Australia's three Aussat satellites, is to develop its own launch vehicle which could place a satellite into orbit at half the payload cost of existing boosters.

The company has just been awarded a US$5 million study contract by the US Air Force to design and construct an expendable, all-purpose satellite launch vehicle capable of delivering military and commercial satellites to different orbits on the same flight.

The Hughes launch vehicle, named the Jarvis MLV after the late Hughes engineer, Gregory Jarvis, who died in the Space Shuttle explosion on January 28, will use the same space-proven hardware that successfully transported Apollo astronauts to the moon. It will be capable of carrying up to six Navstar GPS satellites or a combination of GPS and other payloads to a variety of orbits.

The mid-sized rocket, measuring approximately 30 metres by 11 metres, is expected to achieve a systems reliability of 98.5%, and because of its size, power and economy, to halve the payload cost of competitive launch vehicles.

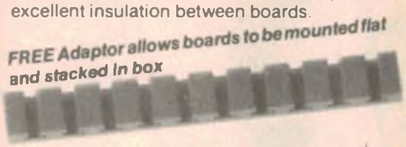
Hughes will team up with the Boeing Aerospace Company in the six-month study. Operationally the booster will have three launch phases. The first stage will employ the Saturn booster engines used on the Apollo moon missions. Both this and the second phase, which will separate from the first at 90 km altitude three minutes later, will be the responsibility of Boeing Aerospace. Hughes will design and construct the third, "transfer vehicle" stage whereby the satellite cargo will be carried into the planned orbit.

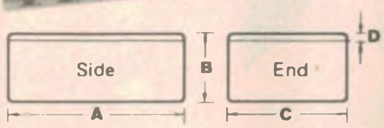
The first Jarvis MLV should be ready for launch around 1990.

WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR C

NEW RANGE OF ABS PLASTIC BOXES

The 2000 series Bimboxes are ideal for projects. Lids are inherently dust, moisture and splash-proof and can be easily sealed for complete water-proofing.
Quality construction includes brass threaded inserts for lid screws (no self-tappers!) plus built-in PCB slots *PLUS* unique BIMADAPTORS which allow flat mounting either singly or sandwich fasion with 5mm spacing. The FREE adaptors fit in the corners and being plastic are easily trimmed and provide excellent insulation between boards.





Part No	A	B	C	D	Price
BIM2002/12	100	25	50	4	$4.75
BIM2003/13	112	31	62	4	$4.85
BIM2004/14	120	40	65	4	$5.10
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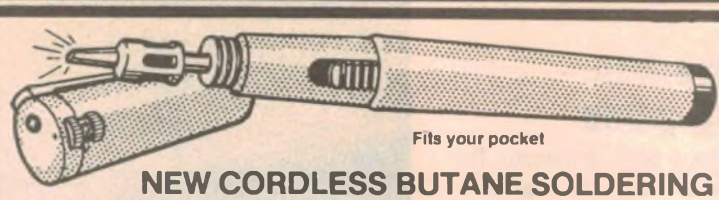

Fits your pocket

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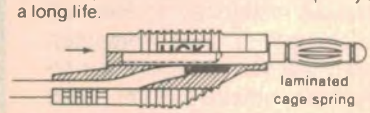
Built-in Flint Lighter — Adjustable from 10-60W

NEW RANGE OF HIGH QUALITY TEST LEADS

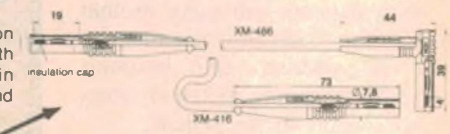
Sick of those stiff plastic test leads that come with most multimeters? You know the ones that kink and produce pungent smoke when you touch them with a soldering iron? Well we've done something about it and proudly introduce the HCK range of quality silicone leads.
It's impossible to describe how flexible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

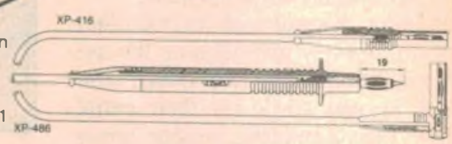


16 A Universal Test Lead with cracking protection grid

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.

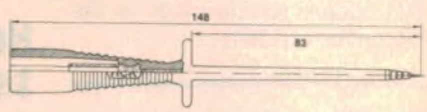


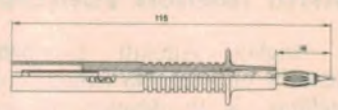
4mm Safety Shrouded Leads
Available with straight or 90 plugs. Available in 1 metre length only. Straight **$9.43** 90 **$9.99**



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**

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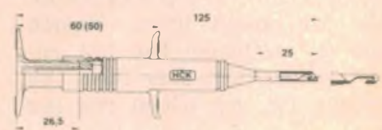
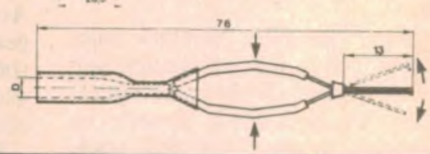
4mm Safety Hook Grip
Accepts 4mm plug and features quality steel hook **$9.43**



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



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News Highlights

Brand new book for the disabled

'Amateur Radio for the Disabled' has been written expressly for the talking book medium of magnetic tape. It not only contains text but 'pictures', or rather off-air recordings of radio amateurs involved in their hobby.

The book is not intended as a textbook, but as a starting point for those who have no idea of what amateur radio is, and how it can help the disabled and isolated. It outlines the history of amateur radio and lists many sources of help, advice and instruction.

The author, Harry Atkinson, has had a long and successful career in both amateur and commercial radio in Western Australia.

'Amateur Radio for the Disabled' (two cassettes) costs $10.00 and is available from: The Director of Library and Information Services, Association for the Blind, PO Box 101, Victoria Park, WA 6100.

GMH orders big on robots

Still smarting from its heavy losses on the Australian marketplace over the last five years, car-maker GMH has responded by placing a large order for industrial robots. The new robots, manufactured by GMF Robotics Corporation in the US and distributed in Australia by John Hart Pty Ltd, will be used by GMH to help modernise its assembly line.

Thus far, GMH has ordered five arc welding robots, with the possibility of follow-up orders for the GMF Arcweld Vision System.

Microcomputer radios for Sydney buses

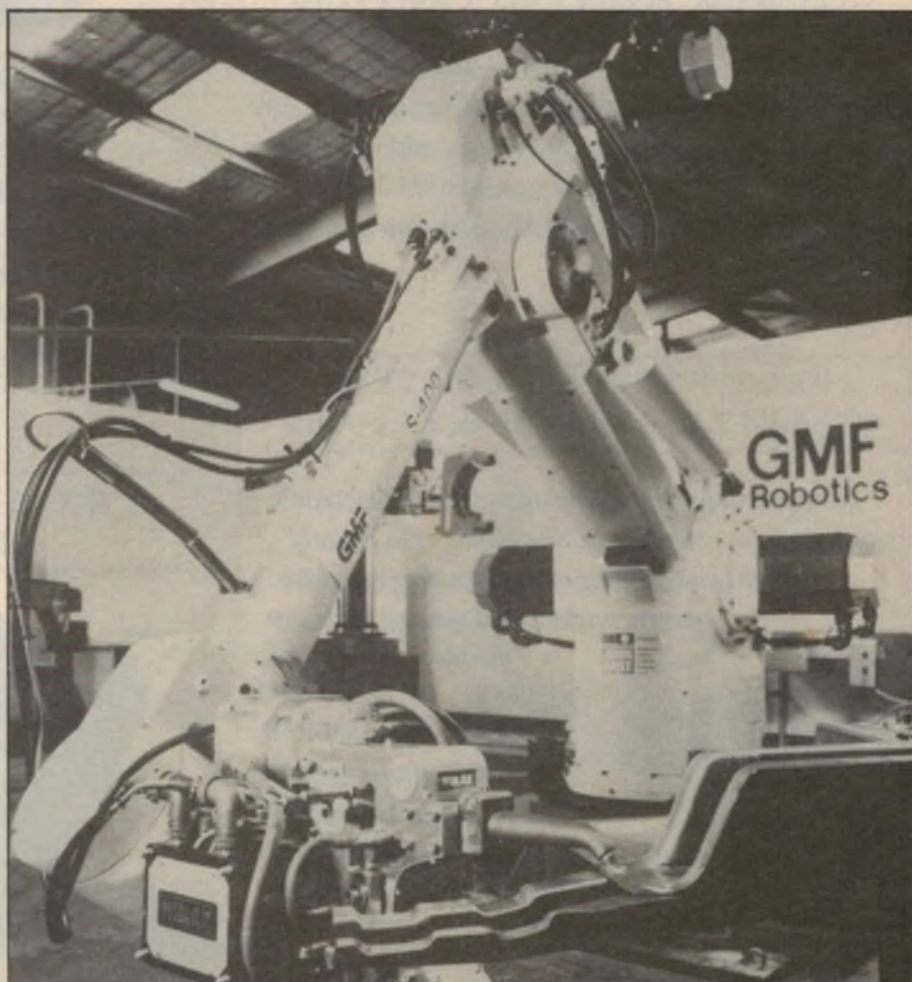
Philips have developed a two-way radio system for buses and they hope to introduce it to Sydney's UTA fleet of 1500 vehicles by the end of this year.

An initial three hundred radios, installed in August, has meant that all buses operating at night are now equipped with radios. In the case of evening travel they will certainly boost the confidence of the drivers and passengers, allowing the driver to instantly call for assistance if there is an emergency.

The Philips system of '900 series' radios will provide an instant link between each bus and the Central Control Room. The system also provides an emergency option which causes the bus identification to be automatically displayed in the Control Room so that police or other assistance can be sent quickly.

The communication system can also be used to give information about traffic holdups, allowing subsequent drivers to detour and avoid the problem.

The multi-frequency system, linked to multiple transmitters at various sites, will surely become an essential part of operating the Sydney bus service efficiently.



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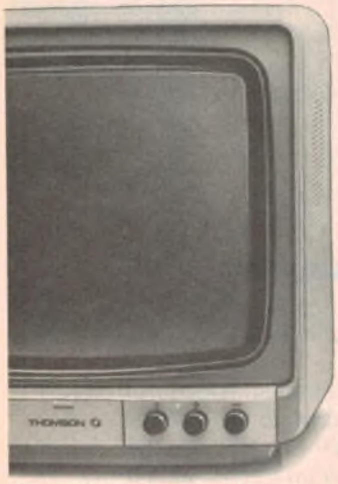


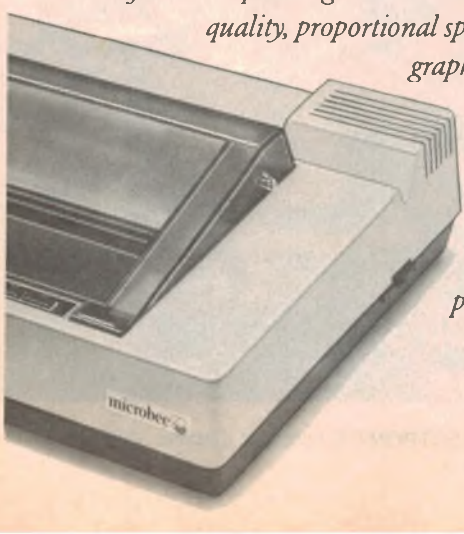
Our Thomson/ESE colour monitor is terrific value for money. It gives good results with IBM PCs and other compatibles, as well as our own Portable PC and Premium Series Microbees. It resolves up to 560 x 240 pixels (12 MHz bandwidth, 0.51 mm tube pitch) and comes complete with cable.

HI-RES 12-INCH RGB COLOUR MONITOR $799.00

Here's the real performer in RGB colour monitors! High resolution, but still very reasonable. And it works just as well with IBM PCs and compatibles as it does with our latest Microbees. Full 640 x 200 pixel resolution (15 MHz bandwidth, 0.38 mm tube pitch). Non-glare screen, complete with cable.

100 CPS NEAR LETTER QUALITY PRINTER $399.00

Fast, general purpose dot-matrix printer which works with almost any computer. Bi-directional, with choice of fonts and printing modes including near letter quality, proportional spacing, bit-image graphics. Takes paper up to 254 mm wide, either friction or sprocket feed. Standard Centronics-type parallel interface.

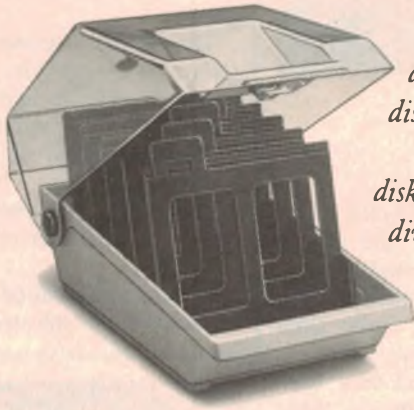


C&MA MBS0033

FLOPPY DISKETTES AND STORAGE BOXES

Very high quality, Microbee/Nashua 5.25 inch double-sided, double density 48 tpi diskettes... $4.95 each.

3.5 inch single-sided, double density 135 tpi diskettes... $6.75 each.



3.5 inch double-sided, double density 135 tpi diskettes... $7.95 each.

Storage boxes for 50 diskettes, lockable, with dividers and smoked acrylic lid: For 5.25 inch diskettes ... $33.50. For 3.5 inch diskettes... $35.00.

IBM-CENTRONICS PRINTER CABLE $34.50

Connects an IBM PC or close compatible with a DB-25 printer socket to a standard Centronics-type parallel printer. Heavy duty cable, 6 feet long with moulded-on connectors.

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RS-232C GENDER CHANGERS M-M $14.50 F-F $14.95

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Standard composite video input works with almost any computer. Crisp, easy-to-read display provided by 35 MHz bandwidth. Non-glare faceplate minimises eyestrain. Inbuilt 10 V/1.2 amp DC power output for powering a Microbee computer or other equipment.

RS-232C MINI TESTER $29.50

Invaluable tool for tracking down problems with modems, terminals, serial printers, etc. LED indicators for all seven main signal and handshaking lines, both male and female connectors. An excellent companion for the Mini Wiring Adaptor.

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Raises your video monitor to a more convenient height, lets you adjust screen for the best viewing angle. Sturdy, suits most monitors.

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Box of 1000 sheets 210x280 mm (8.25x11 in) sprocket feed, fanfold paper, easily separated.

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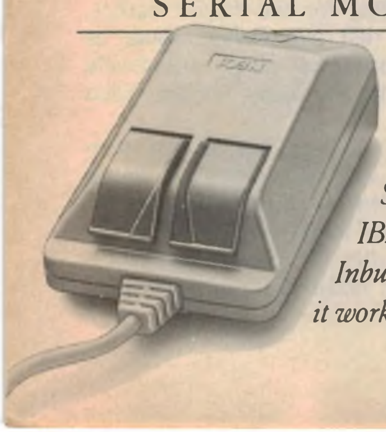

Fully compatible with Microsoft's serial mouse and software, but much cheaper. Standard DB-25 connection for IBM PC or close compatibles. Inbuilt processor, teflon-coated ball so it works on almost any surface.

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Prices quoted are subject to change without notice.

microbee computer

Bump and grind with JVC. Loud music and wild gyrations introduced the latest video and audio products.

Minister for Science Barry Jones had a go at operating the underwater surveillance robot from USAL. Looks like more fun than politics.

Perth's pulsating electronics show

The Perth Electronics Show held during August 1986 was the biggest electronics show ever held in this country, with over 200 companies represented. On display was a vast range of electronic equipment, including consumer appliances, hifi and video gear, professional equipment for broadcast applications, uninterruptible power supplies and remotely controlled marine robots.

by LEO SIMPSON

This was the eighth year of the Perth Electronics Show and exhibitors have built on the reputation of past years by going for bigger and more spectacular stands. Biggest stands this year were those of Sony and Philips, although NEC was very prominent too. It was not all just hifi and video either, as there was a lot of computer gear, professional electronic equipment and, as in past years, all the consumer appliances you could think of.

On top of that, there were direct broadcasts from AM station 6IX and Perth's channel 7 had more outside broadcast vans than you'd expect to see outside Parliament.

Compact disc players and video camcorders provided the major consumer interest at the show. There were quite a few camcorders on display, with 8mm video equipment more prominent than in previous years. Leading the 8mm exponents was Sony with its CCD-V8 Handycam and larger video cameras plus its range of 8mm VCRs and accessories. These included two underwater packs for the Handycam which indicates how serious the 8mm push is becoming. Also showing 8mm camcorders were Canon with their VM-E1 and Aiwa with their Avimax 8 AF.

And just to show that there is plenty of life left in the VHS format, a number of companies were exhibiting camcorders based on full-size VHS cassettes or the one-hour VHS-C cassette. In the former group were National and Hitachi while the latter group included JVC and Akai. Philips had two camcorders, one based on the VHS-C format and the other on the full-size VHS format. Whichever way consumers decide to go, they certainly have a much more attractive path to producing their own movies than the now outmoded Super-8 film format.

But while 8mm camcorders look very attractive, the 8mm VCR format has yet to be fully supported by the video duplicators. This problem was acknowledged by Sony at the show and they indicated that only a few dozen film titles are presently available for the rental market. They hope that will change soon, as they are arranging more attractively priced bulk-tape supplies for the video duplicators.

Countless compact disc players were on display, with many hooked up to headphones for continuous demonstrations. It was interesting to note the precautions that the various companies had taken to make sure that showgoers

Microbee made a big splash with its full range of computers.

did not abscond with discs or players. Perhaps the most positive steps were taken by Philips. Their players had the discs locked into the machines which were bolted to the stands with substantial steel brackets. The headphones were solidly tethered too. Even so, it would have been interesting to know whether any players or discs did vanish.

With this security aspect in mind, Sony were exhibiting their new car CD player which can be loaded with up to ten discs at a time. The player itself is installed in the car's boot and is programmed by a handheld controller attached to the dashboard. The idea of a CD player in the boot appears like a good one but Sony may have taken this approach because the player is too bulky to install in the cabin.

A much more devious approach to car sound security was exhibited by Eurovox. Their top of the range radio-cassette players are security-coded. Whenever the radio is disconnected from the car's electrical system (or the battery is disconnected, the owner has to enter a code into the radio before it will work again. The individual code is supplied on a card which is kept separately from the radio. The code enables the radio's microprocessor.

If a thief steals the radio, he has three chances to load the code before it is disabled completely. After that, the only way to make the radio work again is to return it to the distributors. Naturally, if you're not the owner, that is an unattractive proposition.

Eurovox's security-coded models alternately flash two of their indicator LEDs while they are not in use. As they become more well-known they are certain to gain a reputation amongst thieves as NWP: not worth pinching.

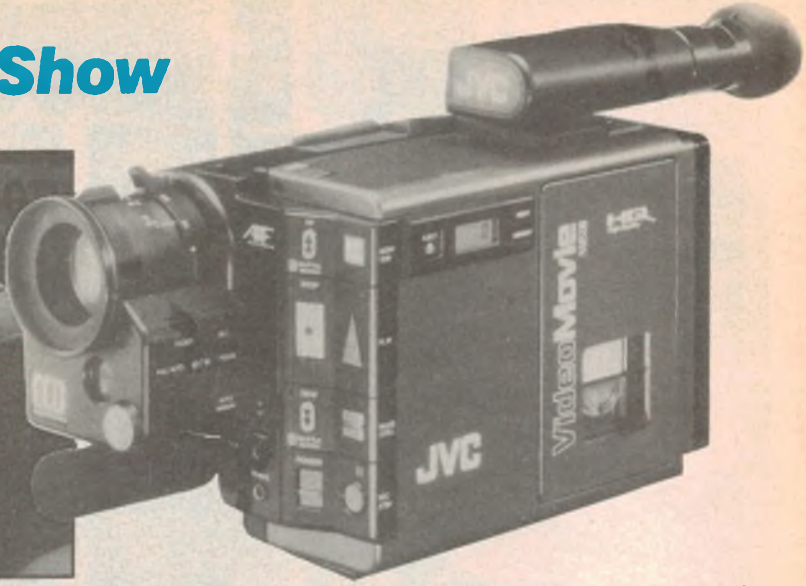
In amongst all the CD players, a number of new models stood out. Philips had their new 16-bit machines on display, including the CD650 with FTS (favourite track selection) as reviewed in the August issue of EA, the midi-sized CD450 and the economy CD-150 model.

Pioneer exhibited their remote-controlled deck which plays up to six compact discs at a time. And Sony had the Discman on show. This is a later version of the original D-50 model but is now fitted with penlite cells for an even

The Atari 1040ST impressed many showgoers with its hotshot performance.

Maybe Kenwood's fancy installation should have been entered in the Guinness Book of Records.

Perth electronics Show



Sony's 8mm video camcorders and the competing JVC videomovie caused a great deal of interest at the show with both offering lots of fancy user features.

Harmon-Kardon introduced a line of three high performance stereo radio/cassette players with back-lit liquid crystal displays.

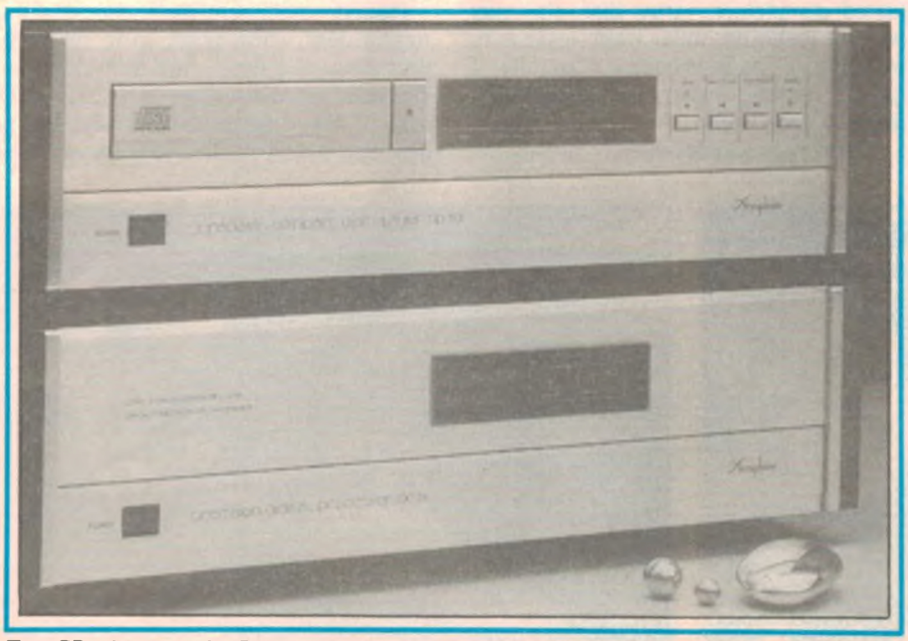
more compact portable player.

But perhaps the most impressive player of all was the $10,000 Accuphase. This double-deluxe machine comes in two parts: the DP-80 which is essentially the transport mechanism and its control systems, and the DC-81 precision digital processor. The outstanding features of this system include the use of optical fibres to completely isolate the two parts of the player, a specially designed linear motor and control system for the player which obtains a track access time of less than a second, and discrete (ie, not in single integrated circuit form) dual 16-bit digital-to-analog converters with 121-stage oversampling filters.

To give some idea of the circuit complexity, the semiconductor complement of the complete system is 88 transistors, 78 diodes and 95 ICs. All-up weight is 30.5kg or 67.3 pounds. Mind-boggling is the word.

While CD players were clearly the item of most consumer interest, the industry was expecting tougher times ahead for the hifi market generally and the forecasts for total CD player sales during this year have been drastically downgraded from in excess of 100,000 to somewhat less than 80,000. The days of $299 CD players appear to be over too unless decisions are made to rapidly liquidate large stocks of players presently in warehouses around the country. Pity the same did not apply to compact discs themselves which seem to be perenially in short supply.

Interestingly, AM stereo was not a drawcard at the show although some AM stereo equipment was on display. This may have been because of a move behind the scenes by Perth's AM stations. While they are all equipped to broadcast in stereo and are currently doing so, they are supporting a move to dual AM/FM licences which is presently being considered by the Department of Communications. The reported rationale behind this move is that the AM propagation conditions in the south-west of WA are poor, supposedly because most of the region lies over limestone strata.



Top CD player at the Perth Show was this new two-unit machine from Accuphase with optical-fibre signal coupling between the two. It's a superb machine in a totally rarefied price range.

If AM stereo wasn't being sold, car sound certainly was, with a big push by exhibitors such as Kenwood, Alpine, Nakamichi and a number of others. The most impressive car exhibit was a 1984 VH Commodore fitted out with a vast array of Kenwood gear. It started with the Kenwood car CD player and KRC-999 AM/FM stereo radio cassette player feeding a KEC-1000 electronic crossover.

From there the audio signals are split and fed to one 7020 37 watt/channel amplifier to drive the tweeters, one 8020 80 watt/channel amplifier to drive the midrange speakers and four 9020 100 watt/channel amplifiers to drive assorted woofers, four of which were 200mm sub-woofers driving directly into the back of the rear passenger seat. That would make for a really visceral musical experience!

All the amplifiers were mounted on a sturdy platform which occupied most of the car's boot space, together with a maze of wiring, a large heavy-duty battery and a battery isolating solenoid — very necessary to avoid being stranded in Woop-Woop after a music listening session.

Needless to say, the car needed a heavy-duty alternator and for the duration of the sh[illegible] battery was permanently connected to a mains charger. So loud was the system that you did not need to be anywhere near the car to happily listen to it. With Billy Ocean's "Caribou Queen"* ripping out of those multiple speakers you could stand back fifty feet and feel the sound — literally. (*Yes, I know it's "Caribbean Queen" but it always sounds like "Caribou Queen" to me.)

Funnily enough, this car was not especially fitted out as a stunt for the show. I talked to the owner, one Craig Lauterbach, audio consultant with Alberts Car Stereo, of Perth. He told me that he had installed more expensive systems for people who were on quite low wages. They just like lots of sound. Words failed me. The idea of such a preposterous system being not the most extreme in the land was immensely appealing.

In fact, the whole show was very enjoyable. It had a down-to-earth flavour which was obviously embraced heartily by exhibitors and showgoers alike. The total attendance for the five days from 31st July to August 3rd was expected to top 100,000. That's ten percent of Perth's population which is an incredible result for any show anywhere.

JVC kept on grinding on. We went back for another look but the waltz wasn't in the repertoire.

Next year, plans are afoot to move the venue from the Claremont Showground to the Burswood Island casino. I hope it continues to show the same blustering entrepreneurial spirit when it moves to these more salubrious surroundings. Somehow it won't seem the same.

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A well-written Basic Electronics course from ICS

There are only two ways to obtain a formal education in the field of electronics. One is to take a full-time course at a university or CAE and the other is to do a course with International Correspondence Schools. We recently had a close look at their newly released Basic Electronics Course.

by LEO SIMPSON

The course consists of seven binders, each containing five to nine quarto-sized booklets.

The concept of learning electronics via a correspondence course is an intriguing one. As anyone who has attended a formal course in electronics can attest, the idea of not having to attend lectures and being able to progress through the subject matter at your own rate, fast or slow, is very attractive. You would not have any travelling time, would not have the temptation of skipping lectures when the weather is poor or the material is already known to you and so on.

And of course, if you live away from the cities, a correspondence course is virtually the only way of gaining such an electronics education.

On the other side of the ledger, anyone contemplating a correspondence course will probably wonder whether their absorption of the material will be as efficient when there is no formal structure such as lecturers and lecture rooms, exams and the sanction of failure in the event of not being up to par. International Correspondence Schools have answers to these questions so that students can proceed in confidence.

At present, three courses are available from ICS with the aim of turning the electronics neophyte into a well-informed electronics technician. They are Basic Electronics, Digital Electronics and Industrial Electronics. We reviewed the first course, Basic Electronics.

As the photograph shows, the ICS course is made up of seven modules, each of which consists of a three-ring binder with the relevant course material enclosed in the form of five to nine quarto-sized booklets which generally run to about 40 pages each. The contents of each module are listed in the accompanying panel.

As may be gathered from the course summary, the material is practical rather than being theory-oriented which is appropriate for a course intended for technicians. The course starts out with an assumption that the student knows nothing at all about electricity or electronics and proceeds from there.

Indeed, there is an assumption that the student has little mathematical background either, hence the inclusion of three sections on Fractions and Decimals, Formulas, and Equations. Again, the maths is practically oriented rather than being the more or less abstract material which turns many school students off. Where appropriate, there are plenty of worked examples to illustrate the text.

At the end of each booklet there is a self-test to enable the student to test knowledge gained at each stage.

Module 1 is very much an introduction to the course, with booklets talking about electron and current flow, resistance and conduction, basic units, primary and secondary cells and the basic passive components such as resistors and capacitors. This module also contains the three booklets on maths already referred to.

Module 2 is devoted to industrial safety and would be helpful for anyone involved in industry let alone electronics technicians. It has different sections in the first two booklets devoted to prevention of injuries to the body generally, and specifically to the eyes, ears, skin and lungs. There is a very good booklet on the safe use of hand tools which includes a section on electric shock and the required first aid — cardiac compression and mouth-to-mouth breathing. Very Good.

Module 3 is a practical approach to electric circuit theory and deals with transformers, inductance and capacitance. Module 4 is an introduction to electron devices and the first booklet includes a section on thermionic tubes and there is also a mention of thyratrons. Naturally, the discrete semiconductors such as diodes, transistors and thyristors are also introduced in this module. Measurements on power distribution systems are dealt with in some detail with voltmeters and ammeters being well described and explained.

Module 5 deals with electronic test equipment, starting with a booklet on measurement principles and then moving to multimeters, bridges and signal generators of various kinds. There is one booklet devoted solely to oscilloscopes. After that, there is a booklet which is a further illumination of the subject of valve rectifiers, triodes and so on. It seemed a little out of place although the increasing level of difficulty was consistent. There are also booklets on switches and relays, on resistive, capacitive and inductive components and on semiconductors.

By module 6, the student is really coming to grips with electronics and is dealing with power supplies, amplifiers, oscillators and so on. Logic circuits are dealt with at some length, in three very good booklets on the subject.

Module 7 continues the learning process with more electronic principles including RF circuits and practices. Servo controls are introduced, there is a further dose of logic circuits and finally,

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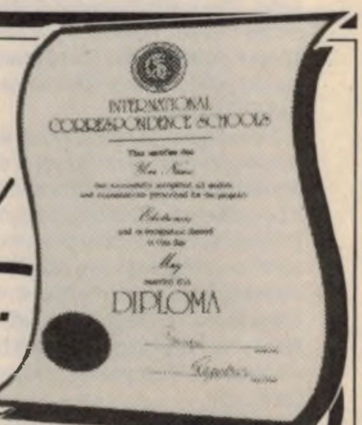

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Take a look around you. Electronics control and guide your everyday life. From Home Computers to Space Travel, from Microwaves to Robots you are part of an electronic revolution. This revolution will continue and many job opportunities will be created...opportunities that are available to you.

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Dynamic-power measurements dramatically demonstrated the effectiveness of the DPD system. The standard EIA dynamic-headroom measurement, with 8-ohm loads, produced a 20-millisecond output of 156 watts (for a headroom of 5.9 dB). With 4-ohm loads, the dynamic power was 288 watts, and into 2 ohms it was a prodigious 530 watts!

By any objective criteria, the Proton D540 is an exceptional amplifier. Its low noise and distortion levels, control flexibility, cool operation, and generally ideal performance by themselves rank it among the finest amplifiers we have seen. There are many good amplifiers on the market, however, and the special quality of the D540 really shows itself in the performance of its DPD system.

Listening to CD's and other wide-range sources left no doubt of the remarkable qualities of this amplifier. It begs the issue merely to say that the D540 is by far the most powerful "40 watt" amplifier we have used (which it certainly is). More to the point, it is one of the few amplifiers of any rating we have seen whose capabilities begin to encompass the dynamic properties of live music.

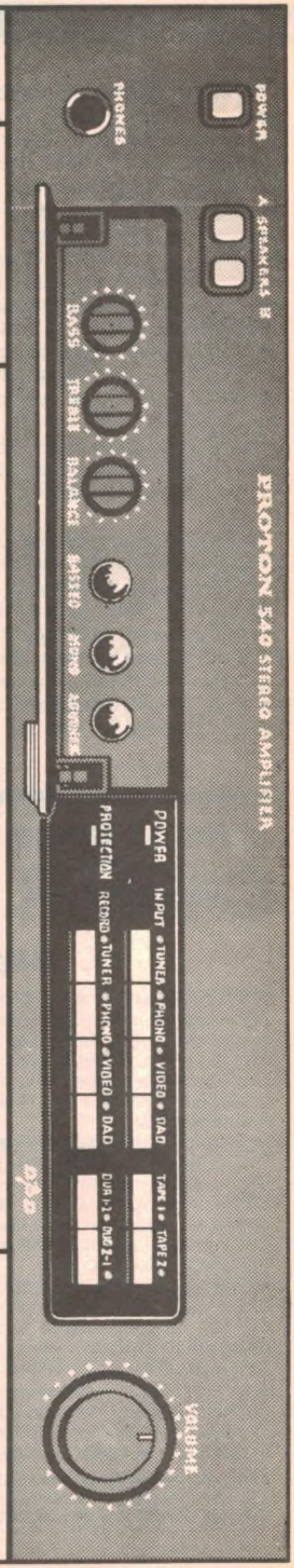
What the Proton D540 *will* give you is a degree of natural dynamics usually obtainable only with a few extremely powerful and expensive amplifiers. But with such amplifiers you have to pay for a huge continuous-power capability to reproduce high peak levels for fractions of a second at a time. The D540 gives you 99 percent of the same sonic impact at a fraction of the price.

EXTRACT FROM
"STEREO REVIEW" U.S.A.

Diversified Science Laboratories' measurements confirm Proton's claims with room to spare. No doubt about it, this is the most powerful "40 watt" amplifier we've ever tested.

All told, Proton has succeeded admirably in meeting its design goals for both performance and value in the D540. The power amp is the star, but the input-selector/tape-switching scheme is admirable as well – as is the flexibility of the phono section. If you want an integrated amp that delivers far more than its price, styling, or power rating would otherwise suggest, by all means consider the D540.

EXTRACT FROM
"HIGH FIDELITY" U.S.A.



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programmable controllers and microprocessors are treated in the last booklet.

Considering that this whole course is referred to as Basic Electronics, it is pretty comprehensive and is a very good start for the following courses on Digital Electronics and Industrial Electronics.

The quality of the technical writing is impressive. It is clear, concise and easy to understand. Since the course material has all been written and prepared in America, it inevitably contains references to Imperial instead of Metric units and also refers to voltage, frequency and other standards which are relevant only in the USA.

Recognising this, the Australian branch of ICS has prepared thorough and comprehensive notes which are attached to each booklet to correct for these national differences. Similarly, where there are references in the booklets to US industrial or electrical safety standards, the equivalent Australian standards, such as the AS 3000 Wiring Rules, have been cited in the additional notes.

As further examples of the thoroughness of course preparation, the booklet on "Safe Use of Hand Tools" has a section on ladders and scaffolding which refers to the US OSHA (Occupational Safety and Health Administration) standards. The correct Australian standard AS1657 is included for Australian students. Similarly, in the booklet on "Materials Handling" there are two pages devoted to the USA hand signals for crane operations. To cater for Australian conditions, the supplementary notes have two pages for the Australian crane hand signals and whistle codes.

One unit of current measurement which is referred to as an aside in the booklet on the "Nature of Electricity" is Ampacity. This rare word is another term for ampere capacity, the amount of current a given size of cable can safely conduct.

Inevitably the material is written in what might be called the "General American" idiom and also uses American spelling throughout but this is not likely to cause any problems. In any case, since many Australian newspapers and periodicals have largely adopted American spelling, it is doubtful whether many students would notice.

Where the course material really scores is in its accuracy. A close perusal of all booklets failed to reveal one technical error or even so much as a misprint. And the material is right up to date, whether by virtue of being written in the last few years or being corrected by the supplementary notes.

Finally, there is the testing process. All of the modules are accompanied by study guides and exams with multiple choice questions. These have to be completed and sent to ICS for assessment before progressing to the next module. ICS have a team of assessors who deal with only a few students each. They are available to give some help with the course material although that is not likely.

Frankly, I was very impressed. Anyone who is motivated to learn will do very well with this ICS course. It will give an excellent background to anyone wishing to take up a career as an electronics technician. And more to the point, the material in the course is probably more relevant and practical than what is offered in formal courses at many Colleges of Advanced Education around the country.

For further information about electronics courses available from ICS, contact International Correspondence Schools (A'asia) Pty Ltd, PO Box 202, Crows Nest, NSW 2065. Phone (02) 43 2121.

ICS Basic Electronics Course

Module 1:
(a) Nature of Electricity
(b) Electric Cells and Batteries
(c) Electrical Components & Ohm's Law
(d) Fractions and Decimals
(e) Formulas
(f) Equations

Module 2:
(a) Personal Safety, Part 1
(b) Personal Safety, Part 2
(c) Safe Use of Hand Tools
(d) Materials Handling
(e) General Industrial Safety

Module 3:
(a) Basic Circuit Arrangements
(b) Magnetism and Electromagnetism
(c) Alternating Current
(d) Transformers
(e) Inductance and Capacitance
(f) AC Circuits
(g) Electrical Language and Hardware

Module 4:
(a) Rectification and Electronic Devices
(b) Electric Energy Distribution
(c) Checking Simple Circuits
(d) Troubleshooting with Basic Meters
(e) How a Voltmeter works
(f) How an Ammeter works
(g) Alternators
(h) Types of Electric Circuits
(i) AC Measuring Instruments
(j) Miscellaneous Electrical Measuring Instruments

Module 5:
(a) Electronic Quantities and Testing Principles
(b) Multipurpose Test Instruments
(c) Bridge-type Instruments
(d) Oscilloscopes
(e) Rectifiers and Electronic Tubes
(f) Switching and Connecting Devices
(g) Resistive, Capacitive & Inductive Components
(h) Basic Semiconductor Components

Module 6:
(a) Rectifiers and Power Supplies
(b) Amplifiers
(c) Oscillators
(d) Modulation and Detection Circuits
(e) Switching Circuits
(f) Gating and Counting Circuits
(g) Pulse and Digital Circuits

Module 7:
(a) Electronic Devices and Amplification
(b) Audio and RF Circuits
(c) Oscillators, Feedback & Waveform Generators
(d) Electronic Power Supply Systems
(e) Industrial Receivers, Transmitters and Video Systems
(f) Servo and Control Systems
(g) Pulse and Logic Circuits
(h) Programmable Controllers and Microprocessors

JAYCAR JAYCAR

JAYCAR'S GIANT SEMI SELLOUT

MAGNAVOX SPEAKERS

Jaycar proudly announces in line with our support Australian Made campaign we are stocking quality Magnavox speakers. Magnavox recently undertook a total change with new owners who are striving to bring you world class speakers made right here in Australia.

Over the last few years Magnavox have gradually been improving each of their drivers and we can now offer you much improved specifications with much higher power handling. For instance, the 8.30 replacement, the 8MV will now handle 100 watts RMS, a far cry from the 30 watts RMS of the old version.

8MV-003

8/30 Replacement

If you own a pair of 8/30 woofers, you can now easily upgrade them. Your old 8/30's handle 30 WRMS, the new 8MV's handle 100WRMS. No need to buy new cabinets. 8MV's mount in the same hole.

Power handling: 100WRMS
Resonant Freq.: 32Hz
Freq. Range: fo - 4000Hz
Sensitivity: 95dB
Cat. CW-2110

$89.50 each

12MV-012

The 12MV is a high power high fidelity woofer utilising a 38mm diameter long throw voice coil wound on an aluminium former and high compliance suspension with a polyurethane foam roll surround, resulting in excellent linearity at very high input powers.

Power handling: 100WRMS
Resonant Freq.: 23Hz
Freq. Range: fo - 3000Hz
Sensitivity: 96dB
Cat. CW-2125

$69.50 each

NEW

8W-020

The 8W Mk 6 is a high fidelity woofer utilising a 25mm diameter long throw voice coil wound on an aluminium former and a high compliance suspension with a polyurethane foam roll surround, resulting in excellent linearity at high power.

Power Handling: 60WRMS
Resonant Freq.: 44Hz
Freq. Range: fo - 4000Hz
Sensitivity: 96dB
Cat. CW-2109

$32.50 each

8WR-020

The 8WR is a high fidelity wide range driver utilising a 25mm diameter long throw voice coil wound on an aluminium former and a high compliance suspension with a polyurethane foam roll surround. An auxiliary cone has been fitted to extend the H.F. response by over 1 octave.

Power Handling: 50WRMS
Resonant Freq.: 44Hz
Freq. Range: fo - 15kHz
Sensitivity: 96dB
Cat. CE-2338

$34.50 each

8JX

The 8JX is a 8" twin cone speaker suitable for medium power handling applications.

Power Handling: 30WRMS
Resonant Freq.: 44Hz
Freq. Range: fo - 14kHz
Sensitivity: 93dB
Cat. CE-2333

$26.50 each

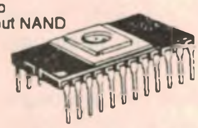
GORE HILL OPEN UNTIL 4p.m. SAT AFTERNOON

Jaycar's advertisements are now produced totally by computer utilising the lastest in laser technology and desk top publishing.

I.C. SALE

Shown below are some incredible bargains in I.C.'s. Some I.C.'s here are now very scarce.
(NOTE: prices INCLUDE sales tax!)

Cat. No.	Description	1-9	10-99	100+
ZZ-8061	6821 MDS PIA	3.00	2.50	2.00
ZZ-8055	6809 CPU	5.00	4.50	4.00
ZZ-8414	2114 RAM	1.50	1.25	0.95
ZS-9500	6810A RAM	2.50	2.00	1.50
ZS-9501	2708 EPROM	3.00	2.50	2.00
ZS-9502	MC14412 MODEM	10.00	6.00	5.00
ZS-9503	MC14411 Bit Rate Generator	8.00	5.00	4.00
ZS-9504	LM370	1.00	0.80	0.50
ZS-9505	4538 Monostable	1.00	0.80	0.50
ZL-3301	LM301 Op amp	0.60	0.50	0.40
ZS-9506	MC1408LS D/A Convertor	4.00	3.00	2.00
ZS-9507	MC14490 Hex CB Eliminator	2.00	1.50	1.00
ZS-9508	75451	1.00	0.80	0.50
ZC-4528	4528 Multivibrator	0.80	0.50	0.40
ZS-9510	74S138 Decoder/Demultiplyer	2.00	1.80	1.50
ZC-4011	4011 NAND	0.40	0.35	0.30
ZC-4049	4049 Hex inverter	0.80	0.60	0.50
ZS-9511	COM2017 VART	2.00	1.80	1.50
ZS-9512	DG201 CJ Interrupt	2.00	1.80	1.50
ZS-9513	74S04 Hex Inverter	0.50	0.40	0.30
ZS-9514	74LS352 (Inverting LS153)	1.50	1.00	0.80
ZS-9515	96LS02 Input NOR x 4	0.80	0.50	0.40
ZS-9516	74188	0.50	0.40	0.30
ZS-9517	XR556	1.00	0.80	0.50
ZS-9518	MCI 4411 Bit Rate Generator	5.00	4.00	3.00
ZS-9519	LM317H (TO-5)	1.00	0.80	0.50
ZS-5807	7407	0.50	0.40	0.30
ZS-9520	78M15 Regulator	0.50	0.40	0.30
ZS-9521	6800 CPU	4.00	3.00	2.50
ZS-9522	DG211 CJ Analog switch	1.00	0.80	0.50
ZS-9523	79MO5C Regulator	1.00	0.80	0.50
ZS-5366	74LS366	0.80	0.50	0.40
ZS-5005	74LS05	0.50	0.40	0.30
ZC-4502	4502	1.00	0.80	0.50
ZC-4050	4050	0.50	0.40	0.30
ZS-9524	78M12 TO-220 500mA	0.80	0.50	0.40
ZS-9525	74L04 Hex inverter	0.50	0.40	0.30
ZS-9526	7403 Q 2 input NAND	0.30	0.20	0.15
ZS-9527	4521	2.00	1.80	1.50
ZS-9528	74145	0.80	0.60	0.50
ZS-9529	LM348	1.00	0.80	0.50
ZS-9530	78L05 Regulator	0.80	0.60	0.50
ZS-9531	741TC Op amp	0.50	0.40	0.30
ZS-9532	7410 3 x 3 input NAND	0.40	0.30	0.20
ZS-9533	7426N	0.30	0.20	0.18
ZS-5085	74LS85	0.60	0.50	0.40
ZS-5175	74LS175	0.70	0.60	0.50
ZS-5273	74LS273	1.50	1.20	1.00
ZS-5373	74LS373	1.50	1.20	1.00
ZS-9534	8T26	2.00	1.50	1.00



TRANSISTOR SALE

Shown below are some incredible bargains in semis. BUY IN BULK AND SAVE!!
(NOTE: Prices INCLUDE sales tax!)

Cat. No.	Description	1-9	10-99	100+
ZS-9560	2N5415 PNP200V 1A	0.50	0.40	0.30
ZT-2297	2N2646 Unijunction	0.80	0.75	0.65
ZS-9562	PN3568 NPN 60V 500mA	0.18	0.12	0.10
ZS-9653	BD680 PNP 80V 4A	1.00	0.80	0.70
ZS-9564	2N5416 PNP 300V 1A	0.60	0.45	0.35
ZS-9565	BD650 PNP 100V 8A	1.50	1.20	1.00
ZS-9566	2N6211 PNP 275V 2A	1.00	0.80	0.65
ZS-9568	2N5400 PNP 120V 600mA	0.30	0.20	0.18
ZS-9569	2N4092 FET	0.30	0.20	0.18
ZS-9570	2N2647 Unijunction	0.80	0.75	0.65
ZS-9571	2N1480 NPN 100V 1.5A	0.30	0.25	0.18
ZT-2298	2N2222A NPN 30V 800mA	0.30	0.25	0.18
ZS-9573	MPS4356(MOT) PNP 80V 1A	0.50	0.40	0.35
ZS-9574	2N4036 PNP 65V 1A	0.20	0.12	0.05
ZS-9575	2N4356 PNP 80V 500mA	0.12	0.08	0.05
ZS-9576	SE4010 (FAIR) NPN 25V 300mA	0.08	0.05	0.03
ZS-9577	2N398B (GERMANIUM) 100V 200mA	0.30	0.20	0.15
ZS-9578	2N2905A PNP 60V 600mA	0.20	0.10	0.08
ZS-9579	BC178 TO-18 20V 100mA PNP	0.15	0.10	0.05
ZS-9580	2N2219 NPN 30V 800mA	0.12	0.08	0.05
ZS-9581	PE6021/MPSA06 NPN 80V 500mA	0.15	0.10	0.08
ZS-9582	BC177B PNP 45V 100mA	0.15	0.10	0.05
ZS-9583	BD679 NPN 80V 4A	1.00	0.80	0.70

DIODE SALE

Shown below are some amazing values in rectifiers and diodes.
Get in for your chop now! Once again prices INCLUDE sales tax!

Cat. No	Description	1-9	10-99	100+
ZS-9540	G3010 DO-4 <1000V 6A Rect.	0.40	0.30	0.20
ZS-9541	F22 DO-13 200V 2A Rect.	0.10	0.08	0.05
ZS-9542	FD333 125V 300mA diode		$3/hundred	
ZS-9543	BZX79 & C6V2 400mW Zener	0.20	0.15	0.10
ZS-9544	BZX79 C12 400mW	0.30	0.25	0.20
ZS-9545	RP1020 20A 100V Rect. DO-5 stud	1.50	1.20	1.00
ZS-9546	ZPD39 39V 500mW Zener 5%	0.20	0.15	0.10
ZS-9547	ZPD62 62V 500mW Zener 5%	0.20	0.15	0.10
ZS-9548	ZPD33 33V 500mW Zener 5%	0.20	0.15	0.10
ZS-9549	ZPD47 47V 500mW Zener 5%	0.20	0.15	0.10
ZS-9550	ZPD56 56V 500mW Zener 5%	0.20	0.15	0.10
ZS-9551	ZPD27 27V 500mW Zener 5%	0.20	0.15	0.10
ZS-9552	BZTO3 C62 62V 1.3W Zener	0.20	0.15	0.10
ZS-9553	AAZ18 Diode	0.20	0.15	0.10
ZS-9554	Zener 22V 5% 10 watt	2.00	1.50	1.00
ZS-9555	ZAA119 Diode pair	0.30	0.20	0.15
ZS-9556	1N748A 3.9V 400mW Zener	0.20	0.15	0.10
ZS-9557	1N5062 800V 1A Diode	0.20	0.15	0.10
ZS-9558	PFZD68 68V Surge Supp Zener	1.00	0.80	0.60
ZS-9559	BAT42 uWave Mixer Diode	1.00	0.80	0.60

JAYCAR JAYCAR

JAYCAR JAYCAR

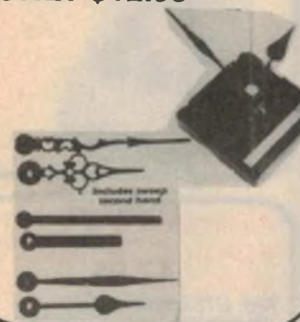
QUARTZ CRYSTAL CLOCK MOVEMENT

• Very compact • Self starting one-second stepping motor has strong torque • Powered by one 1.5V AA battery that lasts for one year • ±15 second/month accuracy • 56mm square, 15mm deep

Fit your own custom clock face. Great for novel applications such as fitting to pictures etc. SUPPLIED WITH 3 SETS OF HANDS

Cat. XC-0100

ONLY $12.95

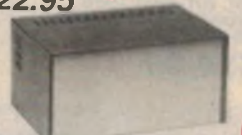


LARGE PROJECT BOX

Another box in our range of Kew Australian made boxes, as used in many projects. Ideal for large projects. Measuers 305mm wide 150mm deep and 200mm high.

Cat. HB-5468 NEW

$22.95



AUTO CABLE

Jaycar now stock 4mm auto cable, for all you weekend car buffs. Perfect for wiring up lights, horns, etc., in cars, trucks, bikes and caravans.

Available in 3 colours. Also great for heavy amp and power supply wiring. 28 strands each 0.3mm.

YELLOW Cat. WH-3070
ORANGE Cat. WH-3071
WHITE Cat. WH-3072

NEW

$18 per 30 metre roll

80¢ metre

MAINS MUFFLERS

This fully approved Electricity Authority unit is the ultimate mains suppression device. It is fitted with a circuit breaker and VDR's for extra suppression capacity. Nothing but clean 240V goes through.

RECOMMENDED FOR:
Computers - Printers - Disc Drives - VDU's - Videos - Medical Equipment

Max load 1000 watts 4 amps 250V.

TWO OUTLET Cat. MS-4040

$149.00

FOUR OUTLET Cat. MS-4042

$249.00 NEW

BUY AUSTRALIAN

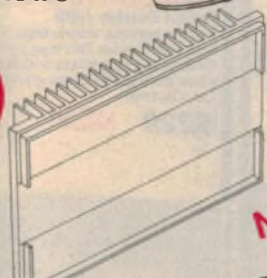
Heatsink Front Panel

This is the special DIECAST panel as used in the new AEM6000 power amp. It is available separately. It can also be used as the SIDES of a 4 unit rack case for high-power rack mount PA amps!

Cat. HH-8520

ONLY $49.95 each

NEW



NEW MODEM SENSATION!

ANOTHER JAYCAR SCOOP BUY!

We have purchased the entire remaining stock of the famous 'Cicada' 300 Baud modem. The modems are NOT mounted in the case nor do they include a telephone. The PCB is completely ASSEMBLED AND TESTED with all parts in place. You only have to connect 240V, your computer and a phone line and you're away!

FULLY APPROVED. This modem (when mounted in its case) holds Australian Telecom approval No. C83/37/1011. Kit modems - even ones designed to comply with Telecom regulations - are NOT Telecom approved. So why take risks? You can now have an approved modem for far less than the price of a kit!!

SPECS AND FEATURES

- 300 Baud FULL DUPLEX
- Answer originate
- Telecom approval C83/37/1011
- CCITT V.21
- Direct connect
- Double sided plated thru board
- Fully assembled and tested

We only have limited quantities so be quick to avoid disappointment.

Cat. XC-4810

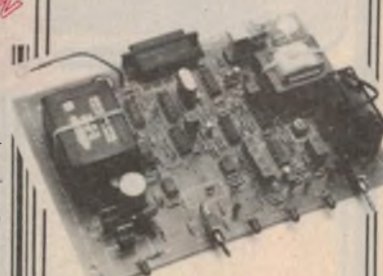
Were selling for $299

ONLY $49.50

Plastic case to suit Cat. HB-5912 **$14.95**

Illustration shows Cicada modem as originally sold. Note that the modem offered is for the assembled and tested PCB only and does NOT include case or telephone. No other electronic components are needed however

TELECOM APPROVED



TURN YOUR SURPLUS STOCK INTO CASH!!

Jaycar will purchase your surplus stocks of components and equipment. We are continually on the lookout for sources of prime quality merchandise.

CALL GARY JOHNSTON OR BRUCE ROUTLEY NOW (02) 747 2022

PHONE TODAY!

MEMOREX 5½" DISCS

Quality discs in a handsome plastic storage box.

Single Sided Double Density - Box 10
Cat. XC-4751 **$27.95**
(includes box worth $4.95)

Double Sided Double Density - Box 10
Cat. XC-4756 **$29.95**
(includes box worth $4.95)

Storage boxes on their own
Cat. XC-4758
$4.95 NEW

SILICON VALLEY POSTER

Normally $9.95

NOW ONLY $4.50

P&P 50¢
Supplied folded

½PRICE

This is a full colour poster measuring 760(w) x 575(h)mm and is a full map of the famous Silicon Valley area south of San Francisco. The poster is full of cartoon characters and statements. You could stand in front of it for an hour and not take it all in. It is printed on very heavy art quality paper.

Cat. BP-9220

TOP VALUE

NEW STUNNING CAPACITOR BARGAINS NEW

We have made a buy of Military/Telecommunications grade Tantalum and Aluminium electros.

Cat. RE-5990 10,000uF 16V axial electro
1-9 $3.00 10 up $2.00

Cat. RZ-6690 15uF/20V axial mil. grade tant.
1-9 $1.50 10 up $1.20

Cat. RZ-6691 22uF/35V axial mil. grade tant.
1-9 $1.75 10 up $1.50

Cat. RZ-6692 47uF/35V axial mil grade tant.
1-9 $2.25 10 up $1.75

REMEMBER! The tantalums are -25 +125°C. Hermetically sealed metal can types - not cheap dipped resin.
*MIL-C-39003

GOT A SWEET TOOTH?

All Jaycar's stores now have a jar full of lollies on the counter for customers to help themselves while they wait to be served.

Judging by your reactions so far we think it's a good move, so have a lolly on us.

PRICE INCREASES

As a result of the continuing depreciation of the $A prices of many goods have inevitably risen. We notice that some competitors have increased their prices already. We wish to ensure our customers that Jaycar will only increase prices as cost increases are forced upon us.

We are not here to rip you off.

Universal TO-3 Transistor Mounting Bracket

Mounts 4 x TO-3 devices on pre-punched heavy duty right angle bracket. Hole pattern conforms to most popular PCB designs for amp kits.

Cat. HH-8500

VALUE $2.50

SCART PLUG

This new addition to our plug range is being used more in video and computer applications. 21 pins.

Cat. PP-0910

ONLY $4.75 NEW

PENLIGHT NiCads

Don't keep wasting money buying throwaway batteries - step up to rechargeable NiCads.

SUPERB "ROCKET" BRAND
AA PENLIGHT 450mAh

Cat. SB-2452

$2.95 each

SPECIAL 4 for $10

JAYCAR JAYCAR

JAYCAR JAYCAR

JAYCAR No.1 FOR NEW KITS

RS232 TO COMMODORE
Ref: ETI July 1986
Supplied without Commodore edge connector.
Cat. KE-4722
$14.95 NEW

PHONE CONTROLLER
Ref: EA June 1986
Cat. KA-1672
$55.00 NEW

LIGHT SAVER
Ref: EA June 1986
Supplied without plate and epoxy.
Cat. KA-1670
$14.99 NEW

DIGITAL SAMPLER
ETI 142
Cat. KE-4720
$119.00 NEW

SCREAMER CAR ALARM
NEW
Ref: EA August 1986
Incorporates two sensors and utilizes a piezo screamer inside car.
Cat. KA-1675
SHORT FORM
$32.50
Includes Piezo

TELEPHONE SCREAMER
See ETI October 1986
If you are bothered by annoying or obscene calls, hit the button and the caller will be deafened by a loud scream. Makes a nice gift for the woman who is perhaps on her own.
Cat. KE-4726
$24.95 NEW
Double Adaptor $7.50

HIGH POWER ELECTRIC FENCE
See EA October 1986
The two previous electric fence projects have been very popular. This high power version is for those big jobs. Works well in conditions where there is a lot of wet grass near fence.
Cat. KA-1678
$229 NEW

PARAMETRIC EQUALISER MODULE
NEW
Ref: ETI August 1986
This module can be used on its own or in gangs as effects units and also in synchronous sweep effects
Cat. KE-4724 **$23.50**

TURBO TIMER
See EA Sept 1986
A simple sensor system to prevent the car ignition being turned off before the Turbo unit has cooled down (approx. 90 seconds). A must for those with turbo charged cars.
GREAT INSURANCE AGAINST A COSTLY TURBO FAILURE!
Cat. KA-1679
$29.95

SOLDERING IRON TEMPERATURE CONTROLLER
See ETI Sept. 1986
A variable control using diodes. No transformer required, soldering iron connects through this to power outlet. Simple to install.
Cat. KE-4725
ONLY $25.00

AEM 6000 POWER AMP
- 240W RMS (total) into 8 ohms!!
- 80,000 uF power supply filtering!
- 2 x 300VA Toroids
- Massive diecast heatsink front panel
- Speaker protection
- Power amp status monitor circuit

Here it is at last, the ***ULTIMATE*** Hi Fi Mosfet power amp. David Tillbrook's latest creation of genius. This massive power amp is likely to set the standard for other Hi Fi amps to reach.
In keeping with the quality design the Jaycar kit is faithful to the final prototypes. We commissioned a special ***DIE CAST*** heatsink front panel especially for the project which is exclusive to Jaycar. The prepunched rugged metal cabinet is as per the design. We are totally confident that you will be delighted with this kit, which is absolutely complete!
Cat. KM-3032
P.O.A.

VIFA SPEAKERS
This new Vifa/EA speaker kit is especially designed for use with the new Playmaster 60+60 amplifier. The kit includes 8" woofers, dome tweeters, crossovers and cabinets. Sealed box design of 15 litres volume. Great sounding speakers at a very affordable price. 60 watts rms handling.
See EA Sept. 1986
ONLY $449
Cat. CS-2470
Complete speakers and cabinets

TELEMAIL PHONE NUMBERS
(008) 022 888
TOLL FREE
FOR ORDERS ONLY
(02) 747 1888
HOTLINE

JAYCAR No.1 FOR HI FI KITS

PLAYMASTER 60+60
High quality, low priced stereo amplifier from Electronics Australia.
See EA May, June, July 1986
ONLY $249

AUSTRALIAN MADE

JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR JAYCAR

INTELLIGENT MODEM ETI 684

See ETI June, July, August 1986

The Ultimate Modem

AUSTRALIAN MADE

Features:

- V21 300/300 full duplex
- V23 1200/75 half duplex
- Automatic baud rate selection on reception (auto bauding)
- Other standards found overseas like Bell 103 and other 600/600 and 1200/1200 standards are supported by the hardware
- Intelligent auto answer
- Intelligent auto dialling
- Fully software driven
- 48K RAM buffer
- Cassette interface under Viatel standard control
- Software controlled loudspeaking
- Responds to industry standard Hayes commands
- Especially tailored for use by both professional and hobby users.

INTRODUCTORY OFFER
BUY BOTH FOR **$419**

MODEM $379.50
Cat. KE-4716

POWER SUPPLY $49.95
Cat. KE-4715

"RAILMASTER" PULSE-POWER TRAIN CONTROLLER

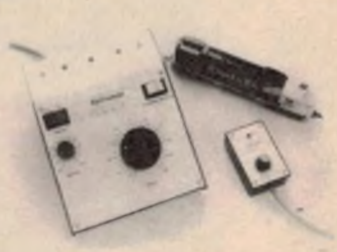
Ref: EA September 1984

This is a state-of-the-art train controller offering tremendous features:

- Variable simulated inertia
- Full short circuit protection including both audible and visual indicators
- Adequate power for double and triple heading locos
- Fixed 12V DC and 15V AC power for lighting and accessories
- Optional walk-around throttle

Cat. KA-1560

ONLY $99.95



Optional Walk-around Controller
Cat. KA-1559
$11.95

Diesel Sound Simulator
Cat. KA-1561
$22.50

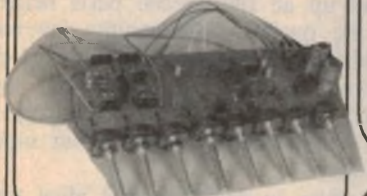
Steam Sound Simulator
Cat. KA-1562
$22.50

ETI 467 MIXER PREAMP

Ref: ETI July 1980

Ideal companion for power amp modules. Mixes up to 4 inputs (high and low level) with individual level controls. High performance 3 band tone controls. Kit comes complete with case. Operates from 2 x 15V AC (use power amp supply or Cat. MM-2008 transformer).
For full specifications check Jaycar's 1986 Catalogue.
Cat. KE-4014

JUST $37.50



8 CHANNEL AUDIO MIXER JAYCAR 8002

A balanced input/output 8 channel mixer with features found in units costing well over $2,000!!
MAIN FEATURES: • Balanced (600 ohm) mic inputs/line inputs • Input attenuators • Cannon connectors included in the price • Bass, mid and treble equalisation on each input • "effects" i.e. echo, etc capability • Foldback on all 8 inputs • Stereo pan on all 8 inputs • 60mm slide faders used throughout • 19" rack mount capability (or console mount) • Professional black front panel with format borders and multi-coloured knobs to assist function indentification • Designed for quick and easy service • VU metering • Only high quality components used • 5534A OP amps used for low noise and very low distortion.
Cat. KJ-6504

ONLY $595

AUSTRALIAN MADE

A TOP CLASS AUDIO KIT FROM JAYCAR

ETI 480 SERIES AMP MODULES

Ref: ETI Dec 1976 & ETI's 30 Audio Projects

ETI 480/100

A complete audio amplifier on a single board. Just add a power supply and you'll have a Hi Fi, musical instrument or PA amp! Use it with the KE-4014 Mixer/Preamp.
Kit contains metal bracket, all PCB items and instructions.
Cat. KE-4052

ONLY $29.50

ETI 480/50

Same circuit as above less one output transistor. Great if you don't need 100 watts - 50 watt unit.
Cat. KE-4050

ONLY $25.00

Suitable transformer 28-0-28V @ 2A
Cat. MF-1095 $34.50

POWER SUPPLY
Cat. KE-4048
$25.00

AUSTRALIAN MADE

INFRA RED REMOTE CONTROL SYSTEM

The system comprises two basic components; the handheld transmitter and the receiver. The handheld transmitter is supplied in an attractive plastic case and is powered by a 9V battery. It has a range of approximately 10 metres.
The receiver consists of a circuit board measuring 110(L) x 55(W)mm and requires 9 - 12V DC. Both units use a proprietary Hitachi encoder/decoder IC set to preclude false triggering by daylight, sparks, flashes, etc.
The receiver output is by relay with N.O. or N.C. output. The relay is NOT 240V AC mains rated but will switch considerable DC loads i.e. 5 amp (resistive) at 12 - 24V or up to 100V AC. An on-board switch configures the unit to either operate only while the transmitter switch is held 'on' or alternatively in latch mode i.e. press transmit button and switch 'on', press again to switch 'off'.
P.S. It also works as an event counter.
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Ref: AEM February 1986

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New design for long fence runs

High energy electric fence

For very long fence runs, say 1km or more, our previous electric fences are inadequate. This new design has a much lower output impedance so that it can drive long fence runs. It's our "industrial strength" model.

by COLIN DAWSON

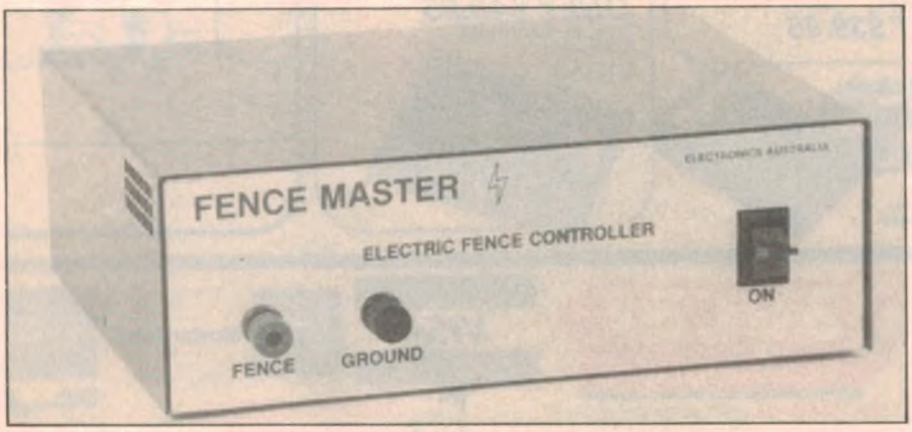
Our previous electric fences have been compact, inexpensive designs with low current drain — the sort of thing you might use to protect a vegetable patch or around an aviary to keep the cats away. And, of course, they were quite suitable for livestock control on farms, provided the fence run was kept short.

That was where the problem came in. From the spate of enquiries we received following publication of our Electric Fence Controller in the December 1985 issue, it was obvious that many farmers required something for use in the wide open spaces — in short, something that could power a fenceline several kilometres long.

This requires a circuit with substantially more "punch" than our previous designs. Our new Fence Master can deliver this punch — a high-energy open-circuit 5kV punch to be exact. These voltage punches are delivered at a nominal 1Hz rate and have an open-circuit pulse duration of about 0.4ms.

But perhaps the most important parameter in an electric fence is the output impedance. This must be kept low to stop the output voltage from drooping due to loading effects along the fenceline. This loading down of the output voltage can be caused by such things as wet grass or dirty insulators, and is one of the main factors affecting range.

Our new Fence Master has really low output impedance to minimise loading effects. So, if you want a really potent electric fence for long fence runs, this is the one to go for.



The Fence Master will require weather-proofing for field operations.

Special parts

The biggest obstacle in achieving a reasonably high power output is that it requires parts which are not normally available off the shelf from component retailers. The main problem was the output transformer — a suitable design simply didn't exist!

Rather than compromise with less than ideal components, we decided to round up all the special parts needed for the project. This mainly involved tracking down a special high-voltage capacitor. As for the transformer, we solved that problem by arranging to have a new design wound to our specifications.

In order to determine the ideal type of output transformer, we experimented with various 'customised' mains transformers (ie, with half the winding ripped out). And although we eventually achieved reasonable characteristics, the output voltage rating ruled out this approach for the final version. With an output in the order of kilovolts, the voltage gradient between adjacent windings had to be considered.

An electric fence output transformer requires a layer-wound secondary, with insulating leaves between layers. Fortunately, Jones Transformers came to the party and will be supplying the JT349 transformer especially for this project.

The high-voltage capacitor problem was solved by Plessey who manufacture a capacitor specifically for electric fences. It is rated at 900V and has a capacitance of 30μF — a brutish component if ever there was one. It should be handled with care — touching the terminals of a fully-charged capacitor could be fatal.

Having stored away nearly a Joule of energy, the next problem is to unleash it instantly. An SCR is the obvious choice, but no ordinary SCR will do. We eventually selected the Philips BTY91-800R to do the job, although the Marconi CR20-U08JY can be directly substituted. Both are rugged stud-mounted devices rated at 800V.

In addition to the stiff requirements imposed by the electrical nature of the circuit, the Australian Standards Association also have a say. The most important considerations are peak output voltage, pulse width and repetition rate. Our Fence Master conforms to the requirements laid down by the SAA.

Circuit description

Despite using some specialised components, the design of our electric fence is conventional. The battery voltage feeds into an inverter which steps it up to 250V. A capacitor is charged to this voltage and once every second is discharged into the primary of the output transformer which steps it up to 5kV.

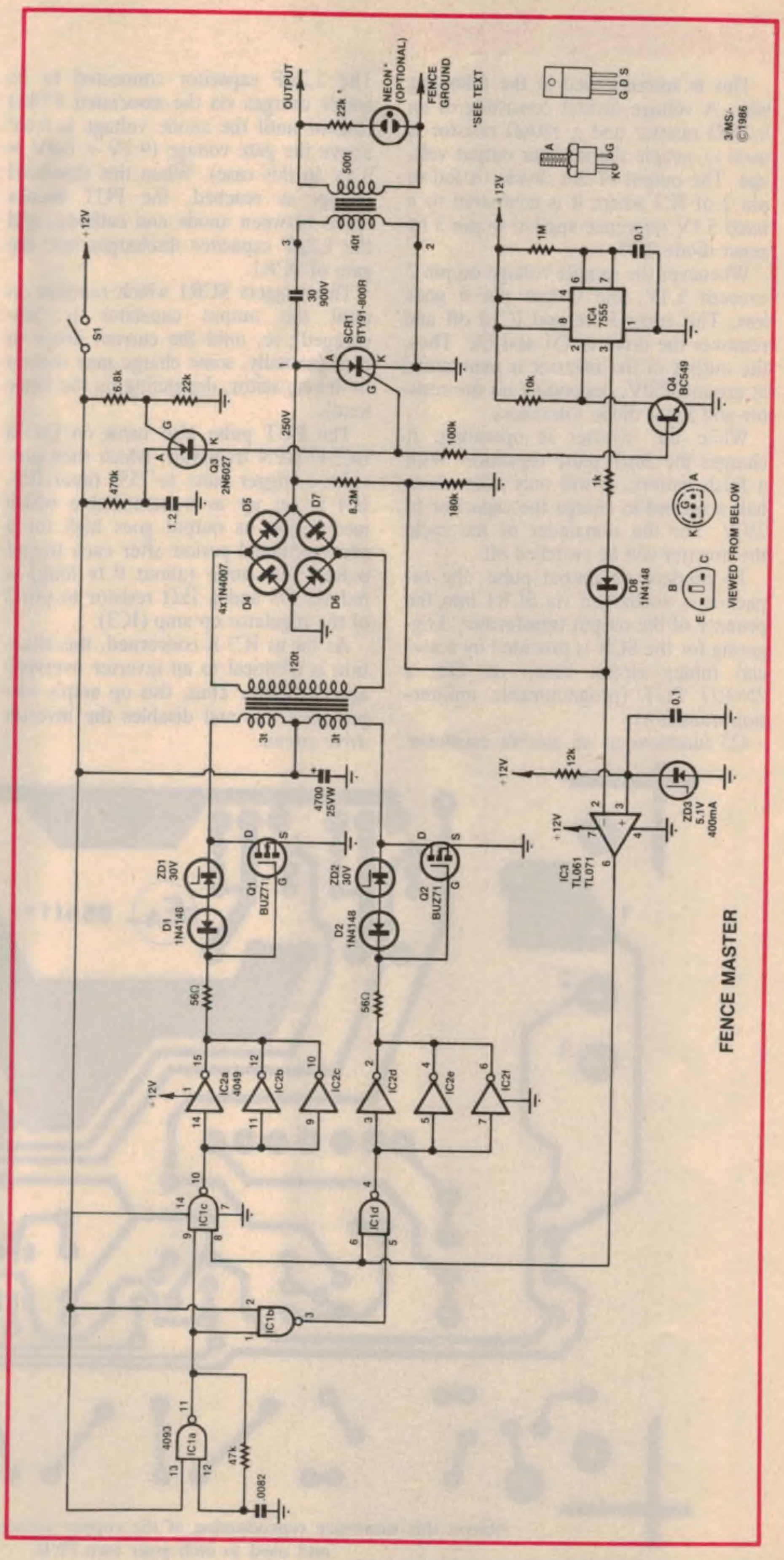
The inverter clock is formed by IC1a which is a 4093 CMOS Schmitt NAND gate. This is set up to oscillate at about 23kHz and its output is fed to pin 1 of IC1b and pin 9 of IC1c.

IC1b functions as an inverter, changing the phase of the signal by 180° before feeding it to pin 5 of IC1d. This means that IC1c and IC1d are fed with complementary drive signals and these signals switch transistors Q1 and Q2 in the inverter circuit via buffer stages IC2a-IC2d.

The remaining inputs of IC1c and IC1d, pins 5 and 8, are connected together and fed with a gating signal from the output of IC3. This gating signal provides output voltage regulation. When the gating signal is high, Q1 and Q2 are driven by complementary square wave signals at 23kHz. When the gating signal is low, both transistors are turned off.

Q1 and Q2 each drive one half of the split primary winding of the inverter transformer. Because the drive signals are 180° out of phase, 12V peak-to-peak is impressed across each half-primary winding and the primary voltage is 24V RMS. This voltage is stepped up by the transformer turns ratio (120:3) to give a nominal 960V peak-to-peak across the secondary.

This secondary voltage is now applied to bridge rectifier D4-D7 to give a nominal 960V output. But we don't want 960V. We only want 250V, so we turn the inverter off whenever the DC output voltage rises above 250V.



Electric fence

This is accomplished in the following way. A voltage divider consisting of an 8.2MΩ resistor and a 180kΩ resistor is used to sample the inverter output voltage. The output of this divider is fed to pin 2 of IC3 where it is compared to a fixed 5.1V reference applied to pin 3 by zener diode ZD3.

Whenever the sample voltage on pin 2 exceeds 5.1V, the output pin 6 goes low, This turns IC1c and IC1d off and removes the drive to Q1 and Q2. Thus, the output of the inverter is maintained at around 250V, depending on the resistor and zener diode tolerances.

While the inverter is operating, it charges the 30μF pulse capacitor. With a fresh battery, it will only take about half a second to charge the capacitor to 250V. For the remainder of the cycle the inverter will be switched off.

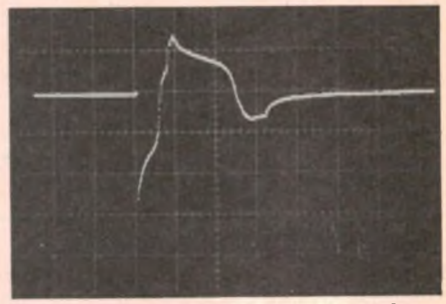
To produce an output pulse, the capacitor is discharged via SCR1 into the primary of the output transformer. Triggering for the SCR is provided by a special timing circuit based on Q3, a 2N6027 PUT (programmable unijunction transistor).

Q3 functions as an astable oscillator. The 1.2μF capacitor connected to its anode charges via the associated 470kΩ resistor until the anode voltage is 0.6V above the gate voltage (9.2V + 0.6V = 9.8V in this case). When this threshold voltage is reached, the PUT breaks down between anode and cathode, and the 1.2μF capacitor discharges into the gate of SCR1.

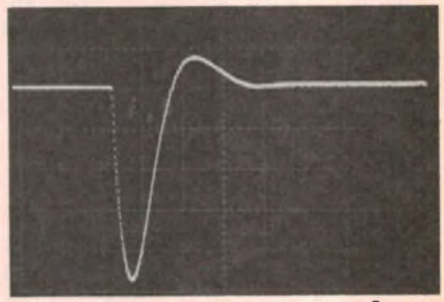
This triggers SCR1 which remains on until the output capacitor is 'discharged'; ie, until the current drops to zero (actually, some charge may remain in the capacitor, depending on the fence load).

The PUT pulse also turns on Q4, a BC549 NPN transistor, which then provides a trigger pulse to 7555 timer IC4. IC4 is set up as a monostable which means that its output goes high for a predetermined period after each trigger pulse. This pulse (about 0.1s long) is fed via D8 and a 1kΩ resistor to pin 2 of the regulator op amp (IC3).

As far as IC3 is concerned, this situation is identical to an inverter overvoltage condition. Thus, this op amp's output goes low and disables the inverter drive circuit.

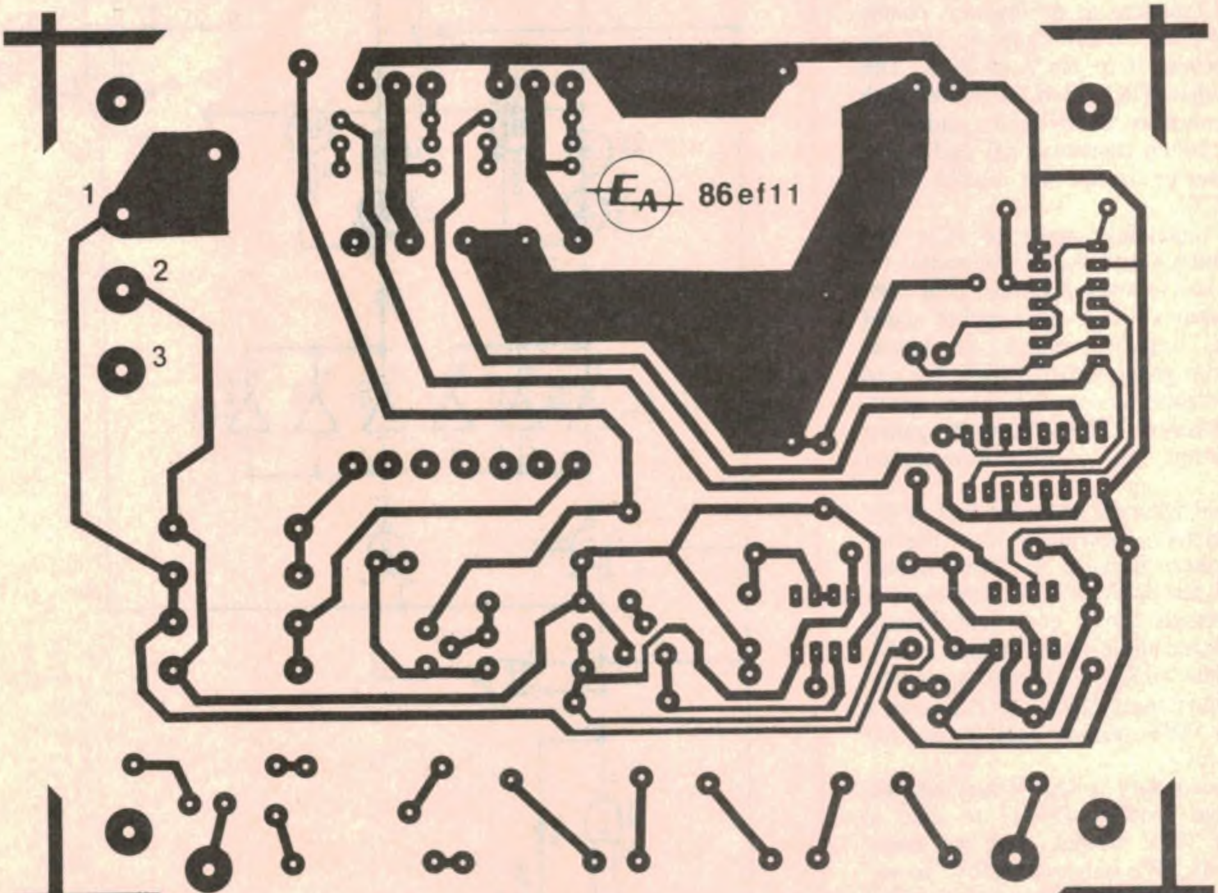


Above: open-circuit output waveform. (CRO settings — 2kV/div and 0.1ms).



Above: output waveform into a 500Ω load. (CRO settings — 400V/div and 0.1ms).

So why has this been done? The answer is that we need to turn the inverter off for a brief period after each output pulse to ensure that the SCR turns off (remember that the current through the



Above: this same-size reproduction of the copper pattern can be copied and used to etch your own PCB.

SCR must be reduced to zero before it will switch off). This technique also ensures that the inverter does not feed into the virtual short circuit when the SCR conducts.

With the output terminals open circuit, the output pulse from T2 lasts for about 0.4ms. This includes a substantial amount of ringing after the first half cycle.

Note that a damping network consisting of 10 2.2kΩ resistors wired in series has been connected across the output of T2. It may seem odd that we have connected such a load across the output of the fence controller, but there is a sound reason for it. Without this load, the output pulse will exhibit a very short (20μs) spike about 2kV above the nominal level. Thus, to conform to AS3129, the circuit would have had to be 'detuned' to reduce this spike.

Unfortunately, this would also reduce the remainder of the pulse to a much less formidable level.

Rather than detune the whole circuit, it makes more sense to get rid of any initial transient which is well above the nominal level. This, in turn, allows the transformer to be driven harder so that a substantial part of the pulse is at a high voltage.

Because the transformer is driven with such a solid pulse, it holds up well under load. Note that the damping network does not reduce the voltage appearing across an external 500Ω load. There would be no gain in omitting it.

Finally, a neon indicator can be connected in series with the damping network if required. This would verify that a high voltage pulse is present at the output of T2. It should not be regarded as a guide to power output.

Construction

Most of the parts are mounted on a printed circuit board (PCB) coded 86ef11 and measuring 145 x 114mm. This is housed in a standard metal cabinet measuring 269 x 222 x 90mm. A Scotchcal front panel was used to give the unit a professional appearance.

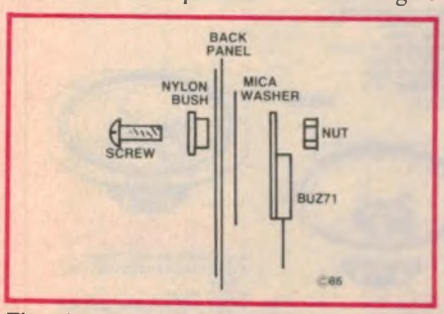


Fig 1: mounting details for mosfet transistors Q1 and Q2.

Before commencing assembly, make sure that the mounting holes for the SCR and the inverter transformer (T1) are large enough. The SCR needs a hole of 6.5mm, while the transformer mounting holes need to be about 1.7mm.

When the hole sizes are correct, use the PCB to mark out the standoff holes on the bottom of the cabinet. These holes should then be drilled to suit the plastic standoffs supplied.

Attention can now be turned to the PCB assembly. No particular procedure need be followed but we suggest that you mount the smaller components first, leaving T1 and the SCR until last. Note that there are four wire links (three if you include the neon indicator).

Make sure that you install the transistors, ICs, diodes and the electrolytic capacitor with the correct orientation. Also, mount transistors Q1 and Q2 at full lead length; this makes it easier to screw them to the back panel for heatsinking.

The SCR requires two insulated wire connections to the PCB in addition to its stud type anode. One of these is the cathode, which is connected to terminal 2 on the PCB, while the other is the gate, which is connected to a pad near the SCR at the back of the board.

Note that terminals 1, 2 and 3 on our prototype do not correspond to those on the wiring diagram. The reason for this is that the PCB was subsequently rearranged slightly to improve the layout.

Terminals 1, 2 and 3 on the PCB, and the two high voltage connections, are all fitted with 3mm machine screws as terminal posts. These screws are passed upwards through the board and each locked in place with a single nut (this can be soldered if you want to ensure its security). Each terminal then has two leads connected to it via solder lugs and these are retained using additional nuts.

This was by far the cheapest method of obtaining high voltage, high current terminals.

Now for the inverter transformer. This is wound on a Siemens B66274-B1011-T1 former fitted with two B66339-G-X127 ferrite cores.

The primary is wound first, with each half wound separately using three turns of 1mm enamelled copper wire. The second half should be wound directly over the first at one end of the former and both windings should be in the same direction. One winding terminates on pins 1 and 2 (see wiring diagram).

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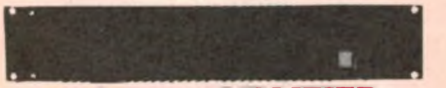

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SERIES 5000 POWER AMP
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SPECIAL, ONLY $329
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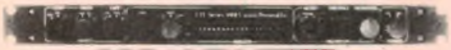
...designed and developed by ROD IRVING ELECTRONICS and is being supplied to other kit suppliers.

SPECIFICATIONS: 150 W RMS into 4 ohms
POWER AMPLIFIER: 100W RMS into 8 ohms (+ − 55V Supply)
FREQUENCY RESPONSE: 8Hz to 20Hz +0 = 0.4 dB 2.8Hz to 65KHz, +0 = 3 dB. NOTE: These figures are determined solely by passive filters
INPUT SENSITIVITY: 1 V RMS for 100W ouput
HUM: 100 dB below full output (flat)
NOISE: 116 dB below full output (flat, 20KHz bandwidth)
2nd HARMONIC DISTORTION: ·0.001% at 1 KHz (0.0007% on Prototypes) at 100W ouput using a + = 56V SUPPLY rated at 4A continues ·0.0003% for all frequencies less than 10KHz and all powers below clipping.
TOTAL HARMONIC DISTORTION: Determined by 2nd Harmonic Distortion (see above)
INTERMODULATION DISTORTION: 0.003% at 100W (50Hz and 7KHz mixed 4:1)
STABILITY: Unconditional

Cat. K44771 .... **$359**
Assembled and tested $549
packing and post $10



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SPECIAL, ONLY $299
SAVE $20

...We believe that dollar for ... a commercial unit available that sounds as good!)

SPECIFICATIONS:
FREQUENCY RESPONSE: High-level input: 15Hz − 130KHz, +0 = 1dB
Low-Level input-conforms to RIAA equalisation + = 0.2dB
DISTORTION: 1KHz ‹0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation)
S/N NOISE: High-Level input, master full, with respect to 300mV input signal at full output (1.2V)·92dB flat ·100dB A-weighted, MM input, master full, with respect to full output (1.2V) at 5 mV input 50ohms source resistance connected ·86dB flat/92dB A-weighted MC input, master full, with respect to full output (1.2V) and 200uV input signal: ·71dB flat ·75dB A-weighted.

Cat. K44791 .... **$319**
Assembled and tested $599
packing and postage $10

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS:
BANDS: 28 Bands from 31.5Hz to 16KHz
NOISE: ·0.008mV, sliders at 0, gain at 0(=102dB...
20KHz BANDWIDTH DISTORTION...
sliders at 0, gain at 0...
FREQUENCY...

SPECIAL, ONLY $209
SAVE $10

...unit **$219**
$429
packing and postage $10

SERIES 4000 SPEAKERS

8 Speakers .... only $549
8 Speakers with Crossovers $795
Speaker Cabinet Kit (complete) $395
(Please specify cabinet to suit 7" or 8" mid range woofer)
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Complete kit of parts (speakers, crossovers, screws, innerband boxes.) $1,095
Assembled, tested and ready to hook up to your system $1,295
(Approximately 4 weeks delivery)

Errors and Ommissions Excepted

VIFA/AEM 2 WAY SPEAKER KIT!

This exciting new speaker kit, designed by David Tillbrook (a name synonymous with brilliant design and performance) uses VIFA's high performance drivers from Denmark. You will save around $800 when you hear what you get from this system when compared to something you buy off the shelf with similar characteristics. Call in personally and compare for yourself!

The system comprises...
2 x P21 Polycone 8" woofers
2 x D25T Ferrofluid cooled dome tweeters with Polymer diaphrams
2 pre-built quality crossovers

The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbond, grill clips, speaker terminals, screws and ports.

D25T SPEAKER SPECIFICATIONS
Nominal Impedance: 6 ohms
Frequency Range: 2 - 24kHz
Free Air Resonance: 1500Hz
Operating Power: 3.2 watts
Sensitivity (1W at 1m): 90dB
Nominal Power: 90 Watts
Voice Coil Diameter: 25mm
Air Gap Height: 2mm
Voice Coil Resistance: 4.7ohms
Moving Mass: 0.3 grams
Weight: 0.53kg

P21 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 26 - 4,000Hz
Free Air Resonance: 33Hz
Operating Power: 2.5 watts
Sensitivity (1W at 1m): 92dB
Nominal Power: 60 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5.8ohms
Moving Mass: 20 grams
Thiele/Small Parameters: Qm: 2.4, Qe: 0.41, Qt: 0.35, Vas: 80.1

Weight: 1.65kg

Speaker Kit Cat.K30021 **$499**
Cabinet Kit Cat.K30022 **$189**
All Together Cat.K30023 **$599**
(Save 79!)

VIFA/AEM 3 WAY SPEAKER KIT!

This superb 3 way speaker kit competes with systems that cost 2 - 3 times the cost of these units! (which may even be using VIFA drivers etc.) Never before has it been possible to get such exceptional value in kit speakers! Call in personally and compare for yourself!

The system comprises...
2 x D19 dome tweeters
2 x D75 dome midrange
2 x P25 woofers
2 x pre-built quality crossovers

The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbond, grill clips, speaker terminals, screws and ports.

D19 DOME TWEETER SPEAKER SPECIFICATIONS
Nominal Impedance: 8 ohms
Frequency Range: 2.5 - 20kHz
Free Air Resonance: 1,700Hz
Sensitivity 1W at 1m: 89dB
Nominal Power: 80 Watts (fo: 5,000Hz, 12dB/oct)
Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2ohms
Moving Mass: 0.2 grams
Weight: 0.28kg

D75 DOME MIDRANGE SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 350 - 5,000Hz
Free Air Resonance: 300Hz
Sensitivity (1W at 1m): 91dB
Nominal Power: 80 Watts (fo: 500Hz, 12dB/oct)
Voice Coil Diameter: 75mm
Voice Coil Resistance: 7.2ohms
Moving Mass (incl. air): 3.6 grams
Weight: 0.65kg

P25 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 25 - 3,000Hz
Free Air Resonance: 25Hz
Operating Power: 5 watts
Sensitivity (1W at 1m): 89dB
Nominal Power: 60 Watts
Music Power: 100 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5.7ohms
Moving Mass (incl. air): 44 grams
Thiele/Small Parameters: Qm: 3.15, Qe: 0.46, Qt: 0.40, Vas: 180.1

Weight: 1.95kg

Speaker Kit Cat.K90000 **$779**
Cabinet Kit Cat.K90000 **$309**
All Together Cat.K90000 **$989**
(Save a huge 110!)

SUPERB NEW VIFA/EA 60 + 60 SPEAKER KIT!

The new Vifa/EA 60 + 60 loudspeaker kit has been designed to completely out perform any similarly priced speakers. This is a 2-way design incorporating drivers which give a deeper, more natural bass response and 19mm soft-dome ferro fluid cooled tweeters which provide clear, uncoloured sound reproduction.

These Vifa drivers are identical to the ones used in such fine speakers as Mission, Rogers, Bang & Olufsen, Monitor Audio and Haybrook just to name a few. Some of which cost well over $1,000 a pair!

The dividing network is of the highest quality and produce no inherent sound characteristics of their own, they simply act as passive devices which accurately distribute the frequency range between both drivers in each speaker.

The fully enclosed acoustic suspension cabinets are easily assembled. All you need are normal household tools and a couple of hours and you've built yourself the finest pair of speakers in their class!

D19 TWEETER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 2.5 - 20KHz
Free Air Resonance: 1,700Hz
Sensitivity 1W at 1m: 89dB
Nominal Power: 80 Watts (fo: 5,000Hz, 12dB/oct)
Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2 ohms
Moving Mass: 0.2 grams
Weight: 0.28kg
Cat. C10301 .... **$38**

C20 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 35 - 6,000Hz
Resonance Frequency: 39Hz
Sensitivity 1W at 1m: 90dB
Nominal Power: 50 Watts (12dB/oct)
Voice Coil Diameter: 25mm
Voice Coil Resistance: 5.5 ohms
Moving Mass: 15 grams
Cat. C10322 .... **$89**
Cat. K86091 .... R.R.P. **$449**
Special Introductory offer ... **$399**

PHILIPS SPEAKERS

"Unfortunately we cannot always guarantee Philips speakers to be in stock due to availability problems, nor can we guarantee the exact models listed. However, Philips equivalent or better will be supplied."
-Rod.

Description	Cat.No.	Price
AD01610T8	(C12030)	$24.95
AD02160SQ8	(C12040)	$69.95
AD80652W8	(C12042)	$69.95
AD070620M8	(C12045)	$69.95
AD12250W8	(C12050)	$129.00

CRYSTAL LOCKED WIRELESS MICROPHONE AND RECIEVER

MICROPHONE SPECIFICATIONS:
Transmitting Frequency: 37.1MHz
Transmitting System: crystal oscillation
Microphone: Electret condenser
Power Supply: 9V battery
Range: 300 feet in open field
Dimensions: 185 x 27 x 38mm
Weight: 160 grams

RECIEVER SPECIFICATIONS:
Recieving Freq: 37.1MHz
Output Level: 30mV (maximum)
Recieving System: Super heterodyne crystal oscillation
Power Supply: 9V Battery or 9V DC power adapter
Volume control
Tuning LED
Dimensions: 115 x 32 x 44mm
Weight: 220 grams
Cat. A10452 .... **$89**

HI FI SPEAKERS

A comprehensive range of matched appearance speakers, all with square silver grey frames and black cones - ideal for building up low cost speaker systems that will look and sound superb.

1½" TWEETER

SPECIFICATIONS:
Sensitivity: 90dB
Freq. Response: 1.2 - 20 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz
Cat. C10200 .... **$4.95**

2½" TWEETER

SPECIFICATIONS:
Sensitivity: 94dB
Freq. Response: 1.1 - 17 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz
Cat. C10202 .... **$5.95**

4" MIDRANGE WITH SEALED BACK

SPECIFICATIONS:
Sensitivity: 96dB
Freq. Response: 650 - 15 kHz
Impedance: 8 ohms
Power RMS: 15 watts
Magnet Weight: 3.6 oz
Cat. C10204 .... **$9.95**

4½" MIDRANGE WITH SEALED BACK

Clothed edge surrounds
SPECIFICATIONS:
Sensitivity: 97dB
Freq. Response: 600 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz
Cat. C10206 .... **$12.95**

6½" WOOFER

Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 96dB
Freq. Response: 55 - 7 kHz
Impedance: 8 ohms
Power RMS: 15 watts
Magnet Weight: 5.4 oz
Cat. C10208 .... **$15.95**

8" WOOFER RIBBED CONE

Cloth edge roll surround
SPECIFICATIONS:
Sensitivity: 94dB
Freq. Response: 55 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz
Cat. C10210 .... **$18.95**

10" WOOFER RIBBED CONE

Cloth edge roll surround
SPECIFICATIONS:
Sensitivity: 95dB
Freq. Response: 37 - 6 kHz
Impedance: 8 ohms
Power RMS: 25 watts
Magnet Weight: 10 oz
Cat. C10212 .... **$29.95**

12" WOOFER RIBBED CONE

Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 92dB
Freq. Response: 32 - 4 kHz
Impedance: 8 ohms
Power RMS: 30 watts
Magnet Weight: 13.3oz
Cat. C10214 .... **$39.95**

ECONOMY 4 CHANNEL MICROPHONE MIXER

Its size and simpliqty makes this mixer very portable and easy to operate.

SPECIFICATIONS:
- 4 low impedance 600 ohm microphone inputs
- Individual gain control for each microphone
- Master volume control
- Power on LED
- Inputs/Outputs - 6.3mm mono sockets
- DC operated (9V battery only)
- Input impedance 600 ohm
- Output impedance 1.5kohm
- Signal/noise ratio 55dB
- Frequency response 20Hz to 20kHz plus or minus 2dB
- Weight 320 grams
- Dimension 148 x 46 x 86mm
- Torque variable range 1-22dB
- Input sensitivity 1mV
- Output level 90mV (at input 5mV)
- T.H.D. 0.01%

Cat. A12001 .... **$39.50**

12" HIGH POWER MUSICAL SPEAKER

- Aluminium die cast chassis
- Carbon fibre impregnated cone paper
- Foam edge
- Light grey cone, silver dust cap
- High temperature "NOMEX" voice coil

SPECIFICATIONS:
Sensitivity: 97dB
Frequency Response: 50-4kHZ
Impedance: 8 ohms
Power RMS: 60 watt
Magnet Weight: 30 oz
Cat. C10216 .... **$59.95**

ULTRASONIC TRANSDUCERS

Designed to transmit at 40kHz (L19990) and receive at 40kHz (L19991) with up to 20V I/P on the transmitter. These units can't be heard and so are ideal for TV remote controls, water level detectors, burgalar alarms, motion detectors and information carriers as they can be either pulsed or used in the continuous wave mode.
Full specifications below for design purposes.
Maximum Input Voltage: 20V rms
Centre Frequency (kHz): 40 + - 1.0
Sound Pressure Level 10V RMS: 110dB min
Sensitivity (dB/v/ubar) min.: - 65 min.
Bandwidth (kHz):
Transmit: 4.0 (at 100dB)
Receiver: 5.0 (at - 73dB)
Impedance:
Transmit: 500
Receiver: 5000
Cat. L19990 (Transmitter) **$4.75**
Cat. L19991 (Receiver) **$4.75**

ECONOMY ROTARY SWITCHES

Cat. No.	Description		Price
S13021	1 pol 2-12 pos	$1.95	$0.95
S13022	2 pol 2-6 pos	$1.95	$0.95
S13033	4 pol 2-3 pos	$1.95	$0.95
S13035	3 pol 2-4 pos	$1.95	$0.95

75V RG ELECTROLYTICS

25% more microFarads!
10,000 uF (R16587) **$12.95**
8,000 uF (R16592) **$13.95**
Less $1.00 each for 10 or more!!

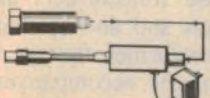
QUALITY RIGHT ANGLE TOGGLE SWITCHES

S11040 S.P.D.T. RA PCB **$1.95**
S11042 D.P.D.T. RA PCB **$2.25**

HIGH EFFICIENCY RADIAL FIN HEATSINK

Black anodised with a thick base plate, this radial fin heatsink can dissipate large amounts of heat for maximum efficiency. Designed by Rod Irving.

105x30mm Cat. H10520	$ 3.50
105x75mm Cat. H10525	$ 3.50
105x100mm Cat. H10529	$ 4.90
105x140mm Cat. H10534	$ 6.50
105x150mm Cat. H10535	$ 6.75
105x170mm Cat. H10538	$ 7.95
105x195mm Cat. H10542	$ 9.90
105x200mm Cat. H10543	$ 9.90
105x225mm Cat. H10546	$10.50
105x300mm Cat. H10549	$12.00
105x600mm Cat. H10560	$24.95



10dB IN-LINE COAXIAL AMPLIFIER

Reduces loss from splitters and long cable runs. Suitable for use with antennas, coaxial feed lines and VCR's. A/C adaptor included.
SPECIFICATIONS:
Frequency Range: 5-900MHz
Gain: 10dB
Power Requirements: 12V A/C Adaptor (included)
Input Impedance: 75 ohm
Output Impedance: 75 ohm
Cat. L15043 **$44.95**

IC SPECIALS!

	1-9	10+	100+
5558pin	0.50	0.40	0.35
4116	$3.95	$3.75	$3.50
4164	$2.95	$2.75	$2.50
2716	$5.90	$5.50	$5.50
2732	$6.25	$5.95	$5.50
2764	$6.25	$5.95	$5.00
27128	$6.95	$6.50	$6.25
6116	$2.95	$2.75	$2.50
41256	$5.95	$5.50	$4.95
6264	$6.50	$5.50	$5.25
27256	$11.50	$10.50	$10.00

WORLD MODEM CHIP

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MEL9501

Have you blown up your Apple drive by plugging it in backwards or not turning off the power while changing bauds? We have the MEL9501 chip!
SPECIAL, ONLY $29.95

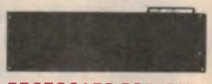
IC SOCKETS (LOW PROFILE)

How cheap can they go?

1+	10+	100+	1000+
8 Pin Cat.			
15c	14c	12c	09c
14 Pin Cat.			
16c	15c	14c	10c
16 Pin Cat.			
17c	16c	15c	11c
18 Pin Cat.			
18c	17c	16c	13c
20 Pin Cat.			
29c	28c	27c	26c
24 Pin Cat.			
35c	33c	32c	28c
40 Pin Cat.			
45c	40c	35c	30c

IC INSERTERS

14-16 pin T12187	$8.95
18-20 pin T12189	$8.95
24-28 pin T12191	$9.95
36-40 pin T12193	$9.95



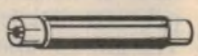
PROTOCARD FOR IBM*

- Size 335 x 101mm (approx.)
- 5,000 holes (approx.)
- 1mm diameter
- Double sided
- Plated through
- Solder pad both sides
- Gold plated edge connector

Cat. H19110 **$49.50**

EXTENDER CARD FOR IBM*

Now available! How long have you been waiting for one of these?
Cat. H19115 **$49.50**



TV INTERFERENCE FILTER

Cuts CB/Ham signals interference.
Cat. L11048 **$5.95**

UHF TO VHF TUNEABLE DOWN CONVERTER

Suits all TV's and allows VHF sets to watch and listen to SBS Channel 28
- Has built in amplifier to ensure no signal loss
- Tuneable UHF band 4/5 to VHF channel 1
- Power supply 12V DC 100mA (included)
- Allows TV without UHF to recieve on-air UHF signal or use VCR Video Game, Computer, etc

Cat. L15021 **$99**

RACK MOUNTING CABINETS

These superbly crafted rack cabinets will give your projects a real professional appearance.
- All dimensions conform to the International Standard.
- Aluminium construction.
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- Quality brushed finish anodised front panel.

A = Internal Height mm
B = Rear Width mm
C = Depth mm

A	B	C	Finish	Cat.No.	Price
38	430	254	Natural	H10401	$49.50
82	430	254	Natural	H10402	$59.50
126	430	254	Natural	H10403	$69.50
38	430	254	Black	H10411	$59.95
82	430	254	Black	H10412	$69.95
126	430	254	Black	H10413	$79.95

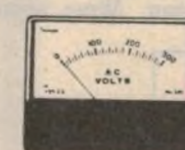
COMPUTER CABLE

CIC6 6 conductor computer interface cable. Colour coded with braided shield. (to IE422 specifications)
Copper conductor 6 x 7/0.16mm.
1-9 metres **$2.50/m** 10+ metres **$2.20/m**

CIC9.100 9 conductor computer interface cable. Colour coded with mylar shielding. 9 x 7/0.16mm.
1-9 metres **$2.95/m** 10+ metres **$2.75/m**

CIC12 12 conductor computer interface cable. Colour coded with mylar shielding. 12 x 7/0.16mm.
1-9 metres **$3.50/m** 10+ metres **$3.20/m**

CIC16 16 conductor computer interface cable. Colour coded with mylar shielding. 16 x 7/0.16mm.
1-9 metres **$4.50/m** 10+ metres **$4.10/m**



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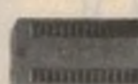
We have a great range of panel meters at great prices!

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



TEXTOOL SOCKETS

P17016 16 pin	$14.50
P17024 24 pin	$14.50
P17028 28 pin	$19.50
P17040 40 pin	$22.50

BRAND NEW FANS

Quality, new fans for use in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.
240V 4 5/8" Cat. T12461 **$12.95**
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10+ fans (mixed) only $10 each!

FAN GUARDS TO SUIT

4 5/8" Cat. T12471 **$3.95**
3 1/2" Cat. T12475 **$3.95**

WELLER WTCPN SOLDERING STATION

The WTCPN Features:
- Power Unit 240 V AC
- Temperature controlled iron, 24 V AC
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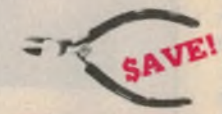
The best is always worth having.
Cat. T12500 R.R.P. $129
SPECIAL, ONLY $109

MICRO NIPPERS

Normally $13.95
Cat. T12050 **$11.95**



TRANSISTOR NIPPERS

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Cat. T12070 **$11.95**

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Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less for less chips).
Features include:
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- Mains powered
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- Dimensions 217 x 80 x 68mm

Without timer Cat. X14950
Special, only $79.95

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20 M/BYTE HARD DISK DRIVE FOR IBM* AND COMPATIBLES

Includes hard disk controller card.
Cat. X20010 WAS $1,250
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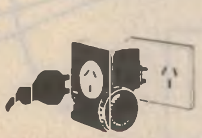

PROGRAMMABLE 24 HOUR TIME SWITCH

- 48 switching possibilities per day
- 240V AC 2400 watt 10 amp
- Suitable for turning on Heaters/Coolers, pool filter, electric blankets, cooking appliances, waking you, even making the coffee! lights etc for security while you're away from home!
- Bargain Price!

Cat. M22002 **only $19.95**

METEX MULTIMETERS

These instruments are compact, rugged, battery operated, hand held 3 1/2 digit multimeters. Dual-slope A-D converters use C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided.

METEX 3800 MULTIMETER

This instrument is a compact, rugged, battery operated hand held 3 1/2 digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, for testing Audible continuity and transistor hFE. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.
Features
- Push-button ON/OFF power switch
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection
- 1/2" high contrast LCD
- Automatic over-range indication with the "1" displayed
- Automatic polarity indication on DC ranges
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001"
- High Surge Voltage protection 1.5 KV-3 KV
- Diode testing with 1 mA fixed current
- Audible Continuity Test
- Transistor hFE Test

SPECIFICATIONS
Maximum Display: 1999 counts 3 1/2 digit type with automatic polarity indication
Indication Method: LCD display
Measuring Method: Dual-slope in A-D converter system
Over-range Indication: "1" Figure only in the display
Temperature Ranges: Operating 0-C to +40-C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)
Cat. Q91530 Normally $99.95
SPECIAL $89.95

METEX 3530 MULTIMETER

This instrument is a compact rugged, battery operated hand held 3 1/2 digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, Capacitance, Transistor hFE and Continuity Test. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.
Features
- Push-button ON/OFF power switch
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection
- 1/2" high contrast LCD
- Automatic over-range indication with the "1" displayed
- Automatic polarity indication on DC ranges
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001"
- High Surge Voltage protection 1.5 KV-3 KV
- Capacitance measurements to 1pF
- Diode testing with 1 mA fixed current
- Audible Continuity Test
- Transistor hFE Test

SPECIFICATIONS
Maximum Display: 1999 counts 3 1/2 digit type with automatic polarity indication
Indication Method: LCD display
Measuring Method: Dual-slope in A-D converter system
Over-range Indication: "1" Figure only in the display
Temperature Ranges: Operating 0-C to +40 C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)
Cat. Q91540 Normally $129
SPECIAL $119

QUICK STICK JOYSTICK

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- 3 Fast Responsive Firing Buttons.
- Arcade joystick feeling
- Comfortable Grip
- Built in stabilizing Grip
- Compatible with: Commodore 64, VIC-20, Atari, Sears, NEC PC-6001

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

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RS232 GENDER CHANGERS

Saves modifying or replacing non-mating RS232 cables by changing from male to female to male. All 25 pins wired straight through.
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Female adaptor to join 2 male ends
Cat. X15652 Normally $19.95
SPECIAL, ONLY $17.95ea

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Errors and omissions excepted
*Apple and IBM are registered trade names

Electric fence

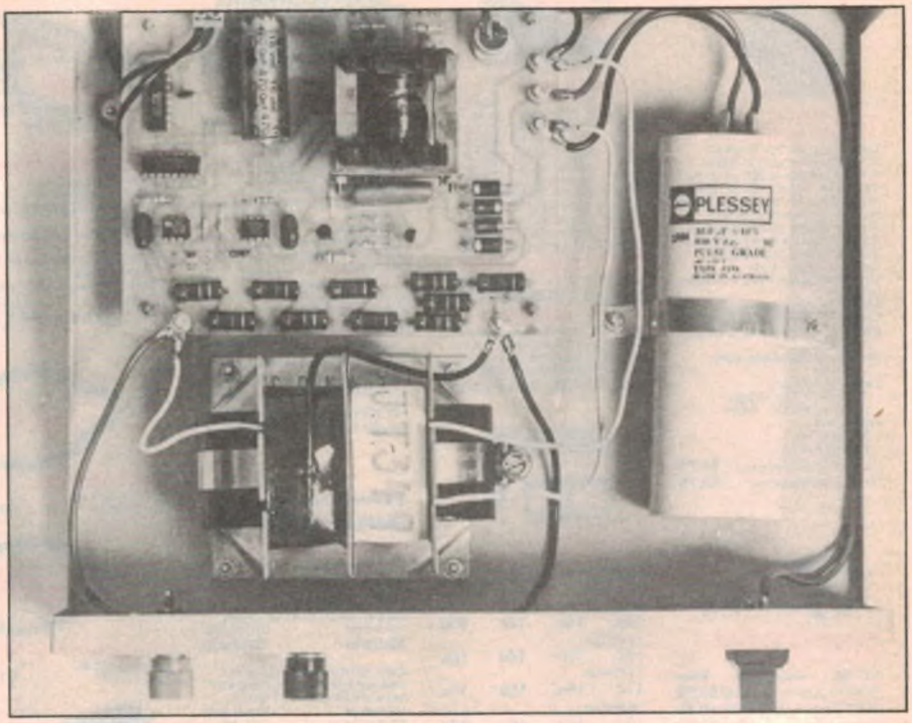
while the other terminates on pins 3 and 4.

The secondary winding occupies the remaining space on the former and consists of 120 turns of 0.6mm enamelled copper wire. Leave a 1mm gap between the secondary and the primary and wind on several layers, each slightly shorter than the preceding layer. Use adhesive tape to secure the windings and terminate the leads on terminals 6 and 12.

Once the PCB assembly has been completed, it can now be pushed onto its stand-offs, and the mounting holes marked for transistors Q1 and Q2. Remove the PCB before drilling the two holes to 3mm.

Four mounting holes must also be drilled for the JT349 transformer. Use the transformer itself as a template to mark out the holes. Similarly, carefully affix the Scotchcal artwork and use it as a template for the front panel holes. An additional hole will have to be drilled to accept the neon indicator if you elect to include this option.

Other holes which have to be drilled in the cabinet include: one for the power lead access; one for the power lead cord clamp; and two for the pulse capacitor retaining clamp. Each of these holes can be 3mm.



This inside view shows the layout of the main components.

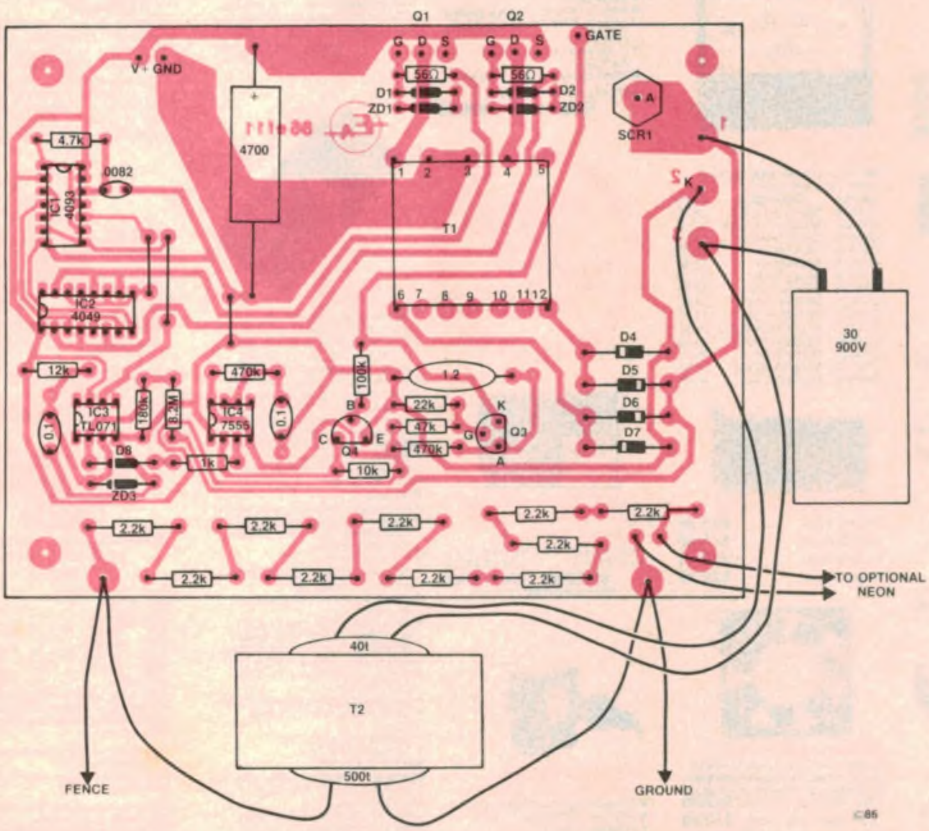
We fashioned a suitable capacitor clamp from a piece of scrap aluminium measuring 150 x 10mm. Wrap some plastic tape around the capacitor before installing the bracket. That way, the bracket can bite into the tape and hold the capacitor firmly in position.

You can now install the PCB and the remaining hardware items into the chassis. The two battery leads pass through a rubber grommet in the back panel and are retained by a small cord clamp. Use heavy-duty (32 x 0.2mm) wiring for the battery leads and for all internal wiring.

The two mosfet transistors (Q1 and Q2) must be insulated from the rear panel using mica washers and insulating bushes. Fig.1 shows the mounting details. Smear heatsink compound on all mounting surfaces before bolting the assemblies together.

Some readers may have an unused C-core transformer which they wish to modify for this project. Here are the details: primary — 40 turns 0.6mm wire, resistance 0.2Ω; secondary — 500 turns of 0.2mm wire, layer wound with polyester interleaving, resistance 75Ω. This gives a turns ratio of 12.5:1.

We can already see you racing for the calculator to prove that 250V x 12.5 does not add up to 5kV. No it doesn't, but we know. Pulse transformers are complicated creatures and do not abide by conventional transformer theory. If you refer to one of the accompanying oscilloscope photographs, you will notice a 'step' in the open circuit output waveform at around 3kV. This represents the transition from pulsed overvoltage to normal output voltage.

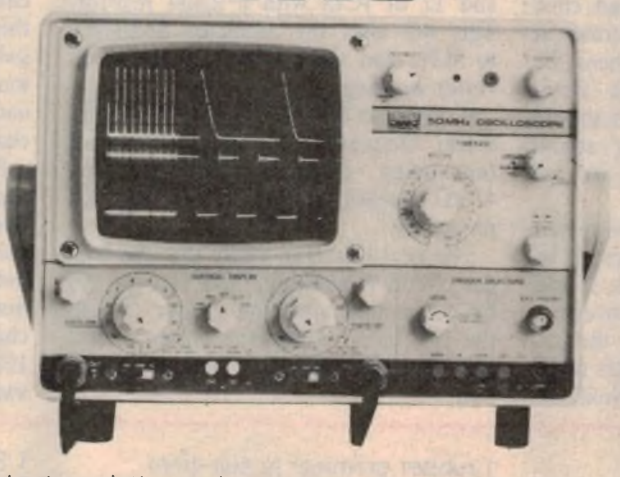


Here is the parts-placement diagram for the PCB. Note that the neon lamp must be replaced by a wire link if not used.

YEN PROOF

MADE IN AUSTRALIA

bwd



Here's a solution to the Yen/Dollar see-saw. Because BWD CROs are made right here in Australia, the price won't change every week. And with the currency fluctuations of the last few months, BWD CROs have gone from being good value to absolute bargains.

Take a look at the BWD 821 50MHz dual trace scope. At about 2/3 of the price of Japanese equivalents ($1150 + tax inc. probes) it sounds good right away. And for power and facilities it's hard to match. 1mV to 20V sensitivity; 7ns rise time; triggering to 75MHz; 20ns/div sweep. Plus our unique MIX-MAG which lets you magnify a portion of the trace by ten. It's like delayed sweep without the complexity (or price). Electronics Australia said 'We have yet to see a trace as fine and as clear...'*

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PERFECTION IN MEASUREMENT

The Farwagi Company 821

Electric fence

Testing

An analog ammeter with a range of at least 0.5A can be used to test the circuit. This should be installed in series with one of the power supply leads to the battery.

At switch on, and immediately after each discharge, the meter should flick towards full scale. In fact, there is a transient of several amps but it is so short that the meter will not respond fully. The current should then quickly return to less than 100mA. If not, you have an error.

The circuit should discharge once every second. You will definitely know when it is discharging by a loud click from T2. Since the oscillator operates at 23kHz, you will not be able to hear the whistle from the inverter as the circuit builds up charge. However, you should be able to hear a faint 'frying' sound from T1 as the regulator cuts in and out.

If you prefer, the circuit can be tested in stages. To do this, disconnect all of the wires leading to terminals 1, 2 and 3. The first step is to check the inverter.

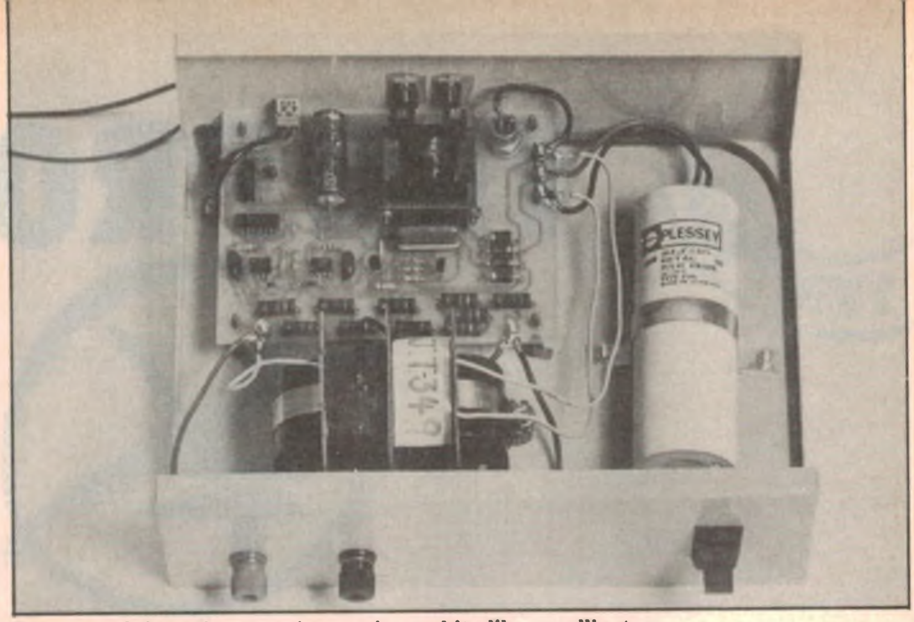
First, connect a load across the inverter output by installing a 10kΩ resistor between terminals 1 and 2. Next, replace the 4.7kΩ resistor between pins 11 and 12 of IC1a with a 22kΩ resistor. This will alter the oscillator frequency to 5kHz and allow you to hear the inverter working.

If you can't hear the new 5kHz inverter frequency, the inverter is not functioning correctly. Re-install the 4.7kΩ resistor at the end of this test procedure.

The next step is to verify that the trigger circuit is working. You can do this by connecting your multimeter (set to the 10V range) across the output of IC4 (pin 3). Pulses should be seen every second.

If all is well so far, only the discharge circuitry remains to be checked. To do this, restore the circuit to normal and switch on: As before, you should hear a loud click from the pulse transformer each time the 30μF capacitor discharges.

Finally, be very wary of the pulse capacitor. It can bite like an alligator as you will quickly discover if you are careless enough to get across the terminals when it is fully charged. You can make the circuit safe to work on by discharging the pulse capacitor through a 10kΩ resistor each time the unit is switched off.



Be wary of the pulse capacitor — it can bite like an alligator.

PARTS LIST

1 JT349 C-core transformer
2 Siemens ferrite cores, B66339-G-X127 (100121)
1 Siemens former, B66274-B1011-T1 (100260)
1 Siemens mounting kit, B66274-B2002-X (100311)
1 Betacom metal cabinet, 269 x 222 x 90mm (or similar)
1 2-way PCB mounting terminal block
1 5A SPST toggle switch with all-plastic body (piano key type)
1 PCB, code 86ef11, 145 x 114mm
2 insulated panel-mounting jack sockets, 1 red, 1 black
1 neon lamp (optional)
4 20mm PCB stand-offs
13 3mm machine screws
18 nuts to suit screws
13 lock washers to suit
2 TO220 transistor mounting kits (insulating bushes plus mica washers)
1 rubber grommet to suit 4mm hole
2 metres heavy duty (32 x 0.2mm) hook-up wire (red)
2 metres heavy duty (32 x 0.2mm) hook-up wire (black)
1 500mm length of 1mm enamelled copper wire
1 cord clamp
1 capacitor bracket (see text)

Semiconductors
1 4093 quad Schmitt NAND gate
1 4049 hex inverter
1 Philips BTY91-800R or Marconi CR20-U08JY SCR
2 Siemens BUZ71 SIPMOS transistors
3 1N4148 diodes
4 1N4007 diodes
2 30V, 400mW zener diodes
1 5.1V, 400mW zener diode
1 2N6027 PUT
1 BC549 NPN transistor
1 7555 timer IC
1 TL071, TL061, LF351 op amp

Capacitors
1 4700μF 25VW electrolytic
1 30μF 900V pulse capacitor (Plessey)
1 1.2μF metallised polyester (greencap)
2 0.1μF greencaps
1 0.0082μF greencap

Resistors (0.25W, 5%)
1 x 8.2MΩ, 1 x 1MΩ, 1 x 470kΩ, 1 x 180kΩ, 1 x 100kΩ, 1 x 22kΩ, 1 x 12kΩ, 1 x 10kΩ, 1 x 6.8kΩ, 1 x 4.7kΩ, 1 x 1kΩ, 2 x 56Ω, 10 x 2.2kΩ 1W 500V (Philips MR52 or PR37).

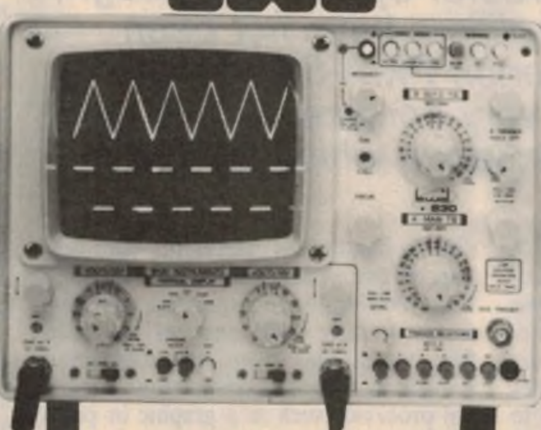
Where to get the parts: complete kits for this project should be available from a number of retailers, including Jaycar Pty Ltd, Altronics and Rod Irving Electronics. All parts, including the PCB, are available separately from Geoff Wood Electronics. The PCB can also be purchased from RCS Radio or from Acetronics PCBs, while the Siemens ferrite cores and formers are available from Altronics and Jaycar Pty Ltd.

YEN PROOF

ANYWHERE

MADE IN AUSTRALIA

bwd



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PERFECTION IN MEASUREMENT

The Farwagi Company 830

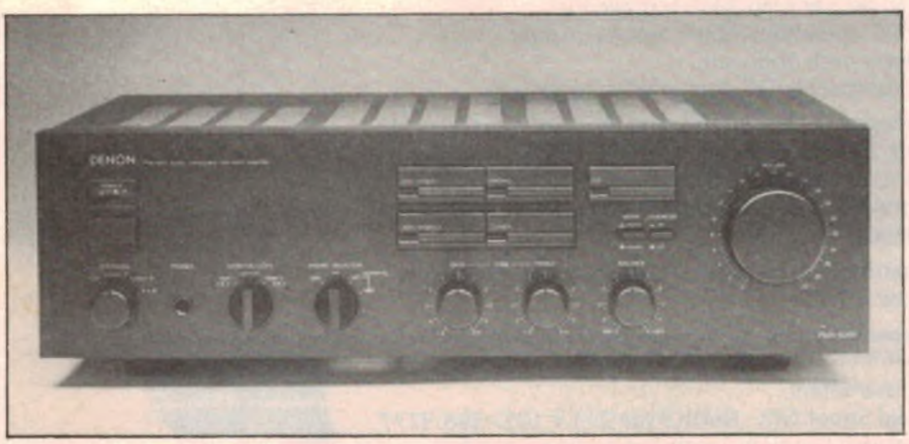
Denon's fancy new amplifier has video facilities

Now that video equipment is more commonly regarded as a source of hifi program material, a few amplifiers are now being released with inputs for video recorders. Up till now though, such audio/video amplifiers have not been truly hifi. This new Denon PMA-500V amplifier changes that. It has very comprehensive input facilities and a performance which is right up to standard.

It is true, isn't it? With the coming of hifi video recorders, hifi amplifiers haven't kept pace. The result has been that many people have wanted to integrate their video equipment into the audio system but have had difficulties because the amplifier wasn't set up to do it. If you have one VCR, your amplifier should be able to handle its audio outputs. If you have two VCRs and a monitor-style TV, the stereo amplifier should be able to switch the video signals as well as the audio outputs.

The Denon PMA-500V has the above capability and more. As well as being able to handle the video and audio outputs of two stereo VCRs, this amplifier has provision for recording and dubbing from two tape decks and has preamplifier output and main amplifier input sockets to allow the connection of a signal processor such as a graphic or parametric equaliser.

In other respects, the user facilities of the new Denon amplifier follow standard practice. There are the usual Bass, Treble, Balance and Volume controls, a loudspeaker selector, stereo/mono switch, loudness switch, headphone socket and power switch. What could be more standard?



Standard it may be but the presentation is above the normal high standard of Japanese amplifiers. Here is an amplifier that is very well finished and which harks back to the superbly finished Japanese amplifiers of the early 70s when tooling costs were less important.

For example, the large volume control knob is silky smooth in its rotation, as are the other rotary controls. Surprisingly though, the volume control potentiometer is not a large attenuator-style unit with click stops. It is physically quite small and devoid of a clicker plate. The Bass, Treble and Balance controls have just a centre detent.

The input selection function is provided by five touch buttons in the case of the line level inputs and a four-position rotary switch in the case of the phono selector. The latter switch caters for moving magnet and moving coil cartridges and also has settings which bring a low frequency filter into play. This removes subsonic signals due to warps and ripples in the surface of vinyl discs.

The five touch buttons for the line level inputs are very nifty and each have an associated LED indicator to show which source has been selected.

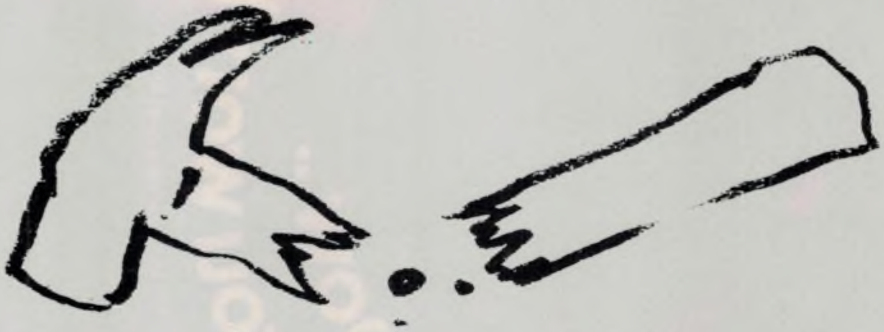
The rear panel of this machine is more than usually crowded with no less than 11 pairs of RCA sockets for connection of audio signals and another three sockets for video signal connections. There are also two sets of loudspeaker connections which use shrouded binding posts.

Chassis layout

Removing the top cover of the amplifier reveals a chassis which is neat and spacious. Most of the circuitry is accommodated on one large printed circuit board which occupies more than half

YEN PROOF

TOUGH



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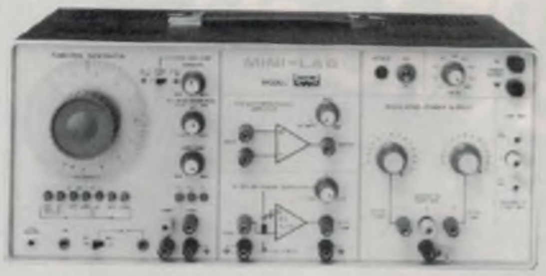

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The Farwagi Company 603B

The name you know...
The sound and price you won't believe!
As manufacturers of high quality professional broadcast and studio equipment, the name DENON is well known.
Our reputation for reliability and technological development may prepare you for the design
and uncompromising quality found in our consumer audio products – but nothing will prepare
you for the sheer excellence in sound of our latest compact disc players.
The DCD 1500, 1100 & 1000 disc players combine audibly superior sound, with a host of excellent features.
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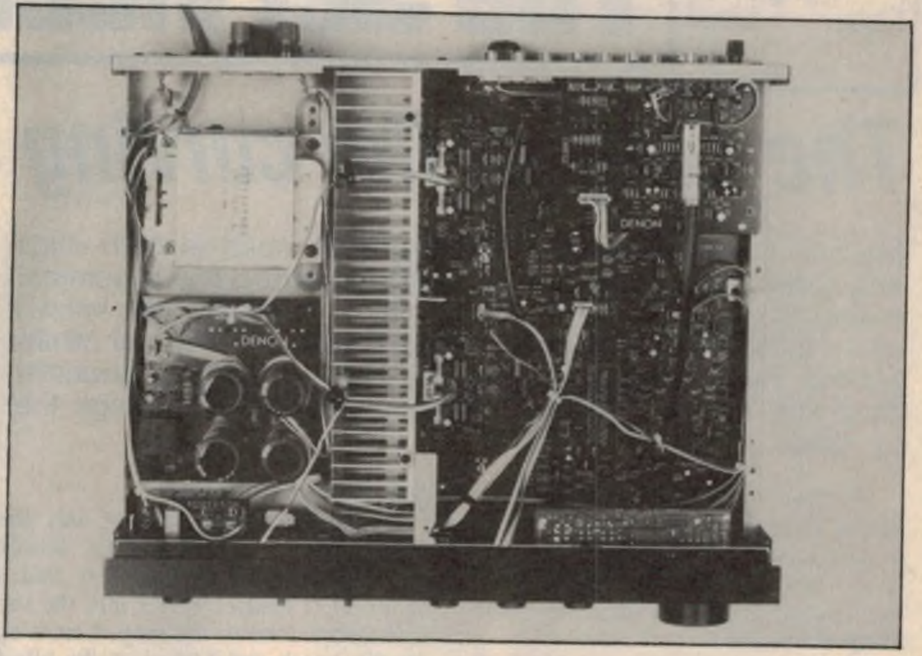
the available chassis area. The printed boards are unusual in that they have a coating of black enamel over which the component values are screen-printed in white.

The power transformer is quite a generously proportioned unit, with a copper strap over the windings and a tinplate wrap over the laminations, all to keep radiated hum to a minimum. Apart from that, the power supply components are fairly standard, with the main filter capacitors being relatively small at 2 x 6800μF 63VW for the positive and negative supply rails.

Loudspeaker protection and initial turn-on muting is provided by a double-pole relay which is again a standard feature on most amplifiers these days. Dimensions of the amplifier are 434mm wide, 137mm high and 385mm deep, including knobs, rubber feet and rear terminals. Mass of the unit is 9.7kg.



Specifications

Rated output power of the PMA-500V is 80 watts per channel into 8-ohm loads for less than .05% total harmonic distortion over the frequency range from 20Hz to 20kHz. Our measurements indicated that the amplifier would easily meet these specs. We measured power output at 92 watts with both channels driven into 8-ohm loads for a distortion figure of .015%.

At 80 watts into the same load, the worst distortion figure achieved was .025% at 20kHz. These measurements were made at a mains voltage of 240-VAC, via a regulated power supply.

Interestingly, Denon place a cautionary label on the rear of the chassis regarding loudspeaker impedance. This is to the effect that for a single pair of loudspeakers, the nominal load impedance may range from 6 to 16 ohms whereas when two pairs of speakers are in use, their nominal impedance should be in the range 12 to 16 ohms.

This would be a hard condition to satisfy these days since there are very few loudspeakers made with a nominal impedence rating of more than 8 ohms. In the specifications through, the manufacturers make a reference of a power output of 130W + 130W into 4 ohms at 1kHz for a total harmonic distortion of less than 1% (this is a DIN spec).

We disregarded the caution anyway, figuring that users would want to use normal speakers. So with 4-ohm loads we measured the power output at 120 watts per channel at 1kHz for a distortion of .015%. With just a single channel driven, the power rises to 156 watts, for the same distortion figure.

To add insult to injury, we decided to make the IHF transient power measurements too. For 8-ohm loads, these tests yielded 200 watts per channel with both driven simultaneously, and 220 watts with just one channel driven. For 4-ohm loads, the IHF results were 250 watts per channel with both driven, rising to 264 watts with one channel.

So there is no doubt that this amplifier can deliver the goods. Still, perhaps it would be wise for users to go along with the manufacturer's recommendations and steer clear of speaker systems with nominal impedances below 8 ohms.

Denon have not quoted a spec figure for intermodulation distortion. We measured intermodulation (7kHz:50Hz, 4:1) at powers up to 80 watts into 8-ohms and found it to be less than .012% which is a good figure.

Phono sensitivity was 2.5mV at 1kHz, as claimed and the overload margin was excellent at 170mV, at the same frequency.

Crosstalk between channels was good although not startling, with figures of −71dB at 100Hz, −69dB at 1kHz and −57dB at 10kHz. Signal to noise ratio figures were also good with a measurement of 95dB unweighted for the line level inputs and 71dB unweighted (includes residual hum).

Frequency response of the line inputs shows Denon's good conservative design approach with the response being 0dB at 10Hz and −1dB at 30kHz. Phono equalisation was within ±0.2dB of the RIAA characteristic for the moving magnet input while the moving coil input was with ±0.2dB which is still pretty good.

All the other specifications of the Denon were confirmed by our testing, reinforcing the conviction gained as we went through the measurements that this was a well-designed, conservatively rated unit and one which is likely to give many years of reliable service. It goes without saying that it has an excellent sound quality too.

Conclusion

In conclusion, we must rate the Denon PMA-500V as very good value for money, with a recommended retail price (at the time of writing) of just over $600. Not only does it offer plenty of power and comprehensive user facilities, it is one of the first such high quality amplifiers to offer connection facilities for two stereo video recorders. It certainly deserves consideration by anyone wishing to fully integrate a hifi video system with their audio equipment.

For further information about the Denon range of hifi products, contact your hifi dealer or the Australian distributor, Amalgamated Wireless (Australasia) Ltd, 545 Parramatta Road, Ashfield, NSW 2131. Phone (02) 797-5757. (L.D.S. & J.C.)

The Serviceman

The case of the curving corners

My two main stories this month are far apart in both origin and technical background, but they do emphasise a common theme; if you think you've seen it all — or, worse still, know it all — think again. The chances are that there is a real stinker around the corner just waiting to knock you off your pedestal. Next time you're "sure" you know what's wrong, change that to "think".

My first story this month has two claims to fame. In the first place it was a fault I had never seen before — and that is always worth reporting. Secondly, the ultimate reason for it was something of a puzzle.

The set in question was our old faithful, the Philips K9. The call for help was originally delivered by the daughter of the house, who was collecting a repair job of her own, and mentioned that her parents' TV set was giving trouble. She went on to describe the symptoms as ". . . the picture coming in from the side."

Based on that description I felt fairly confident that I knew the cause. The main part of the east-west correction circuit consists of two transistors, TS420 and TS421, the emitter output of TS421 feeding directly into a 1Ω resistor, R422. This sometimes goes open circuit, bringing the picture in from the left hand side.

So I duly made the house call, making sure that I had a suitable replacement resistor on hand. But when I turned the set on and it warmed up I was surprised to see that it was producing a perfect picture. When I commented on this the man of the house smiled knowingly. "Oh yes, but just wait a few minutes." I had a horrible feeling right then that all my previous ideas had gone down the drain.

So we waited. It was more like 10 minutes before the effect was clearly visible, and even then it wasn't what I expected. The picture width hadn't actually decreased, but the verticals in each corner had started to curve inwards, producing an effect something like the old barrel distortion which occurred in some early monochrome sets. And, to cap it all, the effect had a tendency to pulsate at times.

At this stage I was sure of only one thing; it was no job for the lounge room. After making sure they had a spare set, I loaded the K9 into the van and took it back to the shop. I set it up on the bench and looked at the effect again. The only good point at this stage was that it was at least consistent. My suspicion still involved the east-west correction circuit and I decided to remove the aforementioned 1Ω resistor and see what happened.

This created more or less the effect I expected, in that the picture came in from left hand side in the usual manner. But the curved verticals were still obvious in the two right hand corners, though much less so in the left hand corners. This, to my mind, seemed to rule out the east-west circuit as a direct culprit.

I restored the 1Ω resistor and took another look at the fault. The symptoms didn't tell me much but I began to wonder whether it could be due to faulty filtering in one of the supply rails. Fortunately, I had on hand a spare power supply board for this model so it was a simple matter to fit it in place of the original. I would not have been surprised at the fault being in this section because I have had some rather weird effects created by partial failure of capacitors C178a and 178b, a 200µF and 25µF respectively.

But no, the set behaved exactly the same with the new board as it did with its own. So all I established was where the fault wasn't. But I still had a gut feeling that it could be due to poor filtering of a supply rail somewhere, and decided to check out each one.

The most likely culprit, now that the main board had been cleared, seemed to be the 25V rail. This is derived from a winding on the line output transformer (pin 8) via diodes D539 and D540 — effectively in series — and two 680µF capacitors, C541 and C542. An important point about this rail is that several lesser rails, ranging from 22V down to 17.5V are derived from it and any one of them could create trouble if there was a main filtering problem.

I checked the 25V rail with a meter and found its value to be spot on, but that wasn't really conclusive. So I stoked up the CRO and connected it to the 1.6A fuse, VL540, which is a convenient access point to the 25V rail. Sure enough, there was a small amount of ripple here, although I seriously doubted whether it was enough to create the fault I was chasing.

On the other hand, there was no point in ignoring it. I fished out another 680µF and patched it into circuit. And bingo; the ripple vanished — and so did the fault. It was as easy as that. So all I had to do was replace the two capacitors — there would be little point in replacing only one — and all would be well.

Up until this point I had not actually identified these two capacitors, but I soon found C542, not far from the fuse I had been using as a check point. But C541 was another matter. I found the place on the board for it easily enough, it being in line with C542, but there was no capacitor there. What was more, it was obvious that no capacitor had ever been fitted there.

And that's the puzzle I mentioned at the beginning. Was its omission a deliberate modification? Or was it simply a production line accident which, somehow, eluded all subsequent visual and electrical checks? In an effort to clarify the situation I have made as many checks as possible on K9s since this discovery and, in spite of a substantial number being checked, I have not found another model with this omission. So I tend to discount the deliberate modification theory.

Which leaves the accidental omission theory. Even this I find surprising. It is easy enough to visualise the capacitor being omitted in the first place, but more difficult to imagine that the omission would not be picked up further down the line. If the visual checks these days are anything like those employed during my days on a production line, such an omission would have been picked up quick smart. What's more, the hapless perpetrator would have copped a severe dressing down, with broad hints as to the direction of the way out.

But once past visual inspection, detection would not be so easy. In its new condition the single capacitor, perhaps with some "plus" in its tolerance, was obviously good enough to present a perfect picture. Moreover, it managed to continue to do so for many years. The only difference was that the fault showed up a good deal sooner than it would have had both capacitors been fitted.

I wonder if anyone else has ever struck this one.

And now, as a change from the ramblings from my own bench, here is a story from one of my frequent contributors, Mr J.L. of Tasmania. It is a story that is interesting for two reasons; it describes a rare technical problem about which little appears to be known or written and, in the process, expounds a philosophy which we could all doubtless note and inwardly digest. Here is his story which he calls:

The kase of the kurious Körting

Some time ago the Serviceman wrote about a Sanyo TV set with brightness problems. The fault was one that is fairly common down here and the story produced comments like "Fancy being caught by that one!"

It's easy to be amused by someone else's discomfort, but we all get caught the first time. Only luck gets us through without egg on our faces. If your luck is out, it's no disgrace to call for help.

On the occasion I am about to relate my luck was out and I called for help. The problem even stumped the expert. So if you know the answer before the end of the story, don't laugh. It's just that your luck has been better than mine.

The set in question is a Körting 5507. It belongs to a colleague who runs a small appliance repair shop. He gives me all the TV sets that come over his counter and I felt that I owed him a favour or two. So when he said that his set had gone green, I offered to fix it for him.

The Körting has a novel service feature. It's a plug-in module that indicates with LEDs which parts of the set are working or not, as the case may be. My friend has one of these modules, plus the service manual, so I felt sure that it would be a quick and easy job. Perhaps no more than a grey scale adjustment.

Back at the ranch it took no time at all to get near perfect grey scale, the only problem being that the brightness seemed to be a bit high. So on went the test module and up came all the LEDs, except one.

Excess EHT

Unfortunately, the dark LED should have been on, and one of the others should have been off — its presence showed that the EHT was well over the rated 27kV. A snapping spark gap on the picture tube socket board confirmed the story told by the EHT LED.

While I was comtemplating the significance of the high EHT, the workshop lights flickered and the picture on the TV assumed a distinct bluish cast. I hooked a meter to the main HT rail and found 335 volts instead of the 315 specified on the circuit. The HT is controlled by a trimpot on the regulator board so I tried to reduce the rail, only to have the set trip off.

With the HT trimpot turned back to where I assumed it should be, I could not get the set to start. This set has a delayed start up circuit and it seemed that this was holding the line oscillator off. A careful check of the delay circuit showed that all was in order. The only way I could get the set to start up was to return the adjustment to its original position. But now the rail was up to 345 volts, and the picture had gone green again.

Another meter on the AC input to the main rectifier board showed that the mains were a bit high, at 248 volts. I connected the set through a Variac and brought the mains back to 240 volts. The regulator output dropped to 335 volts. When the AC input was lowered to 210 volts the regulator output was down to the 315 volts specified and the set behaved perfectly. The EHT LED went out, and the other one, marked "600V pulse", came on.

"I SET IT UP ON THE BENCH!"

Quite obviously, the regulator wasn't regulating. What is more, it was actually raising the HT rail above the DC input. The mains rectifier was producing the specified 270 volts, but the input to the regulator was this 335 volts that I was trying to control. The only thing between these two points is an SCR in the excess current trip circuit. No fault could be found on this board and a replacement board seemed to produce even more voltage gain. (If we could get enough of these boards the country's power problems would be over!)

I felt that the trouble must in some way be connected with that 600 volt pulse that disappeared as soon as the DC input rose above 315 volts. The pulse originates in the commutation transformer and is part of the system that returns excess scan current to the power supply. Without a pulse there is no way the excess current could get back to the supply, yet that is what seemed to be happening.

An error in the scan/retrace timing could cause trouble, although I would think it would upset the picture before it would cause the weird symptoms I was seeing. All the capacitors in the timing network came out, and all checked OK. The transformer windings each gave logical readings, as did the scan and retrace thyristors.

Ultimately, almost every component in the supply, line output, and EHT circuits had been checked. A few resistors were a little off spec, but replacing these made no difference at all.

Finally, I had reached the stage where I had to call for help. I had been over everything that could conceivably cause trouble and was starting to go round in circles. A fresh mind, preferably one familiar with this particular set, seemed to be the best hope for a solution.

A friendly voice

A few enquiries led me to a technician on the other side of town who has sold and serviced Körting sets for many years. A phone call connected me to a friendly voice who offered several suggestions as to what the trouble might be. Sadly, I confessed that all his suggestions had been tried, except the changeover board idea. I didn't have a spare regulator board.

That was no trouble, he said. He had plenty of known good boards and if I cared to take the set to him, he would fix it for me and tell me exactly what the fault was. So a few days later the Körting found itself in another work-

The Serviceman

shop, waiting for attention.

A few days passed with no word from my new colleague so I rang him and his comments were discouraging, to say the least. "That's a Lulu you've given me!" he said. He had been over everything that I had done and found all voltages to be significantly high. My regulator board had worked perfectly in another set, but a new board simply would not work in my set.

In short, what he had anticipated as being an average job had turned into a real dog. He had a few suspicions — particularly about the bottom of the EHT overwind. The beam current limiter is controlled from this part of the circuit and was giving some funny results. I had puzzled over this, but lack of familiarity had masked any significance it might have held.

My colleague wanted more time to study the fine detail of the manual and I was in no position to say anything but "go ahead". In the meantime I had other work to do and the owner had borrowed another set to quieten the demands of his children. And there the matter rested for several days.

Stop laughing

Now there are possibly some readers out there chuckling to themselves, amused at our discomfort. But remember this, it was new to you once, and somebody laughed at your floundering efforts to find the fault. We can find no printed reference to this trouble and there is nobody around to say to us "look at the thingummy on the wotcha-board".

Have you worked out the cause of the trouble yet?

A few days later I had a call from my colleague who said "It's fixed, but you'll never believe it!" He had decided that the fault was a component drawing either too much or too little current. So he arranged an identical set alongside the faulty one. He ran them under blankets for half an hour then carefully touched various components in each set. Both were absolutely identical until he came to the commutating transformer. The transformer in the faulty set was much hotter than the other one.

Now, we all know that commutating transformers give little trouble. They either work or they don't work. A shorted turn usually kills the set instantly. Or an open circuit winding does the same thing. So what other kind of fault could there be? This transformer seemed to be converting excess current into excess voltage, with little other effect on the set's operation. We don't know the answer but a new transformer put the set back into normal operation.

Ohm's Law is bunk

This fault contradicts all of our previous experience. It even seems to defy Ohm's Law. If a set draws too much current the power supply gets hot and the output voltage goes down, not up. And if the HT rail has gone up it usually means that a substantial part of the set has stopped drawing current and therefore cannot get hot. This one is a real puzzler.

But now comes the oddest aspect of the whole story. My friend did a grey scale adjustment then replaced the back cover. As he did so the picture went green. Off came the back and a further adjustment corrected the picture. Out of curiosity he gave the set a thump. The picture went bluish.

So the original complaint was not due to the lack of regulation. It was a crack in the copper track under the curiously mounted chroma delay line.

This story brings out several interesting points. One is that component breakdown need not always be obvious. Nothing could be less obvious than a commutating transformer that works apparently normally yet draws just enough excess current to upset the power supply regulation. Another point is the clever trick of comparing the faulty set with a good one, under identical conditions. And finally, don't assume that the fault is caused by the most obvious symptoms.

FOOTNOTE: This story was written quite some time ago but for various reasons has not been published. Fortunately so, because we now have a probable explanation for the fault.

These commutating transformers have a moulded ferrite core and if this is broken the transformer simply won't work. If on the other hand the core is only cracked then the effect is far less drastic. The transformer will still work but its altered inductance will modify its performance.

We don't have the dud transformer to check, but it's guineas to gooseberries that the core had lost a flake of ferrite, or it was cracked inside the former.

An ohmmeter and shorted turns tester will tell us a lot about transformers, but unless the manufacturer publishes the inductance figures for each winding there is not much chance of ever finding a fault like the one just described.

Well, that's J.L.'s story and I think readers will see what I mean about his philosophy; none of us has seen it all, none of us knows it all, and none of us can afford to laugh at the other fellow. He could well be laughing at us tomorrow.

Re-tripping the General

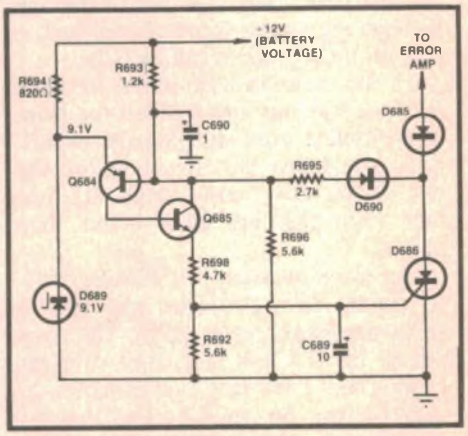
Finally, here is another comment about the General GC145, owned by Mr D.P. of Mudgee, which cuts out prematurely with reduced voltage. Mr M.G. of Gloucester, NSW, writes:

I have modified my GC145 so that the cut-out circuit trips at a considerably lower voltage. The accompanying circuit will help explain the system's operation. The zener diode D689 puts a 9.1V reference on the emitter of Q684. Resistors R693 and R696 form a voltage divider which sets the base of Q684 to 0.824 of the battery supply voltage.

When the battery voltage drops below 11.05V (9.1/0.824) the emitter-base junction of Q684 conducts and turns on Q685 which, in turn, switches on SCR D686, thereby disabling the mains supply.

The cut-out can be made completely inoperative by opening the gate feed to D686; eg, by removing R698. The sensitivity (cut-out voltage) can be changed by altering the values of R693 and R696, or by changing the zener value of D689. Changing R693 from 1.2kΩ to 1kΩ only changes the ratio to 0.849 and the set will cut out at about 10.7V. Lowering R693 lowers the cut-out voltage still further.

I "fixed" my set by soldering an 8.2V zener in parallel with D689. This lowers the cut-out voltage to about 10V.



This circuit solves the cut out problem of the GC145 at low voltages.

While it is possible to get around the original problem by using a 240V inverter, the inverter, running at about 80% efficiency, uses an extra 17 watts. For small solar systems this can be significant.

I agree with your comments about a possible thermal fault in Q684/685, but contacts in the line fuse would also be worth checking.

Thank you for the comments M.G. I'm sure other readers — including, possibly, Mr D.P. — will appreciate your analysis of the circuit operation and suggested degrees and methods of modification. Like yourself, I feel that the inverter is a rather cumbersome approach. Far better to, first, minimise the losses in the system's wiring, then establish that the set is working correctly. Only then should it be necessary to modify the cut-out voltage if performance is unsatisfactory.

TETIA Fault of the Month

Rank C2003

Symptom: Six or more thick black lines down the screen. The lines increase in number when an attempt is made to take a reading at the base of TR416.

Cure: Change TR416 (2SC945). This is part of the multi-vibrator driving the vertical blanking circuit and it develops parasitic oscillations. The transistor is probably quite OK for use in different circuits.

This information is supplied by courtesy of the Tasmanian branch of The Electronic Technicians' Institute of Australia. Contributions should be sent to J. Lawler, 16 Adina St, Geilston Bay, 7105.

Addenda to the September column

Readers of the August notes may have noticed, in the TETIA fault of the month, a set of symptoms for National receivers which appear to be very similar to those described for the National TC-2003 in the September issue.

This was not noticed until the September issue was too advanced to permit any comment to be added. In any case, it is not known at this stage whether the same fault is involved or whether there are two distinct faults giving similar symptoms. Only time will tell.

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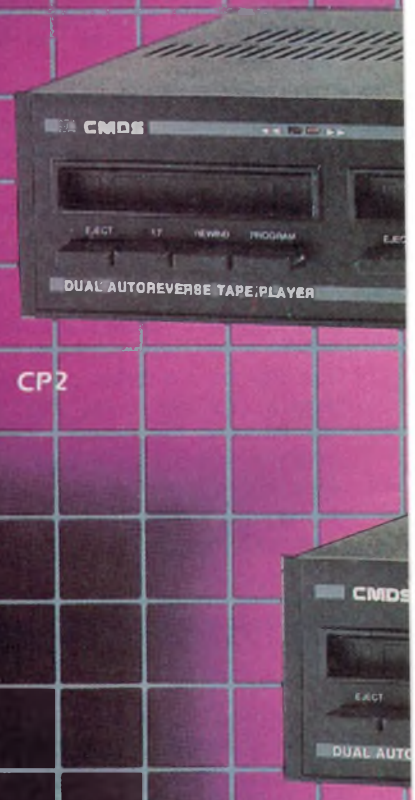

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Two bright ideas for solar panels

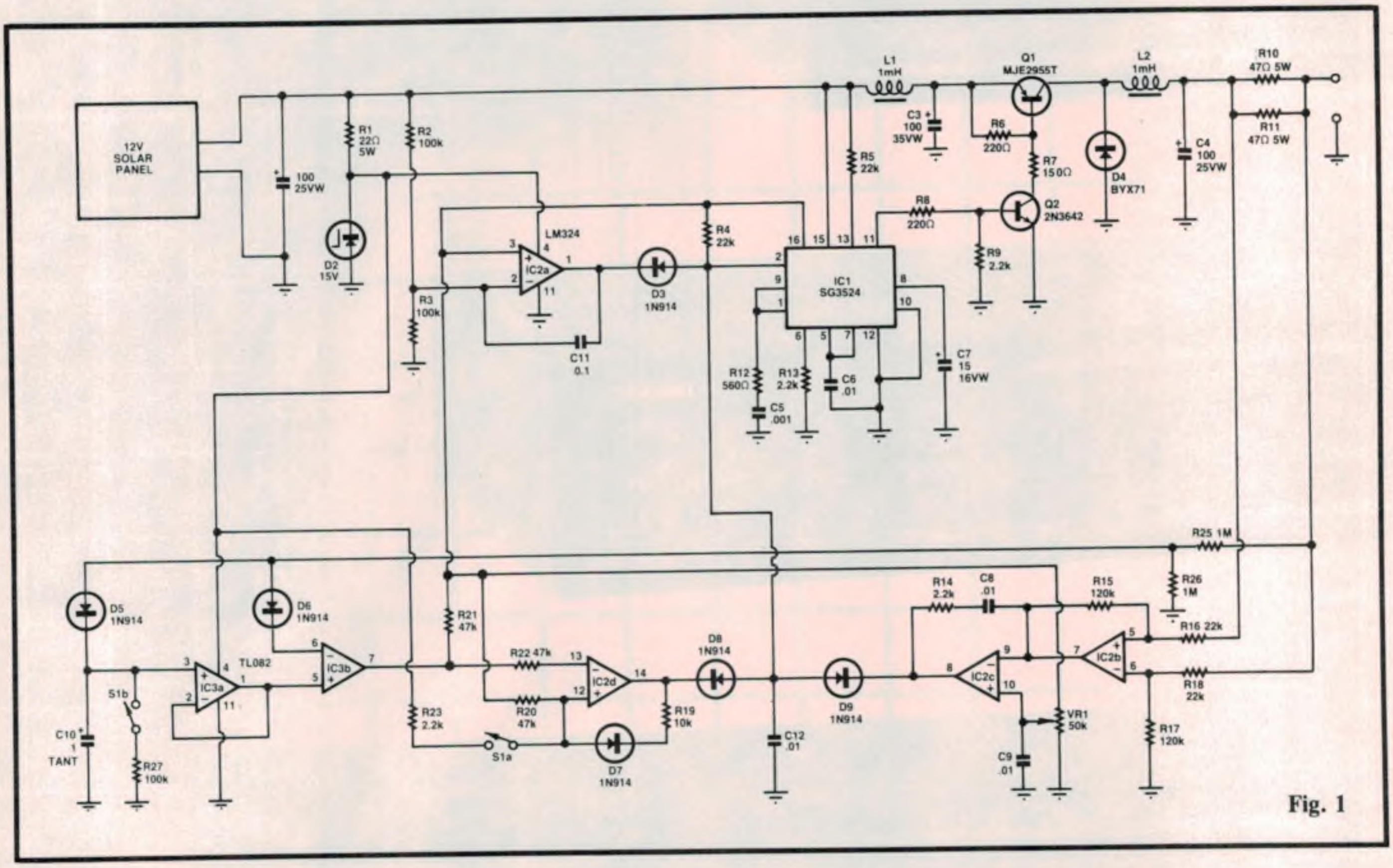

Fig. 1

Solar powered NiCd charger

This efficient charger circuit will allow a 12V solar panel to charge any number of NiCd cells (up to 10 in series) at a preset current level. One 1.1Ah cell can be charged in about 15 minutes at 3.3A while six cells will take approximately 1.5 hours.

by PAUL THOMPSON

In this circuit an SG3525 pulse width modulation control IC, configured with current feedback, is used to vary the output current. Because the switching circuit has negligible losses, almost all the available power can be transferred to low impedance loads.

Fig. 1 shows the circuit diagram. The output of the panel is fed to R1 and ZD1 which limits the maximum IC supply rail to 15V. Note that R1 must be small to limit its voltage drop when the main rail falls below about 15V.

With no load applied to the charger, most of the panel's output will be dissipated in R1 and ZD1 which will limit the main rail to about 18V.

Automatic cutout

The automatic cutout circuit is based on a voltage divider consisting of R25 and R26, which charges capacitor C10 via D5. During the charging cycle, the NiCd cell voltage rises to a certain point and then begins to fall as the cell is overcharged. It is at this point that the voltage on C10 becomes larger than the divider voltage.

This voltage is applied via voltage follower IC3a to pin 5 of comparator IC3b. This switches the output of IC2d low which, in turn, pulls the control line to pin 2 of IC1 low via D8, thus shutting off the charger. Positive feedback via D7 and R19 now holds the output of IC2d low until it is reset by S1a.

The other pole of S1 (S1b) is used to discharge C10 in readiness for the next charging cycle.

In operation, S1 may be closed and the output current adjusted into a short circuit using VR1. The NiCd cells can then be connected and S1 opened.

In addition to the zener regulator, the main rail is further regulated by the action of comparator IC2a. This limits the pulse width so that the load cannot drag the main rail below 10V.

The third control circuit is based on IC2b and IC2c, and provides adjustable current limiting. Differential amplifier IC2b monitors the voltage across R10 and R11. When its output voltage at pin 7 exceeds the voltage preset by VR1, pin 8 of IC2c goes low and pulls pin 2 of IC1 low via D9.

In the absence of a control signal, the SG3525 (IC1) has its control pin (pin 2) pulled high via R4 so that it can provide the maximum pulse width to drive Q2 and Q1. Note that LEDs can be used in place of the diodes to give a status display. Note also that only one of the control circuits will pull pin 2 of IC1 low at any given time.

The supply to the main switching transistor (Q1) is prefiltered by L1 and C3 to prevent noise from affecting the control circuitry. Q1 dumps current into L2 which free wheels via D2 when Q1 is off. C4 provides filtering for the output. To ensure stability of the current loop (the primary control loop), the error amplifier (IC2c) is compensated by R14 and C8.

Solar Panel Contest — The Winner

The EA-Altronics Solar Panel Contest announced in the April 1986 issue attracted a good number of entries. Of the entries received (including one that was published in Circuit and Design Ideas in July 1986), the two published here were judged to be the best.

We found it difficult to separate the two entries in terms of merit but, in the end, decided that the solar tracker would have the widest application. The winner of the Altronics solar panel is therefore Mr Peter Azzopardi.

Low-cost solar tracker

Solar panels which track the movement of the sun across the sky are much more efficient than fixed panels. This simple circuit forms the basis of an automatic solar tracker.

by PETER AZZOPARDI

In this design, two solar panels are supported on a tiltable array in much the same manner as the rotisserie in an electric oven. This is driven by a car windscreen wiper motor fitted with a 25mm-dia V-pulley. A 15cm V-pulley is attached to the panel shaft and is driven by an old fan belt.

Strictly speaking, this device does not track the sun but merely progressively rotates the panels throughout the day so that they are more or less perpendicular to the sun's rays. Every 160 minutes the array is driven for three seconds to change its angle to the sun.

On a hot day, the two panels will deliver just under one amp when charging a lead acid battery (Torque Starter). The hotter the panels get, the better they perform. Note that the two panels are wired in parallel. An isolating diode (eg, 1N5404) is installed between the panels and the battery so that the latter does not discharge overnight.

How it works

Fig. 2 shows the circuit. IC1 is a 555 timer wired as an astable oscillator. VR1 sets the output frequency and, in the prototype, is set so that after dual 4-bit binary counters IC2 and IC3 divide

continued on page 70

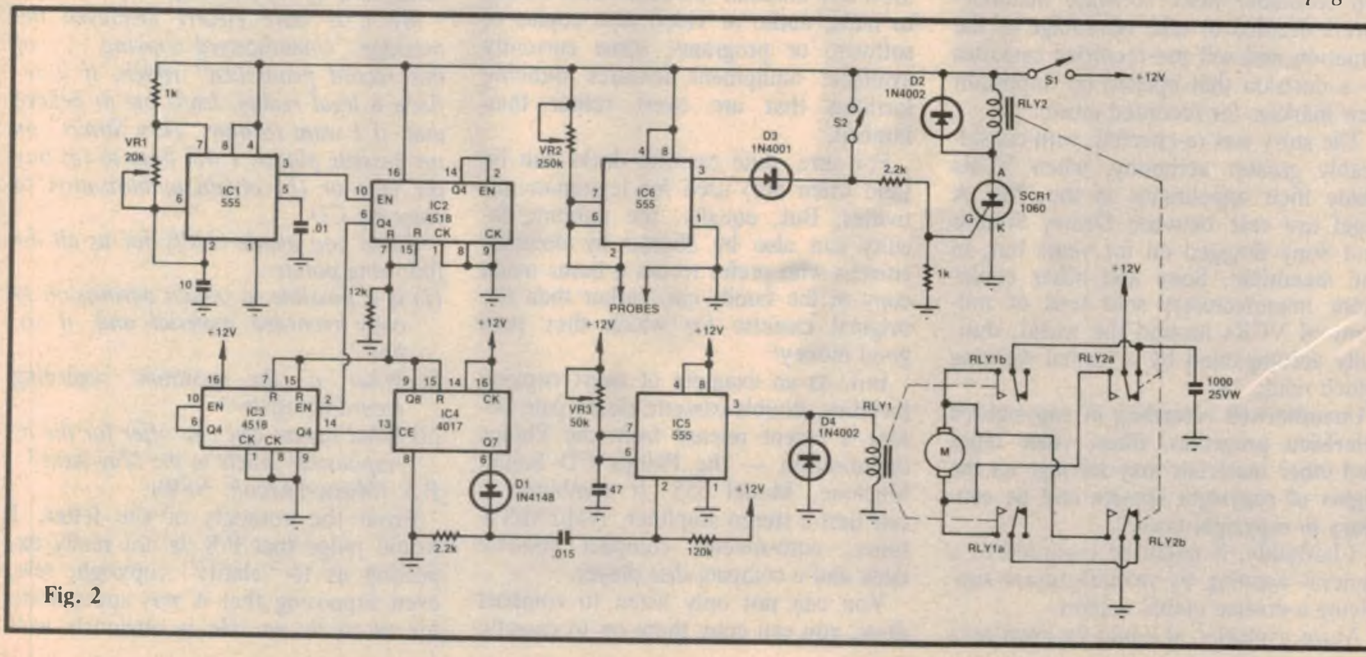

Fig. 2

FORUM

Conducted by Neville Williams

Copyright isn't as simple as all that!

Crazy as it may seem, audio-hifi manufacturers continue to flood the consumer market with home recording equipment of various kinds while, at the same time, software suppliers seek to deny its use for the purpose intended. Buyers have become the meat in a frustrating industry sandwich!

When domestic tape recorders first appeared, composers, performers and record manufacturers alike were concerned that they might be used to copy discs, off-air or borrowed, thereby compromising the viability of the record industry. Their concern deepened when the compact cassette was developed, because it made copying both simpler and cheaper.

Equipment manufacturers were quick to claim, however, that cassette recorders could be used for many purposes other than illicit dubbing and that to restrict their sale on that account would be unreasonable.

When compact cassette equipment ultimately gained acceptance as a standard consumer item, software manufacturers decided to take advantage of the situation and sell pre-recorded cassettes — a decision that opened up important new markets for recorded music.

The story was re-enacted, with considerably greater acrimony, when VCRs made their appearance in the '70s. A legal test case between Disney Studios and Sony dragged on for years but, in the meantime, Sony and other equipment manufacturers sold tens of millions of VCRs around the world, dutifully accompanied by a formal warning which read:

"Unauthorised recording of copyrighted television programs, films, video tapes and other materials may infringe on the rights of copyright owners and be contrary to copyright laws."

Charitably, it might be regarded as a general warning by manufacturers supplying a diverse global market.

More cynically, it could be seen as a way of "getting off the hook" and transferring to individual purchasers the responsibility for deciding whether to use the VCR for something more adventurous than video home movies, or recording non-copyright material!

But, again, with VCRs becoming a legally dubious but highly popular consumer item, an enormous new market opened up for yesterday's movies on tape and the film companies moved en masse to exploit it — an opportunity that would not have existed if equipment manufacturers had not bitten the bullet.

It's become easier

While it's easy enough to set up almost any modular hifi-cum-video system to make audio or video tape copies of software or programs, some currently available equipment features dubbing facilities that are overt rather than implicit.

For sure, dual cassette decks can be (and often are) used for legitimate activities. But, equally, the dubbing facility can also be abused by dreadful citizens who prefer to use a home-made copy in the family car, rather than the original cassette for which they paid good money!

But, as an example of overt copying facilities, double-cassette decks pale before a recent release from the Philips organisation — the Philips CD Sound Machine, Model 555. It combines in one unit a stereo amplifier, AM/FM/SW tuner, auto-reverse compact cassette deck and a compact disc player.

You can not only listen to compact discs, you can copy them on to cassette — and not just by naughty misuse of the playback facilities. The 555 features "synchro recording" to ensure that compact disc and compact cassette start together at the press of the recording button!

Unlike the other audio and video cassette copying facilities mentioned earlier, I am hard put to it to think of any plausible use for the CD-to-cassette facility in the 555 that would not transgress somebody's copyright!

David Frith put it nicely when commenting on the Philips 555 and a somewhat comparable release by Pioneer, in "The Guide" (Sydney Morning Herald, June 30). I quote:

"This is an example of technology running ahead of legality; it remains a breach of the copyright laws to make tapes from compact discs. (It's often not very satisfactory either, since tape cannot cope with the wide dynamic range of CD)."

An "irresponsible article"

It was against this background that the following letter landed on my table:

Sir,

None of us is so naive as to believe that people obey the copyright law. Across all age and social class boundaries, we find people who will happily steal recorded material with, it seems, no conscience at all.

However, it is hard to justify a magazine article which positively promotes such actions. Your article "Compressor for Compact Discs" (May 1986) proudly announces that we can listen to our favourite CDs on tape but, inexplicably, contains not a single reference to the constraints of copyright law.

My CDs have clearly displayed the message "Unauthorised copying . . . of this record prohibited" which, if it reflects a legal reality, leads me to believe that, if I want to play "Dire Straits" on my cassette player, I will have to (a) buy the tape or (b) obtain authorisation to copy my CD.

Could you please clarify for us all the following points:

(1) is it possible to obtain permission to copy recorded material and, if so, how?

(2) What is the position regarding recording off-air?

(3) What excuse can you offer for the irresponsible article in the May issue?

P.S. (Muswellbrook, NSW).

From the contents of the letter, I would judge that P.S. is not really expecting us to "clarify" copyright law, even supposing that it was appropriate for us to do so. He is obviously well aware of the situation and, unless I am much mistaken, poses his three questions, not so much to elucidate, as to support a conclusion he has already reached about that "irresponsible article".

Says P.S.: "None of us is so naive . . . &c." Neither are we. It's by no means the first time that we've had to tread the difficult path between how laws (or regulations) are framed, and how they are actually administered.

I look back on situations involving inter-departmental wrangles about ex-disposals radio transmitters; the one-time wholesale/retail/sales tax arrangements for electronic components; and the confrontations in the mid '70s involving the citizens band.

In all these situations, we had to adopt the attitude that, if the relevant authorities or parties couldn't get their act together, we were not going to get bogged down fighting their battles for them. That's just about the way it is in the present situation.

Copyright law exists to protect the rights of performers, entrepreneurs, &c, and, as a general principle, that's fair enough. To the extent that it benefits by their efforts, the world owes them a living!

Some people stand to make a lot of money by evading their responsibilities in this area, and the copyright owners spare no effort to reclaim what is rightfully theirs. Good luck to them!

At a consumer level

But, at the other end of the scale, copyright owners seek also to dictate what an individual can do, at a family level, with entertainment software which he/she has borrowed or rented or purchased; or with broadcast programs to which he/she has rightful access.

It is a contentious area, in which the end consumer feels strongly that they also have certain rights. In any case, claims at that level are unenforceable anyway.

In practice, copyright owners can do little more than take a token stand. Equipment manufacturers ignore them, the Government remains aloof, and consumers feel no guilt about what, to them, is a purely private, non-profit activity.

And now, as if to heavily underline all this, we have the Philips organisation, which gave us the compact disc, and with its own software involvements, releasing a model expressly designed — among other things — to copy discs on to compact cassette.

Pioneer are offering a similar model and there'll be others to follow, for sure! I've heard of no legal constraint or challenge.

Could it be that, behind the official posturing, a degree of "flexibility" involving radio and TV stations, software suppliers, and equipment manufacturers, is serving the interests of all three parties very nicely?

After all, they do need one another and, if they can jointly keep the public involved — listening, buying, copying, talking — it adds up to insurance for their common future.

Different attitudes

I am not seeking to ridicule P.S. If he feels that, in good conscience, he cannot copy his own compact disc for use in his own cassette player, then so be it. Others may question whether words on a label represent a profound moral issue or the tenuous extremity of an ambit claim, insofar as it affects private individuals.

As far as the magazine is concerned, I am not surprised that Editor Greg Swain chooses not to take a "righteous" stand on what the copyright owners appear tacitly to accept and the world equipment manufacturers ignore. Says Greg:

"We currently take the view that copying recorded material which you have purchased, whether LP, compact disc or cassette, is morally acceptable provided it is for your own personal use. At the same time, we are aware that this approach may not always be strictly legal."

I wonder whether P.S. would have been happier if the article had contained a warning similar to that included in VCR manuals? Or would that have had about it the smell of humbug or hypocrisy?

It's over to you!

A sonic illusion?

Still on the subject of audio-hifi, I have to hand a press release from "dbx, Newton, Mass., USA", the organisation responsible for the well known dbx noise reduction system. Featured particularly in up-market analog equipment, it offers a dramatic increase in the available dynamic range.

The item was passed on to me, some time back, by Gary Fitzsimmons, Managing Director of Audio Engineers Pty Ltd, who represent dbx in Australia, along with Shure. Predictably, perhaps, Gary remains a champion of analog technology.

Headed "It's all in Your Mind", the

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item begins with a statement which could provide the opening gambit for an argument over morning coffee:

"All stereo recordings are a deliberate, personal 'opiniated' production of music/voice/effects. The choices are meant to combine in our minds to create a unified perception — a successful illusion."

To clarify the statement, there follows what purports to be a review of a particular recording. Somewhat abbreviated, it reads:

The recording sounds as if it was made in a room about 8m x 12m, with a liveliness and ambience indicating a reverberant environment.

Imaging is precise, with each instrument occupying a specific and stable position in width and depth. The piano is to the right of centre and somewhat forward of the other musicians. The flute is to the extreme right; the acoustic bass at off-centre left. The drums are centre stage, behind the other musicians.

The overall performance was superb, the musicians very accomplished and tight as a group.

That was the illusion, says the writer. The reality was quite different:

- October 17, 10pm, Willows Jazz Club, Boston: 8-track master tape of piano/flute duet, using one microphone each for the instruments, two for ambience and audience presence.
- November 30, 1pm, Blue Jay Studio, Concord: Drum track added to master tape, using ten mics plus compressors, limiters and equalisers, all mixed down to a single track.
- Same Studio, 4pm: Bass line added to master, Neumann U-47 close up, with low frequency equalisation to achieve the desired effect.
- January 3, 10am, Blue Jay Studio: Mix-down from 24 tracks to 2-track stereo, with digital delay and reverberation to increase ambience, panning to locate instruments, compressors and limiters to prevent saturation.

"Think about it," says the dbx writer, going on to suggest that the incredible technology that allows recording engineers to so manipulate a sonic experience, is just another aspect of our ability to control the whole environment in which we live.

Nor is the writer exaggerating, I look back on a number of releases from Word Records, featuring Gospel singers variously backed by group musicians, chorus, organ, string ensemble, orchestra, &c — with all the sound and atmosphere of a magnificent occasion, with expense no object.

What arrangements, what a challenge for the conductor to get it all together with such balance, timing and dynamics!

Except that, when you read the small print, the credits, you discover that the musical components were performed at various times and places — even in different countries — and mixed and "doctored" in as many others.

What you finally end up with may be an example of magnificent workmanship — masquerading as a performance that never happened!

If you're wondering what all this has to do with dbx, the punch-line comes at the end. Having highlighted "the vast flexibility and the amount of control available in the studio to create a desired result", the writer announces:

"And now, in playback at home, the ability to satisfy personal sonic tastes is made possible by the complete line of dbx high performance options. With dbx, you can control the degree of impact, the amount of bass, and the overall dynamics of the music.

"Why should the recording engineer have the last word on how your music sounds? After all, whose stereo is it, anyway?"

I guess that adds up to a double-barrelled question:

How do we want our music? On what basis do we judge it? As an identifiable performance by an individual or a group, or as a sonic experience concocted by any number of people using all available means over any length of time?

Secondly, do we or should we buy recordings in the expectation that we are going to re-doctor them to suit ourselves, using a still further array of technology — by dbx or anybody else?

Finally, to get right back to where we started, the dbx release makes a very naughty suggestion. Still talking about doctoring commercially recorded sound, it adds:

"You can also record it hiss-free and reproduce it through a computer equalised playback system."

Sorry P.S. but, to equipment manufacturers worldwide, who take for granted the private copying of recordings, we have to add the voice of dbx — without any hint that it's the wrong thing to do!

A HEALTH HAZARD?

Dear Sir,

I am writing to you in regard to any health and safety hazards which may occur as a result of daily regular contact with solder and with the heatsink compound used on transistors. Are there any long-term effects such as child defects, cancer, skin diseases, &c?

I would really appreciate your answering this question as I am an electrical assembler and have heard conflicting stories about the effects solder and heatsink compound can have on you.

K.O. (Chelsea, Vic).

Health hazard

As a complete change from audio-hifi, the letter in the accompanying panel raises the question as to whether there is any risk to health by exposure to solder or to transistor heatsink compounds, as encountered on an electrical assembly line.

Frankly, there is so much discussion, these days, so much apprehension and so many conflicting claims about the possible harmful effects of this, that and the other, that one hesitates to offer a definitive opinion.

We publish the letter, not to stir up vague speculation but to attract comment from readers who may have had reason to study the matter.

For sure, solder contains lead, which can be toxic if an excessive amount is absorbed into the body. However, I have never personally encountered anyone who has experienced identifiable problems from contact with ordinary solder or, for that matter, with the active fluxes that were once common.

Heatsink compounds do need to be treated with caution because some of them contain beryllium oxide. Although a poisonous substance, it has attractive properties for the purpose, being electrically non-conductive, but having a thermal conductivity almost half that of copper.

Conventional wisdom is to avoid direct contact with heatsink compounds but, if contact is made, the affected area should immediately be washed.

As a general precaution K.O., don't expose yourself to avoidable fumes and always wash your hands before eating, to minimise the risk of absorbing industrial chemicals.

I leave the matter open, in case other readers may be in a position to enlarge upon these observations.

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Low cost receiver for FM microphones

Power & antenna for a Walkman

Last month, we described a low-cost FM transmitter for wireless microphones. This month, we show you how to modify a Walkman-style FM receiver to form the other half of the FM link. The resultant receiver can double as an inexpensive FM stereo tuner.

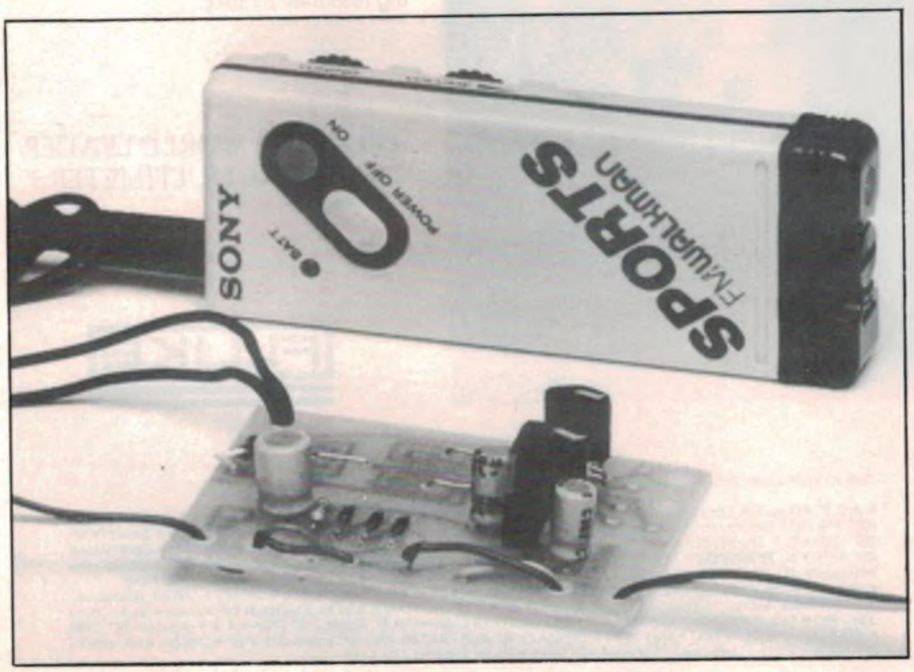
by BRANCO JUSTIC

Those readers who constructed the FM transmitter described last month have a problem: what to use for a receiver.

The logical solution appears to be to purchase a typical hifi AM/FM tuner which can then be connected to a power amplifier and a set of loudspeakers in the usual manner. We expect that many readers will do just that but, often, one needs something that is a lot smaller and less expensive.

The answer is obvious — adapt an FM Walkman-style receiver to form the other half of the FM link. These can be purchased for as little as $20 complete with headphones.

Most of the FM Walkman-style receivers offer good results and are generally much "hotter" (ie, more sensitive) than conventional tuners. Another advantage is that they don't require a separate antenna — it's cleverly hidden and is actually made up by the headphone leads.



Modifications

Unfortunately, it's not just a matter of plugging the headphone output from our personal portable into a power amplifier. First, there are a few problems to overcome:

(1). In most cases, mains operation would be preferable in order to improve reliability (no flat batteries). Also, some readers may want to build the receiver into an existing amplifier, thus making battery replacement difficult.

(2). Many personal portables employ direct (DC) coupling between their amplifier outputs and the headphones. This means that a load resistor and a capacitor have to be added to cater for all situations.

(3). Because the antenna consists of the headphone leads, improper operation may result if the headphone outputs are earthed at the amplifier.

To understand how the headphone leads double as an antenna, it is necessary to refer to Fig.1.

At audio frequencies, the low value inductors L1, L2 and L3 appear as short circuits (ie, they have very low reactance), while capacitors C1, C2 and C3 appear as open circuits (very high reactance). Thus, the audio signals are unaffected by the capacitors.

However, at frequencies in the FM band (ie, between 88-108MHz), the inductors have a high reactance and the capacitors a low reactance. The headphone leads now appear as a short circuit to each other and are connected via C1 to the antenna terminal of the receiver.

Why the above explanation? Well, some readers may choose to disconnect C1 from the headphone lead and connect a separate antenna lead. But, in real terms, that may be harder (and less

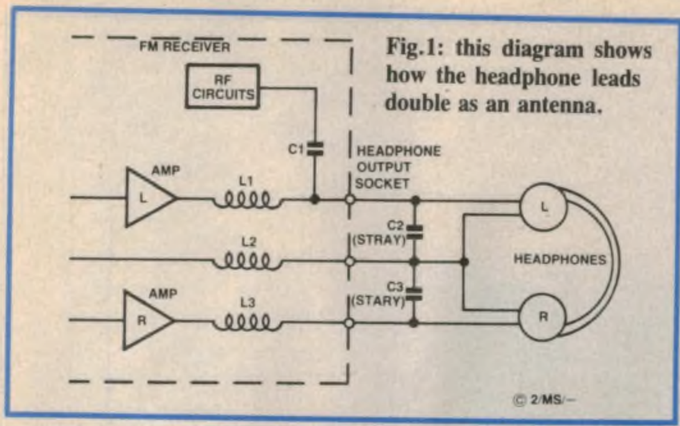


Fig.1: this diagram shows how the headphone leads double as an antenna.

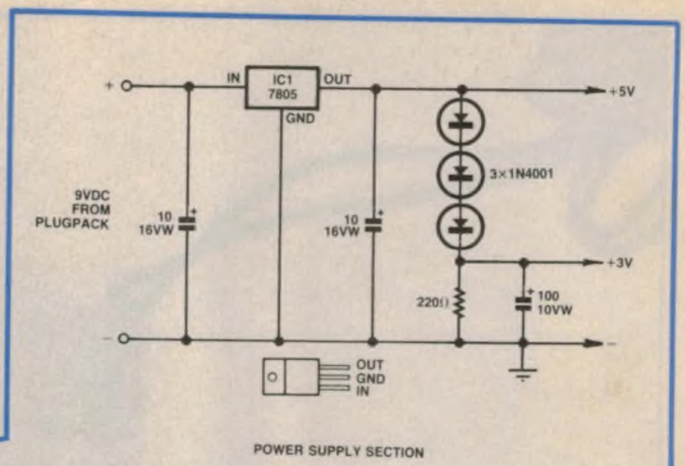
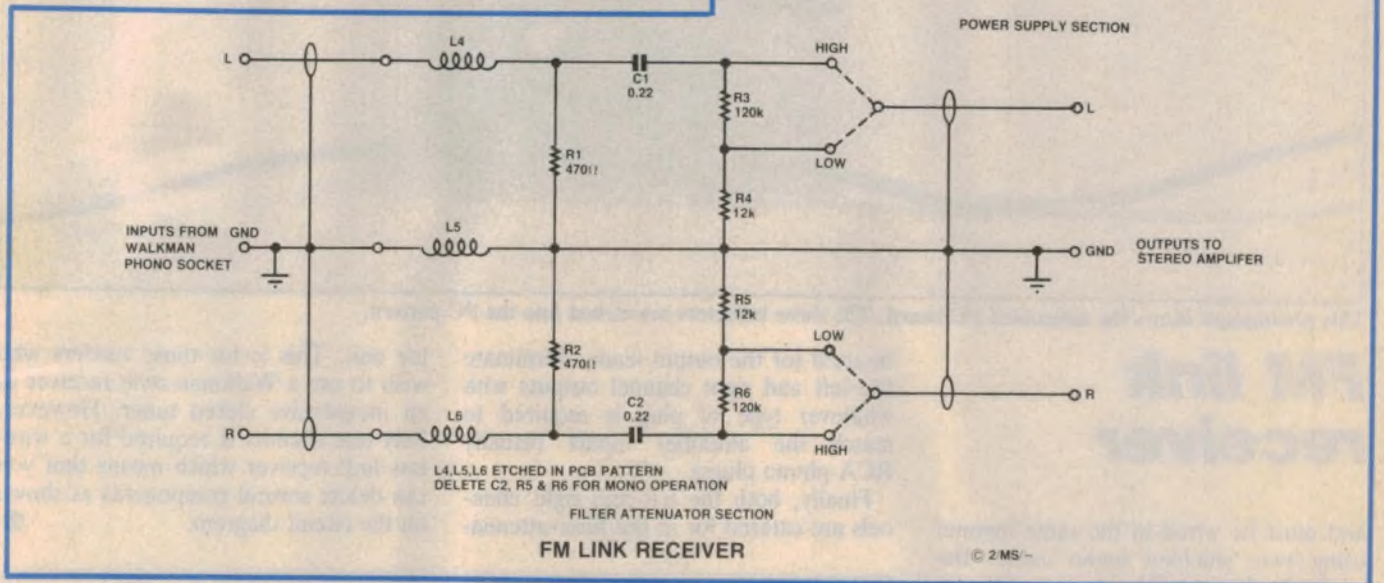



Fig.2: the add-on circuitry includes a power supply section (top, right) and a filter/attenuator network.

satisfactory) than building the simple circuit described below.

How it works

Fig.2 shows the circuitry we need to add to our Walkman-style receiver in order to overcome the three problems listed above. It has two sections: (1) a power supply circuit based on a 3-terminal regulator; and (2) a simple filter/attenuator network.

In the power supply section, the unregulated DC output from a 9V plugpack supply is regulated to +5V by regulator IC1. This +5V output is used to power both 4.5V and 6V receivers directly, while three forward-biased diodes (D1, D2 and D3) are used to drop the 5V rail to approximately 3V to power 3V receivers.

If you are concerned about the voltages being slightly high or low in some cases, just remember that the voltage of a fresh dry cell is approximately 1.65V and it remains useful even as its output drops to about 1V.

Refer now to the filter/attenuator section. This circuit plugs into the headphone socket of the receiver, taking the place of the headphones, while the left and right channel outputs go to the external power amplifier.

As before, the three inductors (in this case L4, L5 and L6) appear as short circuits at audio frequencies, and present a relatively high impedance to frequencies in the FM band. This means that the new antenna is formed by the length of twin shielded cable between the output of the receiver and the input of the filter/attenuator section.

Resistors R1 and R2 simulate the headphone impedance while C1 and C2 block any DC components that may be present in the receiver's outputs. R3, R4, R5 and R6 form simple two-step attenuator networks which enable selection between two output levels: low for microphone and instrument inputs; and high for line inputs.

Construction

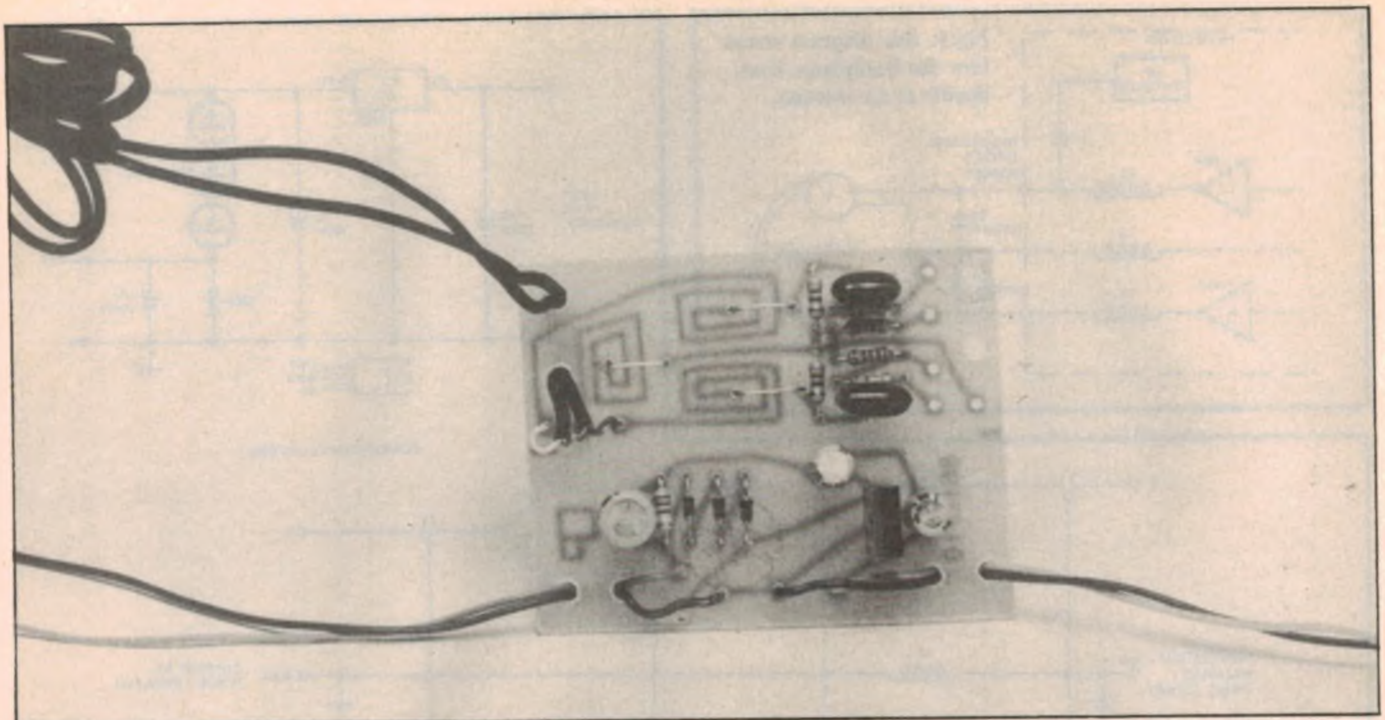
All the circuitry is accommodated on a small printed circuit board coded 85fm10 and measuring 68 x 53mm. Note that the power supply and filter sections can be separated by cutting the board along the guidelines included in the pattern.

Construction is easy — just follow the wiring diagram shown in Fig.3. The three inductors are etched into the PCB pattern, so you don't have to worry about these. Watch the orientation of the 7805 regulator, the diodes and the three electrolytic capacitors.

The next thing to do is to check which supply rail to use. This can be determined by opening up the battery compartment in the receiver. It's then simply a matter of connecting the positive supply lead to either the +3V output or the +5V output on the PCB.

Make sure that you remove all dry cells from the receiver before running it from the mains supply. The supply leads to the receiver can be either soldered directly to the battery terminals, or you can fit a plug and socket arrangement if space permits. Use a DC plug and socket to avoid possible mix-ups with the stereo plug.

The stereo plug should be the same type as fitted to the headphone leads



This photograph shows the assembled PC board. The three inductors are etched into the PC pattern.

FM link receiver

and must be wired in the same manner using twin shielded audio cable. Because it also doubles as the antenna, this cable should be about one metre (or more) long.

Twin shielded audio cable should also be used for the output leads. Terminate the left and right channel outputs with whatever type of plug is required to match the amplifier inputs (usually RCA phono plugs).

Finally, both the left and right channels are catered for in the filter-attenuator unit. This is for those readers who wish to use a Walkman-style receiver as an inexpensive stereo tuner. However, only one channel is required for a wireless link receiver which means that you can delete several components as shown on the circuit diagram. EA

PARTS LIST

1 PCB, code 86fm10, 68 x 53mm
1 miniature stereo headphone plug
1 9V DC 100mA plugpack transformer
1 plastic zippy case, 28 x 54 x 83mm
1 DC plug and socket (optional, see text)

Semiconductors

1 7805 3-terminal regulator
3 1N4001 silicon diodes

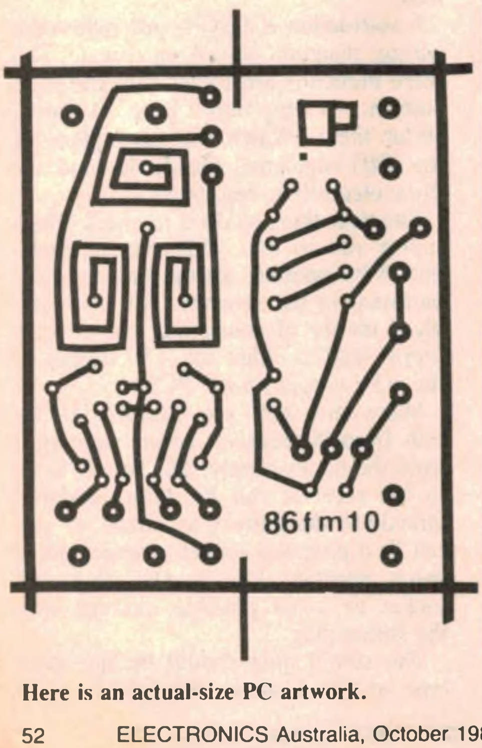
Capacitors

1 100μF 10VW PC electrolytic
2 10μF 16VW PC electrolytics
2 0.22μF polyester

Resistors (0.25W, 5%)

2 x 120kΩ, 2 x 12kΩ, 2 x 470Ω, 1 x 220Ω

Note: the PCB and on-board components for this project can be purchased from Oatley Electronics, PO Box 89, Oatley, NSW 2223. Price: $7.95 (includes pack and post). Add $10.50 for the plugpack transformer.



Here is an actual-size PC artwork.

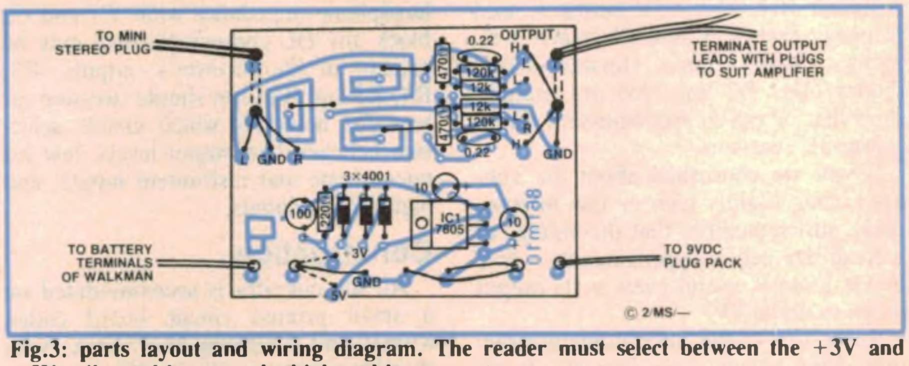


Fig.3: parts layout and wiring diagram. The reader must select between the +3V and +5V rails, and between the high and low outputs.

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Build These Fantastic New Playmaster HiFi Loudspeakers

See Electronics Australia Sept '86

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full kit K 5090

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Some extracts from Electronics Australia Magazine — Each woofer has a foam roll surround and a doped paper cone with an effective (piston) diameter of about 155mm. **The Tweeters** "the Tweeters are exotic little beasties" (Editor EA Magazine) each is a 19mm soft dome unit with a ferro-fluid damped voice coil for high power handling and a very smooth frequency response. Its resonant frequency is around 1.7kHz.

Power Handling (60 watts plus RMS) In an average sized lounge room and driven by the Playmaster Sixty-Sixty or an equivalently rated amplifier, these speakers will deliver enough sound volume to satisfy the most power crazed enthusiast.

Construction Only the most basic of tools are required to assemble these loudspeakers. Even if you are a rank amateur at carpentry you will have no problems putting them together. You don't need special clamps or jiggs and all timberwork has been precisely machined. You do have to be able to use a soldering iron though, to connect the loudspeakers to the crossover network.

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Excellent For Production Soldering

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If you have trouble with fine PCB work or component identification but still want both hands free, this is for you. We thoroughly recommend this quality Australian made product.
TECHNICAL INFORMATION Illumination: 22W Fluorescent **Weight:** 8.16kg **Lateral Extension:** 254mm **Vertical Extension:** 254mm **Fixing:** Heavy table base (grey & Ivory) with two chrome plated flexible arms. Cat A 0980

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95.3mm Diam. Piezo Speaker Suitable for HiFi applications. **Frequency Response:** 3K to 40KHz **Sensitivity:** 104db @ 2.8V **Cat. C 6100**

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RS-232 Surge Protector

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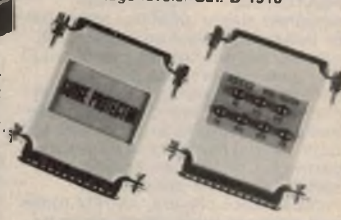

RS-232 Jumper Box

The RS-232 Jumper Box is used to make custom RS-232 interfaces. It consists of a small board with a connector on each end. **Cat. D 1520**

RS-232 Mini Tester

This Tester indicates the presence of all important interface lines by LED illumination when signal is active. **Cat.D 1500**

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The RS-232 Null Modem is used to replace a set 25-pin RS-232 connectors with transit DATA and receive DATA CROSS CONNECTED. (Pin 2 of each connector goes to pin 3 of the other connector). Pins 1 and 7 are connected straight through. Each connector is set up in the loop back mode with pins 4 and 5 shorted together and pins 6, 8 and 20 shorted together. The RS-232 Null Modem is used when the proper operation of a set of modems is in doubt. It also is handy when Transmit DATA and Receive DATA need to be reversed. **Cat. D 1530**

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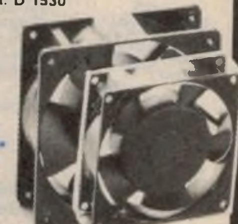

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FEATURES: — This brilliantly designed stereo amplifier will equal or better just about any integrated commercial amp regardless of price. It is a no-compromise design capable of delivering 100 watts per channel at very low distortion. Four basic stereo inputs are provided for both moving magnet and moving coil cartridges. Also three high level stereo inputs are provided for compact disc players, AM/FM tuner and auxiliary input which could be from a stereo TV tuner of Hi Fi VCR. Input facilities are also provided for two stereo cassette decks and full monitoring facilities are available for either deck plus dubbing from Deck 1 to Deck 2 or vice versa. • Full CMOS Analog switching (soft touch) • Twist Type speaker lead binding posts supplied • De-thump muting in-built • All Hi-Spec low noise IC's used. • Incredibly accurate RIAA equalisation. • No control wiring whatsoever • Led indication of switch status (on/off) • All components mount on the PCB, even pots and sockets • Super efficient Toroidal Transformer—Low Hum • Uses Hitachi Mosfet Power devices • In-built over drive protection • Centre detents on Bass, Treble and Balance controls; multiple detents on volume control. • Heavy Duty Heatsinks.

SPECIFICATIONS: — **Power Output:** 100W RMS into 8 Ohms (per channel) **Freq.Response: 8Hz to 20KHz** +0 -0.3db 2.8Hz to 65KHz +0 -1db **Input Sensitivity: 0.775mV for full power Hum:** -100db below full output **S/N Ratio:** 94db flat -100db A-weighted **Distortion:** 0.01% @ 1KHz **Stability:** Unconditional Cat K 5030

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Features: Soft Start. Voltage derating. Over voltage protection. Installs onto rear of standard size switch plate.

(See EA June '86) **$17.50**

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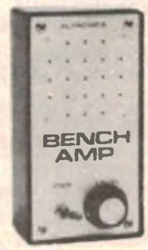

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FEATURES:
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SPECIFICATIONS:
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* Output 13.8V DC 7.5A Continuous - 10A Intermittent * Regulation: - 0-7.5A - 50mV Now includes - Custom Designed Printed Circuit Board as opposed to Vero Board in original article * Supplied in a quality instrument case - attractive silk screened front panel * LED overload indicator.

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(See EA Mag.Jan '85)

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(See EA Sept.'85)

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See EA Aug.'86

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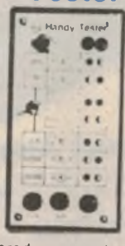

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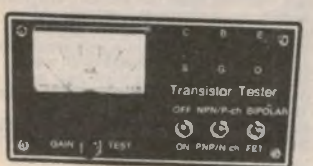

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* 4 digit frequency readout (eliminated tiresome dial calibration) - typical accuracy + or - 2% * 3 overlapping ranges x 1, x 10, x 100 * 600 Ohm Nominal Output - continuously variable 3MW - 2.5V P-P * Distortion - sinewave : less than 0.7% @ 1KHz * Linearity - triangle wave : better than 1% @ 1KHz * Squarewave rise time - 6V/uz maximum output * Amplitude stability - better than 0.1db on all ranges

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Continual Flashing and Flicker or Fluro tubes shortens their life dramaticaly
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AM Stereo Decoder

Almost all AM Stations now transmit in Stereo so why should you miss out on that extra sound realism.
* Uses Genuine Motorola CQUAM Decoder Chip
* Can be built into present HiFi Tuner

Please Note: Circuit diagram of your tuner and possibly a CRO will be required to install this Kit.

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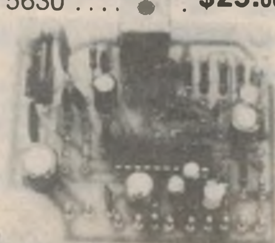

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(See EA July '85) **$59.00**

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Checks audio & RF circuits

Signal Tracer for Trouble—Shooting

(See EA Aug.'85)

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Zener Diode Tester

"Simply plugs into Your Multimeter"

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By simply pluging this handy little tester into your multimeter, it allows you to read out the actual Zener voltage or any Zener Diode up to 60 volts and will also test LEDS! as well as give you a reading of its forward voltage drop.

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Low Power Design also Works as a Battery Charger

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Polar Pattern	Cardoid
Impedance	600 Ohm
Cable	Twin plus shield plus muting pair terminated in 5 pin din plug

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Up to Incredible 1KM Range

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SPECIFICATIONS:

Power Output	20 Watts max.
Effective Range	Approx. 400M (up to 1KM in ideal conditions)
Power	8 Pcs Cell (not Included)
Dimensions	230 Diam. 360 Length
Weight	1.5K (less batteries)
Shoulder Strap	Supplied

Pro Grade Hook Up Wire

All on 100M Reels

Light Duty Tinned 13/.012

Buy Eight Reels For Only $30

.10 per M
$5 per 100M Reel

W 0250	**Red**	W 0254	**Yel**
W 0251	**Blk**	W 0255	**Brn**
W 0252	**Brn**	W 0256	**Blu**
W 0253	**Orn**	W 0257	**Wht**

Get a System for Mum and the Kids

Full Security System Just $99

Fantastic system for this price. Frankly we were amazed at the performance of this very compact system.

Very simple to connect and operate - New Technology has enabled very compact overall dimensions (master unit only 180 x 100 x 65) hence ideal for concealing amoung book shelves etc.

S 5310 **$99**

Look At The Features

EXIT DELAY 30-35 secs. **ENTRY DELAY** 10 secs. **DC SOURCE** AC adaptor 240/9V DC Supplied. **BATTERY BACKUP** 9V Nicad rechargeable- additonal cost S5024 $14.50. **AUTO RESET** 3 minute operate cycle and auto reset. **RANGE** Reliable to 30ft (9M). **LOW BATTERY INDICATOR** included.

Accessories Included for the One Low Price

4 Sets Reed Switches for Window/Doors. 1 Roll fig. "8" cable. 1 External Type Horn Speaker. 1 AC/DC plug pack adaptor. Now there is now excuse for not Protecting yourself, your family and all your hard earned possessions!

PVC Speaker Grill

Suits 8 inch speaker
Attractive White.
Cat. **0800**

1-9 **$2.95** 10 up **$2.40**

Reed Switch and Magnet Sets

3 Types (Surface Mount)

S 5153	SPDT	~~$3.98~~	3.40
Changeover Type			
S 5155	N/C SW	~~$3.98~~	3.40
S 5156	N/O SW	~~$4.50~~	4.10

Strobe Signal Lamps

Uses Xenon Strobe tube for High energy strobe flash output at a rate approx. 1 per second.

Fantastic light energy output for the DC power used. DC input 12V 320mA. Dimensions 97 Diam. 90 H.

Two Colours Available

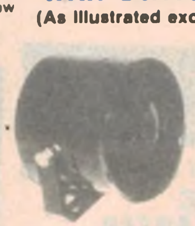
S 5455 Blue

S 5450 Red

$24.50

High Energy Siren with Swivel Bracket

(As Illustrated except white colour)



Absolutely ear splitting SPL 120db. Handy Bracket for wall mounting etc. 12V 300Ma. Dimensions 100mm Diam. 125mm L. Cat. **S 5177**

$22.50

Give Mum Peace of Mind with this Microwave Oven Leak Detector.

A 0900

$19.95

Mini Alarm

Fantastic for Door, Window or Cupboard. This great little alarm simply fixed to one surface (usually fixed surface) with the reed switch magnet screwed to the moving door, window sash etc. **Arm the system by simply switching on**. Battery drain is miniscule! When door/window is opened **bingo** the surprisingly piercing alarm is operated. Sound Pressure level is 90db at 1ft (300mm). Operates from 9V battery (not supplied) (Alkaline type recommended for long service life).

S 5315

$14.95

Ultrasonic Insect and Pest Repeller

Pestrepeller is effective in controlling mice, rats, roaches, fleas, flies crickets, silverfish, waterbugs, moths ants and most other common pests. Laboratory research has shown ultrasonic sound waves attack the auditory and nervous systems of most common pests causing them pain and discomfort. **Specifications— Dimensions:** 100 x 90 x 80 **Power Supply** adaptor supplied 240/9V **Frequency Range** 30KHz to 65KHz variable **Output Level** 130db

Don't Pay $60

A 0083

$39.50

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B 2040 ~~$29.95~~ — **$15.00**

ELECTRONIC MUSIC CIRCUITS

Shows computer and electronics hobbyists, musicians and studio engineers how to build a custom electronic music synthesizer. Outlines many other designs and then shows how to modify them to achieve particular responses. **302P**

B 2050 ~~$29.95~~ — **$15.00**

SECURITY SYSTEMS

Shows you how to design and install your own high quality home security system. Helps you make a security survey of your home, select the most efficient sensors, layout the wiring and complete the job yourself. **144P**

B 2060 ~~$21.00~~ — **$13.95**

HOW TO READ SCHEMATIC DIAGRAMS

Helps you quickly learn to read roadmaps of Electronic circuitry and shows you how contemporary components are combined to form circuits. Also takes you step by step through a sample schematic. Includes updated symbol definitions, logic symbols and more. **192P**

B 2030 ~~$16.00~~ — **$10.00**

COMPLETE GUIDE TO SECURITY

Helps you protect against burglary, theft and armed robbery anywhere - with a wealth of practical advice on using simple self-protection devices and other security measures. **336P**

B 2070 ~~$29.95~~ — **$19.95**

Universal Monitor Stand

With Pan & Tilt Adjustment

This brilliant monitor stand enables you to swivel left/right and tilt up/down i.e. to position monitor to any desired position. Hence viewing position is enhanced and screen glare eliminated. **D 1100**

Altronics Direct Import Price is Now Under $30

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INTERFACE

This data book provides complete specifications for a variety of transmission line drivers/receivers, peripheral/power drivers and level translators/buffers. Product selection guides list applications information and operating features. Memory, dynamic memory, microprocessor, data communications and disk support products are also covered in the data book. The interface appendics section contains cross reference guides, the programmable logic section describes the technology, design and gives application suggestions.

Pages: 1520 Year 1983

B 1005 . . . $13.50

DATA CONVERSION ACQUISITION DATA BOOK

The 1984 edition of the Data Conversion/Acquisition Data book is one the the most comprehensive in the industry. It contains specifications for high technology conversion products in the analog signal path, both preceeding and following the conversion process. Combining high volume production capability with leading edge technology such as thin film resistors, laser trimming and advanced micro CMOS and bipolar processing has helped develop products best suited to your design needs.

Pages: 1232 Year 1984

B 1007 . . . $13.50

HYBRID PRODUCTS DATA BOOK

The Hybrid Products Data book is the only National Semiconductor publication that contains complete information on all our hybrid semicondutor products. Included are precision thin film and thick film products which provide the user with standard functions from operational amplifiers to converters with capabilities beyond those of current monolithic technology. Product selection guides and an application section are also included.

Pages: 792 Year: 1982

B 1045 . . . . . $9.95

LINEAR DATA BOOK

The 1982 edition of the National Semiconductor Linear Data book is the most comprehensive available. It presents approximately 2000 pages of specifications for our high-technology linear products. Applications, descriptions, features and diagrammes in this data book include detailed sections for Voltage Regulators, Op Amps, Voltage Comparators, A to D, D to A Converters, Industrial Blocks and Audio and TV Circuits. The data book also features advanced telecommunications devices and speech synthesis (DIGITALKER). Plus other non state-of-the-art linear products offering performance, economy, quality and reliability.

Pages: 1952 Year:1982

B 1010 . . . $21.50

LINEAR APPLICATIONS HANDBOOK

Provides an indexed & cross reference collection of linear integrated circuit applications using both monolithic & hybrid circuits. Individual application notes written to explain the operation & use of one particular device or to detail various methods of accomplishing a given function. Each section includes applications, descriptions, features, diagrams & specifications.

B 1012 . . . $15.00

LINEAR SUPPLEMENT

The 1984 Linear supplement provides the most recent information on Nationals new linear products. This supplement also provides a comprehensive index published in the Master Data book. New products designed are indicated by an Asterisk and in bold type. Revised data sheets are listed in bold type. Nationals supplement data book system allows you to make product selections of their latest product offerings.

Pages: 566 Year: 1984

B 1011 . . . . . $7.50

MOS MEMORY DATA BOOK

The 1984 MOS Memory Data book is a comprehensive collection of information advanced, high-density memory products covering the spectrum of this mainstream semiconductor component category. National Semiconductor has an array of advanced technology processes to apply to memory design and development. These range from high-density triplepoly process used in the most advanced RAMs, the small-geometry, silicon gate oxide-isolated micro-CMOS technology which is now being applied to high performance memory devices for the first time.

Page: 256 Year: 1984

B 1025 . . . . . $7.50

TRANSISTOR DATA BOOK

National Semiconductor has added many new transistors and product families since publication of the last data book. Many have already been widely acclaimed by users. In addition to small-signal, power-pipolar and field effect transistors that have been the mainstay of our catalogue, there is a section for multiple-field-effect transistors. More part numbers will be added as market needs expand. To keep current on all new National transistors, please contact your National sales representative or franchised distributor and ask to be placed on the customer mailing list.

Pages: 558 Year: 1982

B 1050 . . . . . $9.95

The first 30 customers also receive NATIONAL'S BRILLIANT VOLT—AGE REGULATOR HANDBOOK absolutely free - that's a further $10 value

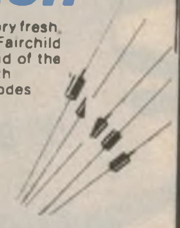
Free Bonus offer for the first 30 Customers Phone order reserve yours now!

VOLTAGE REGULATOR HANDBOOK

The 336 page Voltage Regulator Handbook becomes a must for the selection of three terminal and dual tracking components that meet the system requirements while utilizing the most cost effective approach. Beginning with product selection procedure and a data sheet summary, the text continues with easily accessible information about booster circuitry, power transformer and filter specifications, test methods, manufacturers' cross reference and extended use applications for National's regulators. B 1055

Million Diode Sellout! From 1.5¢ each

Altronics have just purchased around 1 Million (yes million) factory fresh, premium quality IN914/IN4148 diodes. These became surplus to Fairchild Australia as the factory supplied bulk, loose pack diodes instead of the tape/reel diodes ordered. So unless you are a manufacturer with automatic component insertion equipment, these fine quality diodes represent the diode bargain of all time!! **Cat. Z 0101**



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ATTENTION — Social Clubs, Schools, Churchs, Disco Operators, Entertainers, Hotels, Night Clubs and Sporting Bodies. With Altronics low prices - here is your opportunity to install one of these outstanding sound control mixers. Both models include microphone "Soundover" facility - making either ideal for live entertainment use.

Stereo Audio Mixer

A 2550

$125

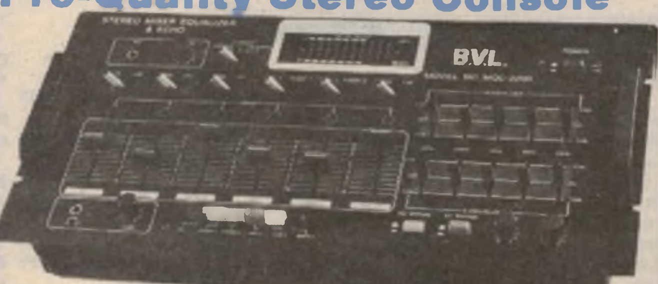
240V Mains Operated

This brilliant little mixing console is absolutely packed with features. Allows blending of Microphone, two Phono inputs and either two Tape or Turner inputs • Right and left VU meters • Separate Bass and Treble controls • 5 slide level controls • Fader control between Phono pickups for professional cueing • Headphone monitor switch • Talkover facility.

SPECIFICATIONS:

• **Input** Mic 0.5mV 600 Ohms Phono 3mV 50K Ohms Tape/Tuner 150mV 100K Ohms • **Output** 250mV •**Frequency Response** 20Hz to 20Hz (plus or minus 1db) • **Tone Control (Treble)** 10KHz (plus or minus 12db) • **Tone Control (Bass)** 100Hz (plus or minus 12db) • **Distortion** Less than 0.07% • **S/N Ratio** More than 60db • **Headphone Impedance** 4—6 Ohms • **Dimensions** 318 (L) x 217 (W) x 85 (H)

Pro-Quality Stereo Console



240V Mains Operated

AMAZING VALUE

A 2570 **$399**

Our sophisticated 'NEW' Audio Mixing Console is ideal for 'live' recording • PA mixing • Fantastic Tape recordings • Even Stereo/Mono VCR recording. A truly professional deck that features separate R/L 5 band graphic equalisers • Echo and Peak LED level indicators • Talkover facility • Separate H/Phone level control • Patch switch bank • Individual microphone, Phono 1 Phone 2, Aux/Line 1, Aux/Line 2, and Master slide level controls — Blend up to two magnetic or crystal turntables, two tape decks or tuners and two microphones all at once!!

SPECIFICATIONS:

• **Input** Mic 1—0.5mV 600 Ohms Mic 2—0.5mV 600 Ohms Mic 2—0.5mV 600 Ohms (low imp.) 2.5mV 10K Ohms (low imp.) Phono 1 & 2 (Mag) 3mV 50K Ohms Phone 1 & 2 (Cry) 150mV 100K Ohms Tape/Tuner 1 & 2 150mV 100K Ohms • **Equaliser** 5 frequency bands—60Hz, 250Hz, 1KHz, 4KHz, 12KHz—Boost Cut range-plus or minus 12db @ Centre frequency. • **Output** 1.5V/0.775V (Selectable) • **Frequency Response** 20Hz to 20KHz plus or minus 1db • **Distortion** Less than 0.05% • **S/N Ratio** More than 50db • **Headphone Impedance** 4—16 Ohms • **Echo** B.B.D.System • **Delay Time** 30—200mS • **Echo Repeat Control** • **Delay Time Control** • **Dimensions** 480 (L) x 240 (W) x 110 (H)

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Why Risk Unnecessary Heart Attack?

Heart disease strikes down many people in their early 40's (or even 30's). The tragedy remains that had such victims been alerted, remedial medical, physical and dietary action could have been prescribed to avoid illness and in many cases restore full bodily health.

Blood Pressure and Heart Rate Monitor

Features:

- Non-Microphone Measurement System
- LCD Readout
- Blood Pressure Monitor
- Pulse Rate Monitor

New Model

X 3055

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$110.00

Monitoring the cardiovascular system of every member of your family is now an easy and affordable necessity with the X 3055 Digital Blood Pressure Monitor. A built-in microcomputer and the microphone-free measurement system guarantee that all readings are highly accurate. The LCD panel shows readings in large numerals for confident measurements. Special symbols to guide you in operation and clear error messages make it easy for every member of the family to use the X 3055. A built-in miser circuit automatically shuts off power to conserve your battery if the unit is not switched off after use. Inflation by the conventional rubber squeeze bulb and deflation by the pre-settable valve make this unit familiar and easy to use daily. Put the X 3055 in your family's health plan — it's a modest investment in your invaluable health.

BLOOD PRESSURE MONITOR SPECIFICATIONS:

Measuring Method	Oscillo-Metric Method
Measuring Range	0-300 mmHg Cuff Pressure 40-150 Pulse/Min Pulse Rate
Acuracy	Pressure ± 3 mmHg (Confirmed A A M I) Pulse Rate ± 5% of Reading
Pressure Build-Up	Squeeze Bulb
Deflation Method	Pre-Settable Exhaust System
Exhaust	Manual Valve

LOGIC PROBE Q 1272 $34.95

New 20MHz Model.

Max. input frequency 20MHz **Input Impedance** 1meg Ohm. Operating supply range 4V minimum **TTL** Logic "1" Hi LED greater than 2-3V Logic "0" Lo LED less than -8V **CMOS** Logic "1" Hi LED greater than 70% Vcc Logic "0" Lo LED less than 30% Vcc **Minimum Detectable Pulse Width** 30 Nano seconds max signal input 220V AC/DC

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Chances are there is an Altronics Reseller right near you — check this list or phone us for details of the nearest dealer.
Blue Ribbon Dealers are highlighted with a ■. These dealers, generally carry a comprehensive range of Altronic products and kits or will order any required item for you.
Don't forget our Express Mail and Phone Order Service—for the cost of a local call, Bankcard, Visa or Mastercard holders can phone order for same day despatch.
Please Note: Resellers have to pay the cost of freight and insurance and therefore the prices charged by individual dealers may vary slightly from this Catalogue — in many cases, however, Dealer prices will still represent a significant cost saving from prices charged by Altronics Competitors.

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50 and 25 years ago...

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

Wireless Weekly

October 1936

Made in Australia: whatever may be the fortunes of the Australian radio industry in the next few months, lack of activity is not likely to be one of them.

Before very long, we shall be in the midst of further plans, which, mainly as a result of tariff restrictions, will further Australianise our radio.

PABX: the use of inter-office communication systems is something which is proving very popular at the moment, and has been readily accepted right from the earliest introduction of such systems.

An "intercom" system is really a series of calling and speaking devices which may be used to link up offices and workshops so that any one point can communicate instantly with any other on urgent matters. It is really a house telephone system without many of the disadvantages and expense such systems generally involve.

Banishing B-batteries: "Within six months there won't be a receiver on the Australian market that operates from 'B' batteries", according to an opinion expressed recently by the sales manager of one of Sydney's leading radio factories. The introduction of a new type of vibrator for supplying high tension voltages from the filament battery is claimed to be responsible for this coming revolution.

"Weekly" in new guise: the issue of *Wireless Weekly* for November 6 will be a very different publication from the issues of the past. The cover will be entirely different and the paper will be made up to include 32 pages of bright and interesting matter printed with rotogravure.

Radio, Television and Hobbies

October 1961

Nuclear power station: at Berkeley, Gloucester, on the estuary of the river Severn, Britain's Nuclear Power Group is building a 275 megawatt nuclear power station for the General Electricity Authority. The station is due to be completed and producing power by the end of 1961.

Colour standards for Britain: the question of colour television is being hotly debated at present, in Britain. The BBC has been pushing hard to commence colour transmissions on present standards. The Authorities are inclined to the view that, if and when colour is introduced, it should be on a new 625-line standard.

FM stereo: after long and careful deliberation, the American Federal Communications Commission recently authorised FM broadcast stations to transmit stereo programs using a compatible multiplex system. Conventional FM tuners will continue to receive what sound like ordinary monophonic programs but specially designed or adapted tuners will provide full stereo output.

Launching ICBMs: a makeshift method of signalling, used in World War 1 and later investigated by amateur operators, is being adapted as a foolproof system of launch control for US intercontinental ballistic missiles. Other important uses for earth-radio are foreshadowed.

If the command to fire must ever be flashed to Minuteman missiles at the newest US rocket bases, it will be transmitted by signals pulsing through the earth.

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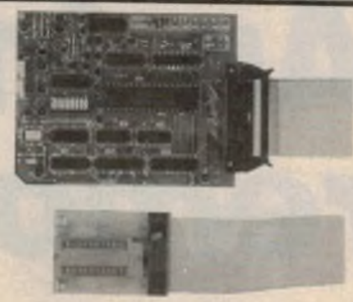

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An infrared remote control preamplifier

Sit back, relax and enjoy total remote control over your hifi system. With this Infrared Remote Control Preamplifier you can select the program while sitting in your armchair. It's the ultimate labour-saving device for laid-back hifi users.

by JOHN CLARKE

The all-new stereo component to be described here comprises a complete preamplifier in which all functions can be selected and varied by infrared remote control. The preamplifier is designed to complement an existing stereo amplifier or receiver, or it can be used as a control preamplifier in conjunction with a stereo power amplifier in a new system.

When used with existing equipment, it replaces the preamplifier section of an integrated amplifier or receiver and can be connected via the tape monitor loop of the existing unit.

As a preamplifier, the unit has all the expected user features. Inputs are provided for Phono, Tuner, Compact Disc and Auxiliary plus a Tape Monitor loop. These can be selected by pushbuttons on the preamplifier itself or via the remote control.

There are also pushbuttons on the preamplifier for volume, balance, bass and treble control functions and for loudness and mute selection. A Normal control switch returns all settings to a preset position. The bass and treble controls will be flat, while the balance will be centred and the volume fixed to a predetermined level. As before, you can either use the front panel switches on the preamplifier unit or the small remote hand held unit.

The preamplifier itself is housed in a metal case measuring 353 x 231 x 63mm (W x D x H). The remote control module has no less than 21 chrome-plated pushbuttons to select all the above functions and is housed in a case measuring 136 x 70 x 27mm.

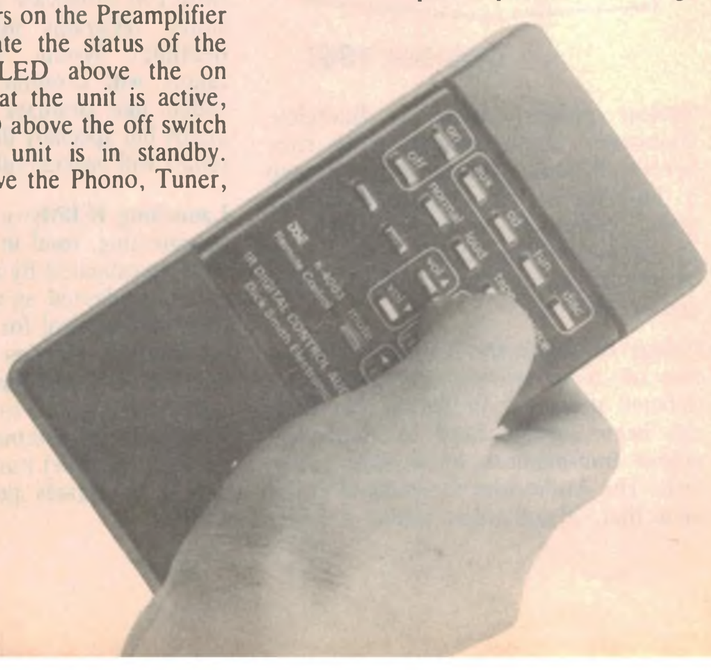
LED annunciators on the Preamplifier are used to indicate the status of the controls. A red LED above the on switch indicates that the unit is active, while a green LED above the off switch indicates that the unit is in standby. Orange LEDs above the Phono, Tuner, CD, Aux, Tape and Source switches indicate which source has been selected.

Similarly, an orange LED above the Loudness switch lights when the loudness function is activated.

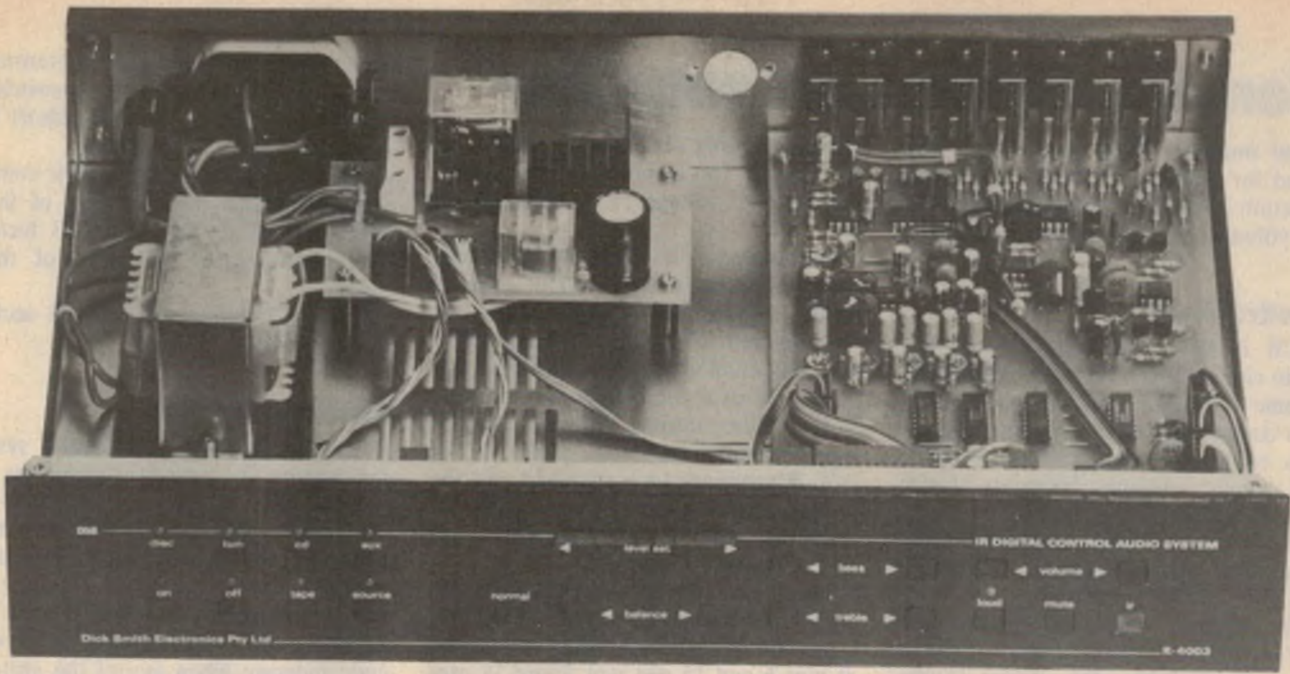
To indicate the status of the remaining functions, a "Level Set" LED bargraph is used. This comprises nine LEDs, eight of which are green and with the centre LED red.

Normally the display indicates the volume setting as a bargraph. When either the bass, treble, volume or balance up or down switches is pressed, the display automatically indicates the setting of that particular function, in the dot mode. After a setting is made for a particular function, the display automatically returns to bargraph volume indication.

The remaining feature of the front panel is the red window for the infrared diode, which picks up and detects sig-



Most of the front panel controls are duplicated on this compact hand-held controller.



nals from the control module.

At the rear of the preamplifier are eight pairs of RCA sockets for program source connection and a 3-pin mains socket for powering an accompanying amplifier.

Performance

The performance of the preamplifier is detailed in a specification panel accompanying this article. As the figures show, the circuit has a reasonable performance but its main claim to fame is user-convenience, not sheer fidelity.

Circuitry

Circuitry for the IR Remote Control Preamplifier can be broken into two sections. Firstly, there is the audio section which comprises the op amps, the signal switching and gain control circuitry. Secondly, there is the logic and display circuitry and the power supply.

Let us begin by taking a look at the audio circuit. This shows both left and right channels, except for the phono preamplifier which shows the right channel only. Components in the right channel start from one while those in the left channel start from 201, ie, the left-channel equivalent of R1 is R201.

The phono preamplifier is the tried and proven circuit featured in the Playmaster Twin Twenty-Five and other amplifiers published over the last decade or so in EA. It employs two transistors in a differential amplifier configuration, driving an op amp. The purpose of using transistors to drive the op amp is to improve the signal-to-noise ratio as well as the loop gain. This latter feature allows more negative feedback to be applied, thereby reducing distortion.

The 56kΩ resistor used in conjunction with Q1 sets the input impedance of the amplifier at close to 50kΩ while the 47pF capacitor and 1kΩ resistor act as an RF suppression network. These in conjunction with choke L1 help prevent RF breakthrough.

The series 1kΩ resistor and .001μF capacitor between the collectors of Q1 and Q2 ensure stability of the preamplifier at high frequencies.

Five components are used in the equalisation network (560kΩ, 56kΩ, .0012μF, .0056μF and 150pF), and give an RIAA response which is typically within ±1dB of the RIAA curve from 40Hz to 20kHz.

Additional roll-off below 30Hz is provided by the 10μF capacitor and 1kΩ resistor at the base of Q2.

The outputs from the phono preamplifier, tuner, CD and aux inputs are applied to IC2. This IC is a CMOS analog multiplexer/demultiplexer which is configured as a 2-pole 4-way switch. One pole of the switch is used for the left channel and the remaining pole is used for the right channel. Selection of one of the four inputs is determined by the code set on the SA and SB digital inputs at pins 10 and 9.

Note that the tuner, CD and aux inputs to IC2 are protected by voltage dividers. In each case, the 1kΩ series resistor protects the IC input from breakdown if a signal is applied when the unit is off. The 56kΩ resistors determine the input impedance.

Outputs at pin 3 of IC2 for the right channel and pin 13 for the left channel are buffered by high pass filters comprising IC3a and IC3b plus associated resistors and capacitors. These are Sallen and Key configuration with a Butterworth response. They provide a very smooth phase and frequency passband response which is important for audio. The low frequency roll off is at about 7Hz which decreases at 6dB/octave or 20dB/decade.

The filters also perform the function of buffering so that a high impedance load is presented to the IC2 CMOS switches. This minimises distortion since the linearity of these switches is very good under minimal loading.

IC4 is for tape monitor switching. It is a CMOS analog multiplexer/demultiplexer similar to IC2 but its configuration is a 3-pole 2-way switch. Logic inputs for control of the switch are at "a" (pin 11), "b" (pin 10) and "c" (pin 9).

Note that the "a" and "b" control inputs are tied together for stereo operation and are controlled at the ST input. The "c" switch pole is connected to IC6 and this has a separate digital control at SL.

When the "a" and "b" switches are in the Y position, the signal from IC3a and IC3b passes through to the pin 14 and 15 outputs. With the "a" and "b" switches set to the X position, the signals from the Tape In inputs are directed to the pin 14 and 15 outputs for tape monitoring.

IC5a and IC5b are unity-gain buffer amplifiers for the right and left outputs at pin 14 and pin 15 of IC4. The 330kΩ resistor at the non-inverting input to each op amp sets the input impedance.

Output from the gain stage is capacitively coupled to IC6. Also at this point are the through Left and through Right

Remote control preamplifier

signal outputs. These outputs are provided for applications when only source selection switching is required without the volume, balance and tone controls.

Controller IC

IC6 is the main controller of the audio circuit. It is a DC-controlled tone, volume and balance control with a loudness compensation feature. Four DC inputs control the bass, treble, balance and volume functions. These are at pins 4, 9, 12 and 14.

In order to control the various functions, it is only necessary to adjust the DC level on the control pins.

For example, when the volume control input is at 0V, the audio volume is about 80dB down with respect to the volume setting at 5V, when the volume is at a maximum of 0dB. The remaining controls have a normal setting of about 2.5V such that the balance is centred and the bass and treble controls are flat.

Note that these inputs are filtered using a two-stage filter comprising a trimpot and 10μF capacitor plus a 47kΩ resistor and 1μF capacitor. The reason for this filtering will become apparent after discussing the control section of the circuit. The trimpots are for adjusting the DC voltage to a maximum of 5V.

For loudness, it is necessary to connect the loudness control input at pin 7 to the volume control input at pin 12. The amount of loudness compensation is a maximum at low volume levels and tapers off to a completely flat response at full volume settings. Loudness switching is accomplished with switch "c" of IC4. When loudness is switched out, the loudness input at pin 7 connects to the reference voltage output at pin 17 to give a flat audio response.

The bass and treble responses are each set by a single capacitor. In this case, the 0.39μF and .01μF capacitors at pins 6 and 15 and pins 3 and 18 provide maximum boost and cut of 15dB at 40Hz and 16kHz respectively.

The audio output from IC6 is capacitively coupled to gain stages IC7a and IC7b for the right and left channels respectively. The 100kΩ trimpots allow adjustment of output signal level to suit various power amplifier sensitivities.

From there, the audio signals are AC-coupled to the left and right channel output terminals. To prevent transients occurring at the output during switching of power, FETs Q3 and Q4 short the outputs to ground at this time.

The "on" signal from the logic control section controls the switching of these FETs. D1, R32, R33 and C33 form a delay network to the gates of these FETs.

Now let's discuss the control section of the circuit.

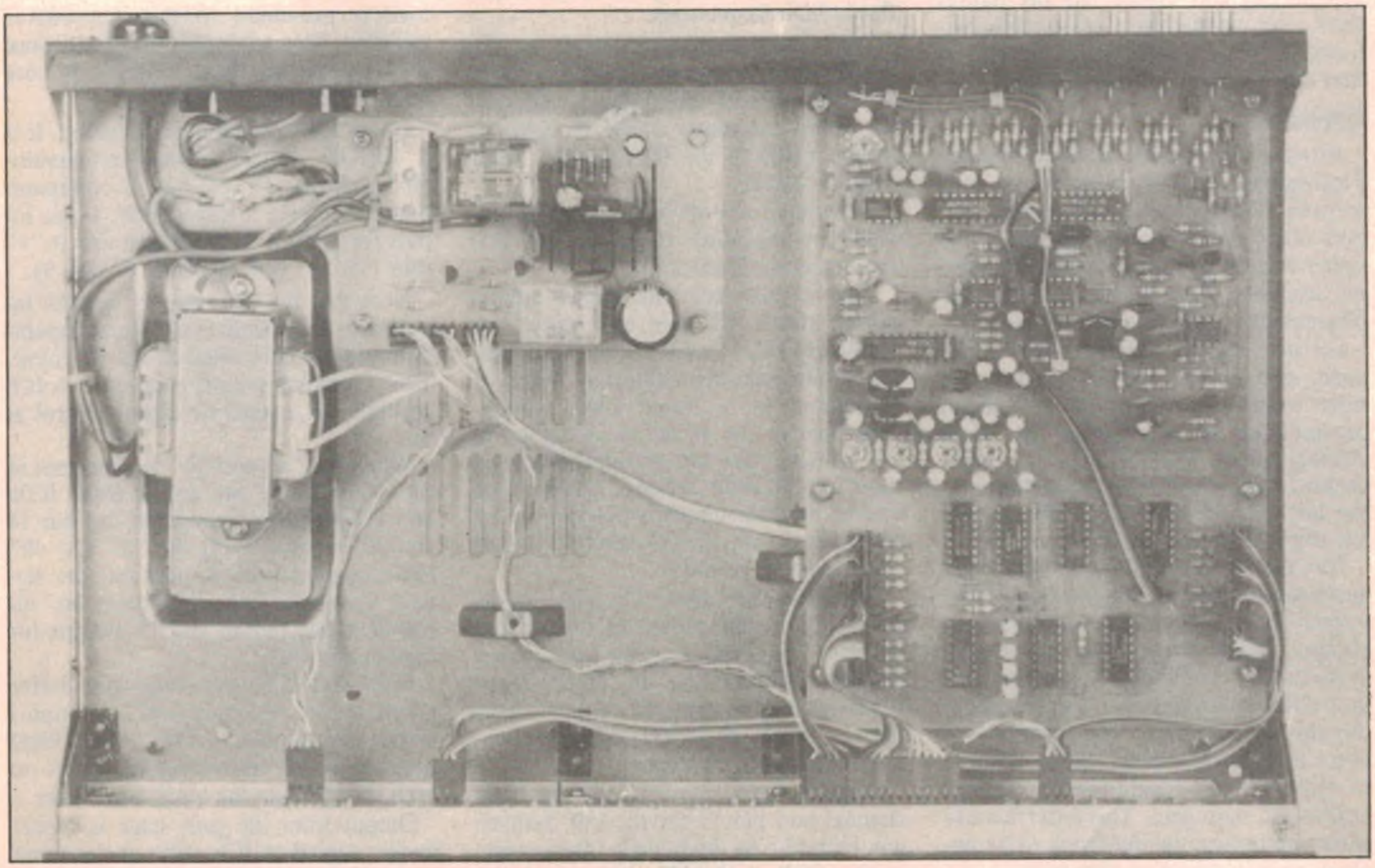
Remote control

The Infrared Remote Control system is based on the Siemens transmitter and receiver set. These were originally designed for TV and radio remote control but they are equally suited for audio control.

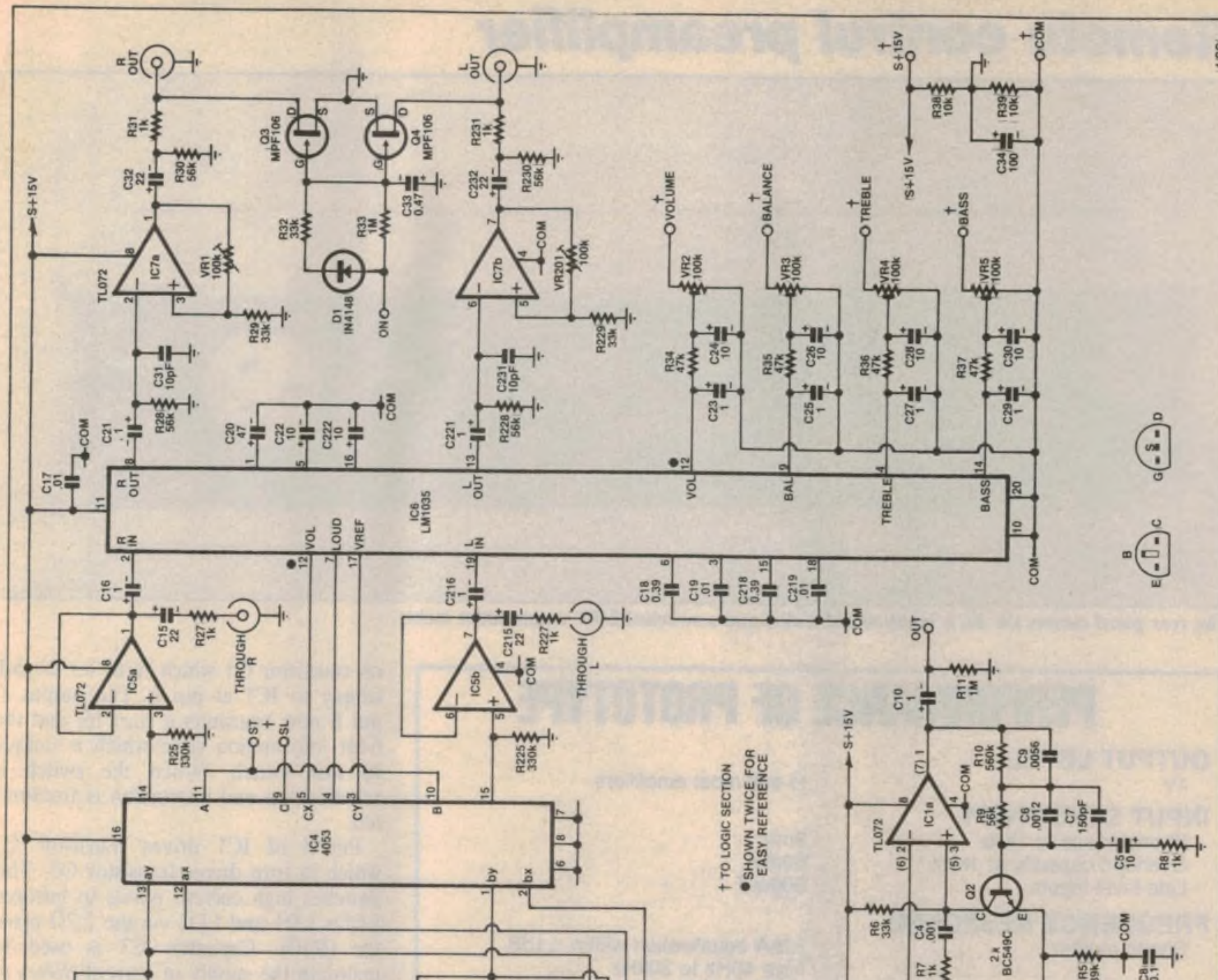
The transmitter circuit uses an SAB3210 IC which produces a 6-bit code message when any of the switches in the keyboard matrix is closed.

Normally only the key scanning function of the IC is operational to minimise the power drain from the IC. But when a switch connects a column to the row, the output at pin 7 goes high to switch

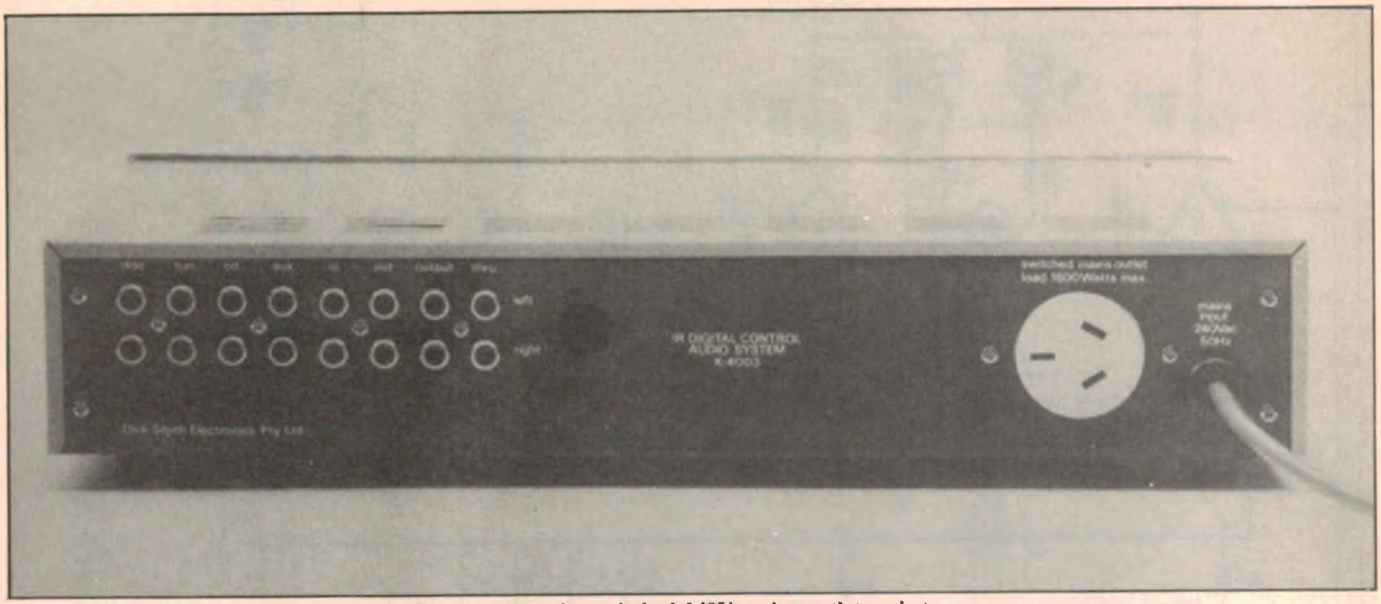
Right: the audio input circuitry is switched by CMOS switches IC2 and IC4 and fed to an LM1035 multi-function controller chip.



The project is easy to build, with all the parts mounted on three printed circuit boards.


IR REMOTE CONTROL PREAMPLIFIER-AUDIO
RIAA AMPLIFIER (ONE CHANNEL ONLY SHOWN)
† TO LOGIC SECTION
● SHOWN TWICE FOR EASY REFERENCE
IC6 LM1035
IC4 4053
IC2 4052

Remote control preamplifier



The rear panel carries the RCA input/output socket and a switched 240V mains outlet socket.

PERFORMANCE OF PROTOTYPE

OUTPUT LEVEL

1V	to suit most amplifiers

INPUT SENSITIVITY

Phono inputs at 1kHz	8mV
Overload capacity at 1kHz	50mV
Line level inputs	560mV

FREQUENCY RESPONSE

Phono inputs	RIAA equalisation within ±1dB from 40Hz to 20kHz
Line inputs	−1dB at 20Hz and 40kHz

HARMONIC DISTORTION

(at 1V RMS output)
less than 0.1% for all output signals up to 1V RMS over frequency range from 20Hz to 20kHz

HUM & NOISE

Phono (with respect to 8mV at 1kHz)	68dB unweighted with typical moving magnet cartridge
Line Level Inputs (with respect to 560mV)	68dB unweighted

CHANNEL SEPARATION

(measured at 1V output and with undriven inputs loaded with 1kΩ resistors)	10kHz	70dB
	1kHz	68dB
	100Hz	55dB

TONE CONTROLS

Bass	±14dB at 40Hz
Treble	±14dB at 16kHz

BALANCE

left to right	−21, +1dB
right to left	−21, +1dB

IR REMOTE CONTROL

Range	6 metres (approx)

MAINS POWER OUTLET

1800W maximum load

on transistor Q1 which turns on the full supply to IC1 at pin 6. The output at pin 8 now transmits a start bit and the 6-bit information code which is unique to that switch. When the switch is released, an end instruction is transmitted.

Pin 8 of IC1 drives transistor Q2 which in turn drives transistor Q3. This switches high current pulses to infrared LEDs LD1 and LD2 via the 2.7Ω resistor (R10). Capacitor C3 is used to maintain the supply of current pulses to the LEDs during transmission.

Inductor L1, resistor R6 and capacitors C1 and C2 form the external oscillator circuit for IC1. The frequency of oscillation is about 60kHz and the transmission frequency is one half this at 30kHz.

Receiver

The receiver circuit is based on two ICs: a uPC1373 amplifier and an SAB4209 decoder. This is shown on the power supply and logic circuit. The uPC1373 amplifies the signal received by the infrared diode PH1. Inductor L1 and capacitor C3 form a bandpass filter centred on 30kHz. This filter reduces response to any random infrared signals picked up by the IR diode (PH1).

An automatic bias level control at pin 7 input of IC1 adjusts the current through the IR diode for various levels of ambient light. This prevents PH1 from saturating under intense light conditions.

Two signals are applied to the SAB4209 decoder (IC2) at pin 15.

These are the output of amplifier IC1 and the output of a second SAB3210 transmitter (IC3) which serves the front panel controls on the Preamplifier.

IC3 is connected in a similar manner to the remote control transmitter. To save oscillator components, it takes its clock signal from IC2 (pin 2). The transmitter output is taken from the collector of Q2 which connects to the input of IC2. R5 is a pull-up resistor for the collector of Q2 and output of IC1.

Decoder

When the SAB4209 receiver (IC2) first receives a signal, it checks that the code is valid and then directs this information to the serial output ports at pins 18 and 16 (the DATA and DLEN signals). In addition, it also decodes the signal at the control outputs at pins 4, 5, 6 and 7 for addressing up to 16 functions.

Other outputs available from the SAB4209 are four analog value memories and on/off and program count outputs.

Audio control

The analog memory outputs at pins 10, 12, 13 and 14 of IC2 are used to drive the DC inputs of the LM1035 (IC6 on the audio circuit) for the volume, balance, treble and bass respectively. These outputs are duty-cycle modulated rectangular waves at a 1kHz frequency. In order to obtain a DC voltage from this waveform, the outputs are filtered at IC6. With an equal duty cycle, the filtered DC voltage is at half the supply and as the duty cycle varies so does the average filtered DC voltage.

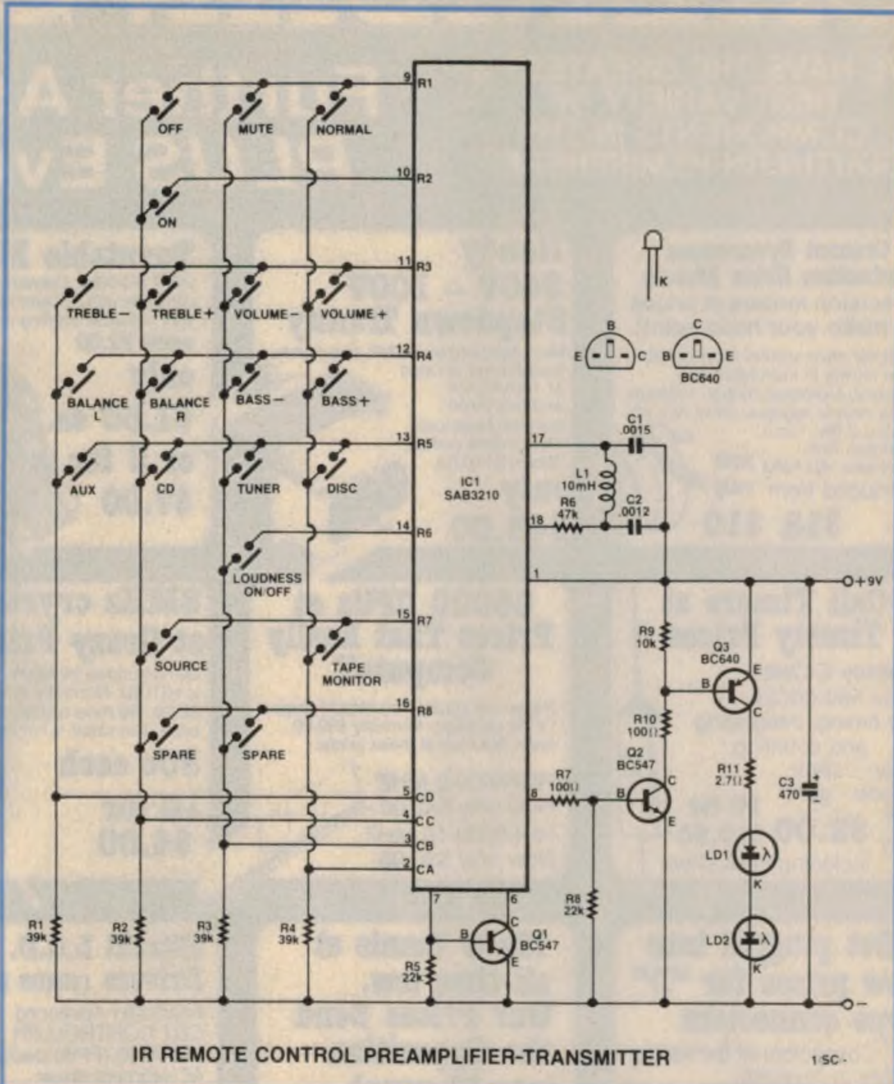
Whenever the Normal function is pressed or the unit is first powered up, the outputs are preset to give 1/3 the supply voltage for the volume and 1/2 the supply for the bass, treble and balance.

Logic

Several logic ICs are incorporated into the circuit to enable IC2 to control the source selection, loudness and tape monitor functions.

First, a dual 4-bit shift register (IC8) is used to convert the serial data from the DATA and DLEN outputs of IC2 into parallel data. IC8 is connected as an 8-bit shift register by tying the clock inputs at pins 1 and 9 together and the most significant bit of the first shift register to the data input of the second shift register. Data is sent to the clock input of IC8, while the DLEN signal is sent to the Data input of IC8.

The data output from IC2 is a 7-bit



The transmitter uses an SAB3210 IC to produce a 6-bit code when a key switch is pressed.

serial stream which includes a start bit plus 6-bit data. Once this data is clocked through IC8, the 7-bit code is present on the a, b, c, d, e and f outputs (pins 12, 13, 10, 3, 4 and 5). This extra logic is necessary since the SAB4209 only decodes the a, b, c, and d codes. These only provide 16 functions while 19 functions are required for this circuit.

IC10 is a BCD-to-decimal decoder. It decodes the most significant bits (the f, e, d and c outputs) from IC8. Outputs "4", "6", "5" and "9" are used for this circuit.

These first three outputs of IC10 are applied via AND gates to the clock inputs of flipflops IC12 and IC13. The AND gates are gated via the Program Change (PC) signal of IC2 via IC11b. The "b" output of IC2 is applied to the data inputs of the IC12a and IC13a flipflops. The "a" output of IC2 is applied to the data input of flipflop IC12b.

Whenever the PC signal changes, which occurs at each new pressing of the control panel or remote control switches, it clocks the data at the "a" and "b" outputs of IC2 to the Q outputs of IC12a and IC12b. Once clocked, the data at the Q outputs remains latched.

The Q outputs of IC12a and IC12b connect to the SA and SB control inputs of IC2 in the audio circuit. This selects the phono, tuner, CD and auxiliary input sources.

Similarly, the Q output of IC13a connects to the ST input of IC4 in the audio circuit. This controls selection of source or tape monitoring.

IC13b is connected as a flipflop with the Q-bar output connected to the data input. At each clock signal, the Q output changes state to control the SL input of IC4 on the audio circuit. This selects and deselects the loudness mode.

Note that the Q-bar output of IC12a

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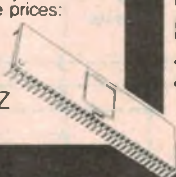

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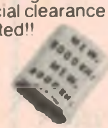

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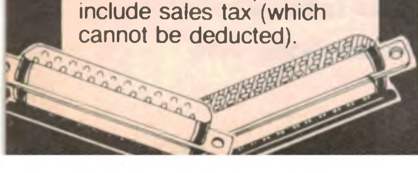

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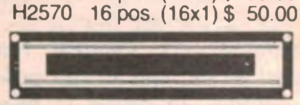

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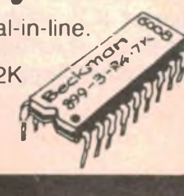

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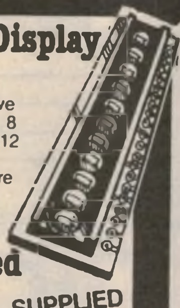

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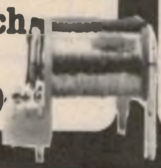

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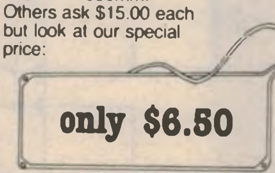

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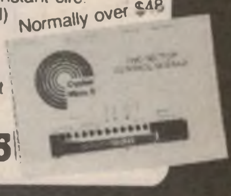

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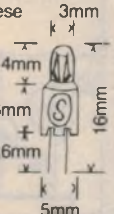

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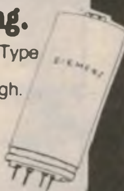

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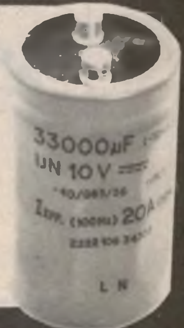

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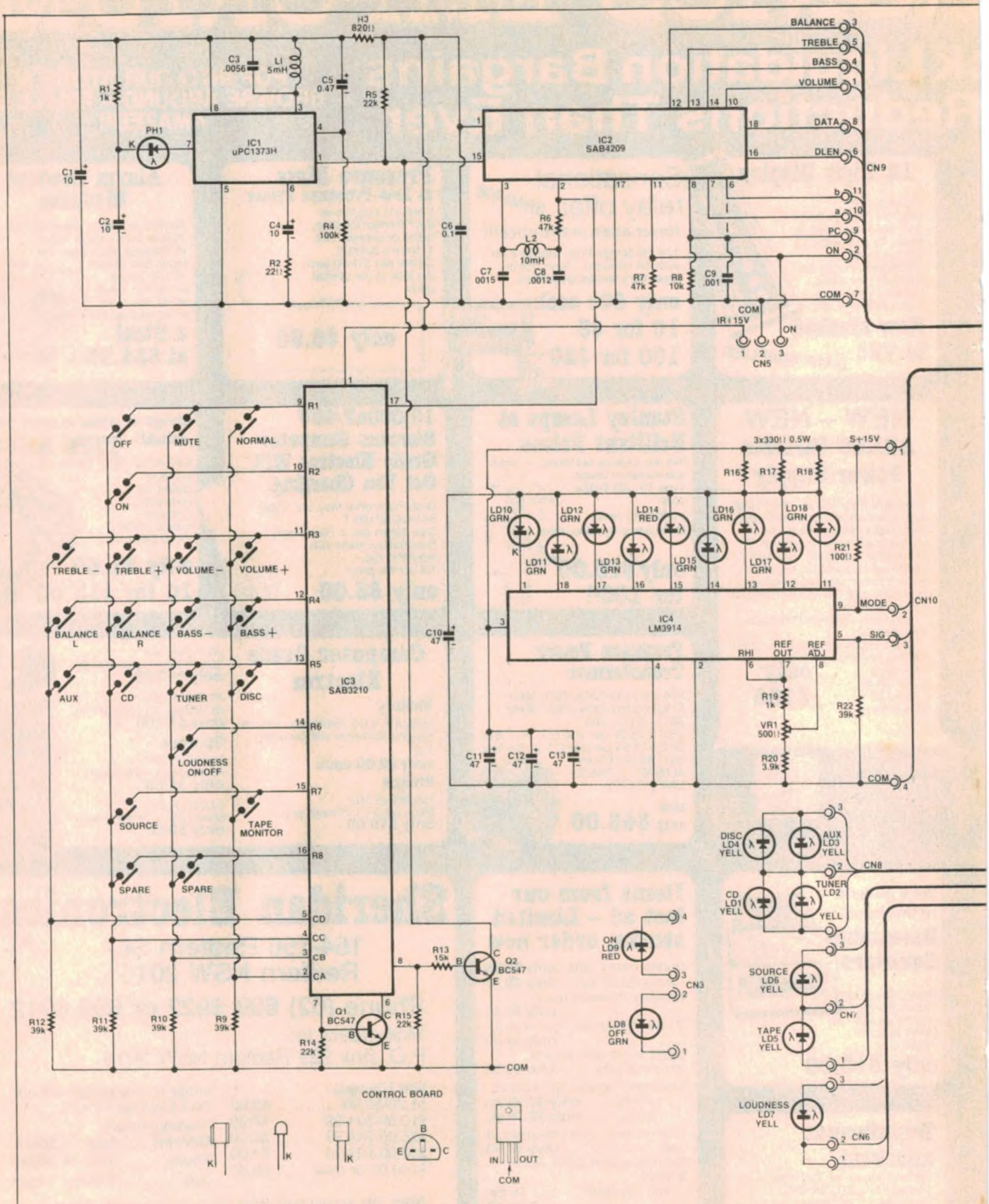
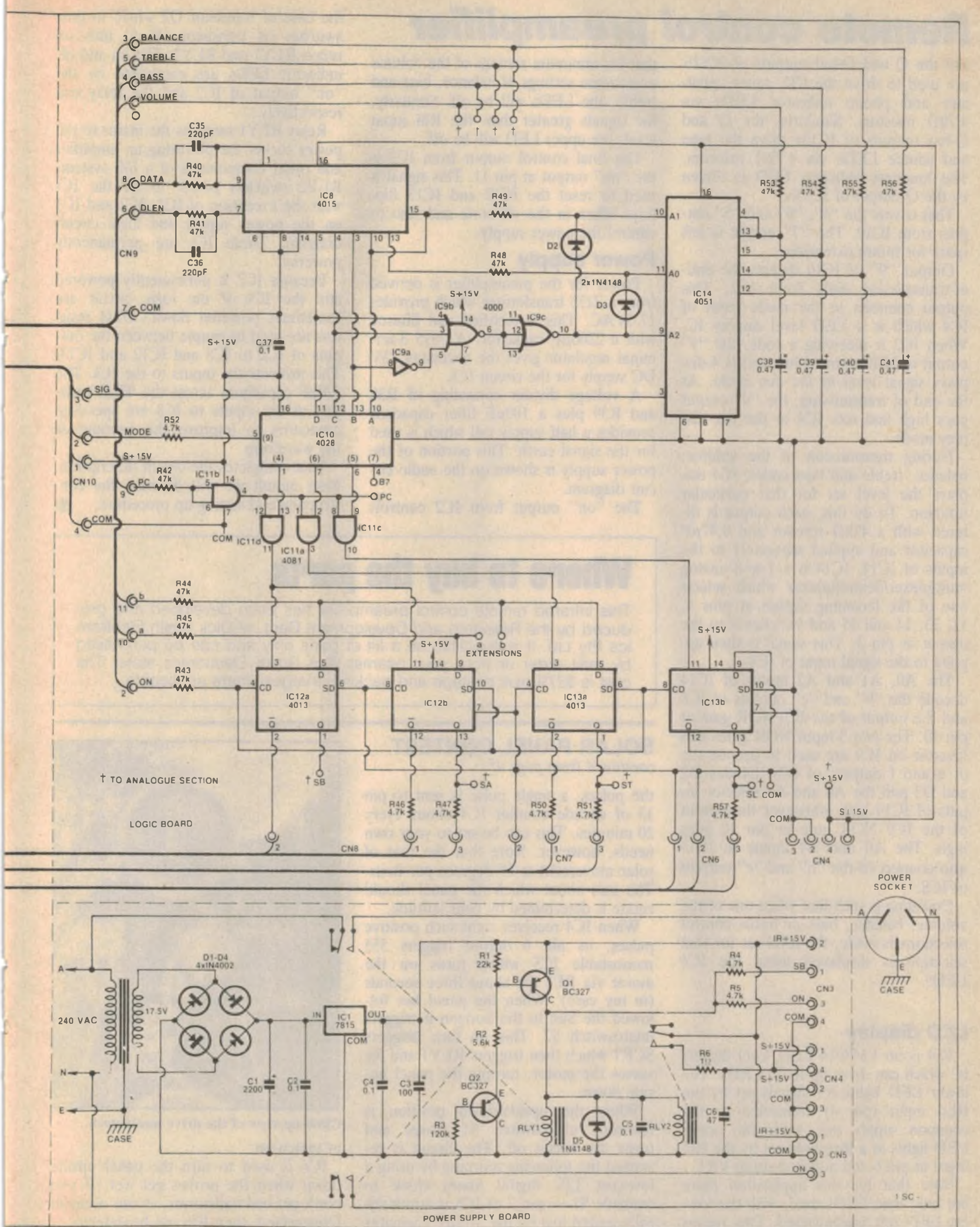


IR REMOTE CONTROL PREAMPLIFIER-POWER SUPPLY & LOGIC



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R3 120k
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D5 1N4148
C5 0.1
RLY2
R6 10
C6 47
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POWER SUPPLY BOARD

Remote control preamplifier

and the Q and Q-bar outputs of IC12b are used to drive the CD, tuner, auxiliary and phono indicator LEDs via 4.7kΩ resistors. Similarly, the Q and Q-bar outputs of IC13a drive the tape and source LEDs via 4.7kΩ resistors. The loudness indicator LED is driven by the Q output of IC13b.

That covers the "4", "6" and "5" outputs from IC10. The "7" output is left spare for future extension.

Output "9" of IC10 detects the end-of-transmission code from IC2. This output connects to the mode input of IC4 which is a LED level display IC. When IC2 is receiving a code, the "9" output of IC10 remains low and IC4 displays signal level in the dot mode. At the end of transmission, the "9" output goes high and sets IC4 to the bar display mode.

During transmission of the volume, balance, treble and bass codes, IC4 displays the level set for that particular function. To do this, each output is filtered with a 47kΩ resistor and 0.47μF capacitor and applied separately to the inputs of IC14. IC14 is a 1-to-8 analog multiplexer/demultiplexer which selects one of the incoming signals at pins 4, 12, 13, 14 and 15 and switches it to the output at pin 3. This signal is then applied to the signal input of IC4.

The A0, A1 and A2 inputs of IC14 decode the "b" and "c" outputs of IC8 and the output of the IC9 NOR gate at pin 10. The two 3-input NOR gates and inverter on IC9 are used to decode the d, e and f outputs of IC8. Diodes D2 and D3 pull the A0 and A1 selector inputs of IC14 high whenever the output of the IC9 NOR gate at pin 10 goes high. The A0 and A1 inputs to IC14 also connect to the "b" and "c" outputs of IC8.

Decoding is such that when one of the volume, balance, bass or treble control selections is made, the level set for that selection is displayed using the IC4 LEDs.

LED display

IC4 is an LM3914 LED level display IC which can drive up to 10 LEDs. The lower LED lights for signals set by the RLo input (pin 4) connected to the common supply rail, while the upper LED lights at a threshold set by the Rhi input at pin 6 and adjusted using VR1.

Note that for this application there are only nine LEDs used, with the lowest LED left unconnected. This means that for minimum settings of the volume or extreme settings of balance, bass and treble, the LEDs will be off. Similarly, for signals greater than the Rhi input level, the upper LED will be off.

The final control output from IC2 is the "on" output at pin 11. This signal is used to reset the IC12 and IC13 flip-flops when in the off state and also to control the power supply.

Power supply

Power for the preamplifier is derived from a 2155 transformer which provides 17.5VAC. This is rectified and filtered with a 2200μF capacitor. A 7815 3-terminal regulator gives the necessary 15V DC supply for the circuit ICs.

A voltage divider consisting of R38 and R39 plus a 100μF filter capacitor provides a half supply rail which is used for the signal earth. This portion of the power supply is shown on the audio circuit diagram.

The "on" output from IC2 controls the base of transistor Q2 which in turn switches on transistor Q1 to turn on relays RLY1 and RLY2. The on and off indicator LEDs are controlled by the "on" output of IC2 and the relay coil respectively.

Relay RLY1 switches the mains to the power socket for powering an amplifier and other components of a hifi system. RLY2 switches power to all the ICs with the exception of IC1, IC2 and IC3 on the power supply and logic circuit diagram. These ICs are permanently powered.

Because IC2 is permanently powered and the ICs of the logic circuit are sometimes powered down, 47kΩ resistors are used to couple between the outputs of IC2 to IC8 and IC12 and IC13. This protects the inputs to the ICs. The 220pF capacitors across the 47kΩ resistors at the inputs to IC8 are speed-up capacitors to improve the risetime of the waveform.

That completes the circuit description. Next month we will describe the construction and setting up procedure.

Where to buy the parts

This infrared remote control preamplifier has been developed and produced by the Research and Development Dept. at Dick Smith Electronics Pty Ltd. It is available as a kit of parts only and can be purchased by mail order or from your nearest Dick Smith Electronics store. The cost is $279 plus postage and packing charges where applicable.

SOLAR PANEL CONTEST

continued from page 45

the pulses, a single pulse is sent to pin 13 of decade counter IC4 about every 20 minutes. This can be set to your own needs, however. Note that the rate of solar movement is 15 degrees per hour. The axis about which the panel should rotate is determined by your latitude.

When IC4 receives eight such positive pulses, its pin 6 output triggers 555 monostable IC5 which turns on the motor via RL1 for about three seconds (in my case). When the panel has followed the Sun to the horizon it triggers microswitch S2. This, in turn, triggers SCR1 which then triggers RLY1 and reverses the motor, turning the panel upside down.

When the upside-down position is reached, microswitch S1 closes and turns the circuit off. The circuit is restarted the following morning by using a low-cost 12V digital alarm clock to override S1 — pin 2 of IC5 is automatically pulled low by the .015μF capacitor at switch on.

Close-up view of the drive mechanism.

IC6 is used to turn the panel upside down when the probes get wet. If you don't get bad hailstorms, as can occur in Queensland, then IC6 can be deleted.

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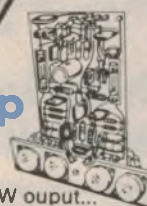

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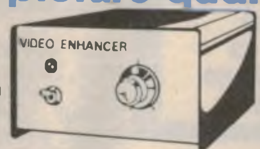

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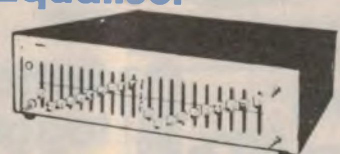

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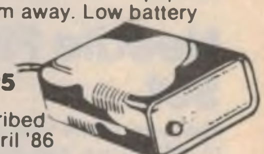

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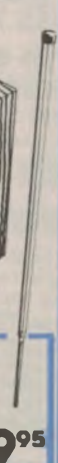

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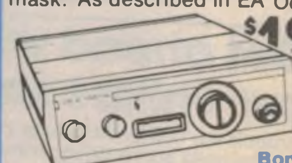

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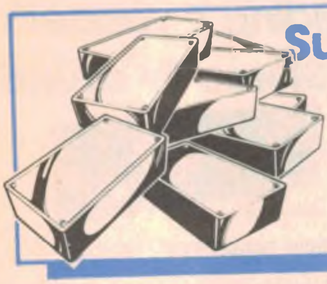

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R-2030	.0039uF 100V greencap (5%)	.30
R-2040	.0056uF 100V greencap (5%)	.30
R-2045	.0068uF 100V greencap (5%)	.30
R-2062	.018uF 100V greencap (5%)	.30
R-2067	.027uF 100V greencap (5%)	.30
R-2075	.039uF 100V greencap (5%)	.30
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R-4025	3.3uF 25V electrolytic cap RT	.40
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R-1968	1M Ohm trimpot 10mm vertical	.55
R-1991	47k Ohm trimpot 10mm vertical	.40
R-1992	2.2M Ohm trimpot 10mm vertical	.40
R-1993	10k Ohm trimpot 10mm vertical	.40
R-4130	100uF 25V electrolytic cap RT	.45
Z-4040	LED 2mm x 5mm rectangular red	.30
Z-4042	LED 2mm x 5mm rectangular green	.30

only 20 CENTS ea

		WAS
R-2125	.39uF 100V green cap 5pct	.35
R-2917	10-100pF trimmer cap (red)	.35
Z-4155	LED display 7 segment common cath.	2.15

only 25 CENTS ea

		WAS
R-2725	.047uF 240VAC polycarbonate cap	.65
R-2807	33pF 630V styro cap	.50
R-2809	39pF 630V styro cap	.50
R-2811	47pF 630V styro cap	.50
R-4175	1000uF 16V electrolytic cap RT	1.05

only 35 CENTS ea

		WAS
Z-4901	74LS01 IC quad 2 input and gate	.85
Z-4904	74LS04 IC hex inverter	.85
Z-4908	74LS08 IC quad 2 input and gate	.85
Z-4910	74LS10 IC triple 3 input nand gate	.85
Z-4914	74LS14 IC hex schmitt trigger	.85
Z-4920	74LS20 IC dual 4 input nand gate	.85
Z-4927	74LS27 IC triple 3 input nor gate	.90
Z-4930	74LS30 IC 8 input nand gate	.90
Z-4912	74LS11 IC triple 3 positive andg	.85
Z-5010	7400 IC quad 2 input nand gate	.55
Z-5011	7401 IC quad 2 in nand open colct	.55
Z-5012	7402 IC quad 2 input nor gate	.70
Z-5615	4015 shift register dual 4 stage	1.40
Z-5682	4082 and gate dual, 4 input	.85
H-3843	knob alum metric silver	1.25

only 40 CENTS ea

		WAS
R-4180	1000uF 25V electrolytic cap RT	1.40
Z-5410	74C00 nand gate quad, 2 input	1.00

only 45 CENTS ea

		WAS
Z-5808	74HC08 and gate quad, 2 input	1.25
Z-5811	74HC11 and gate triple, 3 input	1.25
Z-5827	74HC27 or gate triple, 3 input	1.40
Z-5830	74HC30 nand gate, 8 inputs	1.40
Z-5832	74HC32 or gate quad, 2 input	1.40
Z-5874	74HC74 flip flop dual, D edgetrig	1.45
Z-5622	4022 counter divide by 8 (10F8)	1.95

only 60 CENTS ea

		WAS
Z-5646	4046 PLL phase locked loop	1.95
Z-5886	74HC86 exclusive or gate, quad	1.45
Z-5915	74HC138 decoder multiplxr, 1 of 8	2.50
Z-5920	74HC139 decoder dual, 1 of 4	2.50

only 50 CENTS ea

		WAS
Z-2005	MJE2955 gen purpose power trans	2.50
Z-2072	2N3460 N/ch fet	2.90
Z-2130	2N3053 general purpose switch	1.15
Z-5023	7413 IC DL4IN nand schmitt trig	1.05
Z-5075	7475 IC quad bistable latch	1.40
Z-5283	74LS132 IC Q 2 in nand schmitt trig	1.95
Z-5290	74LS174 IC hex D-type flip flop	1.50
Z-5015	7405 IC hex invertor open colct	.70
Z-5647	4047 multivibrator mono/astable	2.25
Z-5740	4518 counter dual sync div by10	2.40
H-3804	knob plastic metric blue 16mm	1.75
H-3806	knob plastic metric green	1.75

only 80 CENTS ea

		WAS
H-6626	6 pole tagstrip	
Z-4931	74LS31 IC delay line	1.75
Z-4999	74LS190 IC up/down decade countr	1.40
Z-5000	74LS191 IC up/down binary countr	1.95
Z-5288	74LS165 IC par load shift regist	1.95
Z-5644	40441flip flop r/s quad. nand logi	1.65
Z-5742	4520 counter dual, sync, div by16	2.25
Z-5744	4526 counter binary, divide by n	2.25
Z-5885	74HC85 comparator, 4 bit magnitud	2.75
Z-5960	74HC367 buffer hex, 3 state	2.50

only 90 CENTS ea

		WAS
Z-5298	74LS240 octal buff/line driver	2.00
Z-5300	81LS95 octal driver tristate	3.60

only $1.00 ea

		WAS
R-6834	10k linear 6mm dual gang pot	2.85
Z-5047	7447 IC bcd 7 segment decode/driv	2.15
Z-5293	74LS241 IC octal buff/line drive	2.75
Z-5296	74LS221 IC d monostable multivib	2.75
Z-5930	74HC165 shift register, 8 bits	3.85
Z-5945	74HC240 octal buff/line driver	3.85
Z-5965	74HC373 octal transparent latch	4.95
Z-9310	4116 RAM dynamic 16K x 1 memory	4.35
H-6710	BP connector pkt 10 240V	2.95

UNDER $2

		WAS	NOW
H-1972	cable clamp h/d pkt 5	2.75	1.25
H-5618	PC board experimenter	5.45	1.50
H-6770	Jalco terminal board	3.85	1.20
R-4572	2500uF 80V electrolytic cap RP	4.00	1.50
R-4575	22000uF 16V electrolytic cap	13.75	1.50
Z-5376	74C173 register 4 bit D type	3.60	1.50
Z-5955	74HC245 octal bus transceiver	3.85	1.20
Z-6104	LM1872N radio control receiver	8.75	1.80
Z-6520	ZN414 racio IC, AM tuned RF	5.45	1.50

UNDER $2.50

		WAS	NOW
H-1500	screws metric s/t pk 160pc's	3.50	2.00
H-1505	screws metric s/t pk 150pc's	3.50	2.00
H-1510	screws metric machine 320pc	5.95	2.50
H-1515	screws metric c/s mach 270pc	5.95	2.50
H-1520	nut metric asst pack 340pc	7.50	2.50
H-1525	washers metric asst pack 680pc	8.25	2.50
R-6915	1k ohm wire wound pot 5W 6mm	6.95	2.00
Z-5374	74C157 data selector quad, 1 of 2	4.95	2.20
Z-5378	74C221 monostable dual schmitt	3.85	2.10

UNDER $5

		WAS	NOW
Z-5380	74C922 encoder 16 key keyboard	10.45	4.50
Z-6816	MM5865N timer IC universal	6.05	4.00
Z-9209	2732A eprom 2k X 8 memory IC	8.75	3.95
Z-9312	4164 RAM dynamic 64k x 1 mem.	8.25	3.50

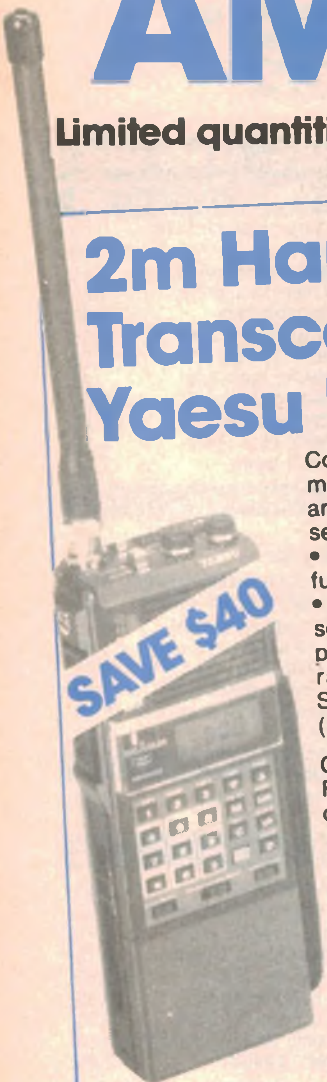
UNDER $9

		WAS	NOW
H-5692	Scotchcal 8001 10x12 red allum	10.95	5.00
Z-1815	2SK134 pwr mosfet NCH	9.85	5.00
Z-2509	MRF629 UHF RF output transistor	18.15	5.00
Z-9206	2513 character generator 64 x 8 x 5	17.55	8.95

AMATEUR & KIT

Limited quantities - not available from every store. Phone your nearest DSE store

2m Hand-held Transceiver — Yaesu FT-209R



Compact, yet one of the most sophisticated units around! • key-in frequency selection and function pad • LCD frequency and function display • memory • manual, programmable scanning with skip and priority scanning. Freq. range: 144-148MHz. Suitable hi/low prower (1.8/3W) Cat D-3502

Choose optional FNB-4 or FNB-5 battery depending on power required.

$399 WAS $439

YAESU

Last chance for Yaesu's mobile antenna system...

Because of the plunging Aussie $, the cost of the Yaesu mobile antenna system has become uneconomic. So if you are even thinking about going mobile on HF, grab some of these — slashed in price to clear — while stocks last.

And if you already have the base & stub, you'll need the resonators some day. Here's your chance. But don't wait!

Note: strictly limited stock — not all parts are in all stores!

RSM-2 Gutter Mount. Deluxe gutter gripper, complete with quality co-ax and PL259 plug. Cat D-4100

Was $50.55 NOW **$29**

RSM-2 Stub. Not just the base for the resonators — it's also a quarter wave on 2m. Screws into RSM-2 mount. Cat D-4102

Was $21.95 NOW **$13**

HF Resonators: Just add on the band you want.

- 80m (RSL3.5) Cat D-4110 Was $54.95 NOW **$34**
- 40m (RSL7A) Cat D-4112 Was $60.45 NOW **$29**
- 20m (RSL14) Cat D-4114 Was $60.45 NOW **$29**
- 15m (RSL21) Cat D-4116 Was $37.95 NOW **$25**
- 10m (RSL28) Cat D-4118 Was $37.95 NOW **$24.95**

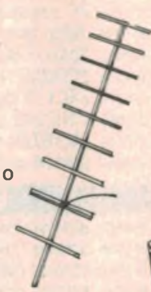
YAESU

Save more with DSE amateur kits

2m Yagi — 10dB gain

This 9-Element gets you into VHF action sooner — it's pre-drilled, so no tuning hassles. Easy to assemble... set up in no time. Cat K-6297
As described in April '85 AEM

$89.95



13.8V-20A VK Powermaster...

Versatile power supply with choice of transformers: M-2010 (14 amp continuous/20 amps peak) to run amateur gear; M-2000 (6 amps continuous/10 amps peak) for light work. Cat K-3448 As described in March '84 EA

$119.95
plus transformer:
M-2010 Transformer $63.50
M-2000 Transformer $29.95

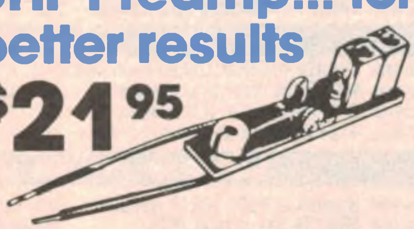
UHF Yagi — 11dB gain

Great investment for 70cm enthusiasts. This 13-element Yagi covers 430-440MHz band with an impressive 11dB gain. As described in AEM
Cat K-6305
As described in Feb '86 AEM

$39.95

UHF Preamp... for better results

$21.95



Really soups up a receiver's soggy front end. Excellent dynamic range and stability. Noise figure of 2dB (or better) between 400-500MHz. Cat K-6306
As described in May '84 ETI

VHF Watt Meter checks your gear

Easily assembled kit measures transceiver's output and antenna's efficiency. Covers 144-148MHz, 0-150 Watts in 2 ranges. Cat K-6316

ONLY **$49.95**

As described in June '86 EA

Phasing Harness to stack UHF Yagis.

Get better range with two antennas — harness matches both to one feed line and boost gain up to a whopping 13.5dB Suits our UHF Yagi (K-6305).

$10.95

As described in March '86 AEM
Cat K-6299

BARGAINS: SAVE!

to avoid disappointment.

70cm GaAsFET Preamp

Get the most from your 70cm gear. Suits relay or diode tx switching, whopping 20dB gain! Covers 430 to 440MHz with noise figure less than 0.8dB. Cat D-2955

Save $48!
Was $97.95
$49.95

Save $280 on the ultimate in 2m versatility

Yaesu's FT290: go-anywhere, do-anything 2m workhorse. It's all mode (FM, SSB & CW) and it suits all users: hand-held (uses "C" size batteries), mobile (12V operated) or base (with optional 240V adaptor). Cat D-2885

NOW ONLY **$479**

Professional quality receivers
The Best from Yaesu

FRG-8800 all band, all mode HF

Everything you could want in a receiver — whether for monitoring, shortwave listening or even part of an amateur station. With all modes in all bands from 2 to 30MHz, selectable IF and bandwidth, CAT system computer control, multi-mode scanning and even optional VHF, the FRG-8800 has become one of the world's most popular receivers. After a few minutes with the FRG-8800, you'll understand why! Cat D-2820

$1259

VHF Converter: Fits entirely inside FRG-8800 for full 118-174MHz coverage. Even accesses memories. Cat D-2823 **$285**

FRG-8800 DC Kit: Want to operate mobile or field? Add this DC kit for 12 volt DC use. Cat D-2822 **$8.75**

FRG-9600 all mode, VHF/UHF

And the latest receiver from Yaesu: the FRG9600 is especially designed for Australian conditions (beware of imitations!) with all mode coverage from 60 to 460MHz and FM coverage from 60 to 905MHz. 100 memories, selectable scanning, computer (CAT) control... everything you could want in VHF/UHF is right here. Cat D-2825

ONLY **$1199**

2m FM Transceiver

144-148MHz coverage with 10-15W output. Similar performance to commercial units costing many times as much! BONUS: Now includes repeater upgrade kit FREE (worth over $30 extra!) Complete kit includes detailed instructions. Cat K-6308

As described in June '84 EA

$199

Save $30 on a 2m Linear Amplifier

Can't quite reach that distant repeater? Need a bit more oomph for DX? Build this one: up to 120W (CW) output from only 15W drive Just plug it in: great for mobile or base operation (12V).

Cat K-6313

$299

As described in March '86 EA

HF Transceiver kit:

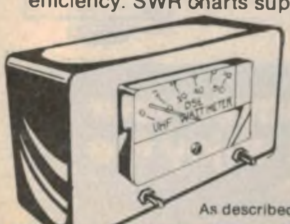
Yes, we've slashed the price on our popular HF transceiver kit. Can cover any single 500Hz segment within 2 to 30MHz (80m version supplied). Covers CW, LSB, USB modes. Cat K-6330

As described in Oct '85 EA

$349

Check the value... UHF Watt Meter

Save time, trouble and $$$. Check your transceiver's output and your antenna's efficiency. SWR charts supplied free!



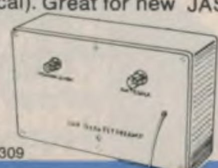
Cat K-6312

JUST **$49.95**

As described in Nov '84 EA

70cm GaAsFET Preamp

What performance! Get that extra performance from your UHF rig: 10dB minimum gain (typical 3dB or so higher). Includes tx/rx switching with quality coax relays. Noise figure less than 2dB (1.5dB typical). Great for new JAS-1 satellite and UHF CB



As described in May '86 EA

Cat K-6309

$129

2m GaAsFET

Into 2m? Build this one. More gain than 70cm version... and the same outstanding savings! Good for satellite use too!

As described in June '86 EA

Cat K-6311

DON'T MISS OUT

$129

Spend a Little Time...

Kits for your car

Beaut LED Tacho Over-Rev Alarm

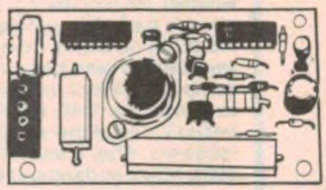
Don't spend a fortune buying a tachometer — build your own and save! Displays engine speed in an analogue form in an illuminated row of LED's. Instructions included — a great kit! Cat K-3240 ETI Aug 80

$26.95

Brake Light Flasher

Just like the taxis use but this one costs next to nothing! Easy to assemble, lets cars behind know you're stopping.
As described in EA Nov 84
Cat K-3245

$16.45



Budget alarm to save your car!

Senses voltage drop in car's electrical system... (eg car door opens, brake light, etc) which triggers alarm. Cat K-3250

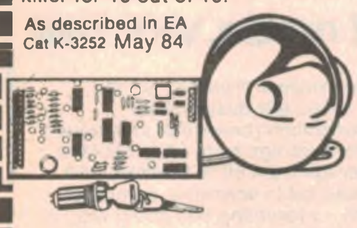
FREE Alarm Book!

ONLY **$15.95**

Our deluxe car alarm is a steal!

Has 9 of the 10 features recommended by the NRMA:
- delayed & instant alarm inputs
- flashing light • key on/off...

and more! Add optional ignition killer for 10 out of 10!
As described in EA May 84
Cat K-3252



$76.45

Ignition Killer: simple & effective!

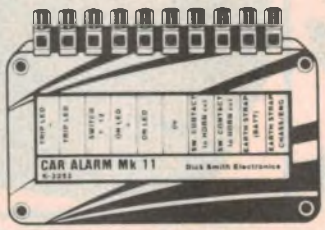
Stops your car dead in its tracks... thief thinks something's wrong and tries another vehicle. With auto re-set.
As described in EA Feb 84
Cat K-3255

$21.45

Thief Stopper car alarm

Great value! Real protection yet very economical. With die-cast case and terminal block.
As described in ETI July 81
Cat K-3253

$35.75



ETI Project Book

Transistor Assisted Ignition

Real efficiency and performance! If your car doesn't already have electronic ignition as standard then this is the one for you! Gives hotter, longer spark. Ideal for all non-diesel cars
As described in EA Feb 83
Cat K-3301

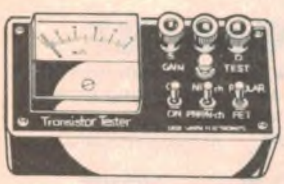
ONLY **$37.50**

BUILD UP YOUR WORKBENCH WITH DSE KITS.

Transistor Tester

Find faults quickly! Test bipolar transistors, diodes, FETs — even SCRs and PUTs. Includes 50 mm meter.
As described in EA July 78
Cat K-3052

$24.75



Turn an old TV into a CRO!

Transforms any old B&W set into an invaluable 300kHz oscilloscope. Large screen for dramatic, easy to read display.
As described in EA May 80
Cat K-3060

$37.95

1 GHz Frequecy Counter

Reads out to 1000MHz in 3 ranges: 20Hz-10MHz, 20Hz-80MHz and 30MHz-1GHz. Input sensitivity (typically) 40 millivolts max.
As described in AEM
Cat K-3437

New! **$249**

3.5 Digit LCD Panel Meter

Affordably replace old analogue meters with this! 200mV reading with < 1 digit accuracy. Great resolution (100uV), automatic polarity and more!
As described in EA Aug 82
Cat K-3450

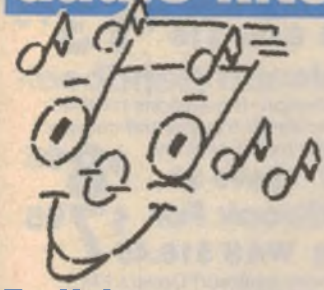
$34.95

DICK SMITH ELECTRONICS PTY LTD

It's true! DSE Kits saves your $$$... and you can enjoy the latest & the best in electronics.

Save $$$ on DSE Kits

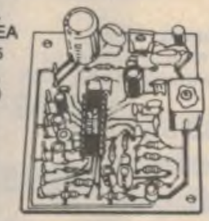
We're No. 1 for audio kits



Enjoy AM Stereo without the expense!

AM Stereo decoder takes IF amp ouput, decodes signal and creates left/right channel separation for superb stereo effect. Turn your old tuner into a AM-Stereo set.
As described in EA Oct 84 Cat K-3415

$32.45

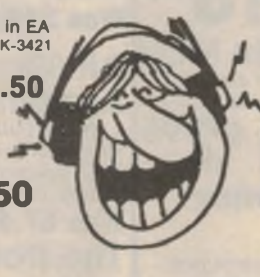


Wow! Stereo Simulator II

Adds a 'zing' to videos by taking a mono signal and creating a sensational stereo-like sound so good, it's hard to tell from the real thing!
As described in EA April 83 Cat K-3421

Was $19.50

NOW $16.50



Improve VCR sound...

VCR Sound Processor creates brilliant stereo-like sound. Inbuilt graphic equaliser to tailor output.

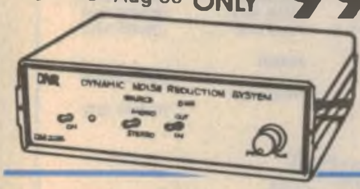
As described in EA April 84 Cat K-3422

$54.95

Build your own VCR DNR System

National Semiconductor's Dynamic Noise Reduction system now in an economic do-it-yourself kit. This superb system can give you up to an 18dB improvement in signal to noise ratio from your mono VCR — and give you simulated stereo as well! Exclusive to Dick Smith Electronics. Cat K-3423
As described in EA Cat K-3423 Aug 86

ONLY $99



Create a dazzling light show

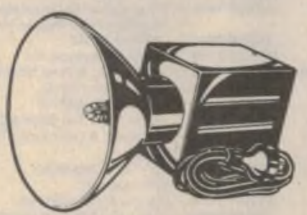
Give your party professional disco light effects with Musicolour IV. Plugs into speakers for synchronised music-light show. With 4 chase patterns, plus auto and reverse too!
As described in EA. Aug 81 Cat K-3143

$129

Liven up the party...

Build a beat triggered strobe to add professional disco effects. Strobe flashes in time to music, or variable rate. It's brilliant!!
As described in AEM July 85 Cat K-3153

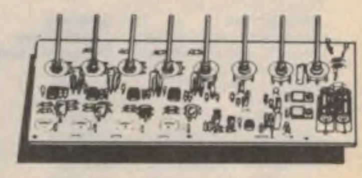
$64.95



4 Input Mixer Preamp

$$$ saver for young bands! Inputs for guitars or a mix... guitars, mics, etc. Features selectable gain and impedance. Bass, treble and presence controls. Cat K-3036 AEM Sept 85

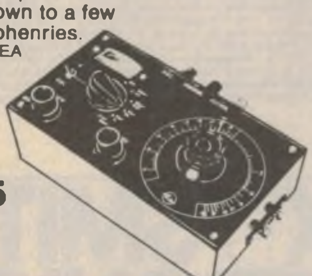
ONLY $55



R-L-C Bridge that's real value...

Measure the values of new and used components. Resistance: 10 ohms — 10 meg ohms. Capacitance: 10pF — 10uF. Inductance: down to a few hundred microhenries.
As described in EA March 78 Cat K-3468

ONLY $48.95



Audio Oscillator

Just what you've always wanted but thought you could never afford: sine and square wave oscillator. Build yourself and save $$$! Covers 15Hz-150kHz. Operates from 9V battery.
As described in EA June 78 Cat K-3469

$48.95

TV Pattern Generator

Professional TV servicing with this compact unit. Generates 3 patterns: dot, crosshatch and blank raster. Includes video modulator too!
As described in EA Nov 83 Cat K-3472

$32.95

Drop into DSE and check out our full kit range... there's something for everyone!

DSE Kits are easy to build... come complete with all components and instructions * unless denoted "short form" kits.

DICK SMITH ELECTRONICS PTY LTD

Sweeping Savings

We've got books covered... Save $$$

LIMITED STOCKS ONLY WHILE STOCKS LAST!

The World of Satellite TV
Everything you ever wanted to know about satellite TV: satellites, programming, what equipment you need and more! Cat B-1842

$16.45

Radio Amateur Prefix Map
Large map details the prefix on each country PLUS DX zones. The perfect companion to put up on the shack wall. Cat B-2264

Was $5.95 Now $3 off! $2.95

Confidential Frequency List
List of all those frequencies you'd love to pick up... maybe hear the President on Air Force One... armed forces and even spy networks. Covers most HF listings to 30mHz. Cat B-9602

Was $21.95 Save $6! $15.95

Home Satellite TV
Gets down to the practicality of setting up a satellite TV station. Sure it can be done, but this 326 page source book makes it easier! Cat B-1840

Was $19.95 Save $9.95 $10

All About Cubical Quad Antennas
A classic publication on Quads... new dimensions, revised gain, mini and monster Quad construction. Even dimensions for 6-80 metres. Cat B-2304

Was $7.50 Save $2.55 $4.95

The Radio Amateur Antenna Handbook
$9.95

Want to know about antennas? This is the book! Everything from beams, verticals to slopers — including info on use and losses. Cat B-2308 **WAS $18.45**

Handbook of Advanced Robotics
Besides the 'what for' and 'how can do' of sophisticated robotics, this amazing book contains instructions on how to build your own remote controlled robot. Cat B-1800

Was $29.95 Save $16 $13.95

Beam Antenna Handbook
A wealth of information! Dimensions for 6-40 metres, how to construct triband and compact beams... and much more! Cat B-2306

Was $15.95 Save $7 $8.95

VHF Handbook For Amateurs
WAS $16.45 $7.95

Great book for every amateur! Covers FM theory, operation and procedure. VHF antenna design and construction. Satellite and moonbounce communication. Cat B-2300

STORE LOCATIONS

NSW		
Swift & Young Sts	**Albury**	(060)21 8399
T55 Terrace Level	**Bankstown Sq**	(02)707 4888
Shop 1, 65-75 Main St	**Blacktown**	(02)671 7722
613 Princess Hwy	**Blakehurst**	(02)546 7744
Oxford & Adelaide Sts	**Bondi Junction**	(02)387 1444
Shop 2, 1B Cross St, Warringah Mall	**Brookvale**	(02)93 0441
Campbelltown Mall Queen St	**Campbelltown**	(046)27 2199
Shop 235, Archer St Entrance	**Chatswood Chase**	(02)411 1955
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Books & Literature

Digital electronics for beginners

DIGITAL ELECTRONICS ENGINEERING by Peter Parsonage. Published 1986 by Longman Paul Ltd, Auckland, NZ. Soft covers, 136 x 215mm, 168 pages, illustrated with many diagrams. ISBN 0-582-71808-2. Retail price NZ$29.99.

This is a book for the person just beginning to take an interest in the digital side of electronics. The Author has produced a clear and readable introduction to the subject, beginning with an explanation of gate types and Boolean algebra, though, a high school student could easily tackle it.

I was particularly interested to see how this book treated the subject of analog-to-digital conversion which is topical. The relevant chapter starts with a description of methods of conversion, progressing to terms used, types of converters and D to A conversion. It was easy to understand, although you'd very soon need another text if you were intending to delve into the subject.

This brings me to the only real complaint: the book is not of sufficient depth, especially if you wish to design digital circuits. Nevertheless, there are a great many people not involved in electrical engineering studies who would find it useful. Our copy came directly from the publisher. (C.R.D.)

Reference work on A-D conversion

THE ANALOG-DIGITAL CONVERSION HANDBOOK: by the engineering staff of Analog Instruments. Published 1986 by Prentice-hall. Hard covers, 700+ pages, 185 x 242mm. Illustrated with diagrams and photographs. ISBN 0-13-032848-0. Recommended retail price $39.50.

Technical books, texts, handbooks — call them what you will, but they all share the objective of explaining certain concepts in straightforward terms. At least, the explanations are usually straightforward to start with. In many instances, the book quickly becomes difficult to read as it progresses. Such is definitely not the case with the Analog-Digital Conversion Book.

Opening the book to a randomly selected passage, I came to a section titled "MINIMISING CALIBRATION ERRORS BY SERVOING". Having no idea what this meant, I decided to read the first paragraph. The explanation was absolutely basic — the only prerequisite knowledge would be what "DAC" stands for. In fact, the explanation flowed so smoothly that I read a couple of pages for the pleasure of it. This is an unusual reaction for a text.

The section I had chosen turned out to be entirely representative of the book. Virtually any section can be read as a separate entity. Every explanation seems to start with a quick summary of the concept, followed by a more detailed explanation. This generally seems to develop to the stage where commonly used formulas are introduced.

The book is arranged in five parts with the following titles: Converters at Work (With and Without Microprocessors), A/D and D/A Converters, Analog-Digital Converters for Special Applications, Related Circuits and Devices (Data-Aquisition-Peripherals), & Guide for the Troubled. To assist in locating your item of interest, there is a one page "Contents in Brief", followed by a ten page "Table of Contents" which lists the headings found in each section.

Although the index covers eleven pages, it is barely large enough to do the book justice. Not so the bibliography, which lists a vast number of references. To assist in research, the bibliography is listed under ten headings.

Certainly the book must be highly recommended for the use of any students involved in A/D study. But to say that the book is only of use to students would be doing it an injustice. For any engineer with an interest in the subject of A-D conversion, this work could be regarded as an essential reference.

The publishing date is 1986, so the information is right up to date. It was written by the engineering staff of Analog Devices. As you might expect, devices listed are always from the Analog Devices' catalog. If the book was practically oriented (ie, with actual circuits and PCBs) this might be a serious handicap. As it is, the orientation is more theoretical and the discussion is equally relevant to other manufacturers' devices.

With over 700 pages and hard covers, the book's price of only $39.50 is exceptional value. Our copy was supplied by Parameters Pty Ltd. (C.R.D.)

Video production manual

THE VIDEO PRODUCTION GUIDE by Lon McQuillin. Published 1985 by Howard W. Sams & Co. Soft covers, 212 x 280mm, 382 pages. Illustrated with diagrams and photographs. ISBN 0-672-22053-9. Retail price $39.95.

A fair part of this book is given over to technical aspects of video production. This includes the cameras, recorders, mixers and switching equipment. In this respect the book is mediocre. Firstly, it is American and therefore concerned primarily with NTSC video signals and 60Hz frame frequencies.

To be fair, other video systems are mentioned and PAL is recognised as the superior system. An interesting comment appeared regarding PAL; it was suggested that countries outside of the US had the benefit of waiting for an improved system (true) and additionally did not have the constraint of having to produce a black and white compatible system (untrue).

No particular expertise in the area of psychology is needed to recognise this statement as dubious: (regarding TV viewers) "In order to cope with this rapid rate of information reception, the mind tends to divert the information directly into the subconscious, with the expectation of returning to it later for consideration . . . They're there, working on your thought processes. Of course, you're less than actively aware of them."

What a terrifying prospect! Years of "Dynasty" and "Perfect Match" just lurking around in the subconscious, awaiting their moment to wreak havoc on the unsuspecting viewer. Fortunately, this statement is not substantiated by any references.

It is only fair to remind prospective buyers that these criticisms are only regarding peripheral areas of the book. It is not primarily intended as a technical manual, and certainly not as a psychology reference. It is a very large book for the money, and with respect to video production, certainly seems to be comprehensive. Our copy was supplied by Jaycar. (C.R.D.)

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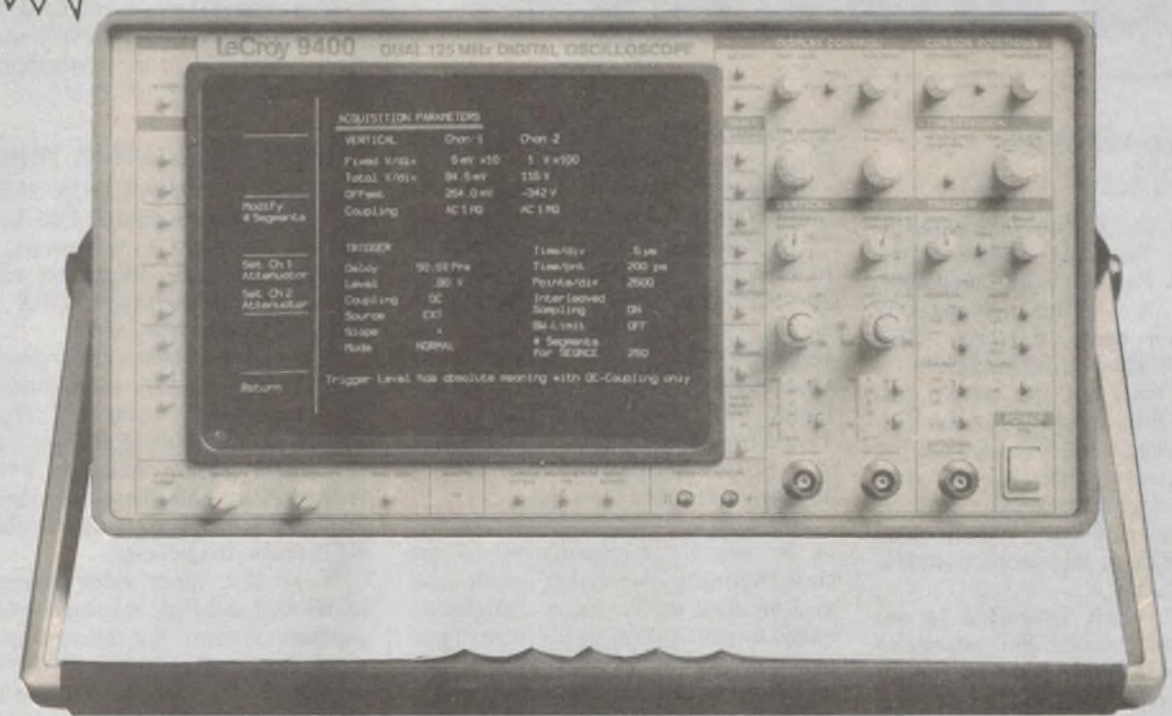

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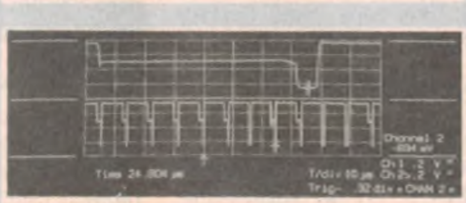

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Inside the OSCILLOSCOPE PT.3

Using the oscilloscope is not difficult when you know how! We look at some simple rules that will help you get almost all scopes up and running in no time.

by MARGE GUSTAFSON, LARRY JOHNSON & CARL LARON

The oscilloscope is considered to be one of the most important and useful test instruments that you can own. That, of course, presupposes that you are familiar with oscilloscopes in general, and the instrument that you are using in particular. Using an oscilloscope correctly, and to its best advantage, can present a challenge to the inexperienced user. That's because oscilloscopes are much more complex than most other types of test equipment with which electronics hobbyists are likely to have contact. In addition, there is a wide array of very different types of oscilloscopes currently on the market.

In this article, we are going to look at some of the rules of oscilloscope use. Our aim is to master the techniques that should be used to get a basic oscilloscope up and running. Once that is done, you will be able to tackle more sophisticated oscilloscopes with greater confidence, and success.

Getting started

When you get your hands on a new, unfamiliar unit, the first step is to plug it in, turn it on, and allow it to warm up. Allowing the scope to warm up serves two important purposes. First, it ensures that trace drift is at a minimum when you begin to make your measurements. Second, it gives you a chance to read the manual! Reading the manual and familiarizing yourself with the unit's controls and idiosyncracies before you start will almost always save you time and head scratching later when you get down to work. But surprisingly, this step is often overlooked, especially by so-called experienced users.

Once the unit has warmed up sufficiently, the next step is to obtain a trace. Be sure that the trigger mode is set to AUTOMATIC and the trigger source is set to INTERNAL. Then select a medium sweep speed, using the TIMEBASE control (often labelled TIME/DIV, or something similar). Set the HORIZONTAL and VERTICAL trace-position controls to about midrange, and adjust the INTENSITY control until the trace appears. If at full intensity no trace appears, use the LEFT-RIGHT and UP-DOWN position controls to move the trace so that it can be seen near the centre of the display.

If you can not find the trace by using this technique, the following systematic approach can be used. Set the HORIZONTAL position control fully counterclockwise. Now, rotate the HORIZONTAL control a small amount in the clockwise direction and then rotate the VERTICAL control through its entire range. (Rotate the VERTICAL control slowly or the trace may shoot across the CRT display screen too rapidly to be seen). Repeat this procedure until the trace is located.

Displaying a waveform

Once the trace is obtained, set the position controls such that the trace is centred vertically and begins at the left side of the CRT. Obviously, if a waveform is to be displayed, a signal must be input to the scope. This is done (usually) via a front-panel, vertical-input connector.

Next, depending on the type of measurement you are making, the VERTICAL INPUT switch should be set to the appropriate setting: AC or DC. Set the vertical attenuator control (labelled VOLTS/DIV, or something similar) so that the entire waveform can be displayed over one-half to three-quarters of the screen height. If you are unsure about the amplitude of the input signal, select the highest attenuation setting.

Once the trace is displayed, the TIMEBASE control should be set so that a few cycles of the input waveform can be seen. Note that the trace may not be stable at this time. If not, the triggering level will need to be adjusted to lock in the display. For accurate measurements, be sure that both the TIMEBASE and the VERTICAL-ATTENUATOR controls are used in their calibrated modes.

Triggering

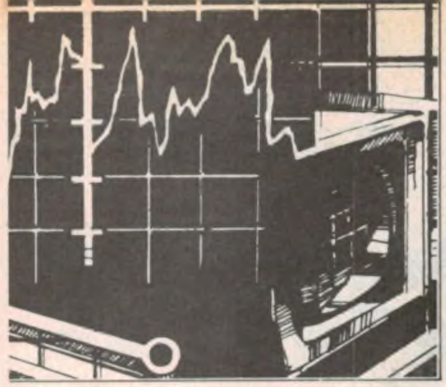
Most scopes have two triggering-mode switch settings: AUTOMATIC (or AUTO) and NORMAL. Automatic triggering is the most frequently used setting. In that mode, a trace is displayed even when the signal level is too low for triggering.

In the AC-coupled, automatic-trigger mode, a trigger signal is generated when the displayed waveform passes through the 0-volt point of the AC portion of the input waveform. Because of that, the automatic mode is not usually appropriate for low-frequency work; if the frequency of the input signal is below that of the oscilloscope's baseline generator, that generator cuts in between cycles of the displayed waveform.

When the DC-coupled automatic-triggering mode is used, the trigger is generated when the signal passes through an imaginary line on the display representing 0-volts (usually the centre of the screen). Note that it is important to be sure that the waveform does cross through that line or an untriggered display will result (see Fig.1). The positioning of the trace can be altered by using the VERTICAL position control to ensure that triggering does occur.

Whether triggering takes place on the leading or trailing edge of the waveform is determined by the SLOPE control.

This article originally appeared in "Hands-on Electronics", Vol.3 No.1, and appears here by arrangement.



Normal-mode triggering is used when proper triggering can not be obtained using the automatic mode. That could occur with complex input waveforms, or waveforms that are near the upper and lower frequency limits of the scope. It is also used when triggering at a specific point (other than the 0-volt crossing points) is desired.

Using a dual-trace scope

Dual-trace scopes can operate in either the alternate or chopped mode. In some scopes, the selection of the display mode is automatic, but in others the decision is left to the operator. Which display mode is best to use will, of course, vary with the timebase selected and with the scope. As a general rule-of-thumb, however, use the chopped mode at timebase lengths of less than one millisecond, and the alternate mode

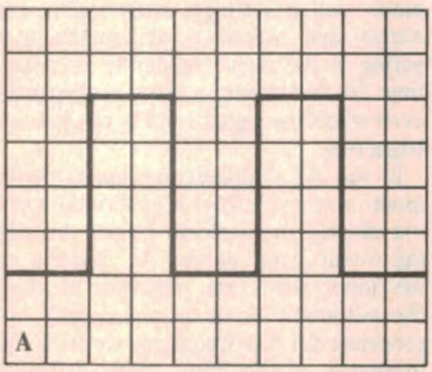
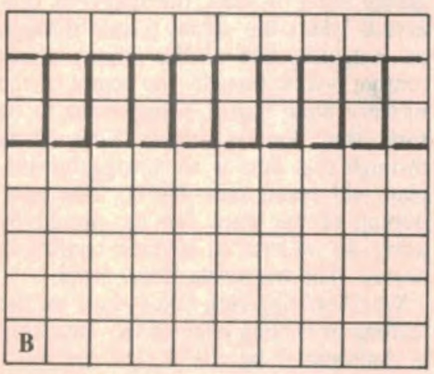


Fig.1: when DC-coupled automatic triggering is used, it is important that the displayed waveform cross the 0-volt line. Otherwise (as shown), untriggered operation will result.



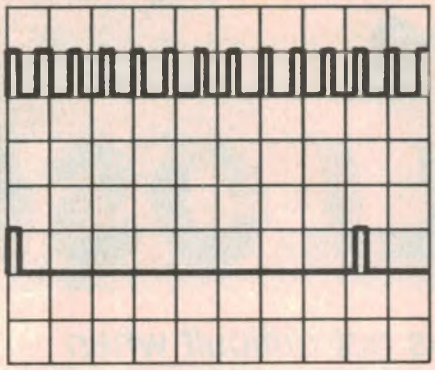


Fig.2: on a dual-trace scope, assuming that the two signals are time related, use the channel with the lower frequency signal as the triggering source.

at one millisecond, and faster.

Usually, dual-trace scopes can be triggered from either channel 1 or channel 2. If the inputs to the two channels are time-related (have the same phase) but are of different frequencies, the channel with the lower-frequency signal should be used for triggering. For example, Fig.2 shows a dual-trace display. The upper trace is the clock signal being input to a BCD counter. The lower trace is the output of that device. There, triggering would be selected to be on the trailing edge of the lower waveform. Selecting the triggering in that way ensures that there will be only one sweep for each output pulse.

Also, some dual-trace scopes have composite triggering. In that type of triggering, the trigger signal is derived from both channel 1 and channel 2; as the display alternates between channel 1 and channel 2, so does the trigger source. The result is that both signals are solidly locked in, despite any differences in phase or frequency.

Making measurements

Now that we have a locked in (ie triggered) waveform displayed on the CRT, we need to interpret what it is we are seeing.

Consider the display shown in Fig.3. In it we see a sinewave. To obtain the AC voltage of the waveform, we need only count the number of divisions between the positive and negative peaks of the signal and multiply that by the VERTICAL ATTENUATOR setting. For instance, if the attenuator were set at 2-VOLTS-PER-DIV, the voltage of the signal shown in Fig.3 would be 8-volts.

But what kind of AC voltage are we measuring? Readings obtained using an AC voltmeter are RMS (root mean square). But oscilloscopes cannot measure RMS voltages directly; the waveform observed on an oscilloscope is

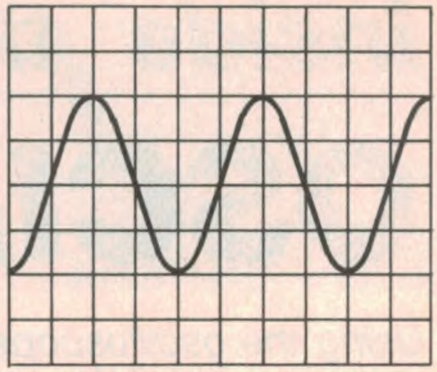


Fig.3: oscilloscopes display peak-to-peak voltages. AC voltmeters provide RMS measurements.

peak-to-peak. For a sinewave, the two quantities can be related to one another through the equation:

$$V_P = 1.414V_{RMS}.$$

For a squarewave, the peak-to-peak and RMS values are identical. For more complex waveforms, more complex relationships exist.

We can use DC coupling to allow an oscilloscope to measure DC-voltage levels. Consider the waveform shown in Fig.4a. Assuming that the vertical atten-

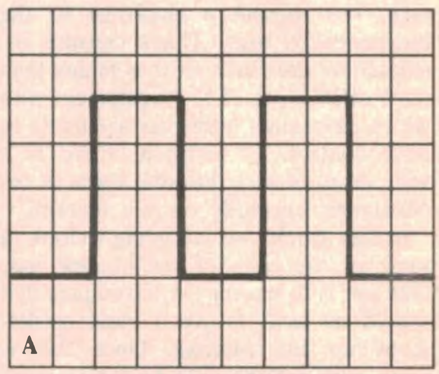
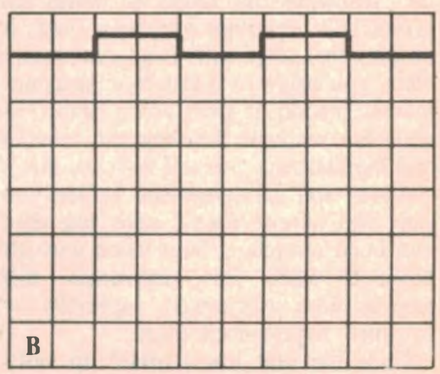


Fig.4: in the AC-coupled mode, there is no way to be sure that the baseline of the displayed waveform (A) is actually 0-volts. In (B), the DC-coupled mode has been selected; there the signal shown in (A) can be seen riding on a DC voltage of 3. (Note the change in the VERTICAL ATTENUATOR settings.)



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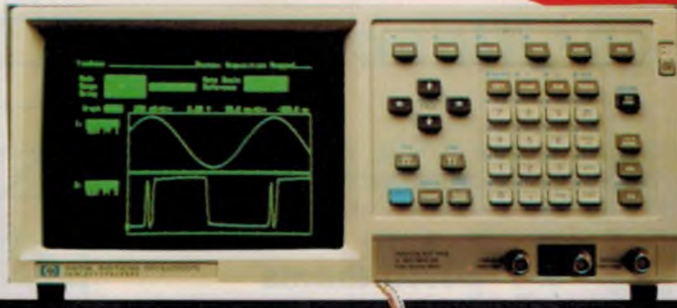

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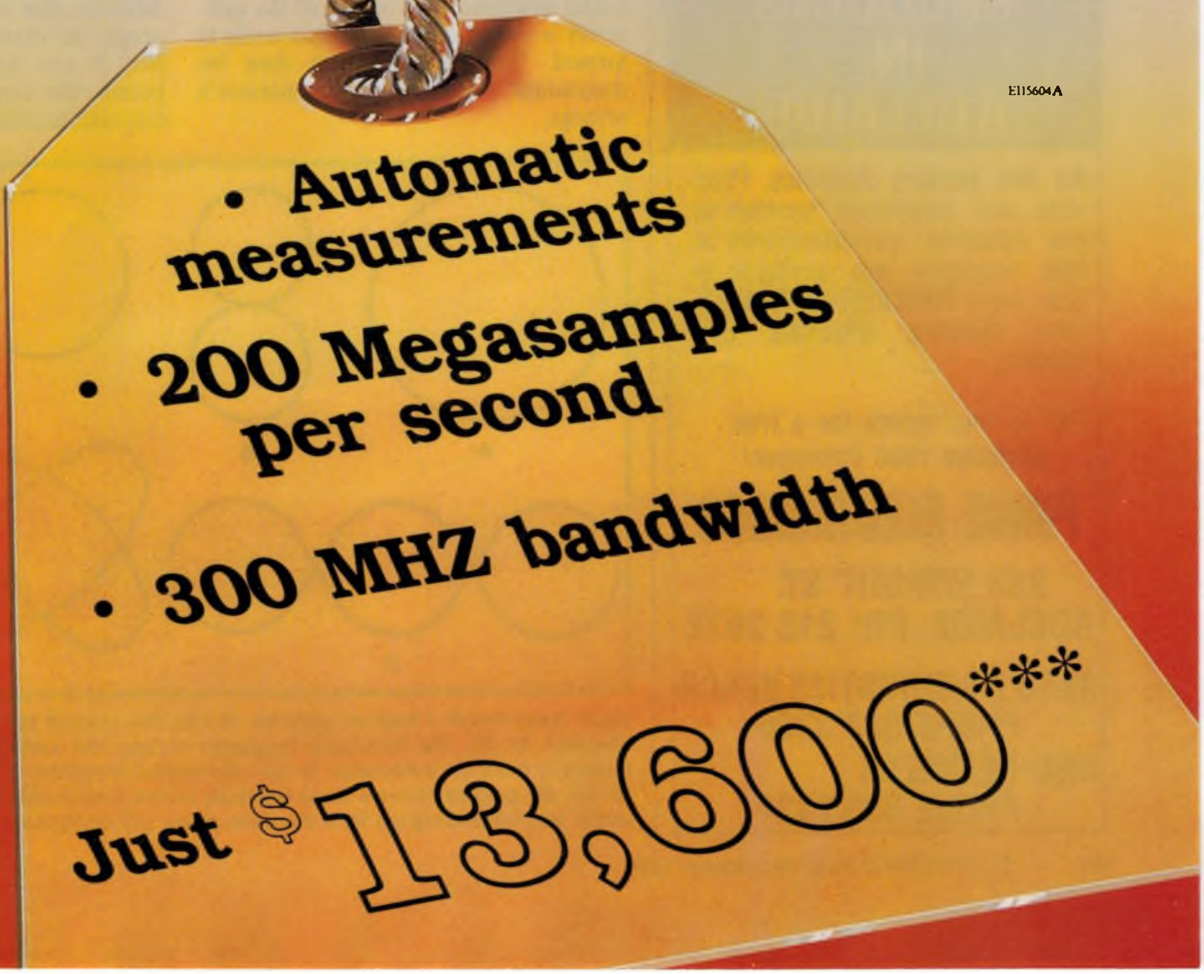

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** Hewlett-Packard Oscilloscope Language.

uator is set for 10mV-PER-DIV, and AC coupling is selected, it shows a 40mV peak-to-peak squarewave. However, there is no way to know whether the baseline is actually zero volts.

In Fig.4b the same signal is shown; but there DC coupling is selected, which reveals that the AC signal is superimposed, or riding, on a 3-volt DC voltage. (Note that the vertical attenuator has been reset to 1-VOLT-PER DIV). The 0-volt line had been previously established as the fourth (middle) line of the graticle (using the GROUND position of the INPUT COUPLING switch).

Oscilloscopes are also used to measure the period (directly) and frequency (indirectly) of a waveform. The period of the waveform is easily found by counting the number of divisions each cycle occupies and multiplying that by the setting of the timebase. For the triangular wave of Fig.5, assuming that a timebase of 5-MS-PER-DIV has been selected, the period is simply 20 milliseconds. Since the frequency is simply equal to 1 divided by the period, here it is equal to 5kHz. When calculating the period or frequency of a waveform, be sure to take into account the effect of a magnifier, if used.

X-Y measurements

The X-axis of an oscilloscope display need not necessarily be time. Many oscilloscopes have an X-Y mode in which one of the input channels is applied to the horizontal amplifier. What is the use of such a mode? Well, one popular use is to measure frequency and phase using *Lissajous* patterns. A *Lissajous* pattern is the pattern that is generated when a sinewave of one frequency is plotted against the cosinewave (a sinewave that is shifted 90°) of another. Studying those patterns can reveal the frequency and phase relationships of the two signals. Several simple patterns are shown in Fig.6.

The most basic of those patterns, the circle of Fig.6a, can be used to determine an unknown frequency. The circle is generated when the frequency, amplitude, and phase of the two input signals are identical. The technique is simple: a frequency generator output is fed to one amplifier, say the vertical one, while the unknown signal is applied to the horizontal amplifier. The output of the generator is varied until the perfect circle is formed. The frequency can then be determined from the generator's settings.

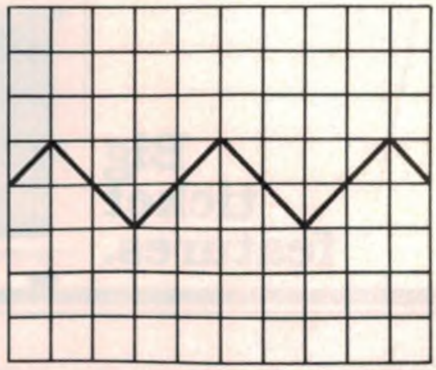

Fig.5. oscilloscopes can be used to determine the period (directly) and the frequency (indirectly) or waveforms displayed on the screen of the CRT.

Common errors

Because an oscilloscope can be one of the most complicated test instruments to operate, errors are often made in its use. As is usually the case, those errors are unnecessary.

Most errors are caused by incorrect assumptions. For instance, failing to be sure that the VERTICAL attenuator and the timebase are in their calibrated positions. Other similar errors include the failure to compensate for the probes, improper trigger selection, or incorrect interpretation of the timebase or vertical attenuator settings.

Other errors are caused by a lack of understanding of the equipment's specifications (for example, using a 25MHz scope to examine a 100MHz signal). But if you keep in mind the above points, the errors can be left to someone else to make.

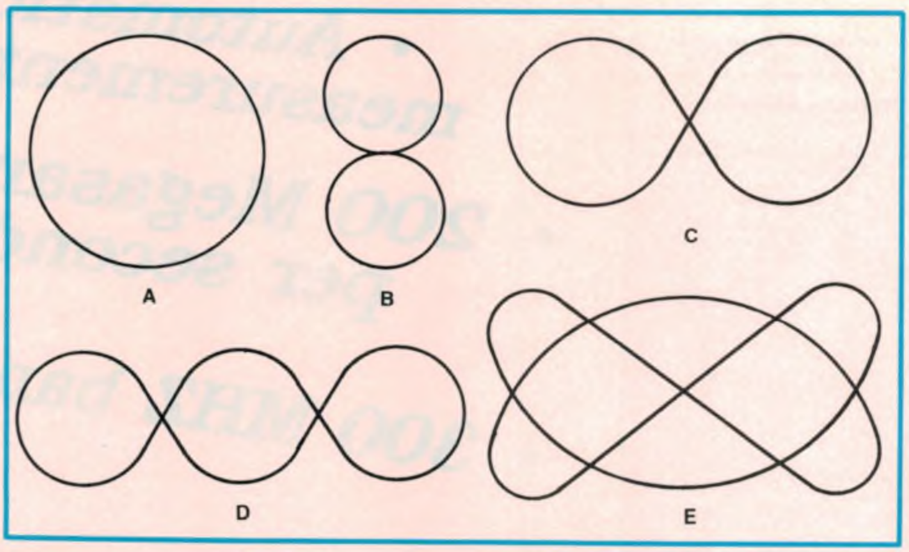

Fig.6: some simple *Lissajous* patterns. In (A), the vertical and horizontal frequencies are identical. In (B), the horizontal frequency is twice the vertical. In (C) the vertical frequency is twice the horizontal. In (D), the vertical frequency is three times the horizontal. In (E), the pattern shows a three (vertical) to two (horizontal) ratio. In all cases the horizontal and vertical signals have the same phase and amplitude.

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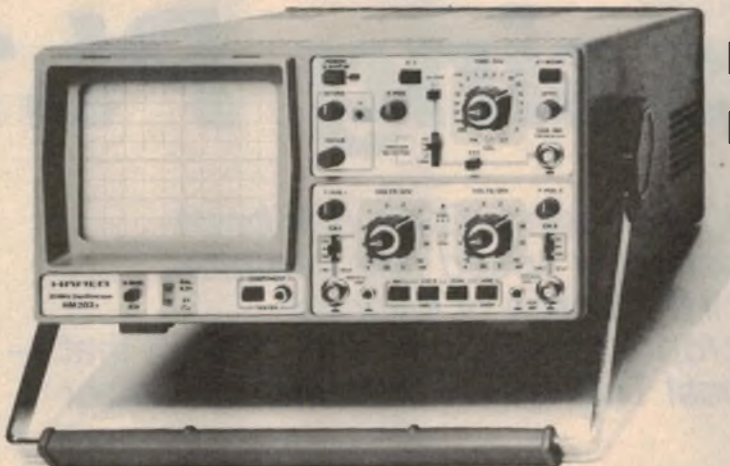

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Another nail in the analog coffin

Digital signal processing Pt.1

In the past, digital signal processing (DSP) has been characterised by high cost, slow speed and complex mathematical theory. The introduction of low-cost "number-crunching" microprocessors has changed all that — except for the mathematics! This article explains the theory behind DSP.

by MIKE FAULKNER*

Lecturer at the Footscray Institute of Technology.

Digital signal processing uses numerical algorithms to perform signal processing functions which, until recently, were associated with resistors, capacitors, operational amplifiers, analog multipliers and other electronic components. In addition, functions which are almost impossible to implement using normal analog techniques can easily be implemented using DSP algorithms.

Signal processing functions that can be accommodated using DSP algorithms include:

- filters, adaptive filters, equalisers and phase-shifters;
- mixers, modulators and phase comparators;
- waveform generators, variable oscillators and noise sources;
- Fast Fourier transforms and Hilbert transforms;
- non-linear devices, limiters and comparators; and
- matric manipulation.

Current DSP microprocessors can interconnect many of these algoıithm building blocks to form a complete signal processing system. Examples include modems, voice scramblers/de-scramblers, and systems for feedback control, signal detection and generation, speech recognition and synthesis, spectrum analysis and image processing. The list is almost endless.

Digital processing of analog signals usually involves the following steps:

(1) sampling the analog waveform at discrete time intervals;
(2) digitising the samples into digital words;
(3) processing the digital words; and
(4) converting the processed words back to analog form.

Block diagram

Fig.1 shows a block diagram of this process with typical signal wave shapes marked. The low-pass anti-aliasing filter band-limits the input signal to half the sampling frequency (Nyquist criterion). This must be an analog filter and is often a bone of contention for diehard analog designers. Why use DSP to replace analog circuits if the signal has to be band-limited by an analog filter in the first place?

It's true that, for some simple processing requirements, DSP is often not worth it. In other cases, however, the advantages of using DSP far outweigh the disadvantage of an anti-aliasing filter. In fact many signals are naturally band-limited and, even if this is not the case, the selection of a high sampling frequency can simplify the design of this filter.

The output of the filter is sampled at a constant rate (every T seconds), and the amplitude of each sample converted into a binary number using an A/D converter. Practical converters require that the input signal be held constant for the duration of the conversion process; hence the need for the hold circuit.

The input to the numerical processor is thus a series of numbers representing the amplitude of the analog signal at the sampling points. The processing of these numbers to perform, for example, a filtering function requires a number of multiplications and additions on present and past input samples, as well as on past output samples. The resulting output is then sent to the D/A converter.

Finally the reconstruction filter, which is also low-pass and analog, removes unwanted high frequency components produced as a by-product of the sampling process. In other words, it smooths the steps in the output from the D/A converter. Again, the choice of a high sampling frequency can reduce the complexity of this filter.

In many practical applications, hardware savings are possible. For example, in a tone detection system the required output is tone present or tone not present. This is a digital output, and there would be no need for a D/A system. Similarly, a voice synthesis system would have no need of an A/D system.

Advantages of DSP

The reasons for choosing DSP rather than more traditional techniques depend on user priorities. Some of the more common reasons are listed below.

(1) Temperature Stability: One of the biggest problems facing the analog designer is component stability. Resistors and capacitors drift with temperature, producing changing system

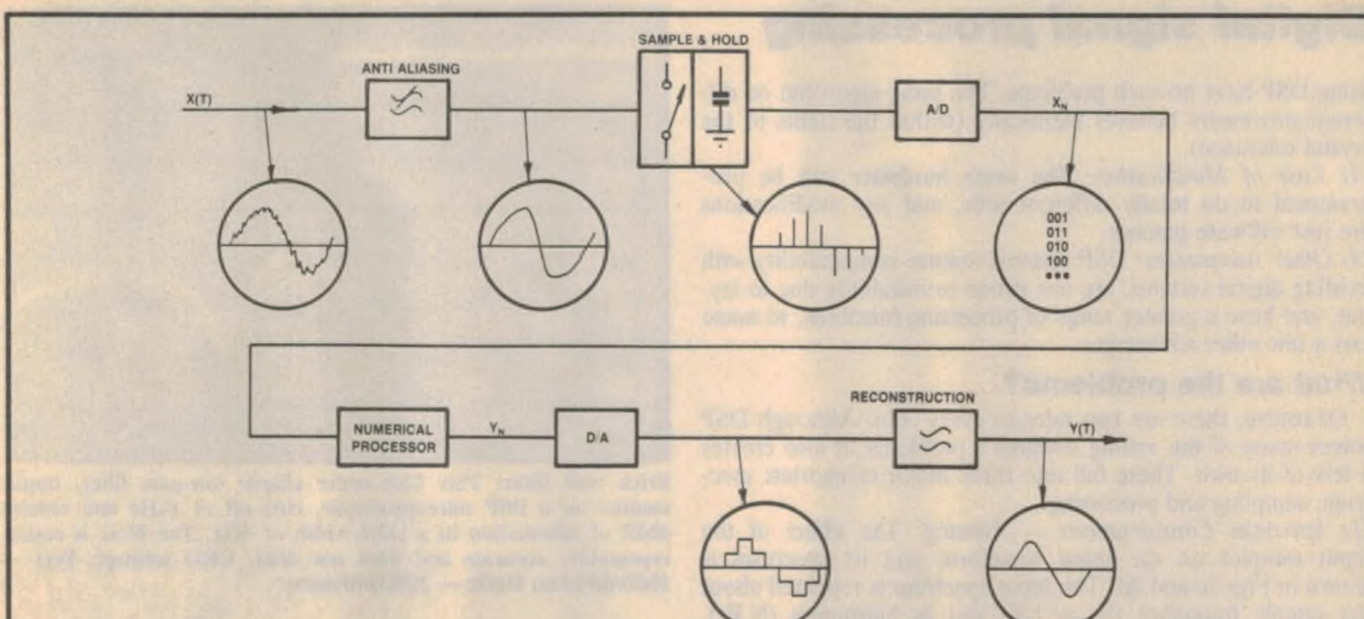


Fig.1: Elements of a DSP system.

characteristics. High Q active filters are particularly prone to this problem.

A DSP system, however, has only two components that can drift. These are the master clock controlling the sampling (this is usually crystal derived), and the A/D and D/A converters.

Crystal drift (typically 10 parts per million/°C) has the effect of shifting the spectral characteristics of the system a proportionate amount. For example, a digital filter with a 1000Hz cut-off frequency would have this changed to 1000.1Hz for a 10°C rise in temperature.

Converter drift, on the other hand, affects linearity. Converter manufacturers are aware of this and in most cases these errors are kept below the resolution of the converter (one least significant bit) and are normally insignificant.

(2) Reproducibility: This is important for designs that must be mass produced. Analog designers have to contend with tolerancing and they are often forced to use trimpots, or "select-on-test" components to obtain reproducible results. Designers

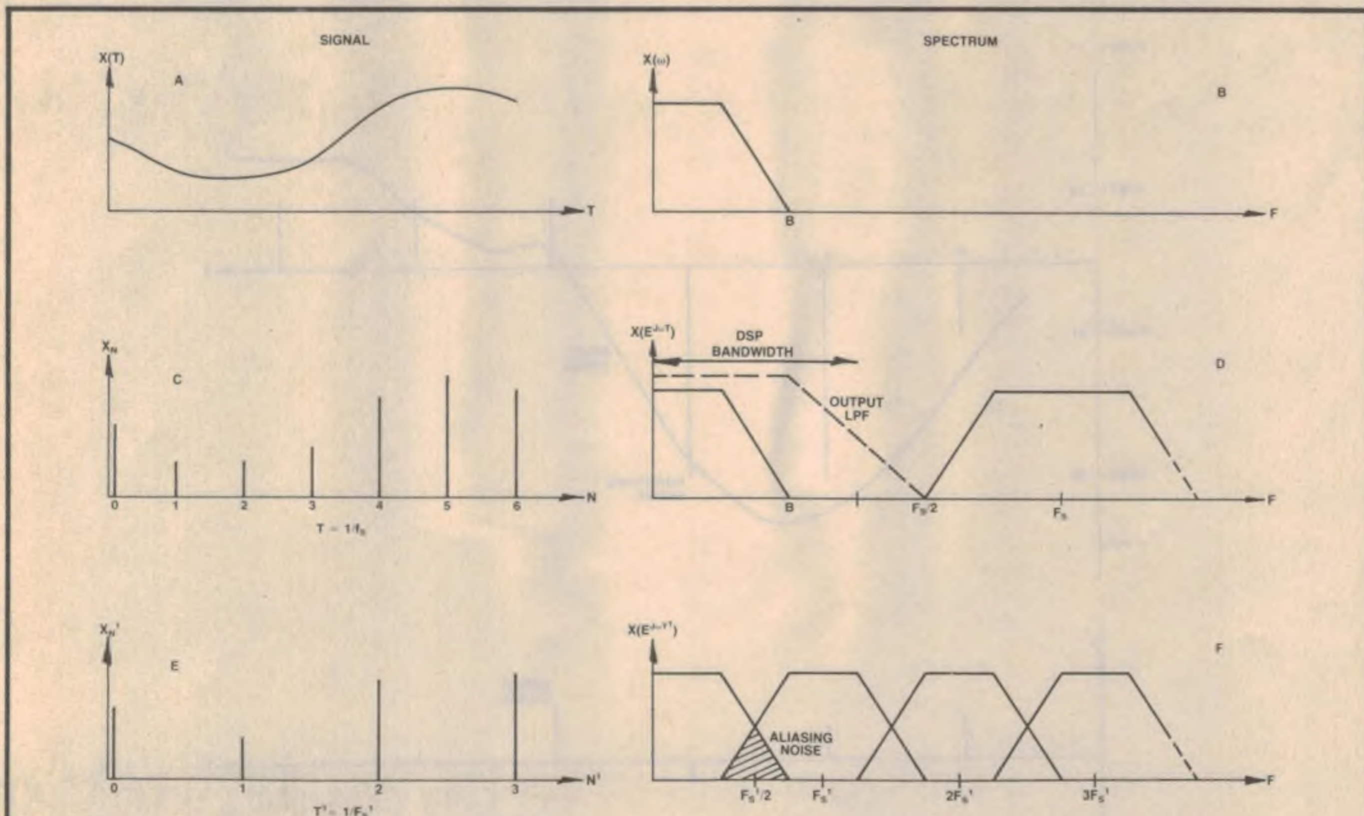


Fig.2: Diagrams (a) and (b) represent the signal and its spectrum; (c) and (d) after sampling; (e) and (f) with reduced sampling.

using DSP have no such problems. The same algorithm on different processors behaves identically (within the limits of the crystal tolerance).

(3) Ease of Modification: The same hardware can be programmed to do totally different jobs, and any modifications are just software patches.

(4) Other Advantages: DSP systems feature compatability with existing digital systems, are less prone to instability duc to layout, and have a greater range of processing functions, to name just a few other advantages.

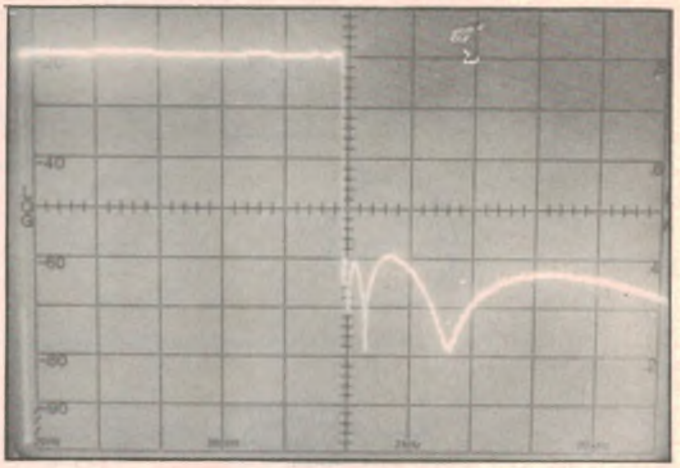
What are the problems?

Of course, there are two sides to every coin. Although DSP solves many of the analog designer's problems, it also creates a few of its own. These fall into three major categories: spectrum, sampling and processing.

(1) Spectrum Considerations — Aliasing: The effect of the input sampler on the input waveform and its spectrum is shown in Figs.2c and 2d. The input spectrum is repeated about the sample frequency (Fs = 1/T) and its harmonics (N.Fs). Readers with a radio background will recognise it as a double sideband suppressed carrier type of modulation.

The effect of reducing the sampling rate on the signal and its resultant spectrum, is shown in Figs. 2e and 2f. As the sample period (T) increases, the sample frequency (Fs) reduces, and so its harmonics and their related spectra move closer together. Overlapping will occur if the sample frequency (Fs) becomes less than twice the bandwidth of the input signal (Nyquist rate).

Any overlapping of the spectra produces 'aliasing noise' which cannot be removed by filtering. It is the job of the input anti-aliasing filter to condition the input signal's bandwidth (B)



Brick wall filter! This 12th order elliptic low-pass filter, implemented on a DSP microprocessor, cuts off at 1kHz and obtains 40dB of attenuation in a skirt width of 4Hz. The filter is stable, repeatable, accurate and does not drift. CRO settings: Vert — 10dB/division; Horiz — 200Hz/division.

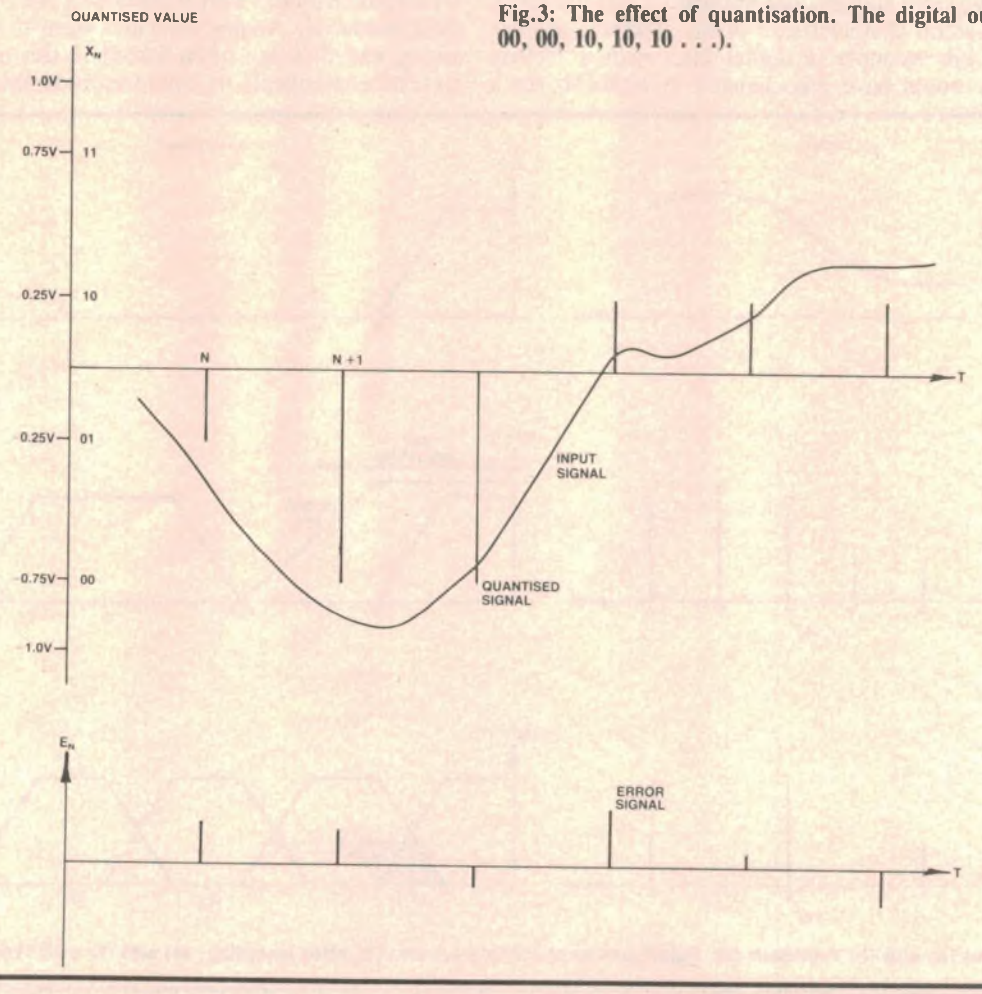


Fig.3: The effect of quantisation. The digital output x_n = (01, 00, 00, 10, 10, 10 . . .).

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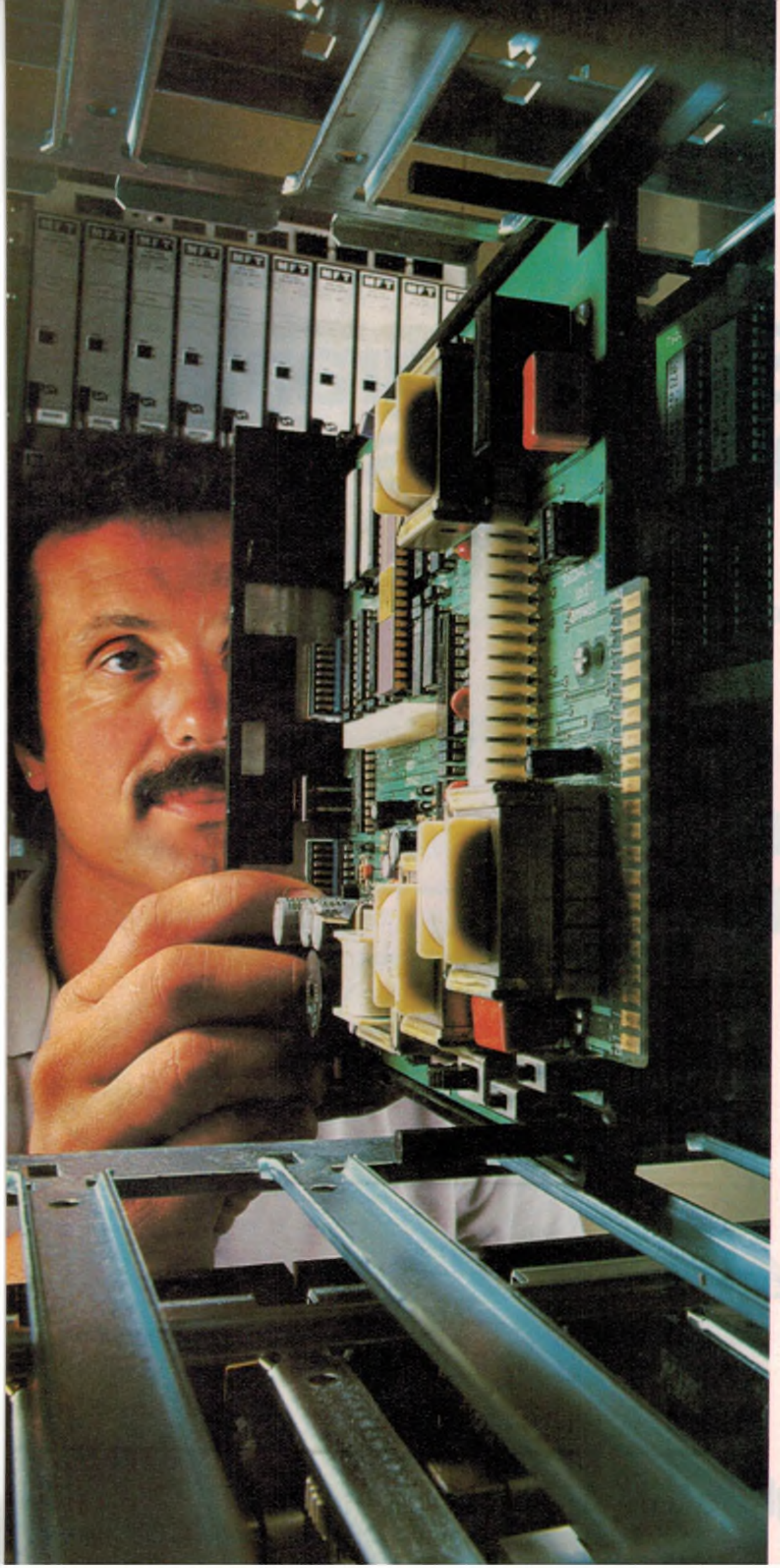

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TMS32011	144	1.5K			✔				✔				2	6x16	60	NMOS	
TMS320C10	144	1.5K	4K		✔	*✔			✔		*✔			8x16	60	CMOS	*✔
TMS32020	544		64K	64K	✔					*✔			1	16x16	109	NMOS	*✔
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Digital signal processing

to less than half the sampling rate; ie $B < Fs/2$.

To recover the desired signal from the infinite spectrum of Fig.2d requires the use of a low pass filter as shown. This is the major function of the output reconstruction filter in Fig.1. Sometimes this filter has to compensate for reconstruction distortion caused by the D/A converter. This distortion is small and is often neglected.

(2) Sampling Considerations — Quantisation, Dynamic Range: After sampling, the A/D converter quantises the analog signal, with each assigned value representing a range of continuous analog values. This range is equal to the step size.

Fig.3 shows a 2-bit A/D converter quantising a one volt bipolar signal. An error signal, which is the difference between the input analog sample and the nearest quantised level, causes a noise component to be added to the signal. This is called quantisation noise, and reduces by 6dB for each additional bit of A/D resolution.

The dynamic range of a converter is a measure of the converter's ability to handle large and small signals and is defined as:

$$\frac{\text{maximum signal that can be processed}}{\text{minimum signal that can be processed}} \simeq 6 \times n \text{ dB}$$

where n is the number of converter bits. The maximum signal is set by the A/D clipping level (normally 5V or 10V), while the minimum signal is set by the quantisation step size, since signals smaller than this are not guaranteed to toggle the A/D converter. From this, it follows that 8-bit A/D converters have a dynamic range of approximately 48dB.

(3) Processing Considerations — Co-efficient Quantisation, Round-off Error: Algorithms using difference equations are used to implement DSP functions. A typical algorithm for a three tap finite impulse response (FIR) filter is shown below.

$$y_n = K0\,x_n + K1\,x_{n-1} + K2\,x_{n-2} \qquad \ldots(1)$$

where x_n and y_n are the current ((n)th) input and output samples respectively, x_{n-1} is the previous input sample ((n-1)th), and x_{n-2} is the (n-2)th input sample. The coefficients K0, K1 and K2 determine the behaviour of the filter.

The multiplication of x_{n-2} by K2 in a microprocessor normally requires that both signals be binary and therefore quantised. Some examples, using a 3-bit fixed point number system, are shown below. The binary point preceeds the MSB (most significant bit).

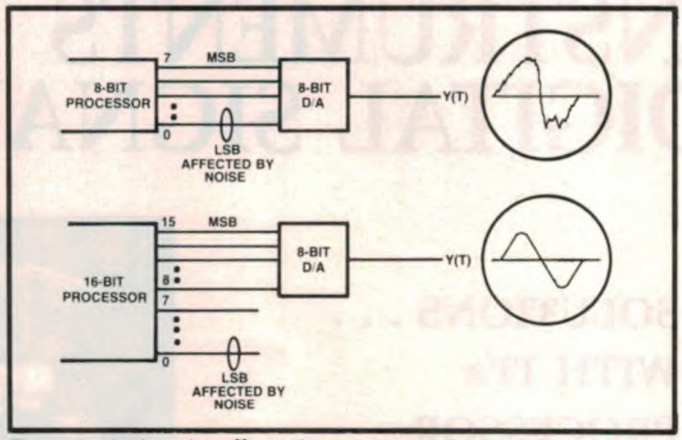

Fig.4: Reducing the effect of processing noise in DSP systems. Processing noise only affects the least significant bits.

Design Value of K2	Value After Quantisation
0.5	$2^{-1} = .100$
0.625	$2^{-1} + 2^{-3} = .101$
0.626	$2^{-1} + 2^{-3} = .101$ + error of 0.015%

This coefficient quantisation error can cause small changes in the overall transfer function and, in some cases, instability. Instability is caused by the quantisation error shifting the pole positions to outside the unit circle (Z plane theory).

Of course these problems do not arise if a high precision number system is used, such as is found in high level languages (Fortran, Pascal etc). However, the implementation speed is considerably reduced.

Similar problems arise when two binary numbers are multiplied together. For example, if both K2 and x_{n-2} were 8-bit numbers, their product would form a 16-bit number. If the processor was an 8-bit machine, then the eight least significant bits of the product would have to be discarded, causing a round-off error. In DSP systems, this error builds up rapidly and manifests itself as a noise signal which affects a number of the least significant bits in the output.

This noise problem can be reduced by using a processor with a higher resolution than the output D/A converter, as shown in Fig.4. For example, the TMS320 DSP microprocessor uses a combination of 16-bit and 32-bit processing resolution. This would be suitable for A/Ds and D/As with resolutions of up to 12 or perhaps 14 bits.

Coefficient and round-off errors often become more prevalent at high sampling rates. This is in direct contrast to aliasing noise. The choice of sampling rate can therefore become a classic engineering compromise.

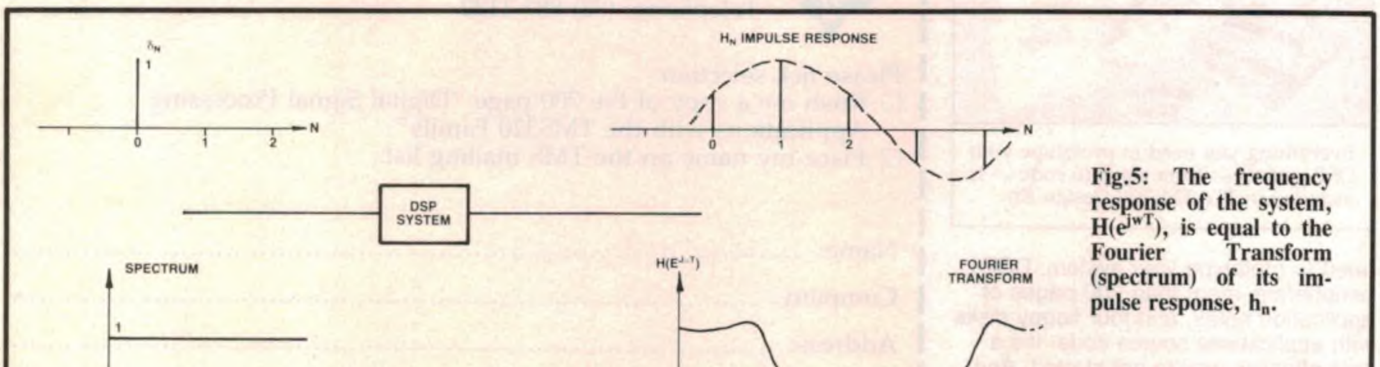

Fig.5: The frequency response of the system, $H(e^{jwT})$, is equal to the Fourier Transform (spectrum) of its impulse response, h_n.

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The Discrete Fourier Transform (DFT)

The system frequency response, $H(e^{jwT})$, can also be evaluated using the DFT or the Fast Fourier Transform (FFT) if some added constraints are placed on the input and output sequences.

The DFT uses the same expression as in Equation (4) to evaluate $H(e^{jwT})$, except that the number of input samples is limited to N, and the expression is evaluated for a finite number of w values (also N) equally spaced between w = 0, and $w = w_s$ the sampling rate. Thus:

$$H(e^{jwT}) = \sum_{n=o}^{N-1} h_n \, e^{-jwnT} \qquad \ldots(5)$$

Where: $w = (r\,w_s)/N$ with r = 0 to N-1

In the example above, taking the DFT of the impulse response h_n would produce the three values shown in Fig.8 (dotted lines). It is obvious that three points are not enough to describe the network's frequency response. Normally, a larger value of N is used by increasing the number of input samples. The length of the impulse sequence h_n would be increased by adding a number of zero valued samples.

Finally, the time taken to evaluate the DFT can be improved if the value of N is restricted to 2, 4, 8, 16, 32, 64, etc. If this is the case, then the binary number system used by computers can be exploited to produce an immense increase in speed. This is called the Fast Fourier Transform (FFT).

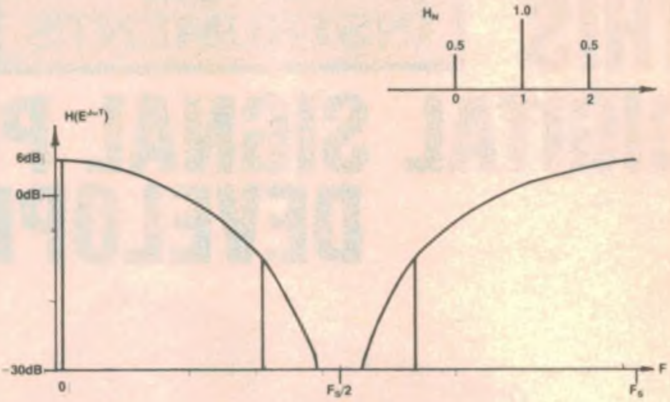
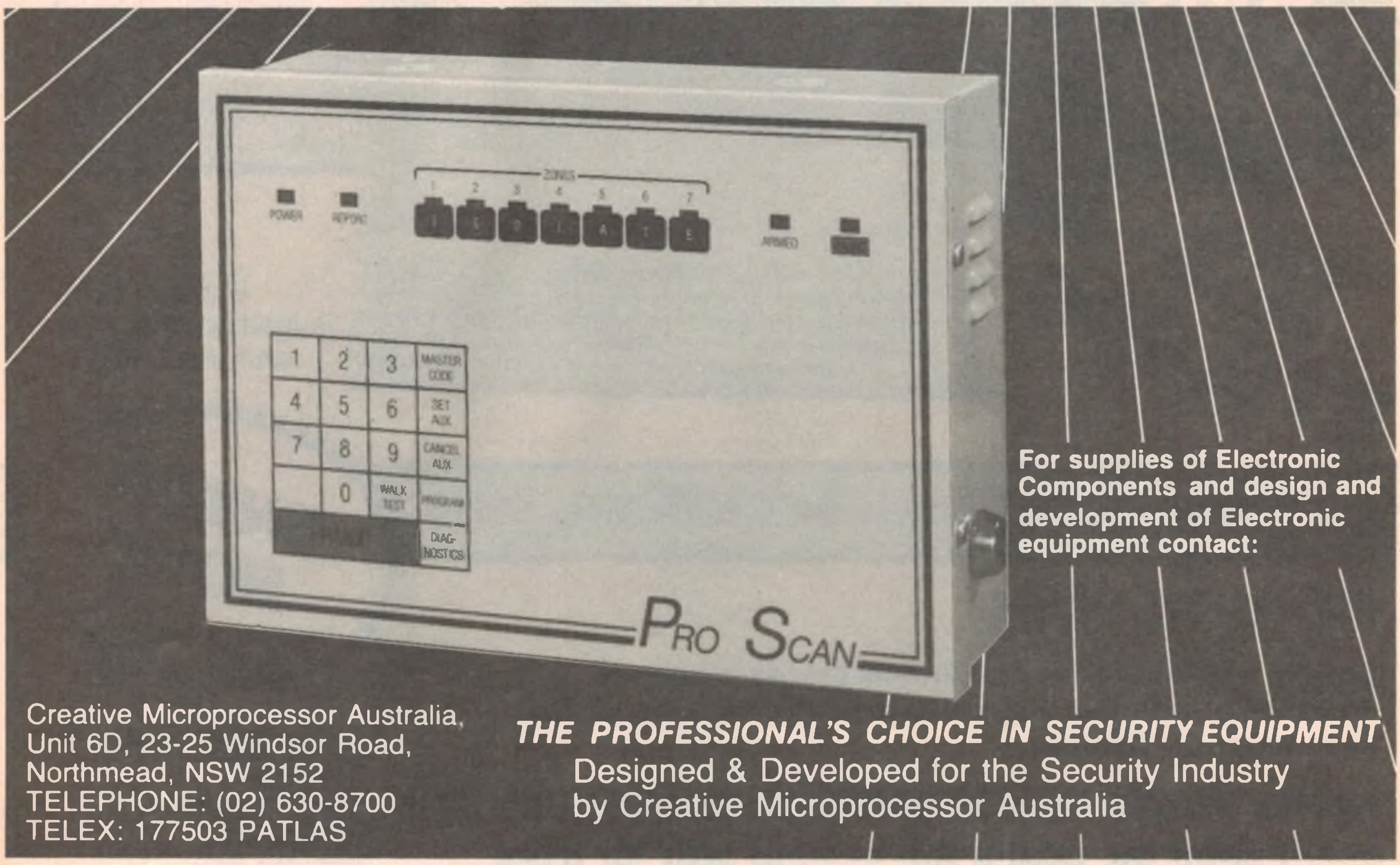


Fig.8: The frequency response of the system with the impulse response, h_n = (0.5, 1.0, 0.5). The vertical lines on the graph represent the DFT of h_n.

Discrete time signals and systems

Obviously, it is the algorithm that determines the processing, but before we can consider its features in more depth it is necessary to review some fundamentals.

To the numerical processor, discrete time signals are just a sequence of numbers; we shall assume, although it is not always the case, that these numbers represent the amplitudes of a sampled continuous time waveform. They, therefore, can be



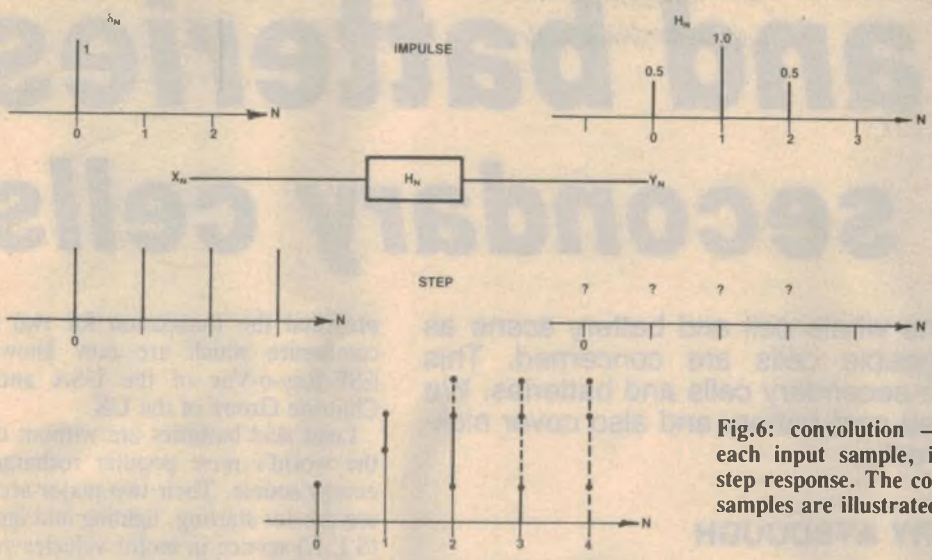


Fig.6: convolution — summing the effect of each input sample, in this case to obtain the step response. The contributions of the first two samples are illustrated.

Linear Systems, Convolution and All That

It is normal to describe linear time invariant systems by their impulse response. Linear systems are those for which superposition holds, and time invariant systems are those that do not vary with time.

Superposition is used to obtain the output of such a system to an input signal. For example, in Fig.6 the discrete time system has an impulse response $h_n = \{0.5, 1.0, 0.5\}$. To obtain its response to an input step the effect of each individual sample is summed at the output to produce a slowed response exhibiting a DC gain of 2 (6dB). This type of response would be expected from a low pass filter.

This process, which is called convolution, can be used to obtain the system response to any input signal, and is mathematically described in the equation below:

$$y_n = \sum_{k=-\infty}^{+\infty} x_{n-k}\, h_k = x_n * h_n \qquad \ldots(6)$$

where * denotes convolution. Digital filters effectively implement this algorithm which, for this particular example, would be:

$$y_n = 0.5\, x_n + x_{n-1} + 0.5\, x_{n-2}$$

The block diagram describing this equation is shown in Fig.7.

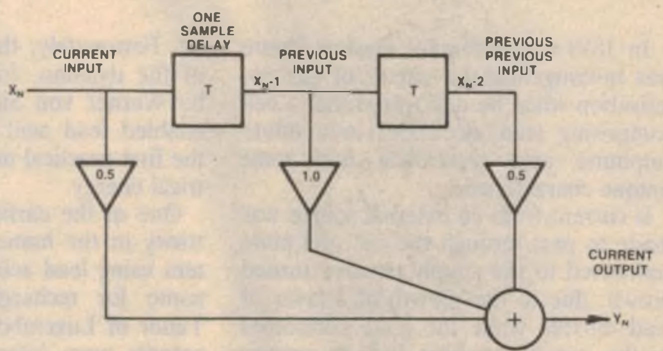


Fig.7: The block diagram of the FIR filter, $h_n = (0.5, 1.0, 0.5)$.

represented in the time domain or, by applying a Fourier Transform, in the frequency domain.

The response of a linear time invariant system to a sampled analog input signal can be obtained by convolution in the time domain, or by multiplication in the frequency domain. In the latter case the spectrum of the input signal, $X(e^{jwT})$, is multiplied by the frequency response of the system, $H(e^{jwT})$.

$$y_n = X_n * h_n \quad \text{or}$$

$$Y(e^{jwT}) = X(e^{jwT})\, H(e^{jwT}) \qquad \ldots(2)$$

(Note: it is convention to use $X(w)$ to represent the spectrum of a continuous signal, and $X(e^{jwT})$ for a discrete time signal.)

The frequency response of the system, $H(e^{jwT})$, is equal to the Fourier Transform (spectrum) of its impulse response, h_n. This can be explained by remembering that the spectrum of an impulse is the same as that for white noise (flat), and passing white noise through a system is a technique for measuring frequency response (Fig.5). In mathematical terms:

$$H(e^{jwT}) = \sum_{n=-\infty}^{+\infty} h_n\, e^{-jwnT} \qquad \ldots(3)$$

For example the frequency response of a system with an impulse response, h_n, of $\{0.5, 1.0, 0.5\}$ is:

$$H(e^{jwT}) = 0.5\, e^{-jwoT} + 1.0\, e^{-jw1T} + 0.5\, e^{-jw2T} \qquad \ldots(4)$$

This expression can be reduced into a form (Re + j Im) by remembering that $e^{jwnT} = \cos wnT + j\sin wnT$. The frequency response, $(Re^2 + Im^2)^{0.5}$, is plotted for frequencies up to Fs/2 in Fig.8. Note that the response is scaled relative to the sampling rate.

This is a fundamental feature of DSP and in this respect, DSP and switched capacitor systems are similar. For example, a 1kHz low-pass filter can be changed to a 500Hz low-pass filter by simply halving the sampling rate.

So far we have considered obtaining the frequency response of the network from its impulse response. However, digital filter design is essentially the opposite process. That is, we start off with the required frequency response specification and then derive its impulse response, from which the filter can be implemented.

Continued next month

Cells and batteries Pt.2 — secondary cells

Last month we surveyed the whole cell and battery scene as far as primary, non-chargeable cells are concerned. This month we do the same with secondary cells and batteries. We start off with the familiar lead acid battery and also cover nickel-cadmium and silver-zinc cells.

by TERRY AYSCOUGH

In 1859 a Frenchman, Gaston Plante was investigating the effects of gas polarisation when he discovered that a cell comprising lead electrodes in a dilute sulphuric acid electrolyte had some unique characteristics.

If current from an external source was made to pass through the cell, the plate connected to the supply positive turned brown, due to the growth of a layer of lead dioxide while the plate connected to the supply negative had its oxygen reduced and developed a greyish coating of spongy lead. The electrolyte also underwent chemical changes which caused its specific gravity to increase. As the cell now contained one electrode which was rich in oxygen and one which was depleted, it would operate as a power cell, giving an output of about 2V and useful levels of current.

During discharge the plates and electrolyte slowly changed back to their original condition, but the process could be reversed as required by again passing current through the cell. Plante also found that the cell could be left for several days without significant loss of charge and so the lead acid storage battery was born.

Because current flow through a secondary cell goes one way during charging and the other during discharging, the electrodes change roles, with the anode becoming the cathode and vice versa. To avoid confusion, we will call the electrodes positive and negative plates rather than anodes and cathodes when dealing with secondary cells in this article.

At the time of Plante's discoveries, the only available source of charging current was from series-connected primary cells, which were quickly exhausted. Fortunately, the rapid development of the dynamo, following its invention by Werner von Siemens in 1857, soon enabled lead acid batteries to become the first practical means for storing electrical energy.

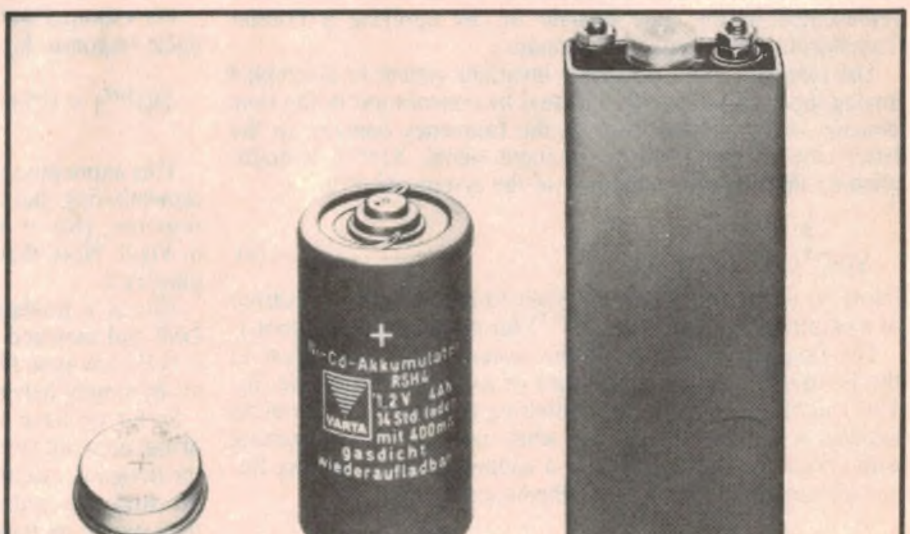
One of the earliest examples of electricity in the home, was a lighting system using lead acid batteries and a dynamo for recharging, built by Henri Tudor of Luxembourg in 1882. Tudor's patents were later bought by a large German company, which is now Varta A.G., who built Tudor battery factories in several European countries.

Many experimenters turned their attention to the development and improvement of storage batteries. Amongst the hundreds of patents taken out were some relating to the use of lead chloride mixtures. These processes were subsequently abandoned but they provided the foundation for two giant companies which are now known as ESB-Ray-o-Vac of the USA and the Chloride Group of the UK.

Lead acid batteries are without doubt the world's most popular rechargeable energy source. Their two major areas of use are for starting, lighting and ignition (S.L.I.) service in motor vehicles and as the motive power source in a wide variety of mining and industrial vehicles such as fork-lift trucks. Neither of these applications has much to do with electronics, so we will not devote further space to them in this article.

In addition to their use in mobile applications, lead acid batteries provide a cheap, rugged and reliable source of energy power for a variety of stationary and portable electronics. They have an on-load output of about 2V per cell, are capable of hundreds of charge-discharge cycles and in favourable conditions, can have life spans of 10 to 15 years.

Their main disadvantages are their size and weight. On the subject of weight however, it has been calculated that during an average lead acid battery lifetime, each gram of active material can deliver over 100Ah of electrical output, which is quite an impressive performance by any standard.



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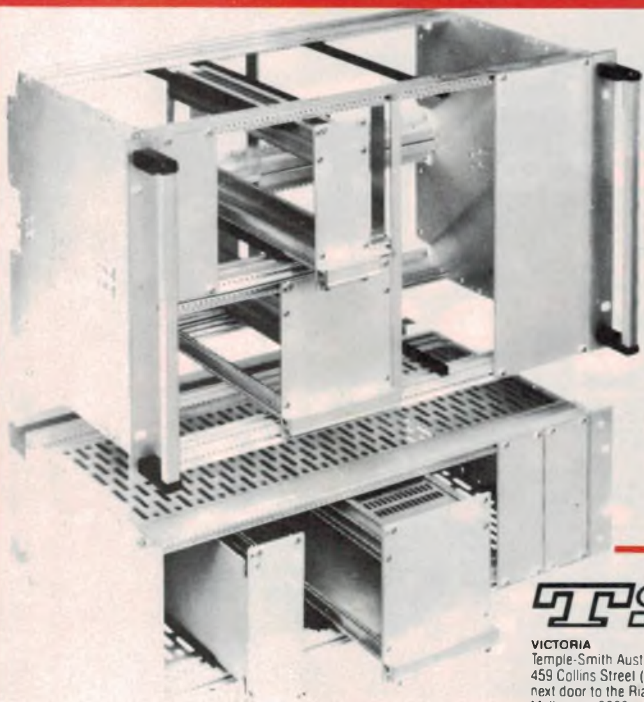

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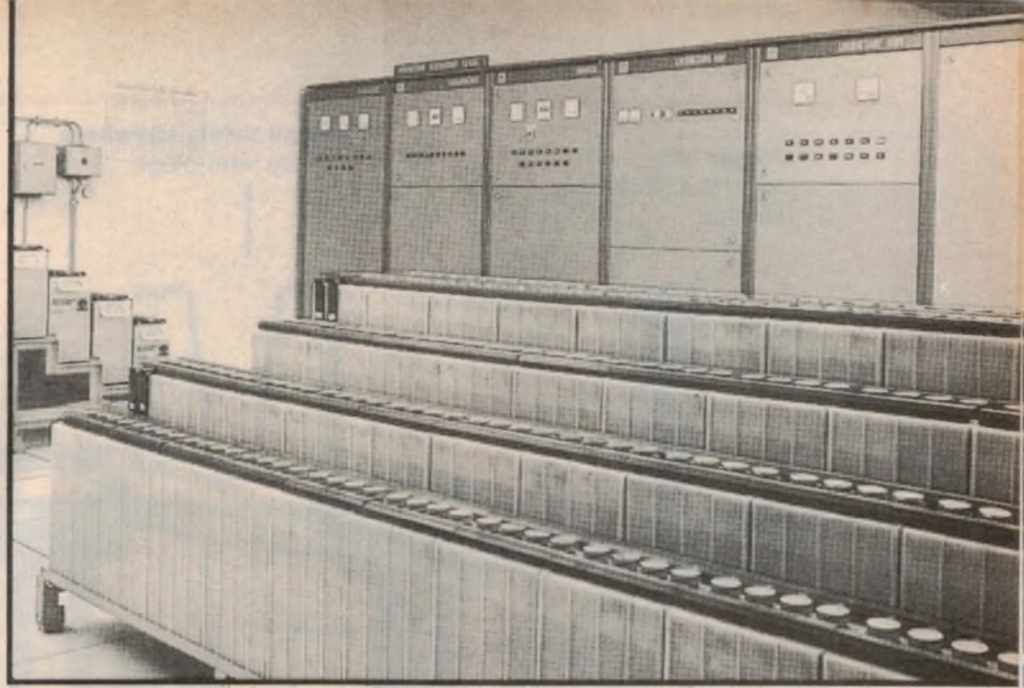
Lead acid and other rechargeable batteries are generally manufactured in larger sizes than primary cells and because of this, it is usual to give their capacities in ampere-hours (Ah) rather than mAh. The actual capacity obtained varies dramatically with discharge rate, as shown by Table 1, which are for a modern sealed Yuasa 12V 30Ah battery.

Because acid electrolytes attack most other metals, all internal components of lead acid cells are fabricted only from lead. In its pure state, lead is rather soft and quite weak so for many years it was alloyed with antimony which greatly improved its strength. This made it easier to cast during manufacture and resulted in thinner, more robust battery plates.



A rack mounted system of medium-rate discharge cells.

How gassing was reduced

A few years ago, the growing demand for low-maintenance long life batteries stimulated fresh research into lead acid systems and it was found that without antimony, gassing (which causes loss of water) and long term corrosion problems were both reduced.

Now, in the USA lead-calcium alloys have almost completely replaced antimony, but in Europe and Japan, manufacturers still use very low levels of antimony plus other additives such as arsenic and tin. Very high quality lead acid batteries for stationary applications, such as power support and telecommunications service, where mechanical ruggedness is not important, often have positive plates manufactured only from the purest unadulterated lead.

In addition to the battery in his car, the electronics engineer may come across some very different versions of lead acid cell technology. These range from the large high quality, long life stationary cells mentioned above, to small portable sealed batteries powering cordless appliances and instruments.

A typical lead acid cell for high reliability stationary applications is shown in Fig.13. This particular unit is manufactured by Chloride in Australia and has been used by Telecom since the mid 1950's. Plates in lead acid cells can be constructed in a variety of ways. In this case, they are in the form of flat grids with suitably formulated pastes packed into the spaces between horizontal and vertical ribs. The positive plate grid is moulded from pure lead. The grid for the negative plate uses a low antimony lead alloy, which permits it to be much thinner without sacrificing strength. When restricted to the negative plate in this way, the antimony does not detract significantly from cell performance as the corrosion and gassing problems mentioned earlier relate mainly to the positive plate.

The first plates are interleaved and high porosity polymer separators prevent movement or corrosion from causing short circuits. Each separator also incorporates a layer of glass wool on the positive plate side, which helps to keep the active paste in place when it begins to soften with age. The cell container is moulded from styrene-acrylonitrile, which is easier to see through the glass and allows easy checking of the electrolyte level.

Big stationary cells of this type are available with capacities ranging from 50 to 3200 ampere-hours. They are usually series-connected to form battery banks providing outputs of between 50 and several hundred volts. A carefully controlled float-charge, giving about 2.25V across each cell during standby periods, keeps them in good condition without causing significant loss of water.

Discharge Time	Current	Capacity Obtained
10h	3.0A	30Ah
3h	8.1A	24Ah
1h	20A	20Ah
30 mins	33A	17Ah
10 mins	61A	10Ah
1 min	94A	1.6Ah

Table 1: the capacity obtained with different discharge rates.

Uninterruptible supplies

In many situations, such as hospitals, airports and large computer installations, sudden loss of mains power could endanger life or cause chaotic disruption. Where this risk exists, uninterruptible power supply (UPS) systems are often installed. These use large solid-state inverters to convert the DC from battery banks to single or three-phase AC mains voltage supplies. In other situations such as telephone exchanges and solar energy systems, where the load is powered by DC, the batteries might be connected directly across the main bus, so they automatically supply current when the primary source ceases to operate.

Progress towards leakproof acid batteries was aided by discoveries about the effects of antimony and other additives mentioned earlier, but further control of gassing was needed before completely sealed no-maintenance units could be produced.

One interesting approach, developed in Japan by companies such as Yuasa, uses a special 'catalyzer' plug which contains small quantities of platinum or palladium in a porous matrix. This causes oxygen and hydrogen gasses to recombine into water which is then returned to the electrolyte. Another technique, known as the O_2 or recombination system, encourages the production of oxygen rather than hydrogen, which is then absorbed by the negative plate. A similar technique is used with sealed nickel cadmium cells and a detailed explanation is given later.

Sealed cells

In most sealed cells, the acid electro-

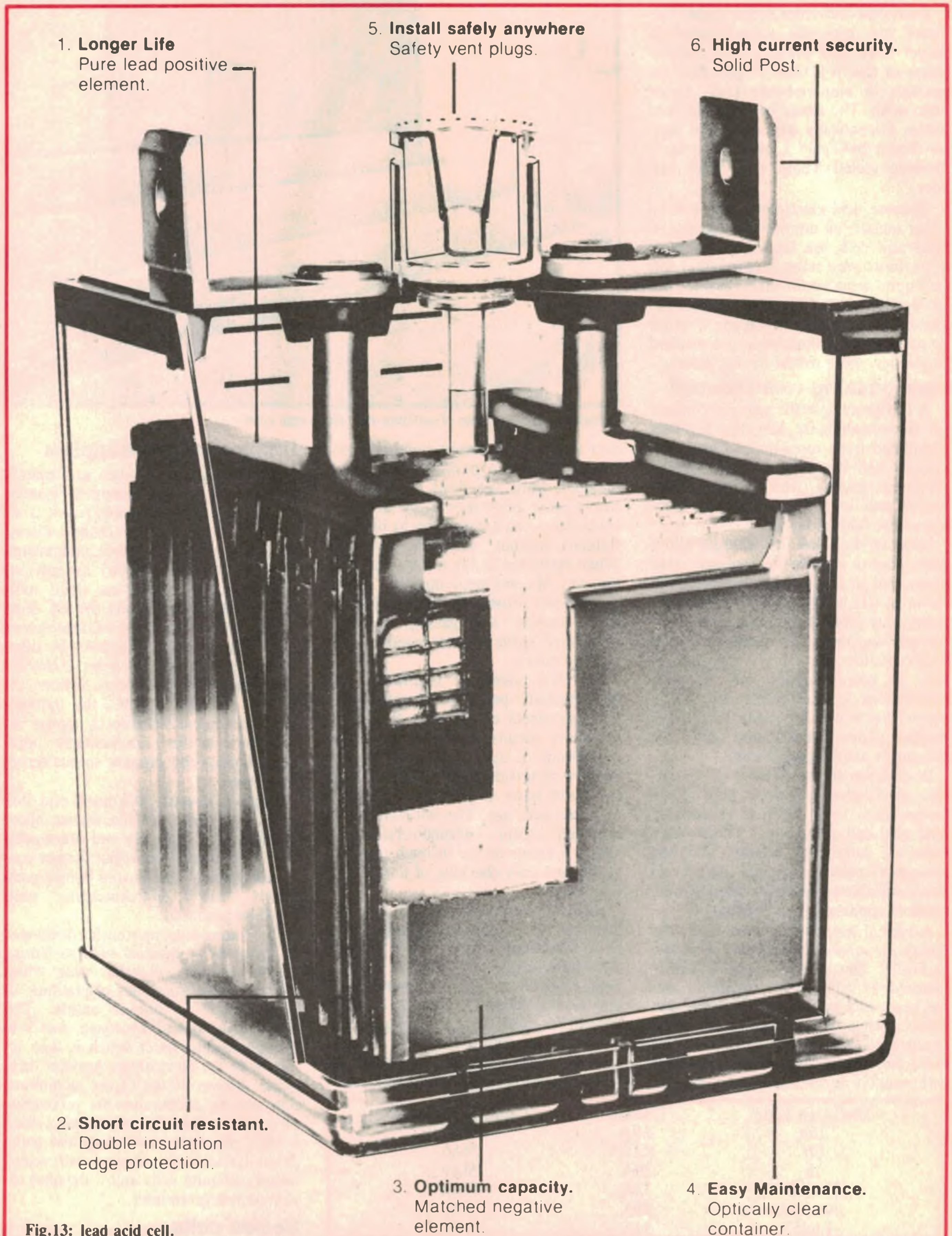


Fig.13: lead acid cell.

lyte is in gel form contained in highly porous glass-fibre mats separating the plates. A wide range of small to medium sized maintenance-free batteries, with life expectancies of about 10 years are now available in Australia under brand names such as Dryfit Sonnenschein, Exide and Yuasa.

At the lower end of the lead acid battery range there are a number of fully sealed rectangular and cylindrical batteries and cells with capacities from about 1 to 10Ah. These are used to power portable TV sets, cordless appliances and small inverter systems.

Cylindrical cells are usually made by rolling up foil electrodes and thin electrolyte impregnated separators together to form a very compact assembly which is housed in a plastic or metal jacketed case. A Varta D-size cell constructed in this way has a capacity of 2.7Ah.

The special construction techniques described will handle all normal levels of gassing in sealed batteries, but care is still needed to avoid heavy overcharging. Most manufacturers recommend the use of purpose-designed charging systems which give constant voltage ouputs, or shut down when the cell terminal voltage reaches a critical level. As a last resort, all sealed cells are fitted with a safety valve to prevent dangerous pressure build up under fault conditions.

Nickel cadmium cells

Even before the end of last century, engineers were becoming conscious of the shortcomings of lead acid batteries especially the high weight, the risk of weak electrolyte in discharged cells freezing and the large volume of corrosive acid solution required.

In about 1895 Swedish inventor Waldemar Jungner realised that an alkaline electrolyte would permit the use of stronger, lighter metals such as steel in a rechargeable cell. In addition, since an alkaline electrolyte would act only as an ionic conductor, it would not undergo chemical changes during charging and discharging. So less electrolyte would be required and there would be no danger of a discharged cell freezing. (While the risk of batteries being destroyed by sub-zero temperatures may not be a major concern in most parts of Australia, it is of vital importance in Northern Europe and many other regions of the world).

Thomas Alva Edison in the USA and Jungner in Sweden worked along very similar lines and in about 1906 both started the commercial manufacture of rechargeable alkaline batteries using nickel positive plates and iron negative plates. The Jungner company sold their batteries under the NIFE brand (Ni for nickel and Fe for iron). Edison continued with nickel iron technology for many decades, but Jungner soon introduced cadmium in place of iron for the negative plate. As the NIFE trade mark had become well established by this time however, its use was continued and today forms part of the SAB NIFE company name.

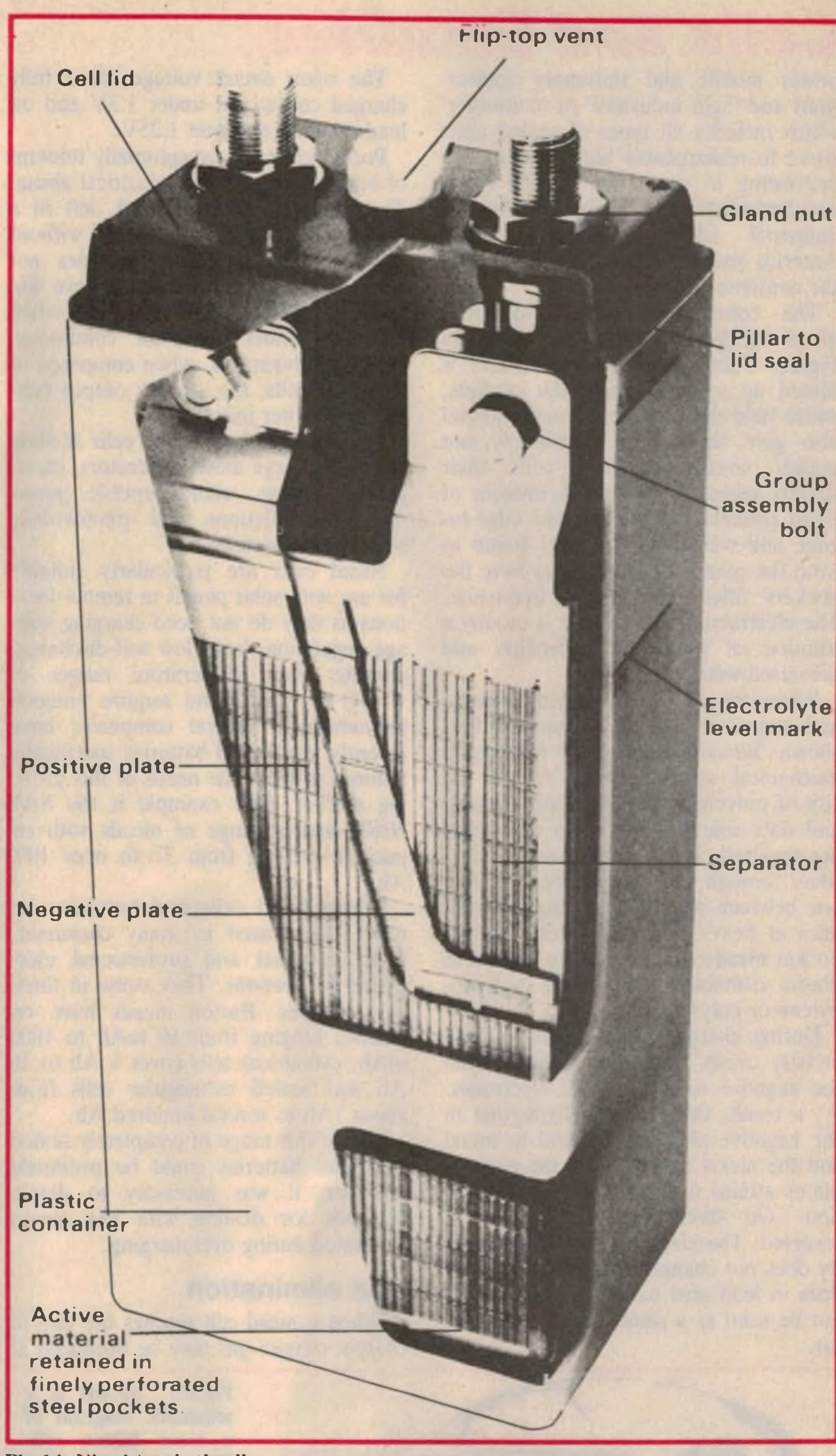


Fig.14: Nicad 'pocket' cell.

Nickel cadmium (nicad) and nickel-iron batteries, like their lead acid rivals, can be roughly divided into two groups. There are 'heavy industrial' for high

Cells and batteries

power mobile and stationary applications and 'light industrial' or 'consumer' which includes all types of sealed units down to rechargeable button cells. It is interesting to note that Europe (both east and west) is the main user of heavy industrial alkaline batteries, whilst America and Japan are world leaders in the consumer area.

The construction of an industrial nicad 'pocket' cell is illustrated in Fig.14. Thin perforated steel sheet is folded up to make long, flat pockets, which hold the active plate material and also give these large (definitely not pocket sized) industrial cells their slightly misleading name. A number of these pockets are then placed edge-to-edge and welded into a steel frame to form flat plates. Positive plates have the pockets filled with nickel hydroxide. The electrolyte in nicad cells is usually a solution of potassium hydroxide and deionised water.

When the cell is assembled, positive and negative plates are interleaved as shown. Because steel plates have good mechanical strength, they reduce the risk of movement causing short circuits, and only simple plastic strip separators are required. This ensures good conductivity through the unobstructed electrolyte between plates, improving performance at heavy discharge rates. Modern pocket nicad cells are usually housed in plastic containers made from polypropylene or polystyrene.

During charging, the electrochemical activity causes oxygen to transfer from the negative to the positive electrodes. As a result, the cadmium hydroxide in the negative plates is reduced to metal and the nickel hydroxide in the positive plates attains a higher level of oxidisation. On discharge, the process is reversed. The electrolyte's specific gravity does not change during cycling, as it does in lead acid batteries, and so cannot be used as a state of charge indicator.

The open circuit voltage for a fully charged cell is just under 1.3V and on load this falls to about 1.25V.

Pocket cells are exceptionally tolerant of both mechanical and electrical abuse. They can be short circuited, left in a discharged state or overcharged without damage. As the electrolyte does not corrode the plates, they can have life spans extending from 15-25 years when operated under optimum conditions. Their disadvantages, when compared to lead acid cells, are a lower output voltage and higher initial cost.

Applications for pocket cells include starting of large diesel generators, emergency lighting, uninterruptible power supply installations and photovoltaic solar energy systems.

Nicad cells are particularly suitable for use with solar panels in remote locations as they do not need charging voltage regulation, have low self-discharge, operate over temperature ranges of −50°C to +55°C and require minimal maintenance. Several companies have recently introduced batteries specifically tailored to meet the needs of this growing market. One example is the SAB NIFE Sunica range of nicads with capacities ranging from 37 to over 1000 Ah.

Sealed nicad cells and batteries are now widely used in many consumer, light industrial and professional electronic applications. They come in three basic shapes. Button nicads have capacities ranging from 10 mAh to 1000 mAh, cylindrical cells cover 1 Ah to 10 Ah and sealed rectangular cells from about 1Ah to several hundred Ah.

Before this range of completely sealed cells and batteries could be produced however, it was necessary to devise methods for dealing with any gasses generated during overcharging.

Gas elimination

When a nicad cell reaches the end of charge, oxygen gas may be produced at the positive plate or hydrogen at the negative plate, depending on which one has all its active material reconverted first. If some surplus cadmium hydroxide material is deliberately built into the negative plate, the positive plate will always become fully charged first and only oxygen will be produced. This can then pass through the highly porous separator material and react with metallic cadmium in the negative plate to produce still more cadmium hydroxide. The negative electrode is thus discharged by the oxygen at roughly the same rate as it is charged by the current flow, and equilibrium is maintained.

Two quite different methods are used for manufacturing the plates of sealed nicad cells.

Most button cells are constructed as shown in Fig.15. The active ingredients for each plate are pressed into a thin tablet form and then surrounded by fine nickel mesh which acts as a container and current collector, rather like the perforated steel in pocket cell plates.

The positive electrode is underneath and connects with the steel case. Next comes a separator of plastic fibres, impregnated with potassium hydroxide electrolyte. The negative electrode is on top and a spring on the underside of the cell lid provides an electrical contact and presses the assembly together.

This method of manufacturing nicad button cells is known as mass plate or pressed powder construction. Sometimes pairs of interleaved pressed electrodes are used to double the effective surface area and increase the maximum current available.

Sintered electrodes

The second nicad plate manufacturing method uses sintering techniques to produce very thin plates on foils with large active surface areas. Sintered plate electrodes vary in thickness from 0.5mm to 1mm. One method of producing the positive electrode starts with a sheet of perforated steel which is coated with nickel powder and heated to about 1000°C. This causes each grain of powder to weld at its point of contact with the plate and forms a highly porous conductive surface looking rather like sandpaper, into which the active materials are impregnated. The cadmium negative electrode is produced by a similar process. Separators in sintered electrode cells are usually thin porous plastic sheets.

Sealed rectangular nicad cells are interleaved sintered plates made as described above. Most cylindrical cells also use sintered electrodes, but these

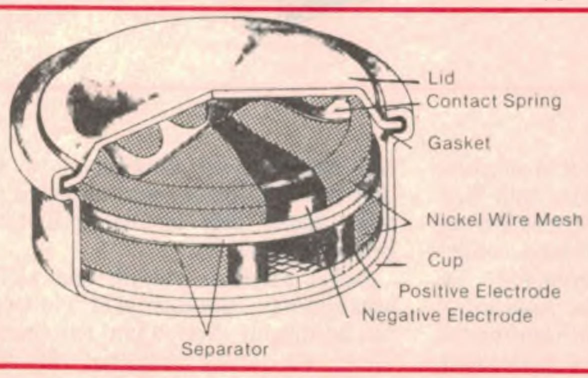


Fig.15: at left is a schematic diagram of a nicad button cell. This series can have a capacity of 10 to 1000mAh.

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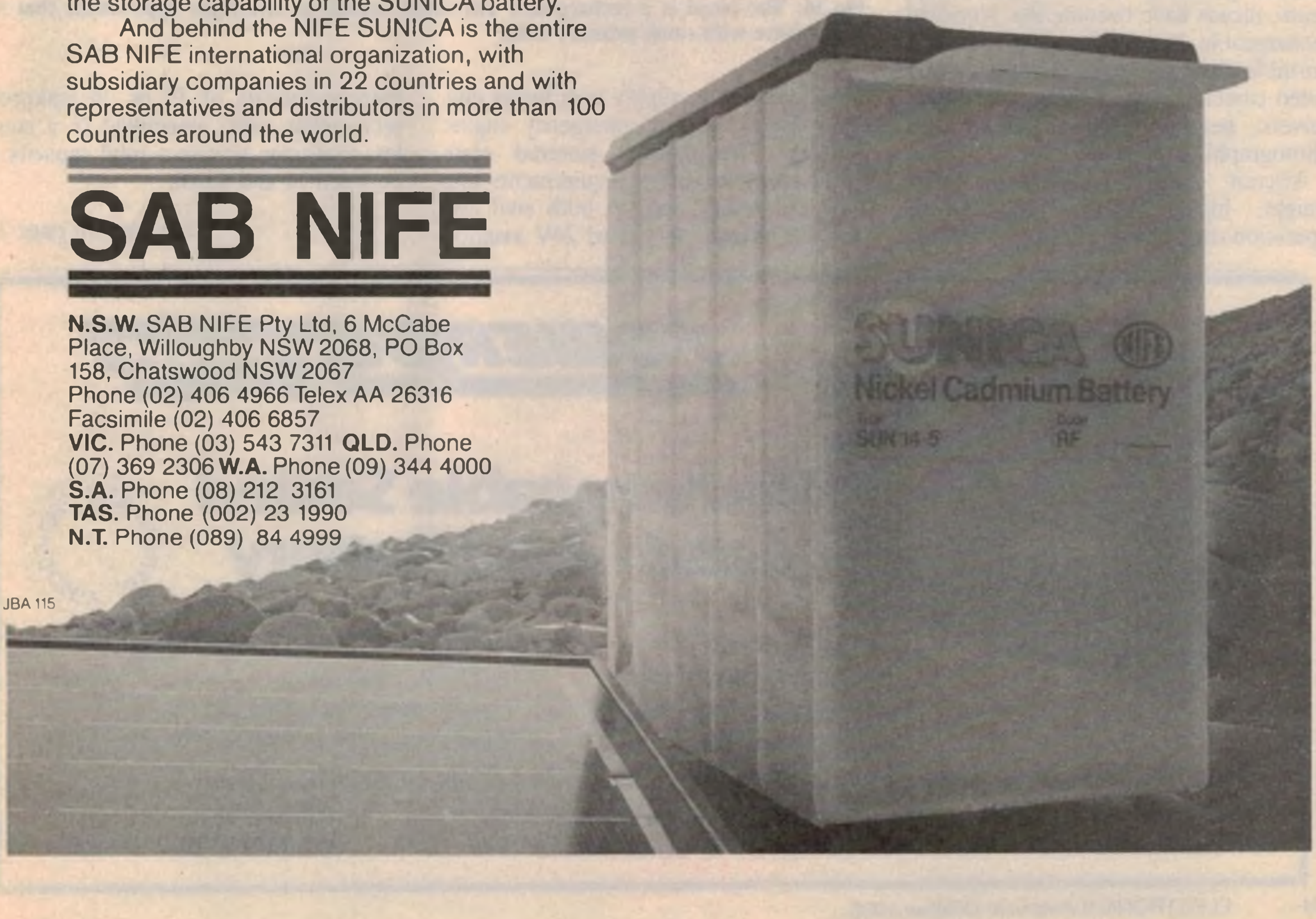

Cells and batteries

are based on metal foils which can be rolled up with flexible separators to provide a very compact assembly as shown in Fig.16. As rectangular and cylindrical cells may sometimes be subjected to excessive rates of charging and discharging, a safety valve is fitted which will prevent the internal pressure from reaching dangerous levels.

Cells using sintered electrodes have lower internal resistance and thus work better under heavier load conditions than pressed powder types. They are also more suitable for use at temperatures down to −40°C. Few secondary cells hold their charge as well as primary cells and at 20°C a pressed powder nicad would lose about 60% of its charge and a sintered electrode nicad about 80% in 12 months.

Pressed powder cells usually have a life of 300-500 cycles, but sintered types are capable of 500-1000 cycles under optimum conditions.

Pressed powder button cell nicads were first marketed in the late 1950s, but it was not until the mid-70s that fully sealed, sintered electrode nicads became generally available. In recent years, nicads have become the standard rechargeable battery for just about all portable electronic equipment, including video cameras, pagers, hand held transceivers, hearing aids, calculators and photographic equipment.

Aircraft batteries must be light weight, highly reliable, capable of operation over a wide range of temperatures and able to supply very heavy currents for normal or emergency engine starting. The modern sintered plate nicad meets all these requirements and they are widely used in both civil and military aircraft. A typical 24V aviation battery consists of 19 or 20 leakproof rectangular cells, assembled in a stainless steel case to give a total capacity of between 20 and 40Ah.

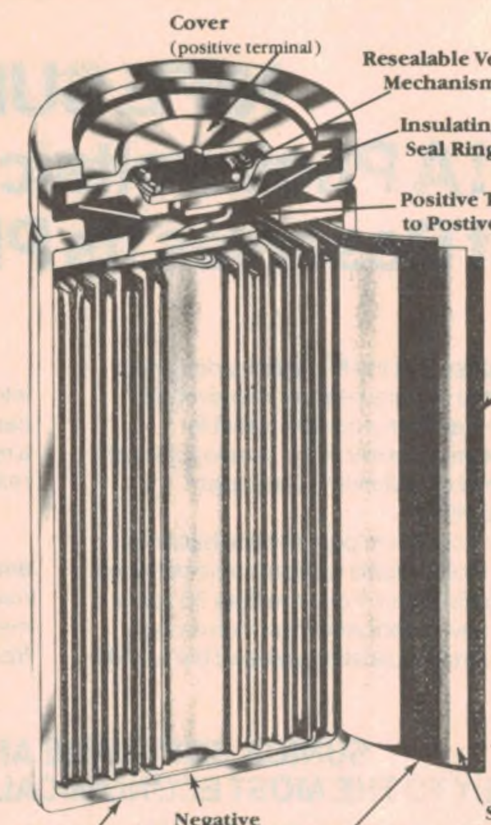

Fig.16: The nicad is a rechargeable cell small enough to find some applications that are competitive with small primary cells.

Continued on page 126

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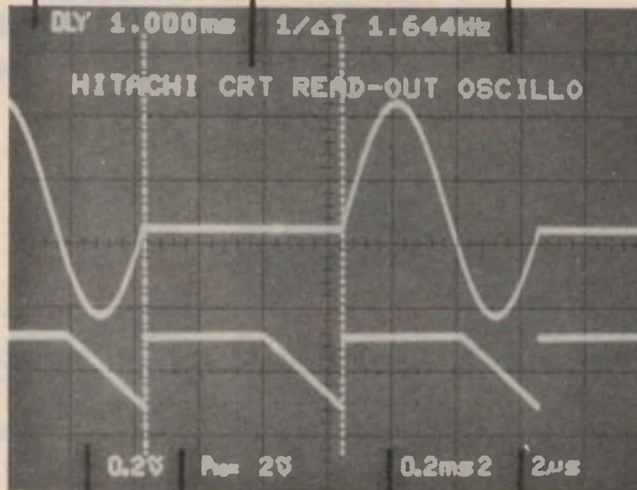

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THE SCREECHER CAR BUGLAR ALARM

Here is a low cost car alarm designed with a new deterrent strategy. Instead of using the alarm to try to draw the attention of passers-by to the felony in progress, this alarm sounds inside the car, to deafen the thief and make it too uncomfortable to proceed with pinching the vechile!
(86a19, EA August '86)
Cat. K86081 .... **$29.95**

FOUR CHANNEL MIXER

This four channel mixer project gives professional quality with impressive specifications.
SPECIFICATIONS:
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Signal to noise ratio: — 78dB relative to +4dB
Distortion: 0.03% at +4dB, 2kHz
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Output impedance: 100 ohms
Frequency Response: 10Hz to 30kHz (— +1dB)
(ETI1404, ETI July '85)
Cat. K54040 .... **$99**

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A simple project to give your Commodore RS232 compatibility.
(ETI 1601, ETI July '86)
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Does your house eat lamps? Does it seem that you are always having to replace expensive spotlights, ornamental lamps or bulbs in inaccessible places? The solution to these problems is the Lamp Saver which will greatly extend the life of any 240V AC incandescent lamp.
(86pc5, EA June '86)
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Does your music system want a new frequency response? Does your guitar or keyboard need some equalisation to brighten the sound? Well, here is a module which can be used by itself on individual instruments or ganged to equalise your music system.
(ETI 1406, ETI August '86)
Cat. K54060 .... **$16.50**

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(86au7, EA September '86)
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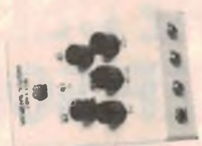
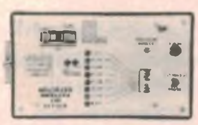


DIGITAL SAMPLER KIT

Digital sampling is at the core of many of the special sound effects used by modern musicians. A trigger input (usually a construction drum pad) triggers a prerecorded sound from the digital sampler. This sound has been recorded into the 4K of onboard memory and can be digitally manipulated so that it sounds completely different on playback. The unit has controls for gain, regeneration and mixing. It also gives a choice of a number of different triggering methods.
(ETI 1402 May, June, July '86)
Cat. K41420
Please phone for price and availability



BIT PATTERN GENERATOR KIT

In applications where you are required to look for a particular byte of information in a serial or parallel data path, short of a logic analyser or a storage oscilloscope, there is not a lot to help you. However, this Bit Pattern Generator gives you a simple and economical way to detect and display specific bytes of data. It may be used on both parallel and serial data paths.
(ETI 172, May '86)
Cat. K41720 (Serial/Parallel Kit)
Please phone for price

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This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting.
(EA April '82, 82AO3A/B)
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Cat. K82041 .... **$109**

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Cat. K47330 .... **$19.95**

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Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. 83) 83TT8
Cat. K83080 **Normally $18.95**
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This module will deliver up to 200 watts into an 8 ohm load and up to 300 watts into a 4 ohm load. Comprehensive protection is included and a printer circuit board brings it all together in a rugged easy-to-build module. It can be built in either fully-complemetary or quasi-complementary versions, so output transistor shortages should be no problem at all.
(80PA6) (EA July '80)
Cat. K80060 **Normally $109**
SPECIAL, ONLY $99

PHONE MINDER

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb '84) 84TP2
Cat. K84021 .... **$27.50**

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This simple project is suitable for most projects requiring a dual voltage. (ETI 581, June '76)
Cat. K45810 .... **$27.50**

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(EA Jan '86. 85tf10)
Cat K86010 .... **$19.95**

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(81AO10) (EA Oct. 81)
Cat. K81101 .... **$59.50**

FREQUENCY STANDARD

Get the equivelent of a rubidium frequency standard by draping a piece of wire over the back of your TV set!! Believe it or not your humble television can provide an extremely stable and accurate reference frequency. The wire acts as a transducer to pick up electromagnetic radiation from the back of the set. Normally you would need to spend thousands of dollars to achieve accuracy beyond the "parts per thousand" you expect from ordinary meters. With this simple project, an extremely accurate 1MHz signal can be dervied for very little outlay.
(ETI 174, July '86)
Cat. K41740 .... **$24.95**

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- Built-in siren driver

The RIE kit includes a superb printed and prepunched metal case and inside metal work, plus a gell battery! Unbeatable VALUE!
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(AEM 3500, July '85)
Cat. K93015 .... **$37.95**

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(AEM 4600 Dec '85)
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The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current metering is provided. (ETI Dec. 83) ETI 162
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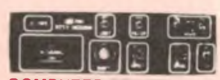

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(80pg6, EA June '80)
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DIGITAL CAPACITANCE METER Mk.2

Updated from the EA March '80 issue, this Digital Capacitance Meter checks capacitor values from 1pF to 99.99uF over three ranges. Its main features include a nulling circuit and a bright 4 digit LED display.
***Note:** The RIE kit contains quality silk screen printed and prepunched front panel AND an exclusive High Intensity Display!
(80cm3a, EA August '85)
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Stop your car from being one of the 70,000+ stolen cars stolen each year with this "state of the art" car burglar alarm. Features include key switch operation, delayed entry and exit, automatic reset, and provision for an auxiliary battery. Further more, of the 10 most important features listed by NRMA, this EA Deluxe Car Alarm has 9 of them!
(84ba5, EA May 84)
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(ETI455,)
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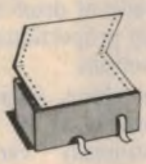

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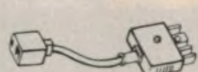

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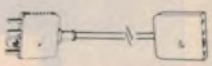

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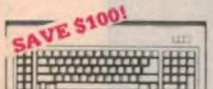

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MasterCard VISA

An introduction to hifi Pt.8

Digital technology — 1

Playing the numbers game!

After a century of analog technology, sound reproduction is swinging solidly towards the digital approach, as evidenced in the marketplace by widespread acceptance of the compact disc. In this chapter, we examine the background and basic principles of digital signal processing, in preparation for forthcoming articles in the series.

Within the past decade the words, "analog" and "digital", have found their way from the computer scene into everyday audio/hifi terminology.

An analog computer is defined as one which "represents information in the form of continuously varying voltages". By inference, an analog audio system is one which processes audio information in a continuously varying form — the traditional method.

A digitial computer, on the other hand, is said to "represent information by patterns of on-off states of voltages".

In an audio context, "digital" is used (rather loosely) on occasions as a collective term, simply the converse of "analog", to describe sampling or pulse techniques generally — any information in a non-continuously varying form. Quite a few such techniques have been employed over the years, principally for communication and data transmission. (See the accompanying panel).

It makes better sense, however, to think of digital audio as a sampling or pulse technique of a particular kind, based on modern, computer style technology. An alternative term, encountered mainly in professional literature is PCM, short for pulse-code modulation.

Within the past few years, digital/PCM technology has gained wide acceptance by professional audio engineers and technically inclined hifi enthusiasts. By contrast, it is regarded with scepticism by some conservative audiophiles who still favour the traditional — and more comprehensive — way of doing things!

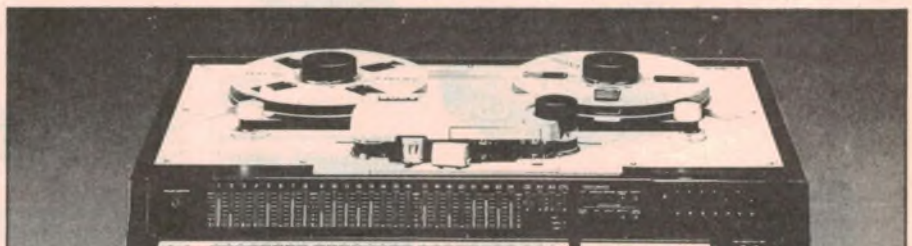
Nature did it first!

In fact, both analog and pulsed (or sampled) sound are at least as old in principle as the human ear itself — discussed in chapter 1 in this series (Feb. '86).

In that article, we explained the nature of sound and how multiple sound waves from, say, the instruments of an orchestra, add together at any given point in the auditorium to produce a single, continuously varying sound pressure resultant, or sound pressure "envelope".

The continuous small "sonic" changes in air pressure cause listeners' ear drums to vibrate, the direction and amplitude of drum movement being essentially proportional to the sound pressure variations.

In effect, sonic or acoustic energy is transformed by the outer ear from a continously varying sound pressure wave to proportional movements of the



Now available in Australia, Sony's PCM-3324 is the first of a new generation of standardised multi-track, fixed head studio digital recorders, intended to take over from existing analog models.

ear drum and stapes mechanism — an analog relationship.

Within the cochlea, however, the analog information is broken up into a pattern of neutral pulses — virtual information "samples" — for transmission to the brain, where they are interpreted as sound.

In short, our sense of hearing involves both an analog and a pulse (or sampling) process — a consideration that might serve to moderate spontaneous prejudice against anything that isn't good, old-fashioned analog!

Analog heritage

Certainly, the thinking and technology of pioneers in the audio field was predominantly analog — even if they could scarcely have recognised it by that description.

The best remembered aspect of Leon Scott's research, last century, was his achievement in using a bristle attached to a diaphragm to trace an analog audio waveform on a cylinder coated with lampblack.

Edison subsequently managed to produce a voice-modulated groove capable of being replayed by a stylus attached to a diaphragm and an acoustic horn. Each successive step in Edison's "Phonograph" or "Speaking Machine" bore an analog relationship to the one before: sound pressure input wave — recording stylus movement — groove modulation — playback stylus movement — sound pressure output wave (Fig.1).

With the adoption of electrical recording and playback, the sequence became more involved, with the signal passing through transducers and amplifiers, but invariably in analog form.

Much the same philosophy applied to radio receivers as they evolved, and later to magnetic tape systems and to other audio equipment. With rare exceptions, designs were based on continuously variable (analog) signal processing, with the output from each section as close a replica of the input as possible, in the interests of overall fidelity.

Analog signal sources

In this predominantly analog environment, electronic amplifier design has posed few intransigent problems. With care, it has been — and still is — possible to produce domestic hifi amplifiers offering adequate frequency response, low inherent noise and distortion, and sufficient power output for current needs.

The same cannot be said, however, for analog signal sources, notably magnetic tape and phono disc systems. By about the mid '70s, engineers realised that they were up against a law of diminishing returns, in that it was becoming progressively more difficult and costly to further upgrade the level of performance in the quest for improved fidelity.

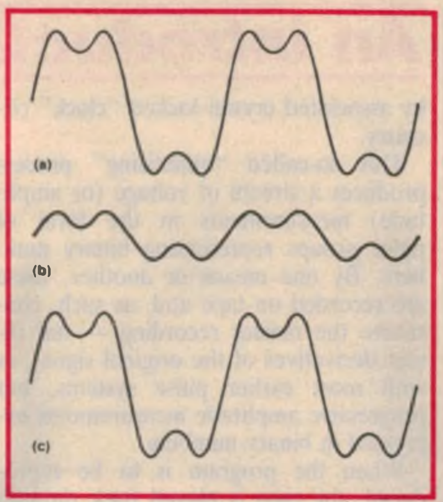


Fig.1: An imaginary sound envelope (a) fed to Edison's "hill and dale" phonograph, might have produced vertical stylus movement and groove modulation as per the analog waveform (b) and (ideally) a sound pressure waveform from the horn like (c).

A better way?

This dilemma lead naturally to speculation about whether it might be possible to adopt a totally different approach that would sidestep the inherent limitations of analog tape and disc players and open the way to a level of performance more commensurate with that already available from hifi amplifiers.

The answer was "yes", thanks mainly to the availability of totally new, computer oriented component technology, broadly categorised as "digital".

Summing up the position in November '77, "Electronics" magazine (USA) had this to say:

Analog technology is mature and no great advances are expected; digital technology, on the other hand, has progressed to a point where all the needed components are at hand and price reductions are in view.

For hifi enthusiasts, the new approach became evident in the late '70s with the introduction of conventional discs mastered from digitally recorded tapes. These were followed in the early '80s by digitally based compact discs and by highly specified CD players, which soon became fully price-competitive with conventional phono decks.

We will have more to say later about these developments but, having set the scene, the logical next step is to outline the basic concept of digital audio technology.

The digital concept

The conversion of an analog audio signal to digital form involves considerable processing, central to which is an electronic module described as an A/D (analog to digital) converter.

In operation, an A/D converter compares instantaneous samples of the incoming signal with a reference "stack" or "ladder" of very small voltage increments or steps, allocating to each sample a discrete value equal to the nearest step. It does this at precise, closely spaced sampling intervals, determined

PULSE SYSTEMS — A SUMMARY

PAM — Pulse Amplitude Modulation: Periodically recurring pulses modulated in amplitude (height) by direct instantaneous sampling of the (audio) modulation envelope.

PTM — Pulse Time Modulation: A collective term covering systems in which some time parameter of the recurrent pulses is varied in accordance with the modulation envelope. PTM takes in PDM, PWM and PPM.

PDM, PWM, PPM: The Duration or Width or effective Position (or Phase) of the recurrent pulses is modified by varying the time of occurrence of either, or both the leading and trailing edges in accordance with the modulation.

PFM — Pulse Frequency Modulation: Samples of the modulation are used to vary the occurrence frequency of the pulses.

PNM — Pulse Number Modulation: A form of encoding in which the number of pulses in unit time indicates the instantaneous amplitude of the audio signal. In practice, PCM is a much preferred approach.

PCM — Pulse Code Modulation: Differs from all the above in that samples of the modulation are quantised into discrete steps. The quantised measurements are conveyed through the system by recurrent pulses normally based on a binary bit code pattern.

DIGITAL: Currently, "Digital" is essentially a synonym for PCM and is the term more widely used in the context of consumer audio. PCM is favoured in engineering circles as a natural extension of the pulse terminology listed above.

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An introduction to hifi

by associated crystal locked "clock" circuitry.

This so-called "quantising" process produces a stream of voltage (or amplitude) measurements in the form of pulse groups representing binary numbers. By one means or another, these are recorded on tape and, as such, constitute the master recording — not direct derivatives of the original signal, as with most earlier pulse systems, but progressive amplitude measurements expressed in binary numbers.

When the program is to be reproduced, the tape is played back through a complementary D/A (digital to analog) converter, which virtually reverses the process. It accepts and reads the numbers at precisely the same sampling frequency and automatically responds with a stream of equivalent instantaneous voltages conforming to the measurements.

The contour of these internally generated voltage pulses closely matches that of the original analog signal and, after suitable filtering to remove artefacts of the sampling process, a virtual duplicate of the original signal remains.

If all this sounds an impossibly roundabout way of doing things, it would be, but for the fact that the various steps can now be rationalised, with the help of integrated circuit technology, into compact, reliable and relatively inexpensive circuit modules.

Indeed, audio signals can now be stored and processed more efficiently and more cheaply by digital technology than by older methods relying on precision mechanical components and procedures: e.g. wow-free drive mechanisms, ultra-precision arms, cartridges and styli, super-quality heads and tapes, &c.

Depicted graphically

Purely to illustrate audio sampling, Fig.2a shows the same waveform as in Fig.1, drawn as a graph. Its amplitude, plus and minus, is referenced to the vertical scale while the instantaneous sampling times are depicted by vertical lines along the horizontal scale.

Reading the graph, one could record that the signal amplitude at the successive time intervals follows the sequence 0, +3, +2, +3, 0, −3, −2, −3, 0, +3, +2, +3, 0, −3, −2, −3, 0. Change the numbers to binary form — 000, 011, 010 &c, and it would qualify as an elementary example of A/D conversion.

Using these figures, one could later construct a waveform such as that shown in Fig.2b. It could be done graphically or, given a DC voltage source and suitable electronic gadgetry, it could be reconstituted electrically and displayed on a CRO screen — in effect, D/A conversion.

Admittedly, it would seem a rather futile exercise, because Fig.2b is at best a very crude approximation of 2a. However, by trebling the number of readings or "samples" along the time scale, and interpolating values between the amplitude scale divisions, the result is 2c, which more closely resembles the original.

A reconstituted electrical waveform would look even more convincing if it were passed through a top-cut filter to moderate the high frequency sampling transients, thereby reducing the steepness of the verticals and rounding the corners.

While diagrams such as Fig.2 may serve to illustrate the process, they also tend to make some audiophiles apprehensive. "Bush" logic suggests that a serrated waveform recovered from a digital — or maybe any other type of sampling system — must sound different or in some way "un-musical".

However, such is the sampling frequency in a modern digital sound recording and playback system, the precision of the signal amplitude meas-

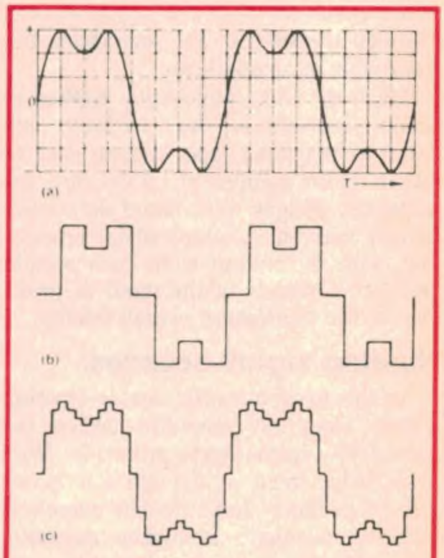

Fig.2: Illustrating how an analog waveform (a) can be reconstituted graphically or electrically. The greater the number of "samples", the more accurate will be the reconstituted waveform (b) and (c).

urement, and the output filtering provisions, that the contour of the reconstituted output turns out to be a more accurate replica of the original signal than can be achieved by any practical analog record-replay technology.

This much is plainly evident from a substantial reduction in harmonic and intermodulation distortion, both a measure of waveform linearity.

Binary notation

We shall have more to say later about the potential performance of practical digitally based systems but, for this to be meaningful, it will be necessary to take in a few facts and figures. For example, why the apparent dependence on the binary system?

The short answer is: for the same basic reason that dictated its use in computers and other areas of electronic information processing. The binary system merges naturally with "on-off" pulse techniques, the basis of digital processing.

If decimal numbers were to be represented directly in electronic equipment, they would require ten distinct identity levels in the selected parameter: ten recognisable levels of resistance, voltage, current, frequency, amplitude, &c. The potential resulting complexity and the scope for error is obvious.

By contrast, the binary system requires only two levels or two digits — conventionally 0 and 1 in printed text, as illustrated in Table 1.

In a decimal number, digits are effectively multiplied by ascending powers of 10, when read from right to left. Thus the right-hand figure of a decimal whole number is (mentally) multiplied by 1, the figure to its left by 10, the next by 100 and so on.

In the binary system, digits from the right are multiplied by ascending powers of 2 — rather than 10 — in short by: 1, 2, 4, 8, 16, &c. Thus, in the table as shown, the binary equivalent of decimal 1 is binary 01, signifying a 1 but no 2. Decimal 2 becomes binary 10 — a 2 but no 1. Decimal 3 is represented by one of each: 11 (2+1=3).

Obviously, a two-digit binary number can represent only four decimal values, 0, 1, 2 & 3. To represent decimal 4 necessitates the addition of a third column; a fourth column becomes necessary at 8, a fifth at 16, a sixth at 32 and so on.

Expressed another way, 4-digit (or 4-bit) binary numbers 0000 to 1111 can denote decimal values 0 to 15; 5-bit binary numbers, decimal values 0 to 31, 6-bit binary 0 to 63, and so on.

Two digits, two states

Whether or not you remember all this, the important point is that, in binary notation, numbers can be depicted using two different digits only: 0 and 1.

In electronic equipment, they can be represented by two easily recognisable states: a mechanical or electronic switch on or off; a light source on or off; current flowing or not flowing; voltage present or not present; a logic gate open or closed and so on.

On magnetic disc or tape, binary numbers can be represented by the presence and absence of magnetic pulses or audio tonebursts. On optical disc or film, the options include tonebursts, photographic patterns or, in the case of the compact discs, physical "pits" which modify the transmission of a laser light beam.

A further important advantage of two-state data processing is that the signal can be made relatively proof against extraneous effects. Residual resistance, light, current, voltage, tape noise, &c, will degrade yes/no signal information only if the extraneous effect becomes so gross as to mask the distinction between the two basic states.

With normal care, once "digitised", or encoded into computer style binary measurements, audio information can be recorded, duplicated, edited, transmitted, and even re-encoded into other digital formats, without cumulative loss of quality — something that could never be said of an audio signal in analog form.

Quantising numbers

Such a statement can only be meaningful if the original audio waveform has been quantised with sufficient accuracy to satisfy modern hifi requirements. As will have become apparent, this depends on two basic parameters:

(1) The number of discrete increments (or steps) in the reference stack (or ladder) against which the amplitude of the incoming analog signal is measured. In turn, the number of quantising increments dictates the length of the binary number needed to identify and encode them.

(2) The sampling rate or frequency — normally expressed in kHz.

The number of increments and the sampling rate should both be as high as practicable, to minimise the discontinuities produced when a continuous analog waveform is translated into discrete steps. In consequence, residual distortion and quantising noise are also minimised.

Both would be at their worst with too

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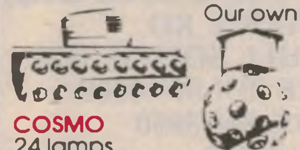
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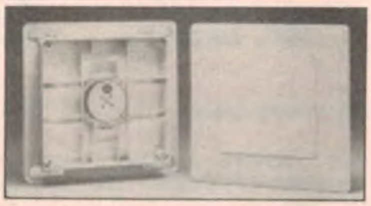

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An introduction to hifi

TABLE 1
BINARY NOTATION

Dec.	Bin.	Dec.	Bin.
0	00	10	1010
1	01	11	1011
2	10	12	1100
3	11	13	1101
4	100	14	1110
5	101	15	1111
6	110	16	10000
7	111	17	10001
8	1000	18	10010
9	1001	19	10011
		20	10100

Table 1: A list of the decimal numbers 0-20 and, alongside them, their binary equivalents. Having only two digits, binary numbers merge naturally with on-off pulse logic systems.

few quantising levels and too few samples, as implied in Fig.2b.

At the other extreme, there is a present limit to the number of effective quantising increments that can be provided economically in an electronic reference stack; and, as well, to the sampling and pulse rates that can be accommodated in practical systems.

16-bit quantisation

Clearly, compromises are called for in both areas which, while being practical and affordable, will limit distortion and noise to levels substantially lower than available from existing analog technology.

"16-bit" quantisation has emerged as the most widely accepted standard, signifying the number of discrete levels that can be encoded by a 16-digit binary number or, in computer terminology, a 16-bit "word". In decimal notation, it represents a total of 65,536 possible increments — a far cry from the 20-odd increments depicted in Fig.2c!

At the time it was selected, 16-bit linear quantisation was a brave choice as a major industry standard, because it represented the leading edge of current mass production technology. But, as Philips and Sony pointed out in their early literature on the compact disc system, it offered performance figures well beyond the reach of practical analog hifi signal sources.

What was then a venture since became routine technology, built into commercial and consumer digital equipment alike. But why "linear" quantisation?

The term "linear" indicates that the increments in the reference stack are equal. It is commonly conceded that it would be preferable to grade the stack so that small increments would be available to quantise low-level signals, but the concept proved much easier to envisage than to implement!

The preferred option, which could be exercised readily enough in professional mastering equipment, would be to double or quadruple the number of increments, adding an extra bit or two to the word length. Whether it would result, at this stage, in a discernible improvement in quality is problematical.

Sampling rate

As indicated earlier, accurate quantisation is also dependent on an adequate number of samples — in short on a sufficiently high sampling frequency.

It has long been accepted that, in pulse modulation systems:

"... a continuous message waveform that has a spectrum of finite width can be recovered from a set of discrete instantaneous samples whose rate is more than twice the highest signal frequency."

Consistent with this so-called sampling principle or theorem, virtually all modern digital hifi audio equipment uses a basic sampling frequency in the region 44–51kHz, the exact figure depending on the standard adopted for the particular system.

Without pushing the ultimate data bit rate to an unduly high figure, a sampling frequency of this order can accommodate an audio passband extending to the full 20kHz, with room above that for a low-pass filter centred on half the sampling rate, at or above 22kHz.

In broad terms, the purpose of such filtering is to remove all redundant supersonic signal components and quantising artefacts, which might conceivably interact to create audible resultants.

It is stated, as a mathematical certainty that, if an original audio signal is sampled and smoothed (filtered) so as to recover frequencies up to 20kHz — and therefore well above the limit of human hearing — there will be no loss of subjective information. The recovered signal will contain all the components (and more) that would have been audible at the microphone position.

In practice the frequency response of a modern digital record/replay system can usually be rated from 20Hz (or lower) to 20kHz, within about ±0.5dB and therefore free from the peaks, troughs and roll-offs that have long characterised more mechanically dependent equipment.

Signal & other data

In digital multi-channel studio recording equipment, each incoming signal is sampled separately at a common sampling rate, the digital data stream from each being encoded and recorded on a separate track on a multi-channel tape.

Sony's PCM-3324 digital studio recorder, pictured at the head of the article, provides for 24 parallel PCM (digital) tracks on 12.7mm (0.5in) tape, plus a stereo pair of analog tracks for backup purposes, a time code track and a control track — the last two for timing, cues, editing, program search, &c.

Sampling rate for the PCM tracks can be either 44.1kHz or 48.0kHz, switchable.

When ultimately mixed down into a stereo pair of digital signals for distribution (e.g. on compact disc) the two streams are merged into one by interleaving the left and right information, with left and right samples presented in turn — a process described as "time multiplexing".

In the home, or wherever else the signal needs to be reproduced, one function of the replay circuitry is to unscramble the two data streams and, by means of high speed electronic switching, to direct the incoming samples this way or that for decoding in separate D/A converters (or switching the output of a single D/A converter to left or right channels).

Time multiplexing has the advantage that the left and right channel signals exist independently, resulting in a stereo channel separation figure of at least 90dB for a digital system. This compares with 20-30dB for phono systems and 30-40dB for compact cassette players.

Fairly obviously, time multiplexing a stereo pair doubles the number of samples, therefore the sampling frequency which the system has to handle — typically 2 x 44.1 or 88.2kHz. Since each sample is specified by a 16-bit binary number, the basic bit rate for a stereo pair of audio signals obviously has to be at least 1.4MHz (or megabits).

Extra bits necessary

But there is more to it than that. A simple sequence of binary pulses recorded on magnetic tape or optical disc would be rather like a builder's tape marked only in millimetres! It would be useless without intermediate graduations.

In the same way, raw binary data requires supplementary encoding to help identify separate bits in a prolonged sequence of 0's and 1's, and to mark the beginning of new words and word groups.

In addition, it is accepted practice to take precautions against short-term loss of signal information due to tape dropouts, &c. These "error protection" measures involve the insertion of so-called parity bits and re-grouping of the signal information to increase the effectiveness of error detection and correction circuits during playback.

In point of fact, the scope for encoding information additional to the audio signal is an encouragement to make provision in digital recordings for cueing, timing information and other data as, for example, in compact discs. As a result, what started out as basic binary encoding ends up as something far more complex.

We shall be looking more closely at such measures in the next article. For the present, it is sufficient to note that these supplementary functions can easily double or treble the system bit rate, running to 4.3218Mbits in the case of compact disc.

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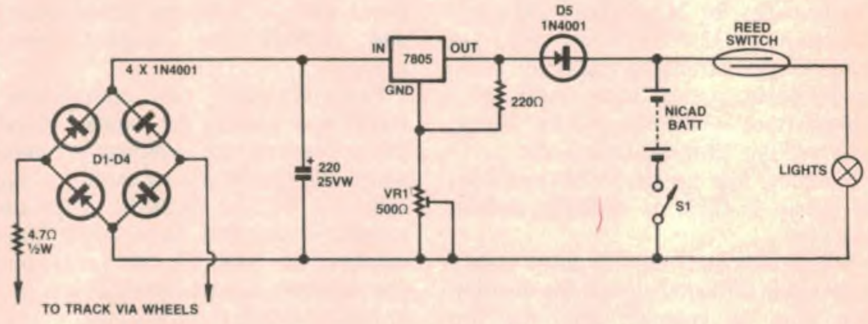
Improved model railway lighting



This circuit will allow the carriage lights of a model railway to be powered by rechargeable NiCd batteries. The batteries are recharged from the rails when the train is in motion.

The EA circuit of October 1967, which was a thyristor type, will not work with the newer controllers. The thyristor latches on and the NiCd batteries try to drive the motor.

Replacing the thyristor with a regulator makes the circuit compatible with modern controllers. Diodes D1 to D4 enable the batteries to charge for either direction of train travel. I used four NiCd batteries as this gives a more realistic light level. Diode D5 stops the NiCds from discharging when the train is stopped, and the 4.7Ω resistor limits the charging current if the batteries are completely flat.

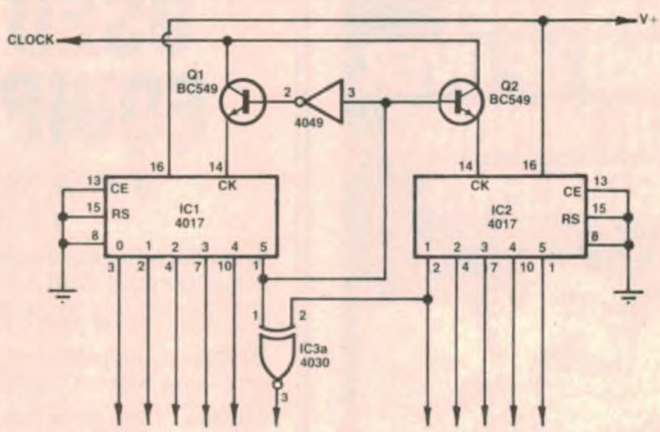
Note that the 220μF capacitor was the largest I could fit in the carriage. If a larger capacitor will fit it should be used.

A magnetic reed switch is included in my circuit so that the lights are only activated when the train is at the station. Switch S1 is used to turn the circuit off when the carriages are in storage.

R. Salter,
Tara, Qld.

$15

How to cascade 4017 counters



This circuit is a suggestion for cascading two 4017 decade counter ICs. It will simulate a counter with 19 outputs that is almost identical in operation to an extended 4017. The only difference is that the 'counter' will not reset automatically after it reaches the maximum count.

Only five outputs of each counter are shown for clarity, although any number of outputs can be used (up to ten for IC1 and nine for IC2). The "0" output of IC2 cannot normally be used as it will be high after the circuit is reset.

The highest output of the first counter (IC1), which is "5" in this case, must be connected through a 4030 exclusive OR (XOR) gate (IC3a). Initially the XOR output will follow IC1's output. However, the first output of IC2 is also connected through the XOR gate and, as soon as it goes high, the XOR output (pin 3) goes low.

In addition to the XOR gate, the highest output of the first counter also drives inverter IC4a and the base of Q2. Q2 gates the clock signal to IC2 while IC4a and Q1 gate the clock signal to IC1.

D. Gray (age 10),
Burwood, NSW.

$15

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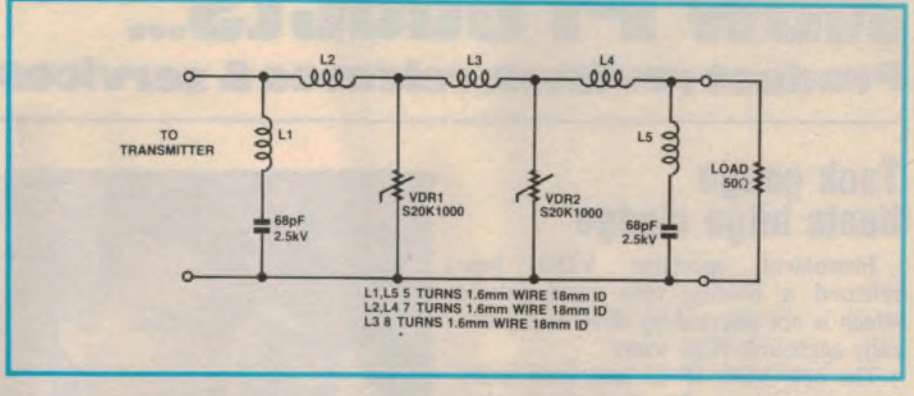
Low pass filter and surge suppressor

Metal oxide varistors are voltage dependant resistors, their resistance decreasing non-linearly with increasing voltage.

During normal operation, the varistor resistance is high enough to have little effect on circuit operation. However, if the incoming voltage is raised above the operating maximum, the resistance falls rapidly. Such a rise in voltage might be due to surges from lightning strikes or due to switching transients.

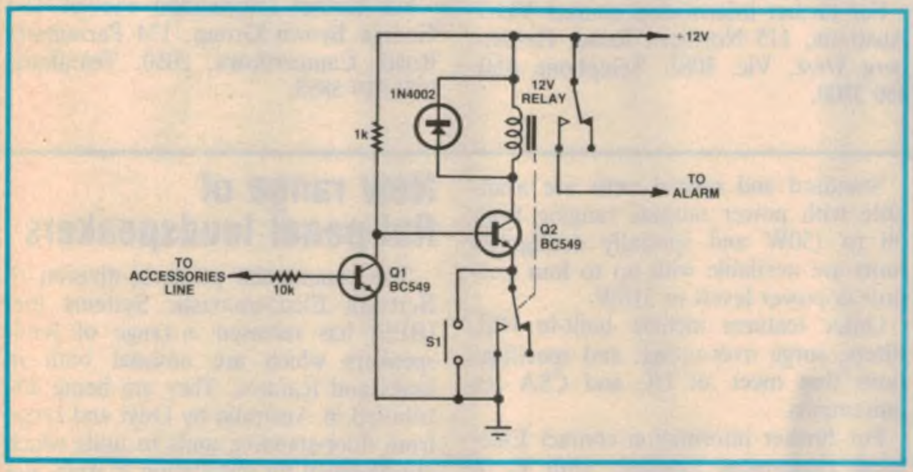
In this circuit, the varistors (VDR1 and VDR2) are used to prevent voltage spikes from damaging the input/output stages of a transmitter. Such spikes could be fed in via the antenna lead. What makes the use of a varistor interesting here is that, at low applied voltages, it acts as a capacitor with a quite usable Q in the HF region (up to 30MHz).



As shown, the varistors and their associated components form a low pass filter. This filter was designed for use with a solid state HF pulse transmitter with a frequency range from 1 to 20MHz and a power output of 3kW. The series inductors add source impedance to aid spike suppression and the filter cutoff frequency is 25MHz.

The varistor used is a Siemens S20K1000 20mm disc type. This has a capacitance of 230pF ±15% and a Q of 65 at 20MHz. The peak single pulse current rating of this device is 6500A for an 8-20μs pulse.

K. Gooley,
Darlinghurst, NSW. **$20**



Ignition switch cutout for car alarms

This simple circuit can be used with car burglar alarms such as the Screecher (EA, August 1986), or even with a fake car alarm such as the Lamp Flasher described in February 1986. When installed, it prevents the alarm (or flasher) from being turned off except by using the car's ignition switch.

Result: improved security compared to the hidden switch method, and a more professional installation.

The circuit can be armed only when the ignition is switched off. Arming is achieved by a separate pushbutton switch (S1) which should be a momentary contact type. This causes the relay to latch and supply power to the alarm circuit via a second set of contacts.

An integral lamp/switch assembly, as used on commercial alarms, is ideal for S1 (the lamp is driven by the alarm's flasher circuit).

To disarm the circuit, the ignition switch must be turned to the accessory position. This turns Q1 on and Q2 and the relay off, thus switching off the alarm.

The accessory line is used because this is readily accessible in the fuse box. Additionally, if the car is hot wired, the accessory line usually doesn't go high.

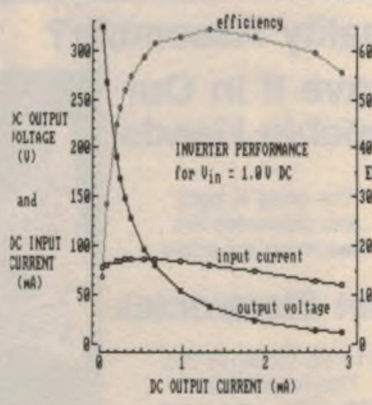
A. Shaw,
Chatswood, NSW. **$15**

Editor's note: readers wanting to use this circuit should check their car's wiring diagram to make sure that the accessory line doesn't go high if the ignition is hot wired.

Addenda for 1.5V photoflash inverter

In the text for the "High-Efficiency 1.5V Photoflash Inverter" (Circuit and Design Ideas, August 1986), reference was made to an efficiency curve (Fig.1). Due to an oversight, this figure was left out of the original article.

Readers are also advised that the inverter transformer should be wound on an 18mm ferrite pot core or similar small ferrite former.



New Products...

Product reviews, releases & services

Tank gauge beats bilge sludge

Instrument specialist VDO has released a holding tank level gauge which is not affected by dirty or chemically aggressive bilge water.

The new VDO IP 65 tank level indicator operates on the ultra-sound echo principle, similar to a depth sounder. Normal mechanical-type fuel and water level systems can be rendered inoperative by sludge and pollution in the bilge and it is this problem that the IP 65 is designed to overcome.

The kit consists of a contact-free transducer/sensor and an analog gauge, which shows fluid level as a percentage. One gauge can be used to monitor the level of different tanks, by connecting individual sensors in each tank to a control switch. The transducer has two potentiometers, for tank height and zero level, and comes with all the necessary seals and fittings.

For further information contact VDO Australia, 115 Northern Road, Heidelberg West, Vic. 3081. Telephone (03) 450 3209.

Universal bandolier counter

The 'Kwickcount' is a completely portable bandolier component counter which can count both axial and radial components.

It is supplied with an internal NiCd battery pack and charger and it has a unique division facility which allows counting of up to 100,000 axial components.

A low battery indicator and automatic switch off are standard features, and a 4-digit LCD counts up or down depending on the direction of component travel.

For further information contact The George Brown Group, 174 Parramatta Road, Camperdown, 2050. Telephone (02) 519 5855.

Low-cost switchmode power supplies

Coutant Electronics has released the new CSC range of low-cost flyback switchmode power supplies, capable of providing +5V, +12V and +24V outputs.

The units are available in open PCB, L-bracket or totally enclosed and are suitable for powering microprocessor based systems, intelligent CRT terminals, disc drives and small printers.

Standard and special units are available with power outputs ranging from 30 to 150W and specially configured units are available with up to four outputs at power levels to 310W.

Other features include built-in RFI filters, surge over-rating, and specifications that meet all UL and CSA requirements.

For further information contact Electrical Equipment Limited, Unit C, 8 Lyon Road, North Ryde, NSW 2113. Telephone (02) 267 1122.

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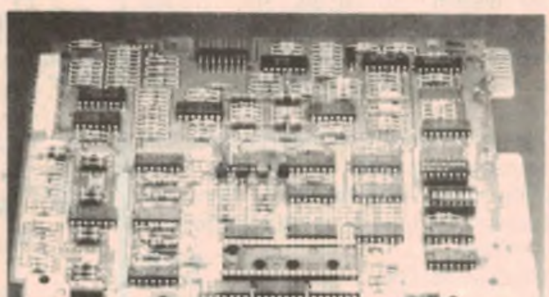


The price is right and deliveries are always on schedule

Duet Electronics

414 St. Georges Rd.
Thornbury, 3017
480-5803 484-4420

New range of flat-panel loudspeakers

The commercial products division of Bertagni Electroacoustic Systems Inc. (BES) has released a range of loudspeakers which are unusual both in looks and features. They are being distributed in Australia by Odyl and range from floor-standing units to units which are designed for installation in walls and ceilings.

Also available is a model which can be used outdoors in even the harshest of weather conditions.

The unusual thing about these loudspeakers is that there are no conventional speaker cones. Instead, the drivers have broad, flat diaphragms which are made from a plastic material and which are almost as large as the entire enclosure. Result — a slimline loudspeaker enclosure.

The floor-standing models include seven models, ranging from the SM90 to the up-market SM300 which can be used with power amplifiers rated up to 250W. The cabinets of the four top line models are finished in oiled oak veneer, the SM80 and SM100 are finished in simulated wood veneer, and the SM90 is finished in anodised aluminium and

Virgin Records to market classical CDs

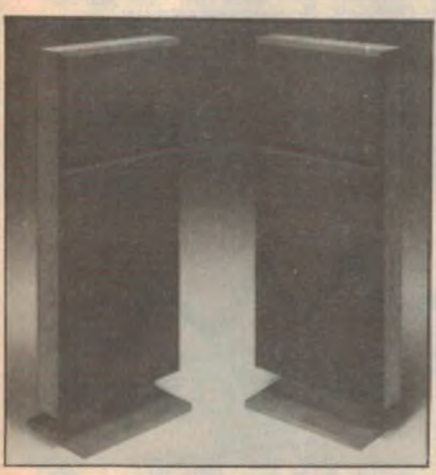
Virgin Records Australia has recently concluded an agreement with Innovative Music Productions (IMP) of the UK to market the latter's popular range of classical CDs in Australia.

These discs (with the solitary exception of James Galway's version of Mozart's Flute Concertos) have all been digitally recorded — ie, they are all new performances recorded specifically for release on compact disc.

The recently released catalog comprises 24 titles, each of which will sell for $21.99. According to Virgin Records, this is about $6 less than other comparable CDs on the market. The company plans to extend its range to some 50 titles within the next 12 months.

The disc titles currently available are as follows: The Four Seasons (Vivaldi, Cat. PCD800) — Tchaikovsky Spectacular (PCD801) — String Masterpieces (PCD802) — Messiah Highlights (Handel, PCD803) — Russian Spectacular (PCD804) — Music of the Masters (PCD805) — Renaissance Masterpieces (PCD806) — Mozart Flute Concertos (PCD807) — Bach Violin Concertos (PCD808) — Vivaldi String Concertos (PCD809) — Mozart Clarinet Quintet & Oboe Quartet (PCD810) — Great Vivaldi Wind Concertos (PCD811) — Bach Harpsichord Recital (PCD817) — Geoffrey Saba Piano Recital, Pictures at an Exhibition (PCD818) — Symphony No.5 Schubert, Symphony No.49 Haydn (PCD819) — Symphony No.40 Mozart, Symphony No.44 "Trauer" Haydn (PCD820) — Six Trumpet Concertos (PCD821) — Italian Madrigals (PCD822) — Organ Spectacular (PCD823) — Symphony No.4 "Italian" (Mendelssohn, PCD824) — A Florintine Carnival (PCD825) — Handel Water Music (PCD826) — The Art of the Coloratura (PCD827) — Beethoven Piano Sonatas (PCD828).

For further information contact Virgin Records Australia Pty Ltd, 5/100 Bay Rd, Waverton, NSW 2060. Telephone (02) 923 1844.



fitted with a weather-resistant grille cloth.

Other models in the BES range include the omnidirectional all-weather B-82 for both indoor and outdoor applications, and the models C60S, C60D, C70S and C70D ceiling-mounting loudspeakers. According to the manufacturers, the radiation patterns of these units provide much greater coverage than conventional cone-type loudspeakers.

For further information contact The Odyl Group of Companies, Melbourne (03) 846 3022, Queensland (07) 394 8284 and Sydney (02) 212 6617.

ANOTHER BRILLIANT RELEASE FROM VIFA!

VIFA EA 60/60
KIT SPEAKERS.

The value and the sound get better and better!
As you probably know, the value of kit speakers has never been greater than it is today. Our falling dollar, together with the rate of import duty, freight costs and other handling charges make fully imported loudspeakers almost a super luxury item. On the other hand, kit speakers can offer the same – and in most cases better – drivers and crossovers and cost far, far less and sound far, far superior.
A perfect example of the sound of excellence.
The new Vifa loudspeaker kit has been designed to completely outperform any similarly priced speakers. This is a 2-way design incorporating drivers which give a deeper, more natural bass response and 19mm soft-dome ferro fluid cooled tweeters which provide clear, uncoloured sound reproduction.
These VIFA drivers are identical to the ones used in such fine speakers as MISSION, ROGERS, BANG & OLUFSEN, MONITOR AUDIO, HAYBROOK just to mention a few. Some of these speakers cost well over $1000 a pair.
The dividing network is of the highest quality and produce no inherent sound characteristics of their own; they simply act as passive devices which accurately distribute the frequency range between both drivers in each speaker.
The ideal Bookshelf Speakers.
The fully enclosed acoustic suspension cabinets are easily assembled and are perfect for bookshelf use or on speaker stands. All you need are normal household tools and a couple of hours enjoyable application and you've built yourself the finest pair of speakers in their class.

For further information and the name of your nearest Vifa stockist, please contact the Sole Australian Distributor:
SCAN AUDIO PTY. LTD.
52 Crown St.,
Richmond 3122.
Phone (03) 429 2199.

vifa

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Description Cat.No.	1-9 boxes	10+ boxes	100+ boxes
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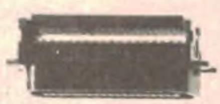

COMPUTER CONNECTORS

Cat No.	Description	1-99	100+	1000+
P10900	DB25 Plug	1.30	1.20	0.80
P10901	DB25 Skt.	1.40	1.30	0.90
P10902	DB25 Cover	.80	.65	.55
P12210	Cent. Solder	3.50	3.15	2.50
P12200	Cent. Crimp	4.50	4.00	3.50
P10880	DB9 Plug	1.30	1.20	0.90
P10881	DB9 Skt.1.40	1.30	1.00	
P10882	DB9 Cover	0.60	0.55	0.50
P10890	DB15 Plug	1.30	1.20	0.90
P10891	DB15 Skt.1.40	1.30	1.00	
P10892	DB15 Cover	0.65	0.55	0.50

Plus 20% tax where applicable

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Cat. No.	Description	Colour
W11251	13/.12	TND BLK
W11252	13/.12	TLD BROWN
W11253	13/.12	TLD ORANGE
W11254	13/.12	TLD YELLOW
W11255	13/.12	TLD GREEN
W11256	13/.12	TLD BLUE
W11257	13/.12	TLD WHITE

PRICES PER 100 METRE ROLL
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Plus 20% tax where applicable

Cat. No.	Description	Colour
W11260	14/.20	RED
W11261	14/.20	BLACK
W11265	14/.20	BLUE
W11268	14/.20	WHITE

PRICES PER 100 METRE ROLL
1-9 $9.00 — 10+ $7.00
Plus 20% tax where applicable

Cat. No.	Description	Colour
W11270	24/.20	RED
W11272	24/.20	BLACK
W11274	24/.20	GREEN

PRICES PER 100 METRE ROLL
1-9 $11.00 — 10+ $10.00
Plus 20% tax where applicable

Cat. No.	Description	Colour
W11280	32/.2	BROWN
W11282	32/.2	BLUE

PRICES PER 100 METRE ROLL
1-9 $12.00 — 10+ $11.00
Plus 20% tax where applicable

PANEL METERS

Cat.No.	Descript.	1-9	10+	100+
Q10500	MU45 0-1mA	7.50	6.95	6.75
Q10502	MU45 50-0-50uA	7.50	6.95	6.75
Q10504	MU45 0-100uA	7.50	6.95	6.75
Q10505	MU45 0-50uA	7.50	6.95	6.75
Q10510	MU45 0-5A	7.50	6.95	6.75
Q10518	MU45 0-1A	7.50	6.95	6.75
Q10520	MU45 0-20V	7.50	6.95	6.75
Q10535	MU45 VU	8.50	7.75	7.50
Q10530	MU52E 0-1mA	9.95	8.35	
Q10533	MU52E 0-5mA	9.95	8.35	
Q10538	MU65 0-50uA	10.50	9.35	8.95
Q10540	MU65 0-1mA	10.50	9.35	8.95
Q10550	MU65 0-100uA	10.50	9.35	8.95
Q10560	MU65 0-20v	10.50	9.35	8.95

Plus 20% tax where applicable

AXIAL ELECTROLYTICS (DOUBLE ENDED)

Cat. No.	Description	10+	100+	1000+
R15705	0.47uF 63V	$0.12	$0.10	$0.09
R15715	1uF 63V	$0.12	$0.10	$0.09
R15725	2.2uF 63V	$0.12	$0.10	$0.09
R15742	4.7uF 25V	$0.11	$0.09	$0.08
R15745	4.7uF 63V	$0.11	$0.09	$0.08
R15761	10uF 16V	$0.12	$0.10	$0.09
R15762	10uF 25V	$0.13	$0.12	$0.11
R15765	10uF 63V	$0.15	$0.14	$0.13
R15792	22uF 25V	$0.13	$0.12	$0.11
R15794	22uF 50V	$0.17	$0.15	$0.13
R15812	25uF 25V	$0.13	$0.12	$0.11
R15815	25uF 63V	$0.17	$0.15	$0.13
R15831	47uF 16V	$0.16	$0.13	$0.12
R15832	47uF 25V	$0.16	$0.13	$0.12
R15835	47uF 63V	$0.22	$0.19	$0.17
R15841	100uF 16V	$0.18	$0.16	$0.15
R15842	100uF 25V	$0.18	$0.16	$0.15
R15845	100uF 63V	$0.27	$0.24	$0.22
R15851	220uF 16V	$0.17	$0.15	$0.14
R15852	220uF 25V	$0.21	$0.18	$0.17
R15855	220uF 63V	$0.50	$0.46	$0.40
R15871	470uF 16V	$0.27	$0.24	$0.22
R15872	470uF 25V	$0.29	$0.27	$0.25
R15873	470uF 35V	$0.75	$0.70	$0.60
R15875	470uF 63V	$0.75	$0.70	$0.65
R15885	1000uF 63V	$0.60	$0.58	$0.55
R15891	1000uF 16V	$0.39	$0.35	$0.30
R15892	1000uF 25V	$0.45	$0.40	$0.38
R15893	1000uF 35V	$0.70	$0.65	$0.55
R15894	1000uF 50V	$0.00	$0.00	$0.00
R15903	2200uF 35V	$1.20	$1.10	$0.90
R15904	2500uF 50V	$1.30	$1.20	$1.00
R15911	2500uF 16V	$0.59	$0.50	$0.40
R15912	2500uF 25V	$0.95	$0.90	$0.80
R15913	2500uF 35V	$1.10	$1.00	$0.90
R15914	2500uF 50V	$1.30	$1.20	$1.00
R15932	4700uF 25V	$1.90	$1.80	$1.60
R15933	4700uF 35V	$2.40	$2.15	$1.90

Plus 30% tax where applicable

TANTALUM CAPACITORS

Cat.No.	Description	10+	100+
R16124	4.7uF 16V	$0.24	$0.18
R16125	10uF 16V	$0.25	$0.23
R16126	15uF 16V	$0.38	$0.36
R16128	22uF 16V	$0.42	$0.40
R16132	47uF 16V	$1.55	$1.20
R16134	68uF 16V	$1.80	$1.50
R16220	4.7uF 16V	$0.35	$0.33
R16224	10uF 16V	$0.38	$0.37
R16228	22uF 16V	$1.20	$1.00
R16300	0.1uF 35V	$0.13	$0.12
R16302	0.15uF 35V	$0.13	$0.12
R16304	0.22uF 35V	$0.15	$0.12
R16306	0.33uF 35V	$0.15	$0.14
R16308	0.47uF 35V	$0.15	$0.14
R16310	0.68uF 35V	$0.16	$0.15
R16311	0.82uF 35V	$0.18	$0.15
R16312	1uF 35V	$0.15	$0.12
R16314	1.5uF 35V	$0.24	$0.20
R16316	2.2uF 35V	$0.24	$0.23
R16318	3.3uF 35V	$0.29	$0.27
R16320	4.7uF 35V	$0.35	$0.33

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LEDS 5mm STANDARD

Desc.	10+	100+	1000+
Red	$0.10	$0.09	$0.08
Green	$0.15	$0.10	$0.09
Yellow	$0.15	$0.10	$0.09

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Description		1-9	10+	25+
4851	5¼" 500K	$195	$185	$175
4853	5¼" 1M/Byte	$265	$245	$215
4854	5¼" 1.6M/Byte	$295	$260	$235
2896	8" 1.6M/Byte	$650	$625	$600

Plus 20% tax where applicable

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$175	$165	$155

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Cat.No./Desc.	10-99	100+
S11010 (SPDT)	0.85	0.78
S11020 (DPDT)	0.95	0.88
S11034 (4PDT)	2.95	2.85

Plus 20% Sales Tax where applicable

HORN SPEAKERS

Cat No.		1-9	10+
C12010	5" Plastic 10W Max	5.80	5.60
C12015	5" Metal 10W Max	5.75	5.50
C12012	12V Siren	9.90	9.60

Plus 20% tax where applicable

ENCLOSED ROTARY SWITCHES

Cat.No.	Description	1-9	10+	100+
S13021	1 Pole 12 Position	1.00	.80	.70
S13022	2 Pole 6 Position	1.00	.80	.70
S13033	4 Pole 3 Position	1.00	.80	.70
S13035	3 Pole 4 Position	1.00	.80	.70

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Cat.No.	Desc.	1-9	10+
P109603	Pin Line Male	1.80	1.60
P109623	Pin Chasis Male	1.90	1.70
P109643	Pin Line Female	2.50	2.20
P109663	Pin Chasis Female	2.90	2.50

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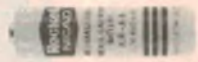

NICADS

Cat No.	Description	1-99	100+	250+
S15020	AA 1.2AH	$1.80	$1.70	$1.50
S15021	C 1.2AH	$5.55	$5.45	$5.15
S15022	D 1.2AH	$5.75	$5.50	$5.25

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RITRON II MONITORS

Swivel base monitor in stylish case.

Desc/Cat.No	1-9	10+	50+
Green Cat. X14506	$175	$165	$160
Amber Cat. X14508	$175	$165	$160

Plus 20% tax where applicable

TRANSISTORS

Desc.	10+	100+	Desc.	10+	100+
2SJ49	5.50	4.95	2SK134	5.50	4.95
PN2222A	.10	.08	PN2907A	.10	.08
PN3463	.15	.13	PN3565	.12	.11
PN3566	.15	.13	PN3567	.10	.08
PN3569	.18	.16	PN3639	.18	.16
PN3640	.18	.16	PN3641	.10	.08
PN3642	.10	.08	PN3643	.10	.08
PN3644	.15	.13	PN3645	.15	.13
PN4250A	.15	.13	PN4355	.16	.14
PN4356	.16	.14	MPSA42	.23	.20
MPSA43	.23	.20	MPSA55	.15	.14
MPSA56	.15	.14	MPSA92	.22	.20
MPSA93	.22	.20	SC1410	.85	.75
BU126	1.50	1.25	BUX80	2.75	2.55
BU208	2.50	2.20	2SD350	2.75	2.40
BU326	1.75	1.60	BC547	.07	.06
BC548	.07	.06	BC549	.07	.06
BC557	.07	.06	BC558	.07	.06
BC559	.07	.06			

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TRANSFORMERS

Cat.No. & Desc.	1-99	100+	1000+
M12851 2851 240V 12-6V CT 150mA	3.00	2.75	2.50
M12155 2155 240V 6-15V 1A tapped	5.50	4.95	4.50
M12156 2156 240V 6-15V 2A tapped	8.50	8.25	7.90
M12840 2840 240V to 9V C.T. at 150mA	3.20	3.00	2.70
M12860 2860 240V to 15V C.T. at 250mA	3.50	3.00	2.80
M16672 6672 240V 15-30V 1A tapped	8.50	7.95	7.70

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75 OHM COAX CABLE IN 100M ROLLS

Cat No.	Descript.	1-4	5+	10+
W11222	3C2V	25.00	24.00	23.00
W11224	5C2V	30.00	29.00	28.00

(5C2V WHITE OR BLACK)
LINE LOSS PER 100 FEET (33M 200MHz)
W11222 3C2V 6.2dB (Approx.)
W11224 5C2V 3.9dB (Approx.)
Plus 20% tax where applicable

TELEPHONE CABLE (200 METRE ROLLS)

Cat.No.	Description	1-9	10+
W11302	2 Pair	$34.00	$28.00
W11303	3 Pair	$42.00	$39.00
W11310	10 Pair	$120.00	$115.00

Per 200m Roll
20% Sales tax where applicable

WE HAVE THE BEST MEMORY PRICES!

"Check for the latest memory prices!"

	10-99	100+	1000+	10K+
4164-15P	$ 2.00	$ 1.70	$ 1.65	$ 1.60
41256	$ 4.50	$ 4.00	$ 3.60	$ 3.30
6116P-3	$ 3.00	$ 2.90	$ 2.20	$ 2.00
2716	$ 7.50	$ 7.00	$ 6.50	$ 6.00
27128	$ 5.00	$ 4.50	$ 4.00	$ 3.50
2532	$ 7.50	$ 6.50	$ 6.40	$ 6.30
2732	$ 6.50	$ 6.10	$ 5.90	$ 5.50
27256	$ 9.00	$ 8.00	$ 7.00	6.50
6264	$ 5.50	$ 5.00	$ 4.50	$ 4.00
2764	$ 6.00	$ 5.00	$ 4.50	$ 4.00

Plus 20% tax where applicable

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New Products...

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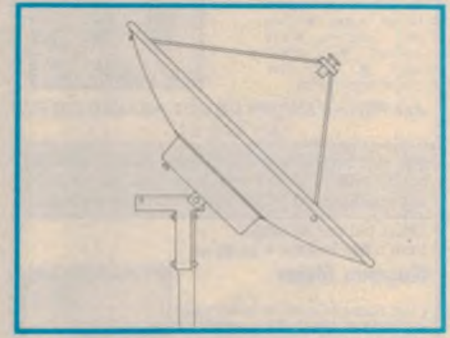
Just released by Jaycar, this handy gadget can automatically transfer incoming telephone calls to another number of your choice.

It's called the TC-101 Automatic Telephone Transfer and is ideal for small businessmen. It can also be used as a security device, warding off potential burglars who may ring to check if the house is empty.

The unit is both easy to install and easy to operate, although it does require access to two telephone lines. Once installed, all the user has to do to transfer incoming calls is: (1) press the * button; (2) punch in the phone number to which the call is to be transferred (via the front panel keypad); and (3) press the # button. To cancel the transfer function, the * button is simply pressed again.

Power for the unit is derived from a small plugpack transformer which is supplied as standard. Also supplied are the necessary telephone plugs and connecting cables, and a set of instructions.

For further information contact Jaycar Electronics, 115-117 Parramatta Road, Concord, NSW 2137. Telephone (02) 745 3077.



Australia-made satellite dish

The A1210 satellite dish is a 1.2m receiving antenna for the Aussat Ku band. It is made of spun aluminium sheet and is smaller than most competitive antennas on the market, yet it meets all requirements of DOC specification 512.

The A1210 is supplied complete with adjustable mount and feed horn. Its forward gain is 43dBi and co-polar side lobes are down 20dB at ±2°. The feed focus and polarisation are adjustable ±25mm and 90° respectively, while the angular resolution of the mount is 0.1°.

Designed and manufactured in Australia, the A1210 satellite dish sells for under $500 and is intended for domestic and commercial reception of TV, radio and data via Aussat satellites.

For further information contact Satellite Antennas Pty Ltd, PO Box 307, Nelson Bay, NSW 2315. Telephone (049) 82 7977.

Up-market DC power supplies

Hewlett-Packard has extended its family of system power supplies with the addition of four new multiple-output units: the HP 6621A, HP 6622A, HP 6623A and HP 6624A.

Each model has a total output capability of 160 watts and is housed in a 5 ¼-inch high full rack-width package with two, three or four independent isolated outputs.

The four models are different combinations of 40W and 80W outputs. The HP 6621A features two 80W outputs, both variable between 0 and 20V; the HP 6622A two 80W outputs of 0-50V and 0-20V; the HP 6623A one 80W output and two 40W outputs of 0-20V, 0-20V and 0-50V respectively; and the HP 6624A four 40W outputs of 0-20V, 0-20V, 0-50V and 0-50V.

The following HP-IB (IEEE-488) programmable functions are available: voltage and current setting; output voltage and current measurement and readback; present and accumulated current status readback; programmable service request mask; programmable overvoltage protection setting; overcurrent protection enable/disable; echo queries of all programmable function settings; and software calibration to name just a few.

Most of these functions and others can be implemented from the front panel. Parallel or series operation for increased voltage or current is possible.

For further information contact Hewlett-Packard Australia Ltd, 31-41 Joseph Street, Blackburn, Vic. 3130. Telephone (03) 895 2895.

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New Products...

New power op amp from Siemens

Siemens has extended its IC product range by releasing a new dual power op amp, the TCA 2365. Main features of the new device include an output current capability of 2.5A per amplifier, a supply voltage range of 8 to 30V, and a slew rate of 4V/μs.

The new dual op amp is suitable as a switching amplifier for motors, contactors and relays, as a power comparator, power Schmitt trigger, speed controller for DC motors and as a high-output pulse and signal generator.

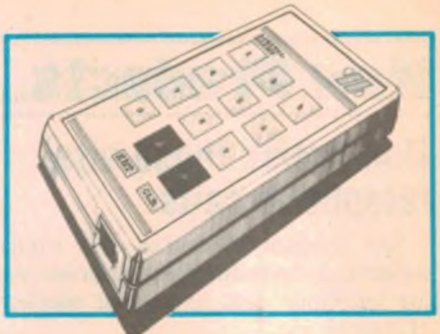
For further information contact Siemens Limited, 544 Church Street, Richmond, Vic 3121. Telephone (03) 420 7204.

Thin-film resistor networks

Allen-Bradley Electronics has released the series FGST1000 precision voltage divider thin-film resistor network for such applications as input attenuation and range selection in digital instrumentation, voltmeters and multimeters. These new standard thin-film resistor networks feature a 10MΩ range, with six decade attenuation, 0.033% resistance ratio match, 0 to 1000V rating, and an operating temperature of 0°C to 70°C.

The interconnections are metal film, eliminating soldered or welded joints and their associated problems in precision applications.

For more information contact Allen-Bradley Pty Ltd, 2 Parramatta Road, Lidcombe, NSW 2141. Telephone (02) 648 2652.



Electronic log book for FBT recording

Invented by the Western Australian firm Beaver Corporation, "Digital Diary" is a new electronic gadget designed to beat the paper and log book hassles of the new Fringe Benefit Tax — at least as it applies to company cars.

The device is easily installed and, with the touch of a button, automatically records the date, time, odometer readings, kilometres travelled, vehicle registration, whether it is a business or private trip and driver identification. A beeper sounds continuously if user data is not entered before starting the vehicle.

The Digital Diary provides users with two standard report forms. The first is a vehicle usage report that becomes the primary audit trail for vehicle usage. It lists, in chronological order, all user names (whether business or private use), distance travelled and destinations.

The second report provides a listing of all trips undertaken by an employee. Date, time, distance, vehicle use, and destination are provided. The diary can be used in conjunction with any IBM style computer utilising the industry standard MS.DOS operating system.

For more information contact Beaver Corporation, Unit 7/24 Thorogood Street, Victoria Park, WA. 6100. Telephone (09) 361 7766.

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51 Queensbridge Street, South Melbourne (03) 61 2911.

Versatile video effects generator

Billed as 'tomorrow's technology today,' the Showmaster Creator video effects generator boasts non-synchronous and synchronous editing, dubbing and psychedelic video art capabilities.

The device features four video and hifi stereo inputs while the pattern generator section features 30 basic patterns plus reverse for a total of 60 pattern wipes. There is also the choice of black and white fades, dissolves, cuts or super-imposition of genlocked video sources.

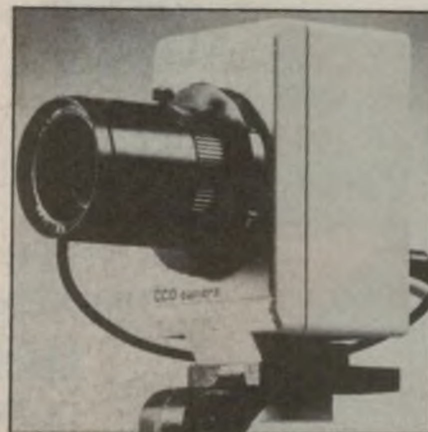
Other features include spotlight and highlight manipulation by joystick with soft/hard selection, polarisation, effects threshold control, monochrome video, audio dub and audio breakaway capabilities.

For further information contact Commodore Television Pty Ltd, 675 Botany Road, Rosebery, NSW 2018. Telephone (02) 699 1199.

Miniature camera

Capable of operation from the mains or from 12V DC, this compact solid state camera from Philips is ideal for surveillance work. It features a CCD imager which provides excellent picture quality, as well as facilities for auto-iris, automatic black level control, automatic gain control and gamma correction.

For further information contact Philips Scientific and Industrial, Paul Street North, North Ryde, 2113. Telephone (02) 888 8222.



Super-compact video security system

An interesting new product from Sony is the Portable Watchcam HNS-14AS, a video home security system.

This compact system incorporates a black and white camera with a sensitive microphone and super compact monitor for remote surveillance of the family home or a small business.

The system can also be used around the home to monitor danger areas such as the family swimming pool or the playroom.

The unit comes with various installation accessories for mounting on the ceiling, wall or connected through the front door viewer. The fish eye camera lens has a 150° view which is visible on the 10cm compact monitor while a microphone picks up sound from the viewing area.

Another feature of the Watchcam is that it can be connected to household VCRs so that recordings of the surveillance area can be made.

For further information contact Sony (Australia) Pty Ltd, 33-39 Talavera Road, North Ryde 2113. Telephone (02) 887 6666.

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Softbound, 245 x 185mm, 176 pages. Photos, line illustrations. EA0003 **$29.95**

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RADIO CONTROLLED FAST ELECTRIC POWER BOATS — David Wooley. A complete and essentially practical reference to all aspects of the subject: hulls, props, construction and fitting out, motors, batteries, trimming, radio installation and the controls you need, battery chargers and battery charging. This book will appeal to the expert as well as the beginner.
Softbound, 210 x 148mm, 112 pages, over 80 photos, drawings, circuits, tables, etc. EA0005 **$14.50**

UNDERSTANDING SOLID-STATE ELECTRONICS — Texas Instruments Learning Centre. For anyone who wants to understand how semi-conductor devices work, either alone or in systems. Covers basic theory and use of diodes and transistors; bipolar, MOS and linear integrated circuits. Written in clear, down-to-earth language. Ideal for self-study. Softbound, 210 x 130mm, 276 pages, line drawings, flow charts, etc. EA0006 **16.95**

UNDERSTANDING DIGITAL ELECTRONICS — G. McWhorter. Assumes a secondary knowledge of electricity, and describes digital electronics in easy to follow stages. It covers the main families of digital integrated circuits and data processing systems. Typically, it includes a look at the workings of a simple calculator.
Softbound, 210 x 135mm, 264 pages, line drawings, circuit diagrams. EA0007 **$16.95**

UNDERSTANDING AUTOMOTIVE ELECTRONICS — W. Ribbens, N. Mansour. Learn how electronics is being applied to automobiles. How the basic mechanical, electrical and electronic functions and the new microprocessors and microcomputers are being applied in innovative ways for vehicle drive train control, motion control and instrumentation.
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FAULT DIAGNOSIS OF DIGITAL SYSTEMS — Don L. Cannon. This book has been written to help understand digital systems. Its express purpose is to relate faulty system operation to faulty operation of the system part that caused the problem. An excellent review of digital systems for the reader.
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UNDERSTANDING COMMUNICATIONS SYSTEMS — Don L. Cannon, Gerald Luecke. An overview of all types of electronic communications system. What they are. What they do. How they work.
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MANUAL OF ELECTIC RADIO CONTROLLED CARS — Bill Burkinshaw. A completely practical book on the construction, fitting out and operation of radio-controlled electric powered cars of all types, from racers to off-road buggies, possibly the fastest growing aspect of radio control modelling in the 1980s.
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Compact Disc Reviews

MOZART

Piano Concerto No. 20 in D minor, K466.
Piano Concerto No. 21 in C, K467.
Mitsuko Uchida, piano.
The English Chamber Orchestra conducted by Jeffrey Tate.
Philips CD 416 381-2 DDD
Playing time: 61 min 7 sec.

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

This series of recordings of Mozart concertos contains two works on each disc composed about the same time, yet showing profound differences of emotional content. This is certainly the case with the D minor K466 No. 20 concerto, finished on the 10th February 1785 and performed the next day, and, likewise, the C major concerto K467 No. 21 completed on 9th March 1785 and performed the next day.

The first performance of the K466 was precisely that; Mozart was so busy at the time checking copied parts that he did not have time for a rehearsal — what a guy!

Both the works on this disc have much appeal. If you like Mozart these just help the overall effect. The performer was unknown to me but the result leaves no doubt to her ability.

Unfortunately this and most other CDs do not give any information about the artists in their cover notes. I hope this will be rectified in time.

With its good tempos and excellent recording technique it is superb. (R.L.C.)

BACH HANDEL

Handel Oratories
Bach Arias
Arleen Auger Soprano
The Mostly Mozart Orchestra conducted by Gerard Schwarz.
Delos D/CD 3026. DDD Sept 1984
Playing time: 37 min 35 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

This is the first recording combining the talents of Arleen Auger, Gerard Schwarz and the mostly Mozart Orchestra, and it provides a most delightful musical experience.

Arleen Auger, a new voice to me, has been described as 'extraordinary'

SAINT-SAENS CHAUSSON RAVEL

Saint-Saens; Introduction et Rondo Capriccioso, Havanaise.
Chausson; Poeme
Ravel; Tzigane.
Kyung Wha Chung violin
The Royal Philharmonic Orchestra conducted by Charles Dutoit.
Decca CD 417 118-2 ADD 1977
Playing time: 44 min 3 sec.

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

During the nineteenth century a virtual cult of virtuoso violinists brought out a wealth of works from composers matched only by a public craving for musical sensation.

France was particularly attuned to this phenomenon with composers like Saint-Saens, Chausson and Ravel.

Saint-Saens' 'Rondo Capriccioso' was written for the Spanish virtuoso, Sarasate, in 1863 and revised in 1870. It is a most rhythmic and tuneful work.

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by RON COOPER

and 'simply stunning' among many overseas reviewers. Likewise Gerard Schwarz has been described as 'America's fastest rising conductor'.

The Handel Oratories in their treatment of Bible stories, served to exalt English spiritual life. The famous 'Messiah', his only true 'sacred' oratorio, with words from the Bible, was conceived as spiritual 'entertainment' to be presented during Holy Week when theatres were closed.

The Bach arias complement the Handel selection on the disc with their excellent orchestration, particularly so in Track 12 "Sich uben im lieben" by the sensitive oboe solo, firmed by the bassoon and strings.

Delos have a real winner with this disc as it sounds virtually faultless in all respects. And you get over 73 minutes playing time, excellent cover notes and even the libretto. (R.L.C.)

The 'Poeme' by Chausson is quite different with a somewhat sombre introduction leading to brief cadenzas featuring a kind of fluid tonality.

The Ravel 'Tzigane' exploits dance forms of gypsy and Hungarian themes — do I detect a little Bartok here and there? It is also a real showpiece.

The performance on this recording by Kyung Wha Chung is little short of staggering and is matched only by the Decca technical team.

Fantastic front-row sound with only silence between the notes, created an illusion of eerie presence without any electronics anywhere. (And they don't say how they did it either).

Highly recommended. (R.L.C.)

CHOPIN

Piano Sonatas No. 2 & 3, Op.35 and Op.58.
Maurizio Pollini, piano.
Deutsche Grammophon CD 415 346-2.
DDD 1985
Playing time: 50 min 1 sec.

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

The sonatas on this disc are lesser known Chopin works but are nonetheless very worthy. Although, in the case of Opus 35, written between 1837-39, a lot of attention was paid to the piece by Schumann and Mendelssohn who actually detested the last movement.

The third movement is no doubt familiar to all, commonly know as the Death March and played here by Pollini with brilliant solemnity.

The B Minor Sonata No. 2 (Op.58) written in the summer of 1844 was regarded as having no 'repulsive' features. The work exhibits a wealth of ideas and is all Chopin in form and balance, though overall I would prefer his Nocturnes and Polanaises.

Pollini's playing and interpretation on this disc leaves little to be desired and certainly shows his brilliance and the technical nature of the recording.

Though not quite in the stunning class, this disc is very good with a background so quiet that I could detect the odd page turn or was it a quiet acoustic shuffle?

I can recommend this CD but not as an introduction to Chopin's music, if you are unfamiliar with his works. (R.L.C.)

C.A.D.
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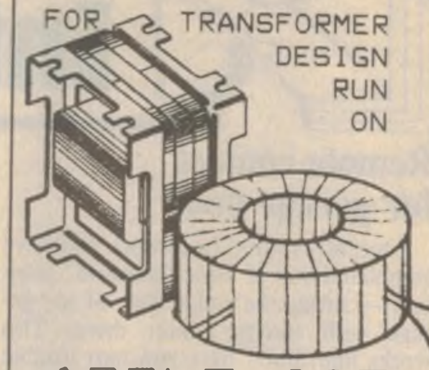

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Information centre

Remote control for garage door

I recently retired from work and have completed one of those "must-do" projects — fitting the roller door of my garage with electric motor drive. This works fine, but I have run into trouble with operating the door by radio control from my car.

I purchased a preassembled remote control module kit comprising a transmitter and a receiver, operating on 27.145MHz. This works fine, except that the receiver seems to be triggered by every CB or 2-way radio in the area. Obviously, some sort of coded signal is required to stop this interference.

Can you supply details of a kit that I can build to operate from my car over a range of up to 10 metres? I don't want to pay $500 for a commercial unit, as quoted by the door supplier. (W.D., Mt Waverley, Vic).

• We hope to describe the very circuit you require later in the year. It's a low-cost UHF remote control unit with over 13,000 codes to choose from. The transmitter is housed in a compact case, the range is around 30 metres, and it can be used as a garage door opener or as a remote-controlled key for car burglar alarms.

Electronic fluorescent lamp starter

As you know, the old-style "fat" fluorescent tubes are no longer available. Instead, they seem to have gone for those thin "Energy Saver" tubes. A similar fate seems to have befallen the old 20W units.

The trouble now is that the EA electronic fluorescent lamp starter will not work with these tubes. I know it's an old project, but it's still available from several retailers in kit form. Is there some simple modification which can be done? (G.H., Mornington, Vic).

• You're quite correct, G.H. — the electronic lamp starter will not work with the new "slimline" tubes. Reason: the new tubes have a much higher starting voltage than the units they replace.

Unfortunately, there's no simple modification that will enable the present design to work with the new tubes. And while we could undoubtedly come up with a new circuit, it probably wouldn't fit into a standard starter housing.

In short, the constructor would have to mount the unit inside the batten and break into the mains wiring to connect it into circuit. And that's not something we are keen to promote. Strictly speaking too, that kit should be discontinued by the retailers

Fuzzy AM stereo

I recently purchased a reasonable quality AM/FM digitally synthesised car radio and fitted it to my vehicle. My main aim was to enjoy the new AM transmissions.

I have been very disappointed with the audio quality in the AM mode (although the stereo spread is good), as most of the music and some of the announcers sound very "fuzzy" or "raspy". The effect is not evident with all music, nor with all announcers, but it makes listening to the radio an unpleasant experience.

I have tried all combinations of tone control, IF bandwidth control, loudness control, antenna length, and engine on/off as per the manufacturer's instructions, but all to no avail. The effect is

---

Batteries

Continued from page 104

RAM power

Low current applications such as IC memory back-up are best served by pressed powder button cells and these are often stacked one on top of another to form batteries and then sealed into shrink plastic sleeves or moulded cases.

A small 3 cell (3.6V) battery of this type would be able to keep a CMOS memory supplied for several months whilst the equipment was without a mains supply and could be float-charged from a 5V rail during normal powered operation.

Silver zinc cells

For rechargeable applications where the highest possible stored energy density is required and cost is not an important consideration, silver zinc or silver cadmium alkaline systems may be used.

Sintered silver cathodes and pressed powdered anodes are often used together. Cells of this type give on load output voltages in the 1.1 to 1.5V range, have very low internal resistance and can retain 80-95% of their charge after a year's storage. Their main disadvantage is a very poor service life which may vary from only 1 to 100 cycles for silver-zinc or up to 500 cycles for silver-cadmium.

Cells of this type can be ruggedly constructed using all non-magnetic materials and are mainly used in military and space applications.

Conclusion

Hundreds of different primary and secondary battery systems have been developed and patented over the years. Some of these have enjoyed a limited commercial production, until they fell by the wayside, superseded by cheaper and more efficient alternatives. In the military and aerospace areas, there are a host of systems designed for specialised applications where cost, convenience, safety or long life are not overriding factors.

This article has concentrated on currently available, 'mainstream' civilian technology, so it is possible that readers may come across battery systems that we have not covered. Those wanting to know more, will find many excellent books on electrochemical theory and battery design. One which we particularly recommend is "Electrochemical Power Sources, Primary and Secondary Batteries," Edited by M. Barak and published for the IEE (UK) by Peter Peregrinus Ltd.

Acknowledgements

The author wishes to thank the following companies who generously supplied information used during the preparation of this article:

Adilam Electronics Pty. Ltd., (Sonnenschein)
Amtex Electronics (Yuasa).
Chloride Batteries Australia Ltd.
Duracell International Inc.
Greenwich Marine Electronics Pty. Ltd.
RFD-Safety Marine Pty. Ltd.
SAB NIFE Pty Ltd.
Varta A.G. Australasia Branch.

not evident with FM stations or with the cassette player, so it must be peculiar to AM stereo.

I would appreciate your comments on this problem, as I suspect that it may be an inherent characteristic of AM stereo. I have followed your series of articles on this topic but was not made aware of any such technical problems, and find it hard to believe that such a state-of-the-art development could have such a fundamental problem. (P.S., Carlingford, NSW).

• We note that you live fairly close to many of the transmitters for Sydney's AM stations, and we suspect that the problem may be due to overload of the RF stages of the radio. Some radios are much better in this respect than others, with the cheaper Asian models being quite poor.

It is also true that if the station concerned uses excessive compression, there is a strong possibility of distortion which may or may not be exhibited in the radio, depending on the design of the decoder circuitry. Even though they may all use the same Motorola stereo decoder chip, they are not all created equal.

It is also possible that the AM circuitry of the radio is not working properly. You do not mention if the reception is good in mono mode. Try listening to 2FC which is the only Sydney Metropolitan station not now in stereo apart from 2EA on 1386Hz. If it is distorted in mono mode it is highly possible that the RF stage or local oscillator is not correctly biased.

Either way, whether the distortion is in mono or stereo modes, you have a legitimate complaint which should be directed to the retailer or to the distributor.

Notes and Errata

TUNABLE WHIP ANTENNA (July 1986, File 2/AE/40): the gremlins got to this one! D1 in the text should read D1a, D2 should read D2a, D3 should read D2b, D4 should read D3, D5 should read D4 and D6 should read D5.

In the table showing the coil winding details, L2 should be tapped two turns from the cold end (not 22 turns). Finally, the parts list should specify two BB212 varicap diodes (not three) and a 5-pole 3-position switch (not 3-pole 5-position). The BB212 varicap diodes can be purchased from Geoff Wood Electronics, PO Box 671, Lane Cove, NSW 2066. Phone (02) 427 1676.

PLAYMASTER HIFI AM TUNER (December 1982, File 2/TU/50): to eliminate distortion in the narrow band position, CMOS switch IC6 should be powered from split supply rails. This will prevent clipping of the audio during negative signal swings.

To alter the circuit, you will require two 6.8V 1W zener diodes and two 680Ω 0.25W resistors. Connect one 680Ω resistor to the +15V rail and the second 680Ω resistor to the −15V rail. This done, connect the cathode of one zener diode to the free end of the 680Ω resistor connected to the +15V rail, and the anode of the remaining zener diode to the 680Ω resistor connected to the −15V rail. The free ends of the zener diodes should then be connected to ground.

Pin 14 of IC6 now connects to the +6.8V rail, while pin 7 goes to the −6.8V rail. Note also that both the 10kΩ resistor at pin 6 of IC6 and the "narrow" terminal of S1 should also connect to the +6.8V rail. The 10kΩ resistor from pins 5 and 13 of IC6 should connect to the −6.8V rail.

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In the Ace radio advertisement in the September issue of "Electronics Australia", the price of the 50 Watt Etone speakers should have read $54.95 a pair or $31.95 each NOT $49.95 and $28.95, respectively.

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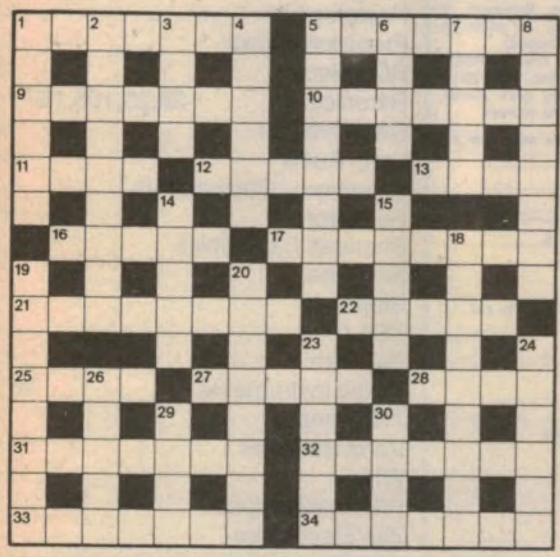
OCTOBER CROSSWORD

ACROSS

1. Specified a lower operating limit. (7)
5. Control position. (7)
9. Transceiver operating mode. (7)
10. Mode of trasnmission. (1,1,5)
11. Cursor drive. (4)
12. Sharp component. (5)
13. Unit for rate of energy consumption. (4)
16. Region of influence. (5)
17. Common name of a capacitor. (8)
21. Material used for tool or display rack. (8)
22. They are grounds for having high TV aerials. (5)
25. Retain frequency, etc. (4)
27. Switch label. (2-3)
28. Metric prefix. (4)
31. Type of circuit. (3-4)
32. Warned by early detection. (7)
33. Imperfections on magnetic tape. (7)
34. Deactivates a burglar alarm. (7)



DOWN

1. Kind of current. (6)
2. Tape deck's operating mode. (9)
3. Wire left available for circuit extension. (4)
4. Aspects of spark timing. (6)
5. Reference value. (8)
6. Winding factor. (4)
7. Ninth letter of phonetic alphabet. (5)
8. Such hints for soldering are very much to the point. (4,4)
14. Mixture of metals. (5)
15. Acronym for an Australian electronic technicians' organisation. (5)
18. Electrode. (9)
19. Discoverer of an ionospheric effect. (8)
20. Output devices. (8)
23. Section of the electromagnetic spectrum. (1,1,4)
24. Basic circuit components. (6)
26. External source of static charge. (5)
29. A cursor traverses this. (4)
30. Typical points for input by the press. (4)

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Digital sound recorder

This audio recorder has no tape. Instead, it stores up to 15 seconds of audio in RAM (random access memory) for instant replay at the press of a button. It's just the shot for use with a shop display or as a novel doorbell.

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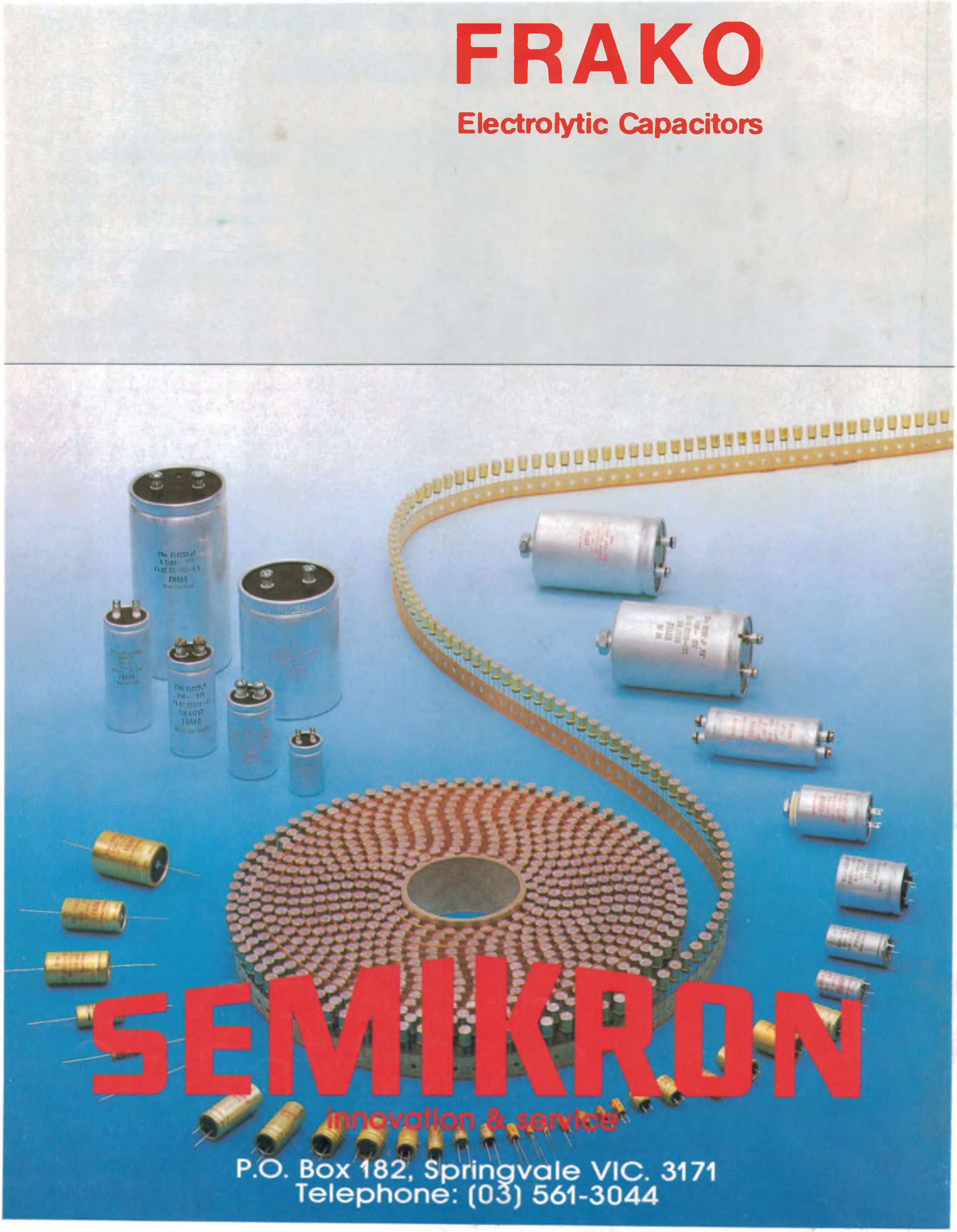
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