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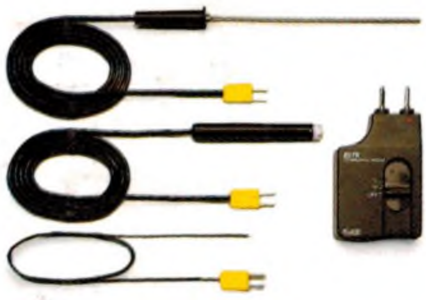

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Volume 48, No. 5

Electronics Australia

May 1986

THIS MONTH'S COVER

The PC board for our new Playmaster Sixty-Sixty stereo amplifier takes pride of place on this month's front cover. Turn to page 38 for the details.

Features

Entertainment Electronics

Projects and Technical

News and Comment

Departments

UHF antenna for Channel 28

Looking for a UHF antenna for Channel 28! Save money by building this high-performance 18-element design. Construction begins on page 18.

What's coming

Next month we intend to publish the circuit details of our new Playmaster Sixty-Sixty Stereo Amplifier and describe a lamp saver project. See page 105 for further details.

Compressor for compact discs

Want to record compact discs for use in your car cassette player but stymied by excessive dynamic range? This easy-to-build stereo compressor is the answer. See page 64.

Special notice

Lack of space has forced us to postpone the introduction of our compact disc reviews. For the same reason, Pt.8 of the "Practical Electronics" series has been held over until next month.

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Letters to the editor

2CH is south of Charters Towers

I bring to your attention a misprint in the last edition of *Electronics Australia.*

You have listed 2CH (1170kHz) as a stereo AM station, power 0.1kW and located at Charters Towers.

2CH is on 1170kHz and is a stereo AM commercial station. However, our aerial power is actually 5kW and we are located approximately 1630km south south east of Charters Towers in Sydney.

I commend you for the stereo AM article. Keep up the good work.

Alan Liddelow,
Network Chief Engineer,
Radio Station 2CH,
Sydney, NSW.

Don't blow your fuse

On page 89 of the March edition of EA, in an article entitled "What to do when the fuse blows," there is a most incongruous statement. Surely your author must have shares in a fuse factory.

He advises the reader to buy two 100mA fuses and to blow them by connecting them directly across a battery. Now, really!

The poor reader already has a handful of blown fuses — this is the very fault he is trying to cure — and your writer asks him to blow two more! Hells Bells!

Whatever is wrong with your reader using two of his already blown fuses to make the test rigs being suggested by the writer? Why add to the slaughter by blowing two more?

In fact, it often pays to keep a small selection of blown fuses, shorted transistors, u/s integrated circuits and other small mechanical parts. These come in useful for test rigs as mentioned in the above article or as templates when cutting or drilling chassis panels.

But for heaven's sake, don't buy new fuses and blow them deliberately.

Jim Lawler,
Geilston Bay, Tasmania.

Intelsat reception in Australia

We read with interest Mr Garry Crapp's letter in your November issue regarding the satellite television scenario across the Tasman. We were even more interested in the reply from your Department of Communications in the January issue.

Whilst not being in a position to comment categorically on reception, either domestic or international in Australia, we can certainly point out a few minor facts about footprints from our experiences in New Zealand.

It is true that the aging Intelsat IV A died on Tuesday, 4 February, 1986, at 11 pm New Zealand time. An Intelsat V was moved from the Indian Ocean at 53°W to the 180°E spot to fill the role of Pacific operational spare. The results to date in New Zealand have been very encouraging as signal quality has improved on all 30 of our 7-metre dishes which we have shifted 1°.

The comment regarding beams not being receivable in Australia from Intelsat V appears incorrect as both west hemispheric and global beams should be receivable. The west hemispheric beam covers an area up to Fiji and the global beam covers the entire Pacific basin. Obviously such signals will only be resolvable on dishes of larger than five metres diameter with appropriately modified receivers but they are there for anyone who wishes to receive them.

Our information indicates that there are over a dozen satellites with footprints to many different parts of Australia. These consist of high power spot beams, medium power hemispheric beams, and low power global beams, which should be able to be resolved using a 7-metre parabolic dish antenna, 55°K LNA, and receiver with an international bandwidth filter.

Tony Dunnett,
Technical Co-ordinator,
Motueka, NZ.

Teletext in South Australia

Your article "Forum" in last month's issue of *Electronics Australia* quite rightly poses the question "Do we have Teletext or not?" when based on the correspondence between the ABC and a viewer at Quorn in South Australia.

Regrettably, our reply to the viewer's Teletext enquiry, which you reprinted in your article, not only contained some outdated information but also arose from some degree of confusion in respect of the specific Teletext facility (Supertext) as distinct from the general Teletext services.

Please allow us to set the record straight.

In South Australia, the ABC has been transmitting the Supertext Subtitling Service for the Hearing Impaired since 4th November, 1984. It was introduced with appropriate media references at that time.

As your article correctly states, only selected programs are captioned and carry the symbol 'S'.

In January the following year, we began transmission of four test pages as part of the Teletext Information Services. The expansion of this service is currently under review in our head office.

We apologise for compounding any confusion and have informed the viewer accordingly.

John Geyer,
Manager Television,
Australian Broadcasting Corporation,
Adelaide, SA.

Not everyone benefits

I have finished reading your article on the wonderful new world of AM stereo enjoyed by a few lucky Australians.

It seems strange to me that while broadcasting in some areas of this country races ahead at a great pace, in other areas it has changed very little in the last 50 years.

Here in Burnie we have only one commercial AM station broadcasting narrow band mono, and the only FM station is an ABC FM transmitter 100km away.

I feel it is the responsibility of the Department of Communications and the Australian Broadcasting Tribunal to ensure that all Australians enjoy the benefits of new broadcasting technology and not just those in metropolitan Australia.

Clinton Hodgetts,
Burnie, Tas.

Editorial Viewpoint

Custom ICs: the way of the future

This month we have made a big effort to bring you a feature story on one of the most potentially far-reaching developments in electronics since the introduction of the microprocessor. I refer to custom ICs. The story starts on page 75. Whether you have previously heard or seen reference to them as gate arrays, programmable logic arrays, uncommitted arrays or whatever, they represent one of the biggest opportunities that Australia has to compete with electronic products in the world market.

The problem for Australian manufacturers is that the home market is not really big enough to enjoy large economies of scale yet we still demand the latest technology. That means that any manufacturer developing new products must try to incorporate the latest technology without being committed to large development costs. At the same time, once the product is developed, the manufacturer needs to be sure that he will have a market advantage for a sufficient time to make a good profit.

In other words, he wants to be sure that the product won't be copied almost as soon as it reaches the market. And having designed the product for the local market, he ideally then wants to be able to sell it overseas and be able to make much bigger profits.

This is where custom ICs come into their own. They enable exclusive design features to be economically incorporated into an encapsulated chip. Depending on the type of IC and volume of production, the cost of this can be quite low and the development time quite short. So an up-to-date product with special features can be brought to market quite quickly. And once on the market, the product is much harder to copy than if it used standard off-the-shelf ICs.

Given that Australians have generally been quite innovative in developing new products (although not necessarily so effective in marketing them), the use of custom ICs will enable us to protect that innovative advantage.

Combined with the advantages of surface-mount components, custom ICs could well be the path of success for Australia's electronic industry in the future. One thing is sure: if Australian industry is slow to adopt the technology of custom ICs and surface-mount components it cannot hope to succeed on world markets.

(We last covered the emerging field of surface mount devices in July 1985. We plan to have another feature article on this subject in the coming July issue.)

Leo Simpson

News Highlights

West Germans to computerise ID cards

While debate on Australia's proposed ID card system waxes fast and furious, the West German government has passed a bill making that country's existing ID card and passport system computer-readable. Germans will be required to carry the new cards from the middle of next year.

The move has inspired mixed reactions among West German citizens. Some see it as ushering in a police state, while others view it as a necessary step in the fight against internal and external terrorism and political dissent.

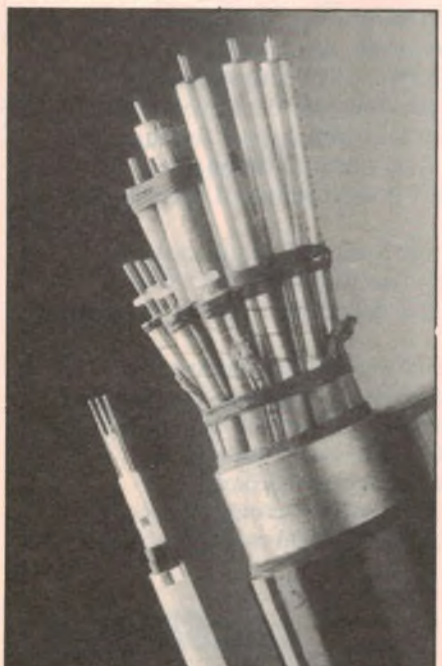
The new cards will allow authorities to store data on an individual's movements in central computers. This data will be made available to all law enforcement agencies, ranging from traffic wardens to the state intelligence agency and border police.

Seven data-protection laws were enacted to go with the new bill on ID cards. These are meant to ensure that the information is not misused by the security authorities. However, opponents of the system see it as yet another state infringement of the citizen's right to "informational self-determination".

Optical fibre factory opened

Australia's first commercial optical fibre manufacturing plant was recently opened in Melbourne by the Victorian Premier, John Cain.

The $12 million plant with a capacity to produce 50,000km of optical fibres annually has been built by Optix Australia Limited, an international joint venture with three partners: Pacific Dunlop Limited, Sumitomo Electric Industries of Japan and Pirelli Cables Australia.



The technology employed at the plant was developed by Sumitomo Electric and is accepted as being of world standard. Both Pirelli Cables and Olex Cables purchase the bulk of the output of the Optix plant for fabrication of optical fibre cords and cables in their own factories.

The fibre consists of a core of optically transparent material surrounded by a cladding with a refractive index slightly smaller than that of the core. Compared with traditional copper cable, an optical fibre cable has considerably greater transmission capacity in a physically smaller cable and can be manufactured in longer lengths, thus eliminating costly joining and manual handling.

In addition, optical fibre cables are not subject to electrical interference, offer greater flexibility, and have higher stress and temperature tolerances than coaxial cable.

Optical fibre cables are already being installed in Australian communications networks. For example, Telecom Australia has begun installation of an 8-fibre optical link in the Northern Territory and, in January of this year, began work on the Melbourne-Sydney optical fibre link.

The latter has a planned route of approximately 1000km, will contain 30 single mode optical fibres, and will cost around $44 million. It will be capable of carrying 150,000 simultaneous telephone channels and will be used for data and video transmission.

SBS-TV goes west and south

SBS-TV has recently expanded its activities and is now available on UHF channel 28 in both Hobart and Perth. According to an SBS press release, programs originate from Sydney and are relayed via Aussat to transmitters atop Mt Wellington (Hobart) and Mt Bickley (Perth).

To pick up UHF TV, viewers can either use a TV set with a built-in UHF tuner or use a VCR as a downconverter. In the latter case, the UHF signal is simply tuned in on the VCR and the output from the VCR fed to the TV set (usually on either channel 0 or channel 1).

The third approach is to build the UHF Converter described in *Electronics Australia,* April 1986. This can be purchased in kit form from several electronics retailers (see advertisements this issue).

A Band IV antenna suitable for channel 28 will also be necessary in most cases (see *Electronics Australia,* December 1985). This can be either a commercial design, or you can build the high-performance design described elsewhere in this issue.

CD sales soar — digital tape next?

With compact disc players now a mass-market item, a number of Japanese manufacturers are gearing up for the introduction of digital audio tape (DAT) records.

First cab of the rank is Onkyo Corp., which surprised industry observers by showing a prototype DAT recorder at the Winter Consumer Electronics Show held last January in Las Vegas, USA.

Known as the DT-1000, the Onkyo machine is the first of its ilk to make an appearance at the CES, though Sony and others have quietly shown prototypes in Japan. According to Onkyo, the unit is slated for introduction in the US early next year with an estimated price tag of $1000.

The DT-1000 is based on the rotary head (R-DAT) format, one of two standards formalised last year by a committee of 81 member companies. It uses a cassette measuring just 73 x 55 x 10mm, slightly smaller than a conventional audio cassette.

Because of the compact size of the cassette, Onkyo believes that DAT players will have a big impact on CD in-car sound.

Australian company to make compact discs

A small Adelaide company, Pro-Image Studios Ltd, has scored a major industry coup by securing the rights to build Australia's first compact disc factory.

Pro-Image, which produces television programs in Adelaide and Melbourne, has beaten some high-powered opposition to win the first Australian manufacturing licence from the patent holder, the Philips electronics group.

Pro-Image has proposed building a $15 million plant with a production capacity of five million compact discs per year. The growth in CD sales in Australia has been so rapid that directors believe the plant will operate at capacity virtually from start-up.

It has yet to be decided where the highly automated plant will be located. According to the company, the factory will be made larger than necessary to allow room for expansion into video discs at a later date.

Once underway, the project should benefit from the rapid expansion in demand for compact discs. World production of disc players increased from 770,000 in 1984 to four million during 1985, while estimates for 1986 exceed 10 million.

Want to buy a hot PC?

Personal computers are going the way of video cassette recorders — they have become a target for thieves.

It is believed that organised groups are gaining access to lists of computer owners, stealing their equipment and then selling it through classified advertisements in newspapers.

High on the risk category are those who own IBM PCs and compatibles. One victim who recently lost two IBM PCs from his office has now set up a "PC Theft Database" to help police stop the rise in burglaries. PC Theft Database can be contacted by calling Steve Townsend on (02) 81 3070.

Subscription Prize Winner

The winner of the January 1986 special subscription offer is Mr K. Koschel of East Ringwood, Victoria. Mr Koschel's prize is a Sharp DX-110 compact disc player.

Communications overhaul for Australian Army

Contracts valued at $575 million have recently been awarded to the Australian telecommunications industry to take the army's communications networks into the 21st century.

The main aim of the program is to replace analog communication systems — some of which have been in service for almost 20 years — with state-of-the-art digital equipment. One of the many advantages of a digital network is that signals are much easier to encode, thus ensuring security.

Three major and distinctly different areas of communication will be updated. These are code named DISCON, RAVEN and PARAKEET.

Project DISCON (Defence Integrated Secure Communications Network) is the nearest to completion. Managed by Plessey Australia Pty Ltd, it is a $200 million fully integrated digital secure telephone, telegraph, facsimile and data network linking Australia's permanent military bases.

In its final form, DISCON will link with RAVEN, a tactical system employing manpack radios, and PARAKEET the tactical defence communications network which uses vehicular transport.

The RAVEN family consists of a manpack HF transceiver, a manpack VHF transceiver, RF power amplifiers, headsets, message entry devices, power cables and other ancillary equipment.

A number of local sub-contractors are involved in this section of the project and they include Scalar Industries, LJ Wallace, Tubemakers of Australia, Antenna Engineering Australia, Hallmark International New Zealand and Computer Sciences Australia. Additional sub-contractors will be added as the project develops.

Project PARAKEET, which is managed by Racal Electronics, is aimed at the communications system needed above the immediate combat level. The existing network consists of an array of terminal switching systems, control and transmission equipment, and various stop-gap items of equipment.

This will be replaced with an all digital secure multi-mode (voice, data, facsimile, telegraph) system. The total cost of project PARAKEET exceeds $225 million alone.

A major difference between PARAKEET and overseas systems is the degree of integration of HF bearers. Although satellite links will play an important role in PARAKEET, the Army believes that, given Australia's unique terrain, HF is indispensable.

New act gives RIs greater clout

Department of Communications' radio inspectors have recently hunted down and prosecuted a number of illegal users of the airwaves.

In one unusual case, an unlicensed radio operator, who identified himself as "the original wombat", was driving a locomotive around Sydney railway yards late at night, transmitting obscenities.

Stopping his illegal activities was all in a night's work for Department of Communications' radio inspectors. The story ended in court where the wombat had $300 worth of equipment confiscated and was fined $200 plus $28 costs.

In another case recently, a Queensland man made repeated calls to emergency services on marine distress channels, claiming he was on a boat with several other people outside the Southport sandbar. The condition of the bar at the time was dangerous. Although he didn't say his boat was in trouble, his continued requests for information about the bar, and his failure to acknowledge repeated warnings, alarmed rescue services.

The man was, in fact, transmitting from home. As well as losing his equipment, he was fined $300 plus $30 costs.

Both these cases were prosecuted under the old Wireless and Telegraphy Act 1905. Late last year, the new Radiocommunications Act came into force. Penalties under the new act are much more severe, as another Queensland man found out. He made hoax calls to the Cairns coastguard and was fined $2500 and had a $150 marine transceiver and a $200 CB transceiver confiscated.

In recent cases involving unlicensed operators of CB equipment, the minimum fine imposed by the courts has been $400 but fines up to $750 are common. And, under the new Act, the Department not only expects more prosecutions, but is planning on introducing on-the-spot fines similar to those given out for traffic offences.

Flat-screen TV displays

A joint research project in Britain is working on an interesting new approach to flat-screen displays for computers and television sets.

Tech-Nel Data, which funds the work, and the Department of Electrical Engineering at the Imperial College of Science and Technology in London have developed a small working prototype which they intend scaling up with the help of further outside investment.

The screen is made from a parallel grid of optical fibres, each of which takes light from a source at one edge of the screen and carries it across to the other edge. The fibres themselves are covered with a liquid-crystal. The light normally remains trapped inside the fibres but if the optical characteristic of the LCD material is changed at any position along the fibre, the light pours out and is visible as a bright dot.

A perpendicular grid of thin wire electrodes is used to control these changes in the LCD's characteristics. By controlling the strength of the light from the edge sources and the leakage pattern, an image can be created on the screen.

Colour images can be created by transmitting red, green and blue light down alternative fibres.

Moonwriter aids blind

Developed by three British schoolboys, the Moonwriter is a device which enables blind people to read and write letters, telephone numbers, labels and other messages. The device is now available commercially.

Moon is a simple language based on nine uncomplicated embossed characters and invented by Dr Moon in 1847. Before the machine was developed, the language was produced as reading material only at the Royal National Institute for the Blind's (RNIB) printworks.

Greatly enhancing blind people's capacity to communicate, the system is particularly suited to those who lose their sight in later life and whose finger touch is not so sensitive. It is also easier to learn than Braille and can be read by sighted relatives and friends of the blind.

Manufactured in conjunction with the RNIB by Possum Controls Ltd, the Moonwriter is easily adaptable to most languages based on the Roman alphabet.

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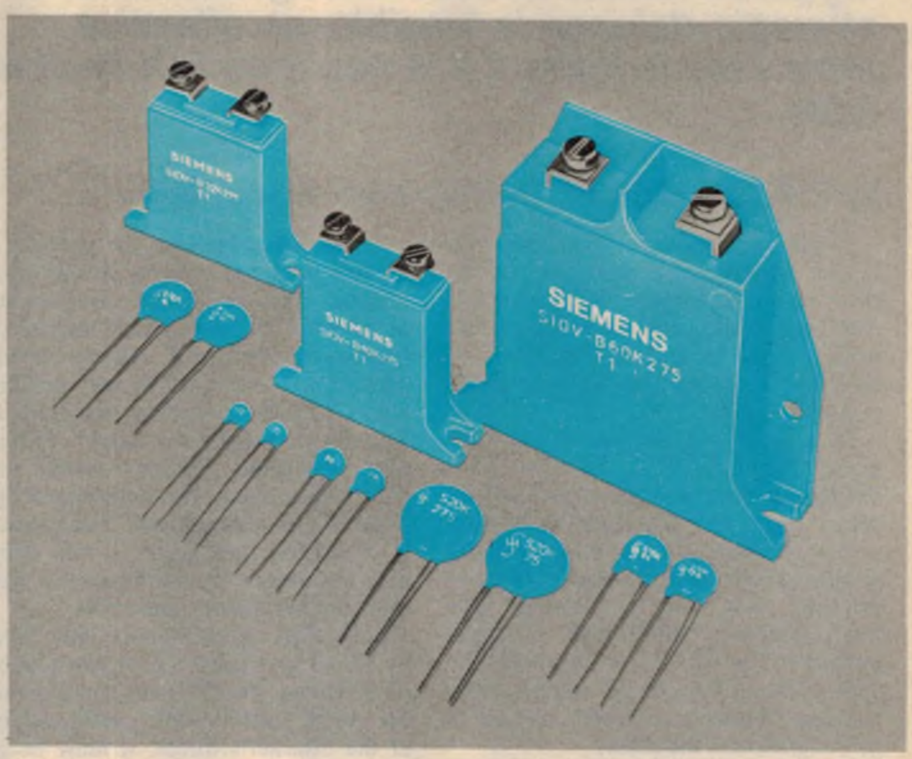

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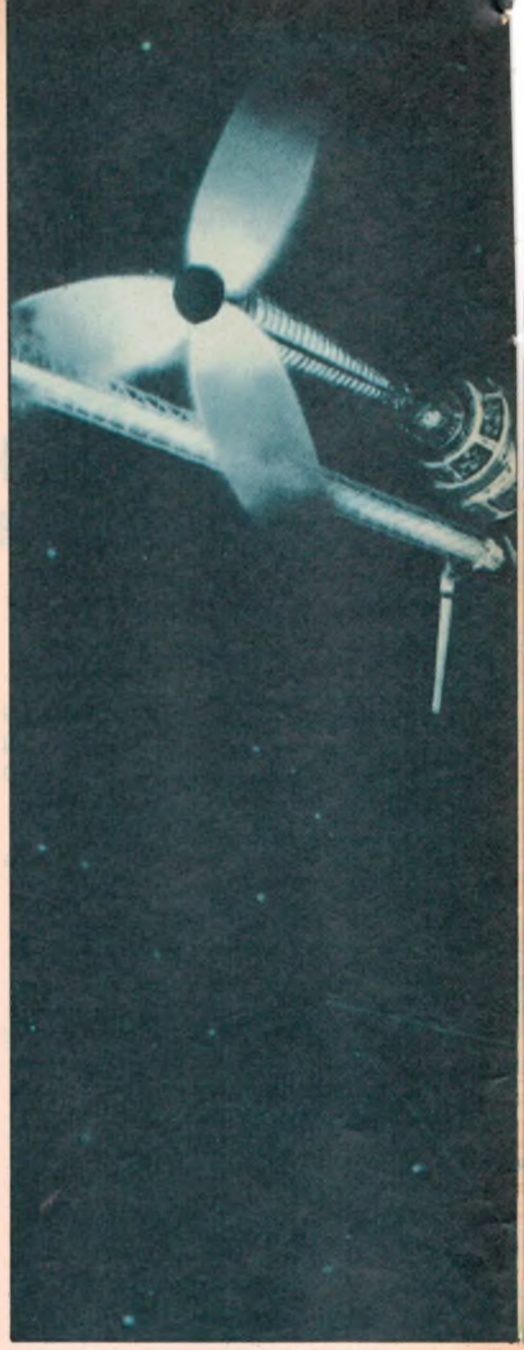


by ERIC J. LERNER* *Electronics Editor, Aerospace America.*

"I call upon the scientific community in our country, those who gave us nuclear weapons, to turn their great talents now to the cause of mankind and world peace, to give us the means of rendering these nuclear weapons impotent and obsolete."

With these words, in a televised speech March 23, 1983, President Ronald Reagan launched the ambitious and controversial research effort to develop a defence against nuclear-armed ballistic missiles. From the start, the program — officially known as the Strategic Defense Initiative (SDI) and popularly dubbed "Star Wars" — has been the centre of intense debate among scientists and arms-control experts as well as in Congress and the press.

SDI critics, among them many scientists who have been or still are deeply immersed in weapons development, contend that the program is unachievable, that there is no way to defend the US (or any other country) from missile-borne nuclear weapons, nor can these weapons be rendered "impotent and obsolete". Critics also warn that the effort to develop these defences could sabotage any chances for arms control and for a reduction in the numbers of nuclear weapons. They fear that deploying space-based defences could lead to confrontation, even war, or at best to an exhausting and costly arms race between offence and defence.

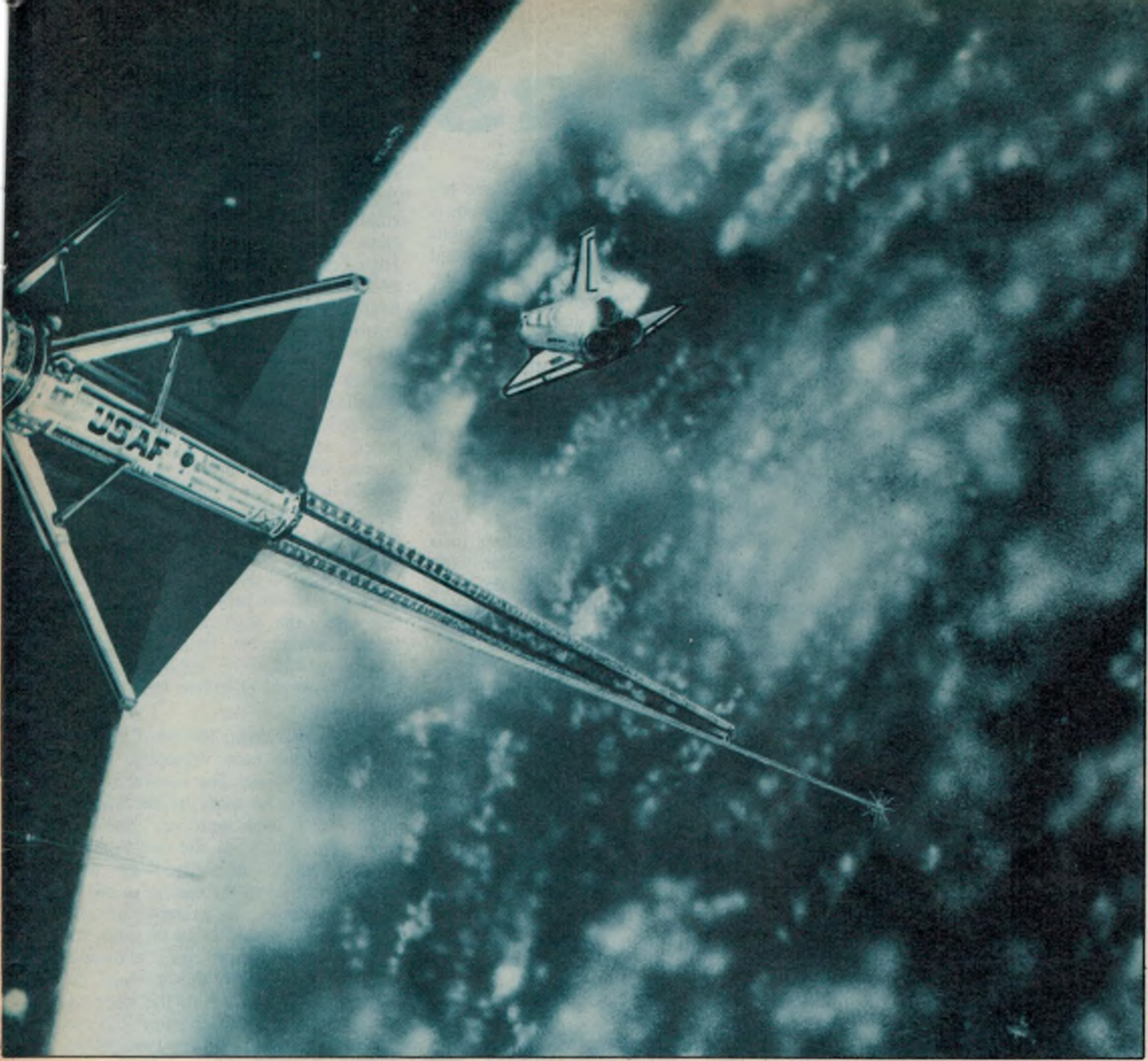
Supporters argue that the program is feasible or that it warrants serious investigation. They reason that development of effective defences would render offensive missiles poor military investments, and therefore would diminish Soviet military expansion and prod the Kremlin to reduce its nuclear arsenal. SDI proponents further contend that the defence effort will complement and assist, rather than subvert, arms control. If successful, they argue, it will eliminate the danger of nuclear war by making a nuclear attack impossible.

Both sides agree that the task faced by SDI is formidable. A system capable of defending the US from nuclear missile attack must not only eliminate most of the attacker's forces, it must be invulnerable. It must also contribute to nuclear stability, when deployed, by allowing no advantage to a first strike. Lastly, it must be cost-effective, that is, it must cost the attacker much more to overwhelm a given defence than the defence costs to build.

The main obstacles to the realisation of the SDI program are the immense destructive power of nuclear weapons and the large number of such weapons already deployed. A single one-megaton nuclear warhead — a typical size in the Soviet arsenal — delivered on a US metropolitan area would kill one or two-million people. According to the US Arms Control and Disarmament Agency, as few as a dozen such weapons detonated over major US cities would bring death or severe injury to over 20-million people. One hundred of them would wipe out US society.

The Soviet Union has over 5,000 one-megaton warheads, over 250 warheads yielding between 15 and 20 megatons, and a couple of thousand sub-megaton warheads. A US defence would have to knock down 99.99% of the incoming missiles to be "leak proof". To reduce the threat of annihilation of the US population would call for between 99.5 and 99.7% effectiveness, allowing penetration of no more than 25-50 warheads.

Adding to the difficulty is the very nature of intercontinental ballistic missiles (ICBM) or sub-launched ballistic missiles (SLBM) that deliver these weap-



ons. ICBMs travel at about 7-8 km/sec and complete their journey in some 30 minutes. Some SLBMs can complete their mission in five minutes. Each of the ICBM's three-part trajectory — boost phase, mid-course, and terminal phase — poses special defence problems. During boost phase, while the rocket is still firing, the missile is most vulnerable. Yet, for at least part of this phase, it is protected against some weapons by the atmosphere itself. This protection also exists during the terminal phase as the warhead-laden re-entry vehicle returns to the atmosphere. In its mid-course phase, the re-entry vehicle can be protected by swarms of decoys.

An effective defence must thwart not only current threats but prepare for future ones, as the Soviets might develop weapons designed to negate any new US defence system. Since the A-bomb, the arms race has been characterised by one-up-manship on either side, first with the development of the H-bomb, ICBM, and multiple independent re-entry vehicle missile (MIRV) by the US, and subsequent development of similar weapons by the Soviets. To negate this effect, SDI must rely on a system that can unequivocally defeat countermeasures that may use the same technology as the defence.

"An effective defence must thwart not only current threats but prepare for future ones."

The current debate over strategic defence is the second such controversy in the history of nuclear weapons. The first round, deployment of the Sentinel/-Safeguard system in the late '60s and early '70s set the stage for and raised many of the issues still under discussion.

In 1967, the Johnson administration decided to build a ballistic missile defence — or antiballistic missile (ABM) — system to protect American cities from attack. The system was to use two layers of nuclear-armed missiles, Sentinel to intercept warheads outside the atmosphere and Sprint to destroy those slipping through the first layer. Both were to be guided by ground-based radar. At the same time, the Soviets began to deploy a similar ABM system — Galosh — around Moscow.

STAR WARS

Sentinel sparked an immediate and intense dispute. Critics argued that it could not work as it would be saturated by an overwhelming attack and that its sensors were a very soft target, highly vulnerable to any stray warhead. In addition, critics warned that, in a crisis, the system could tempt both the Soviets and the US to exercise a first strike. Since Sentinel could handle a disorganised retaliatory strike far more capably than a coherent and massive first strike, both the US and USSR might reason that if a war seemed inevitable, a first strike would greatly reduce the damage the attacking nation might sustain.

In an effort to penetrate Soviet defences, the US came up with a simple but effective countermeasure: MIRV. By allowing a single missile to saturate the defence with 10 or more warheads, MIRVing effectively undermined the Sentinel-Galosh-type defence. In addition, no reliable means of sorting out re-entry vehicles (RVs) from decoys outside the atmosphere was ever devised.

In 1969, faced with the discouraging prospect that Sentinel could never really protect US cities and owing to mounting popular opposition to basing nuclear-tipped rockets near populated centres, the Nixon administration backed away from the concept, reoriented Sentinel to the defence of missile silos, and rechristened it Safeguard.

In 1972, the Soviet Union and the US agreed to curtail sharply development of ABMs by signing the ABM Treaty in conjunction with limits on offensive missiles agreed to in the SALT I round of talks. Initially, the treaty limited both sides to two, and later one defence site (Moscow, in the case of the Soviets, and a Minuteman base for the US).

The ABM Treaty, currently the only arms limitation agreement in force between the US and the Soviet Union, is of unlimited duration and prohibits development, testing, and deployment of any ABM of the type now contemplated by SDI. All mobile systems — air-, sea-, and space-based — and all systems using technologies other than rockets are permanently banned. It can be revised by mutual consent once every five years. The treaty allows each party to withdraw when "extraordinary events have jeopardised its supreme interests."

In the aftermath of the ABM Treaty, the US eventually dismantled its ABM site in 1975, while the Soviets kept their Moscow system. In the meantime, both the Soviets and the US deployed MIRVed missiles. Result: The number of warheads on each side approximately quadrupled during the '70s.

The issue of strategic defence lay dormant during the rest of the '70s while the Nixon, Ford, and Carter administrations focused on controlling the expansion of offensive arms. This effort ended in failure when the US did not ratify the SALT II agreements. The Reagan administration, sceptical at first of the prospects for arms agreements, turned out to offer a more fertile ground for cultivating the strategic defence approach.

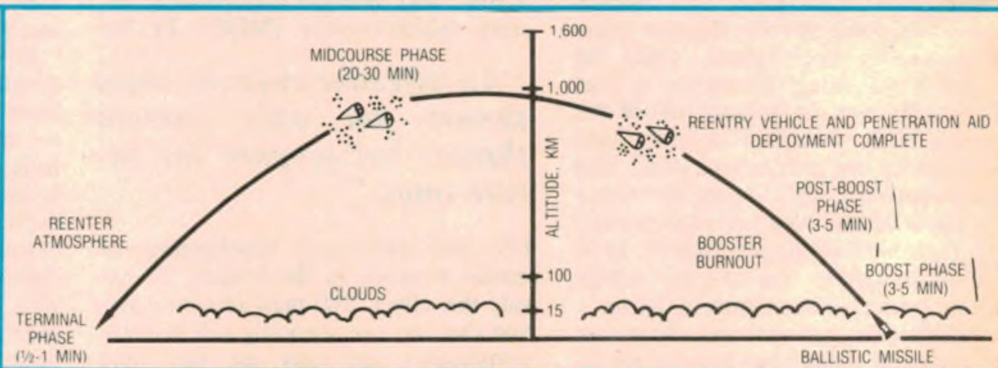
"I do not look forward to having our satellites, their mines, our countermines and so on, all floating around in the same place."

Soon after taking office, Reagan was briefed on strategic defence by two groups of proponents. One, based at Lawrence Livermore Lab and led by Edward Teller, urged the President to launch a broad research program to investigate advanced missile defence concepts, especially Livermore's own brainchild, an X-ray laser energised by a nuclear weapon. A second group, called High Frontier, and led by former General Daniel Graham, advocated the near-term deployment in space of a defensive system that would use current rocket technology.

Both concepts, and others then being investigated by the Defence Advanced Research Projects Agency that were based on lasers or intense particle beams, differed from the Sentinel approach in that they emphasised defences from space that could neutralise missiles during the boost and mid-course phases of flight. The idea of a three-tiered defence would cut down the need for each layer to be leak proof and prevent the last layer, the terminal defence, from being overwhelmed. Thus, for example, a defence with three layers, each 90% effective, would eliminate 99.9% of all warheads.

Equally important, the boost phase is considered the most vulnerable leg of the missile's flight. The booster is easy to spot and is far more fragile than the smaller RVs and there are fewer of them. The attack on the boost phase, which must by necessity come from space, is critical to the success of the remaining layers. If, for example, a boost-phase layer designed to knock down 900 out of 1,000 missiles only eliminates 800, the mid-course and terminal defences will be faced with the awesome task of handling twice as many RVs and decoys as planned, and the terminal defence 10 times as many.

In his speech in March 1983, President Reagan ordered development of such a multi-layered defence. Adopted and now being carried out by the SDI Office, the plan includes a broad-based



Left: the US Army's experimental anti-missile missile. Right: SDI would stop missiles during the boost and mid-course phases of flight.

program of research and development into all non-nuclear defence systems. The nuclear-based X-ray laser is funded through the Dept. of Energy, as is other research on nuclear weapons.

Funded last year at $1.4 billion and with $3.7 billion requested for 1986, the program represents the largest current defence research effort. If it grows at the pace outlined by the administration, it will rapidly become the largest military program since the Manhattan Project.

The research now included in SDI did not originate with the president's speech. Instead the defence initiative centralises research already ongoing in various DOD programs, and greatly increases their funding for fiscal years after 1985.

SDI and the Dept. of Energy nuclear weapons program aim at developing a wide panoply of defensive systems. These weapons fall into three categories. The most exotic and most publicised are the directed-energy weapons — lasers and beams of accelerated particles (protons, electrons, or hydrogen atoms) — that could strike against missiles at the speed of light or close to it!

The second group consists of kinetic-energy weapons, a fancy name for projectiles that would have to ram the missile head-on to kill it, and could be accelerated either by conventional rockets launched from space platforms or by much newer devices that fire the projectiles electromagnetically.

The third type of weapon is the X-ray laser, which is based on submarines and popped up on rockets into the vicinity of opposing ICBMs whose launch has been detected. The program is conceived of as a research effort leading to later development programs, with deployment of weapons, if any prove feasible and desirable, sometime in the 1990s or later.

As with Sentinel, SDI has been greeted with intense criticism, both from US scientists and from the Soviet Union. Leading American critics, including IBM's Richard Garwin, Hans Bethe of Cornell Univ., Sidney Drell of Standford, and Ashton Carter of MIT (Massachusetts Institute of Technology), contend that SDI goals are unreachable and that the mere effort to pursue them will put an end to arms control, speed up the arms race, and possibly provoke a war.

Key technical issues hinge on feasibility. "There are three reasons why space based defences can't work," Garwin asserts. "Such defences are too easily defeated by countermeasures, too vulnerable, and hence too costly."

One countermeasure to SDI would be the fast-burn ICBM. The technology already exists.

Critics claim that countermeasures such as fast-burn boosters greatly reduce the time boost-phase defences have to operate and increase the attacker's ability to use the atmosphere for protection. Millions of decoys can further weaken and defeat US defences. "We have to remember that this project is not working against nature, as other research programs do, but against a determined opponent who will try to thwart anything we do," Garwin points out.

They are too vulnerable, says Garwin, because those based in space in peacetime (except the pop-up X-ray) can be targeted by systems as simple as space mines — bombs floating close to the stations — ready to explode on command. US X-ray lasers can be destroyed by Soviet X-ray lasers launched shortly before a Soviet offensive.

They are too costly, critics argue, because there is no way to produce them more cheaply than their targets. The expense of immense mirrors for lasers, accelerators for particle beams, and thousands of rocket projectiles is too great. The Soviets can therefore overcome such a system just by building more ICBMs.

SDI proponents deny that space-based weapons are impossible to defend. "In World War I, people started to shoot at airplanes, but that was not the end of aircraft," says Maj. Peter Worden, assistant to SDI Director Lt. Gen. James A. Abrahamson. "We can use the same types of defences as aircraft used: armour, manoeuverability, deception, dispersion . . . and shooting back!"

As to cost, Gerald Yonas, SDI's scientific director, counters, "We are working on advanced automation and mass-production technologies to reduce the cost of all the systems we might deploy. We also have a tremendous cost advantage in launching our system into space in peacetime. With advanced, high-capacity boosters, we can do this much more cheaply than the Soviets can boost warheads into space during an attack."

Countermeasures can themselves be countered, Yonas points out. "We are developing cheap and effective ways of sorting out decoys and RVs." Although fast-burn boosters may make the defence job harder, it is not impossible, SDI supporters affirm.

Technical arguments over feasibility strongly colour and overlap with the debate on the impact of Star Wars on arms control and prospects for war and peace. To critics, deployment of a half-baked system capable of dealing with a "ragged retaliation" but not a concerted first strike, could prompt a greater willingness on both sides to strike first in a crisis. This was the same argument used against Sentinel. For the same reasons, the Soviets contend the system is aimed at negating their capacity to retaliate.

Some of the systems proposed, especially the pop-up X-ray, appear to place the launching of nuclear weapons and the start of a war into the hands of computers. "The pop-up system must respond in only seconds. How can you put a human judgment in them?" asks Kosta Tsipis of MIT's Program on Science and Technology for International Security.

Deploying such a system would violate the ABM Treaty, jeopardise any arms control agreement, and lead to confrontation in space, Garwin and others say. "I do not look forward to having our satellites, their mines, our countermines, and so on, all floating around in the same place," Garwin warns.

To Yonas, however, the defence effort represents the best hope for preserving world peace. "Look, the Russians are practical. If the defensive technology we deploy is really good, and they see that it is, they won't invest in more missiles, but in a defence of their own. That way we can start down a road toward arms reduction. And as the number of missiles decreases, defence looks better and better." As for confrontation during deployment, Yonas replies, "If they think defence is good for them, they'll come to terms with us that will ensure such confrontation won't ever happen. If our technology isn't so clearly superior, we wouldn't deploy it, and we won't."

Policy, therefore, as in far less momentous issues, hinges on the central question of feasibility. EA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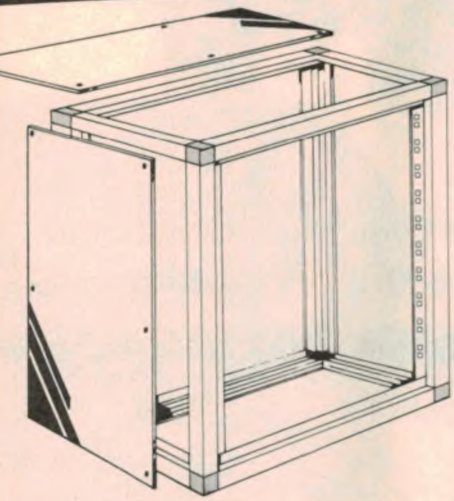

Dear Customer, Over the last 9 years we at Altronics have toiled away often
into the night with one major goal in mind — to provide you will competitively
priced quality components and products with a superior standard of service.
Looking back in 1986, I guess you could say the 10's of thousands of Shop and
Mail Order Customers served, stand testament to our endeavours. We have
resisted the "high powered advice" from Advertising firms to churn out
expensive colour brochures and the like as eventually this must add to the cost
of our products and unnecessarily waste your hard earned cash. (Even today
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otherwise). The secret to our phenomenal growth we believe must lay, apart
from our extremely concienclous attitude to service and delivery, in our policy
of employing **Electronic Enthusiasts, Just like yourself**, in virtually every
section of **Altronics**, so remember when you want a little technical advice —
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Jack O'Donnell

Rack Frames for the Home Stereo System
Rack Cabinets for Equipment Manufacturers

The all new Altronics racking system is available in 2 formats.

(1) **Racking Frame Only** Fantastic for neatly housing your home Hi Fi System. Looks fine as is with your various sound system modules bolted in place, however, should the little woman disagree, then it is dead simple to obtain some low cost timber panels from your local cabinet shop to fill the side and top recesses. Edging of the timber is not required due to the 15mm recesses.

(2) **Complete Equipment Cabinet** with the simple addition of the panel sets you now have a series of professional equipment cabinets of appearance and ruggedness second to none - and just look at the savings!

Assembly Each Frame System is supplied complete with 12 Custom extruded Natural Anodised Aluminium sections, 8 ABS corner connector pieces, 6 clip in M6 captive nuts and 6 M6 mounting screws. The sections and corner pieces simply push-fit together. A rubber or wooden mallet is recommended to fit together the self aligning pieces. Further strength can be obtained by pop rivetting the various overlapping extruded sections if desired, although we hardly feel this is necessary.

Side and Top Panels Tough powder coat medium grey gives a pleasing contrast with the natural anodised frame. The resultant product is extremely professional in appearance and well and truly strong enough for the heaviest of electronic equipment.

Supplied in Flat Pack Format
Easily Assembled in Minutes

New For '86

6 Unit (370mm H) 18 Unit (907mm) 30 Unit (1450mm) and 38 Unit (1804mm) Racks available
All 450mm Deep

	ea.	10 Up
H 0365 Rack Frame 6 unit (370MM)	89.50	85.00
H 0367 Panel Set for H 0365	49.00	44.00
H 0370 Rack Frame 18 Unit (907MM)	119.50	110.00
H 0372 Panel Set for H 0370	89.00	84.00
H 0375 Rack Frame 30 Unit (1450MM)	149.50	139.00
H 0377 Panel Set for H 0375	129.00	119.00
H 0380 Rack Frame 38 Unit (1804MM)	189.50	175.00

	ea.	10 UP
H 0332 Panel set for H 0380	149.00	139.00
H 0385 Rack screw M6 PK 12 Natural	2.95	2.70
H 0386 Rack screw M6 PK 100 Natural	19.95	17.95
H 0390 Rack screw M6 PK 12 Black	2.95	2.70
H 0391 Rack screw M6 PK 100 Black	19.95	17.95
H 0395 Rack captive nuts M6 PK 12	3.95	3.50
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Rack Panel Screws

Low, Low prices on Nickel Plated and Black finish Rack Screws Dome Head, M6 Thread, 25mm Overall Length.

New Innovation
High Energy Rack Case

Yet another inovation from the Design Team at Altronics. The use of Super Heavy Duty Heatsinks as Rack Case sides now allows a myriad of Amplifiers, Power Supplies, Battery Chargers etc to be built in an "Off the Shelf" rack case.

Fantastic for Stereo Amplifiers, using each Heatsink will accommodate an audio output stage of approximately 120W per side with normal efficiency and dissipation.

A Great Chassis for Heavy Duty Power Supplies and Battery Chargers. We suggest the mounting of Rectifier Bridge or diodes on one Heatsink and the Regulator devices on the other.

For very high heat dissipation this design allows the simple fitting of computer type fans to inside back of rear panel, adjacent to each respective heatsink. Fans are thus very cheap and easy to fit and provide very efficient cooling of the heatsink.

Specifications:
Heatsinks Altronics H 0590 **Front Panel** 3 unit Rack size 480mm x 132mm x 3mm **Rear Panel and Base** 1.0mm steel, ventilation slots provided **Top cover** 1.0mm steel, ventilation slots provided. **Internal Dimensions** 125 x 370 x 250mm **External Dimensions** 130 x 440 x 252mm plus standard front panel. **Finish** Black anodised aluminium plus powder coat black top/base.

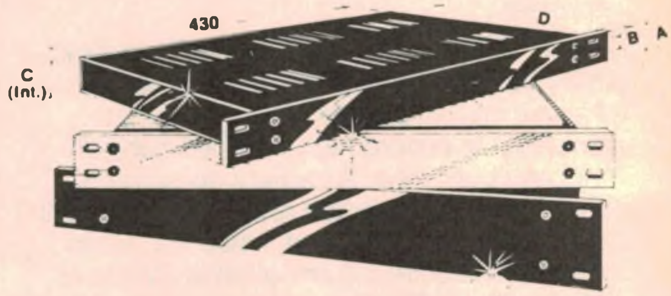
Vented Lid Not Shown

New For'86

Amazing Low Price
H 0418 **$79.00**
4 Up **$74.50 ea**

PROFESSIONAL SERIES RACK CABINETS

Now your preamps, Amps, Control Modules Monitor Panels etc. can look every bit as good as Technics Nakamichi and other top manufacturers.



ALL ALUMINIUM CONSTRUCTION

FEATURES: These beautifully crafted rack cabinet boxes will give your equipment a real Ist class appearance with removable top and bottom cover panels • All dimensioning conforms to the International Standard • Natural or Black finish • Ventilated lid • Deluxe finish front panel • Individually cartoned • Supplied in Flat Pack Form - Easily assembled in minutes - **Side Elevations:-** D=254mm C (Internal Chassis Height) • B (mounting Bolt Centres).

SIX NATURAL AND BLACK FINISH MODELS — The Black or Natural finish cabinets are each available in 44mm, 88mm or 132mm high models. Mounting hole centres conform exactly to International Racking Specifications both vertically and horizontally.

Cat. No.	Finish	A	B	C	ea.	5 +
H 0401	Natural	44	34	38	$49.95	$47.50
H 0402	Natural	88	57	82	59.50	56.00
H 0403	Natural	132	89	126	69.50	62.95
H 0411	Black	44	34	38	55.00	50.00
H 0412	Black	88	57	82	65.00	59.50
H 0413	Black	132	89	126	75.00	69.50

Sloping Front Boxes

Give a real Professional appearance to your desk mounted consoles, controllers etc.

- Colour Hammertone finish
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Size 1 150 x 105 x 35 (F) x 73 (R)
H 0432 **$9.50** 5 Up **$8.50**

Size 2 200 x 150 x 35 (F) 70 (R)
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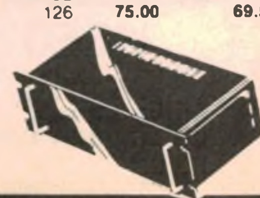
Economy Pack Cabinet

• Solid steel construction • Black anodised front panel • 3 unit (132mm) • Conforms to International Standards • Ventilated top and side panels **H 0400**

ONLY **$49.50** 10 Up **$45**



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Toroidal Power Transformers

Why a Toroid?

- Smaller size and weight to meet modern "Slimline" requirements.
- Low electrically induced noise demanded by compact equipment.
- High efficiency enabling conservative rating whilst maintaining size advantages.
- Lower operating temperature.
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Dimensions and Weight

160 VA Models 110 Diam. 45mm H. 1.8Kgs Leads 200mm
300 VA Models 125 Diam. 45mm H. 25Kgs Leads 200mm

160 Watt Models

Cat.No.	SEC.V
M 3050	12 + 12
M 3055	18 + 18
M 3060	25 + 25
M 3065	30 + 30
M 3070	35 + 35
M 3075	40 + 40

All **$45ea** 10 Up **$43.50**

300 Watt Models

Cat.No.	SEC.V
M 3085	12 + 12
M 3086	18 + 18
M 3088	25 + 25
M 3090	30 + 30
M 3092	35 + 35
M 3100	40 + 40

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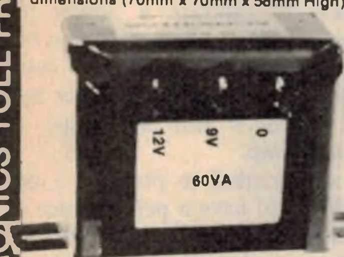
Low Cost Multipurpose Power Transformer

240V to 9, 12, 15, 18, 21, 24 volts at 60VA (60W) High grade silicon steel laminions (Sorry we could not do a Toroid at this price!)

Our Multitap 1 amp and 2 amp Transformers have proved so popular we decided to release a big brother. Made right here in Australia. Use of high grade Silicon steel has enabled surprisingly compact dimensions (70mm x 70mm x 58mm High).



M 2165
Outputs
Two Simple Secondaries, each with just one tap, permit an amazing range of outputs i.e.

9V @ 6.6A	12V @ 5A	18V @ 3.3A	24V @ 2.5A

Voltage	Current	Centre Tap
3	6.6A	No
6	6.6A	Yes
9	6.6A	No
12	5A	No
15	4A	No
18	3.3A	Yes
21	2.9A	No
24	2.5A	Yes

An exclusive Altronics Design

Just **$22.50**

Super Versatile Exclusive to Altronics

New PCB Mount Mains Transformers

7/9 Rating Super Compact, wound on Grain Oriented Steel Core for High efficiency and low temperature rise.

Power Rating:
7VA Load Full voltage +3% -0%
9VA Load Full voltage -6% to 8%

Model	Prim/SEC's
M 7012	240/6+6
M 7015	240/7.5 + 7.5
M 7018	240/9+9
M 7024	240/12+12
M 7030	240/15+15

Overall Height 36mm
Length 43mm
Width 36mm

1—9	**$9.80ea**
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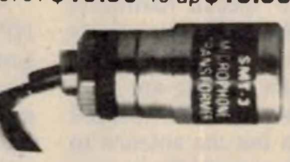
25 Plus	**$8.40ea**

Mu Metal Shielded Microphone and Input Transformers

Microphone Type

Primary: 200 Ohm
Secondary: 50K Ohm
A high quality item eminently suited to mixers, PA amplifiers and where an ultra low "hum" pickup level is desired.

M 0701 **$19.50** 10 up **$18.30**



Bridging/Isolating type

Use for coupling audio modules—prevents earth loops, hum etc. Essential coupling device where DC isolating is required.
Nominal Impedance Ratio 10K/10K (1:1)

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Low Cost IC Inserters Extractors

Features:

- CMOS SAFE conductive plastic.
- Exclusive bent pin alignment guides in handle. 8 to 40 pins.
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T 2520 IC Inserter 14/16 Pin	$7.95
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INSERTERS EXTRACTOR

Stereo Mixers at Low Import Price

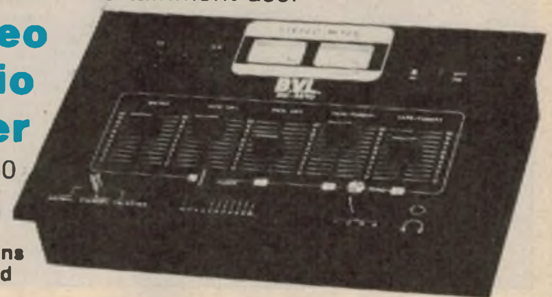
ATTENTION—Social Clubs, Schools, Churchs, Disco Operators, Entertainers, Hotels, Night Clubs and sporting Bodies. With Altronics low prices—here is your opportunity to install one of these outstanding sound control mixers. Both models include microphone "Soundover" facility—making either ideal for live 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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UHF antenna for channel 28

Save money by building this high-gain Yagi antenna for UHF band 4, 520 to 620MHz. It is an 18-element Yagi design with 16 directors, folded dipole and a corner reflector and it gives a performance comparable with the best commercial antennas currently available.

by BOB FLYNN & LEO SIMPSON

For many years now, building TV antennas has not been a popular pastime with electronics enthusiasts. Principally this has been because commercial VHF antennas have been reasonably priced and of good performance. There has also been a continuing problem with the non-availability of special brackets and saddles to attach the various elements to the boom and the quantity of aluminium needed to make an antenna equivalent in performance to a commercial design has been quite expensive.

So much so that few people have bothered with making their own TV antenna although we have published articles on the subject, the most recent being the six-part series entitled "How to obtain better TV reception" (June 1983 to March 1984).

UHF antennas are a different proposition though. For a start they are nowhere near as large and unwieldy and they can be built using a relatively small quantity of aluminium which can be of thicker stock than an equivalent commercial model. They also can be built without resorting to special hardware, and can be assembled using pop rivets or self-tapping screws.

This does not mean that we are forecasting a renaissance of do-it-yourself antenna construction but the antenna to be described is quite a practical proposition for those with access to basic metal-working tools, ie, vice, hacksaw, electric drill and pop-rivet gun.

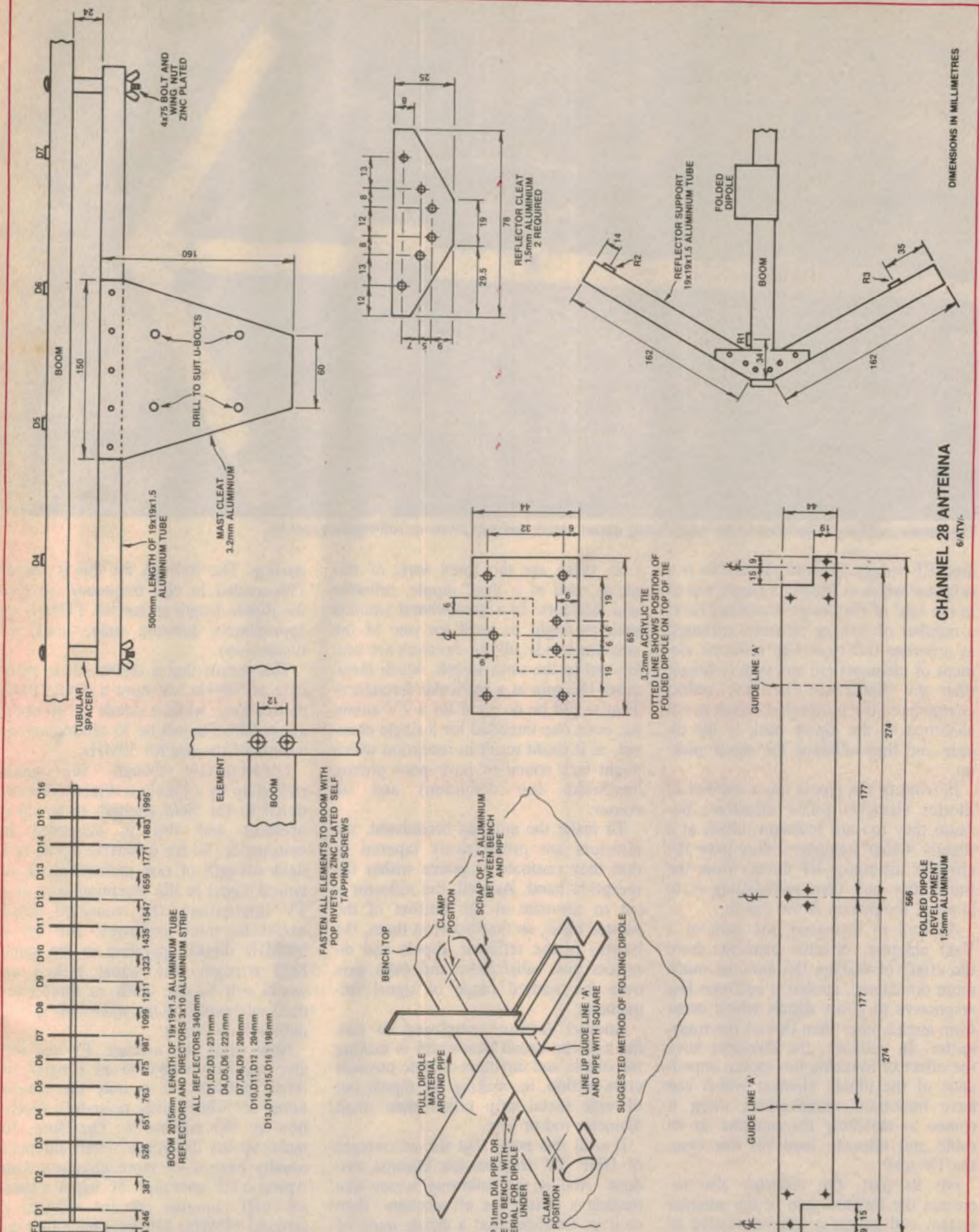
In setting out to present this project, we decided to produce a design for fringe-area reception. The reasoning behind this is that UHF antennas for close metropolitan reception are cheaper and therefore there is less advantage in building your own.

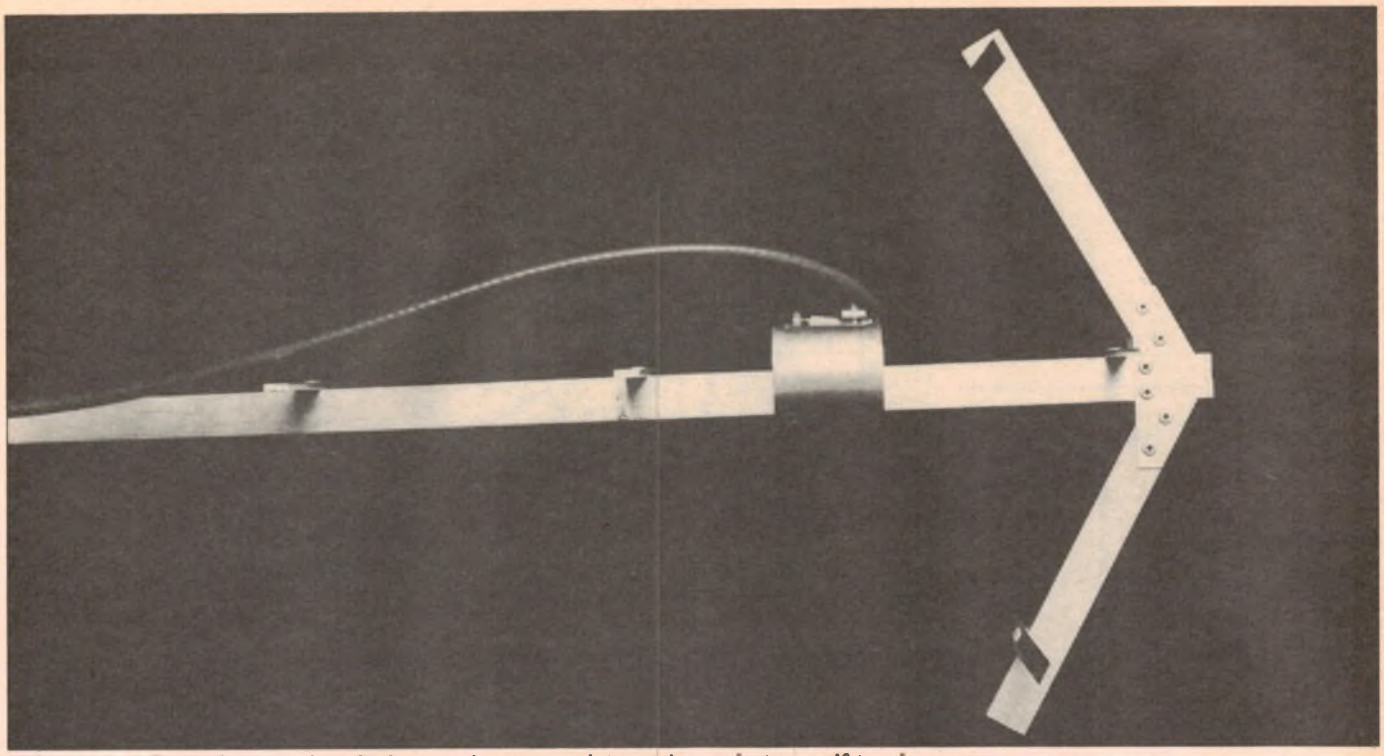
Hence we decided to produce a design which would have a performance at least equivalent to the most popular fringe antenna currently on the market, the Hills TC18. This is a tried and tested unit, based on a design from the UK company, Antiference. Accordingly, we have produced a design which is roughly equivalent. The major difference is that our design has been optimised for channel 28 which is presently the only one operating in the Australian UHF Band 4.

Antenna design

A typical Yagi, whether designed for HF, VHF or UHF, follows the same general principles. There is a dipole, usually a folded type, which is cut to be resonant at the frequency of interest. In the case of a broadband design, as all television antennas are, the dipole is usually cut to resonate at the centre frequency of the wanted channel or band.

The dipole is aimed broadside at the transmitter so that it intercepts the radi-


CHANNEL 28 ANTENNA
6/ATV/-
DIMENSIONS IN MILLIMETRES
BOOM 2015mm LENGTH OF 19x19x1.5 ALUMINIUM TUBE
REFLECTORS AND DIRECTORS 3x10 ALUMINIUM STRIP
ALL REFLECTORS 340mm
D1,D2,D3 : 231mm
D4,D5,D6 : 223mm
D7,D8,D9 : 208mm
D10,D11,D12 : 204mm
D13,D14,D15,D16 : 198mm
R1 FD D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16
40 164 246 387 528 651 763 875 987 1099 1211 1323 1435 1547 1659 1771 1883 1995
ELEMENT
BOOM
TUBULAR SPACER
500mm LENGTH OF 19x19x1.5 ALUMINIUM TUBE
MAST CLEAT 3.2mm ALUMINIUM
DRILL TO SUIT U-BOLTS
BOOM
4x75 BOLT AND WING NUT ZINC PLATED
FASTEN ALL ELEMENTS TO BOOM WITH POP RIVETS OR ZINC PLATED SELF TAPPING SCREWS
CLAMP 31mm DIA PIPE OR POLE TO BENCH WITH MATERIAL FOR DIPOLE UNDER
CLAMP POSITION
PULL DIPOLE MATERIAL AROUND PIPE
BENCH TOP
SCRAP OF 1.5 ALUMINIUM BETWEEN BENCH AND PIPE
LINE UP GUIDE LINE 'A' AND PIPE WITH SQUARE
SUGGESTED METHOD OF FOLDING DIPOLE
REFLECTOR CLEAT 1.5mm ALUMINIUM 2 REQUIRED
3.2mm ACRYLIC TIE
DOTTED LINE SHOWS POSITION OF FOLDED DIPOLE ON TOP OF TIE
REFLECTOR SUPPORT 19x19x1.5 ALUMINIUM TUBE
FOLDED DIPOLE
R1 R2 R3
FOLDED DIPOLE DEVELOPMENT 1.5mm ALUMINIUM
GUIDE LINE 'A'
566



The corner reflector is secured to the boom using gusset plates and pop rivets or self-tapping screws.

ated RF energy. Behind the dipole is a reflector which is usually a single rod or in the case of the design presented here, a number of rods or elements arranged as a corner reflector. The reflector element or elements are cut slightly longer than the dipole so that they reflect energy from the transmitter which is not absorbed by the dipole back to the dipole and thus enhance the signal pickup.

In front of the dipole are a number of shorter elements called directors. Because they too are resonant, albeit at a slightly higher frequency, they have the effect of absorbing RF energy from the transmitter and then re-radiating it to increase the pickup of the dipole.

As well as increasing the gain of a Yagi antenna, director elements have the effect of making the antenna much more directional, so that it becomes less responsive to ghost signals which come from angles other than that of the transmitter. In addition, the directors have the effect of lowering the source impedance of the dipole element which can have important ramifications when it comes to matching the antenna to its cable and ultimate load (in this case, the TV set).

For its part, the reflector also increases the forward gain of the antenna system and makes it less responsive to signals coming from behind the antenna. The technical term for this is front-to-back ratio.

So these are the three sorts of elements used in a Yagi: dipole, reflector and directors. In a narrowband antenna such as might be used for one of the amateur bands, all the directors are usually cut to the same length, which maximises the gain at a particular frequency. That would be no good for a TV antenna, even one intended for a single channel, as it could result in reception which might lack sound or have poor picture bandwidth (no definition) and no colour.

To make the antenna broadband, the directors are progressively tapered so that they resonate at points within the reception band. As well, the reflector is cut to resonate at the bottom of the wanted band, so that between them, the lengths of the reflector, dipole and directors give satisfactory and even gain over the wanted range of signal frequencies.

Another measure employed to give the antenna broad bandwidth is making the dipole and directors of wide physical cross-section, ie, making the dipole out of wide metal strip rather than small diameter rod or wire.

It is at this point that the advantages of UHF TV transmission become evident. And if the following seems like making a virtue out of necessity, then so it is. Consider that a dipole must be cut to resonate at the frequency of interest. Its length will therefore be close to one half wavelength of the signal frequency. The formula for this is simply 150 divided by the frequency, to give the dipole length in metres. (This is an approximate formula only, used for illustration).

This means that a dipole cut to resonate at 50MHz will have a dipole three metres long, while a dipole cut to operate at 500MHz will be 30 centimetres or a tenth of the size for 50MHz.

Unfortunately though, the signal picked up by a dipole is directly proportional to the field strength in which it operates and this is measured in volts/metre. So for a 50MHz dipole in a field strength of one millivolt/metre (a typical signal in the reception area of a TV transmitter), the recovered signal would be three millivolts. But for a 500MHz dipole operating in the same field strength, the signal picked up would only be one tenth, or three hundred microvolts. (One microvolt is one millionth of a volt).

Now while the average TV set will give excellent reception on a signal of three millivolts, it is only the exceptional set which gives noise-free reception at 300 microvolts. Therefore, to make up the difference, UHF antennas usually have a lot more directors than typical VHF antennas. So while a typical VHF antenna cut for channel 2 (around 65MHz) will only have one director, a UHF antenna will usually have 10 or more directors to give about the same signal.

SCAN-SPEAK 200 & 300

The professional kits from the kit professionals.

SCAN-SPEAK 300 Kit
Total kit price $1598

INTRODUCTION PRICE IN APRIL ONLY:
$1399
incl. cabinets and freight

The new SCAN-SPEAK 300 is a larger version of the successful model 200. The powerful 10" woofer gives an extended bass response down below 40 Hz. At the same time, it can produce very high power level, even with medium sized amplifiers, due to its high efficiency.

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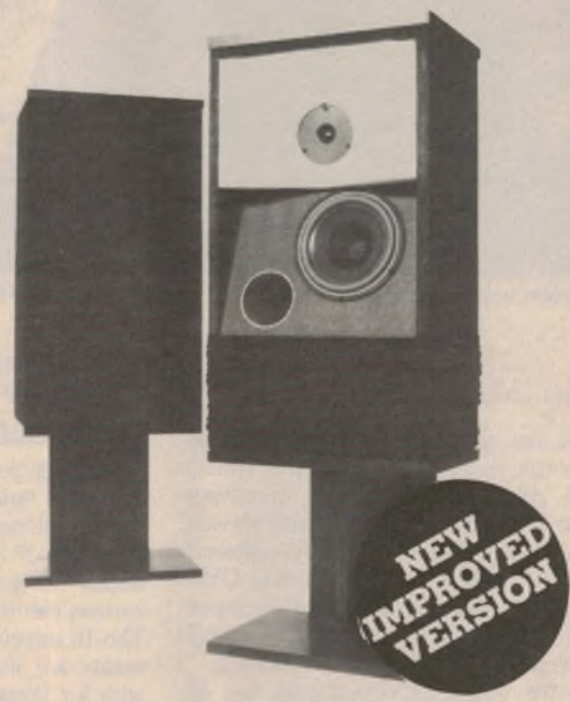
SCAN AUDIO Pty. Ltd.
52 Crown St., Richmond 3121
Ph. (03) 429 2199



SCAN-SPEAK 200 Kit
Total kit price $898

The Scan-Speak 200 Kit offers you the opportunity to build and enjoy a speaker system which produces magnificent results over the entire sonic spectrum – at a price which would be trebled, or more, in ready-made imported speakers.

The key to performance lies in the components used. Both the woofer (180mm) and the ferro-fluid soft textile dome tweeter (19mm) are manufactured in Denmark by Scan-Speak. Their drivers are chosen by such world leading names as ProAc, Linn, NAD, Carlsson, Rogers – just to name a few.

The dividing network is a most advanced L-C design, using metalised polypropylene capacitors with a polystyrene by-pass, giving the speakers an outstanding transient response. The heavy-duty inductors are air cored, using far thicker wire than commercial x-overs. The internal wiring is done with 516 strands cables.

The result is a sound that the hi-fi critics now are raving about:

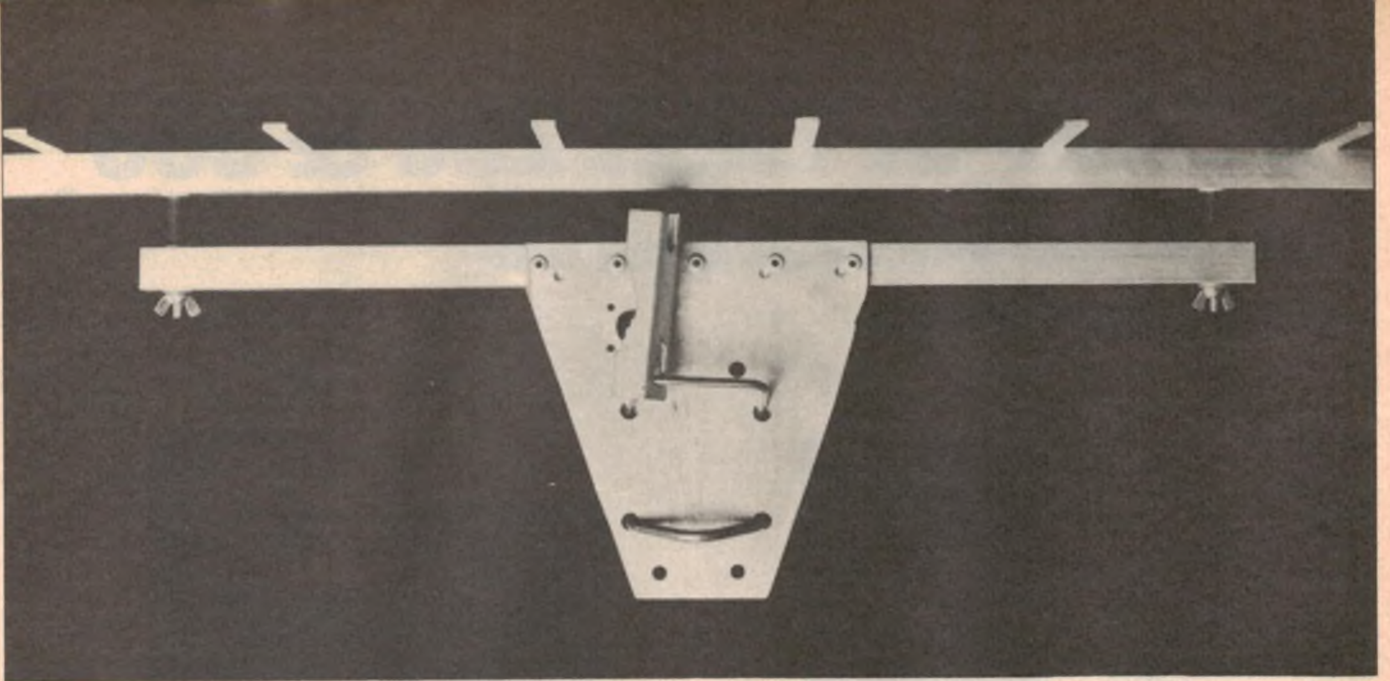
"An impressive debut from Scan-Speak..should leave most of the competition at the post."

"Imaging was very good indeed to excellent...instruments were well placed and rock solid in position, with a sense of space around them... The midrange was smooth and the treble transparent and detailed."

"...unfussed on complex orchestral and massed choral works. ...bass was deep...no sign of doubling even at the lowest frenquencies...."

Frequency response is 50 to 20kHz ± 3 dB, sensitivity is 89 dB, crossover point 3kHz, and 2nd and 3rd harmonic distortion is less than 0.7% (100 to 20kHz).

The kit comes with easy-to-follow instructions. No carpentry skills are required. All exposed cabinet areas are timber veneered. When assembled, each speaker measures 65 x 26 x 36cm. The optional stand is veneered and lifts the speaker 30cm from the floor. The price is $68.00 per pair.



The main boom is supported by a shorter parallel boom attached to the mast via a large gusset plate and two U-bolt clamps.

Antenna

The net effect is that UHF antennas are much more directional than typical VHF antennas and so give reception which is much less plagued with ghosts. That is the virtue of necessity, referred to above. When you consider that UHF TV reception is also just about immune to most sources of man-made electrical interference, it has quite an advantage.

So the design presented here has 16 directors, a folded dipole and a corner reflector. The reason a corner reflector is used instead of a single reflector element is that it improves the front-to-back ratio, increases the gain slightly (over a single element reflector) and reduces the vertical acceptance angle. This last factor means that the antenna will be less responsive to signals reflected by aircraft which, in severe cases, can be sufficient to cause very bad rapidly moving ghosts and picture flutter.

By the way, we refer to the design presented here as an 18-element Yagi, ie, dipole, reflector and 16 elements. That is in line which Australian and European practice. Some manufacturers prefer, for obvious reasons, to count all the reflector components as elements. By that criterion, our design could be called a 20-element unit.

The reason such a rating method is not ideal is that each additional element in a corner reflector gives very little, if any gain, whereas each additional director means an increase in the overall length of the antenna (for the boom) and a greater increase in cost, which is why some manufacturers prefer to count every separate part as an element.

Construction

So much for the theory. Our antenna design is built around a 19mm square section aluminium extrusion with a wall thickness of 1.5mm. This square section makes for a strong boom to which the various elements can be easily attached. The 16 directors and three reflector elements are made from aluminium strip with 3 x 10mm cross-section.

The accompanying drawings show the lengths and positions of all elements on the boom and show how the corner reflector is assembled. Each element is secured to the boom via two pop rivets, or failing those, via two galvanised self tapping screws. Note that the directors are progressively tapered in length, in groups of four, from 231mm to 198mm. Their spacing also progressively reduces from director D1 to D4 and then stays constant at 112mm for successive director elements.

Accuracy of metalwork is particularly important for a UHF antenna such as this and so the specified dimensions should be adhered to as closely as possible.

The folded dipole is fashioned from a strip of 1.5mm thick aluminium, 44mm wide and 566mm long. This has notches cut into each end before folding and should also be drilled as shown.

The method of folding is also illustrated in the diagram. Briefly, the method is as follows. Clamp the prepared strip of aluminium to your bench or table together with a pipe or dowel of 31mm diameter. Then use your set square to line up with one of the "A" guide lines. This is so that the two radiused bends are precisely located. This done, fold the dipole up and over the pipe, in the direction of the arrow. The process is then repeated for the other end of the dipole. When finished, the two free ends of the dipole should be lined up and with a gap of about 6mm.

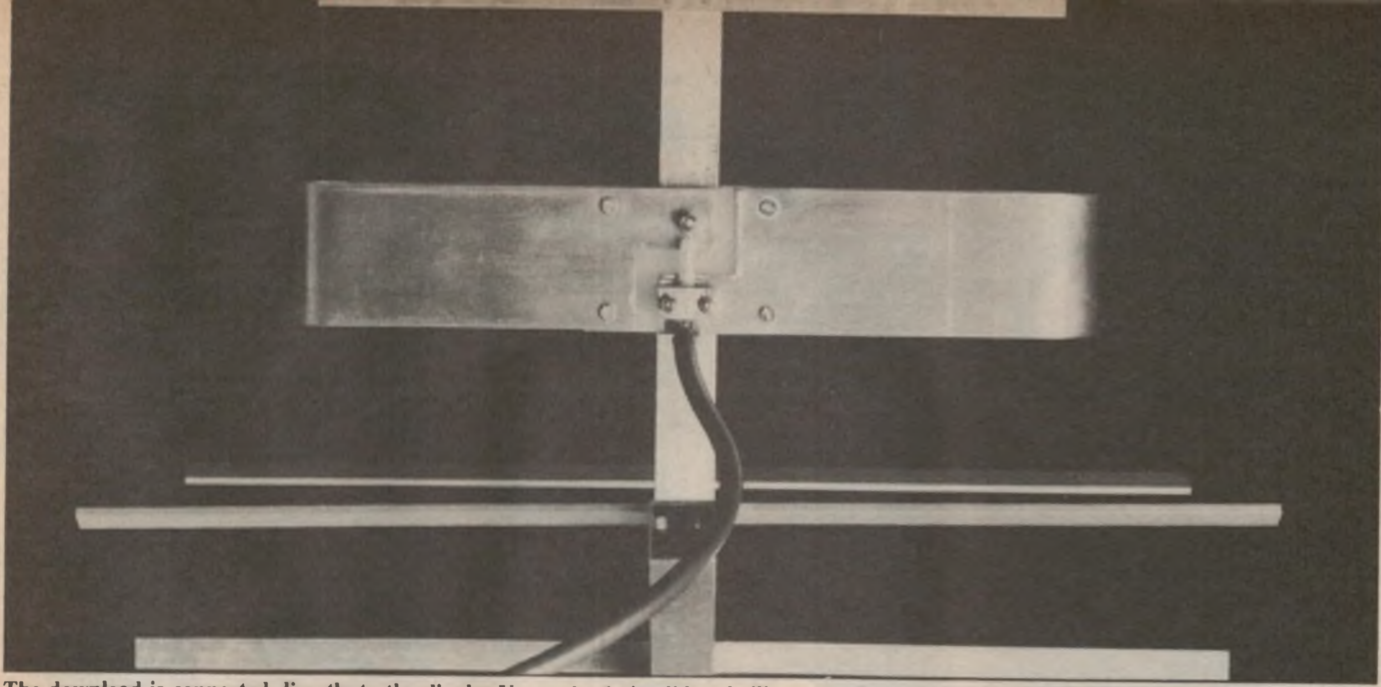
This gap is bridged and supported by a tie piece fashioned from a piece of 3.2mm thick clear acrylic material (Lexan or Perspex) measuring 44 x 65mm. This is secured to the ends of the dipole using four plated 6BA screws, nuts and lockwashers. Alternatively, four pop rivets could be used.

The dipole is secured to the underside of the boom using three pop rivets or self tapping screws.

As mentioned above, the antenna employs a corner reflector, which consists of three elements. Reflector element R1 is attached to the boom while elements R2 and R3 are attached to angled members made from the same square section tube as the boom. These are 162mm in length and are attached to the boom with the aid of gusset (cleat) plates, made of 1.5mm thick aluminium and also attached with the aid of pop rivets or self-tapping screws.

The pop rivets should preferably be of the closed type (for waterproof applications) and have aluminium instead of steel mandrels, to minimise the chance of corrosion.

The boom is supported and strengthened by a short parallel boom attached to it by 75mm x 4mm bolts and wing nuts and spaced away from it by 25mm, by tubular spacers. These may be of



The downlead is connected directly to the dipole. Use a plastic jar lid and silicone caulk to weather-seal the termination.

fibre or aluminium. This short boom section is then attached to the mast via a large gusset plate made of 3.2mm thick aluminium. This is drilled to take two mast clamp and saddle assemblies. These allow the antenna to be securely mounted to the mast as well as allowing it to be fixed horizontally or aimed slightly upwards, if necessary to optimise signal pickup. The saddles of the mast clamps should be against the gusset so that they contribute to its stiffness.

Termination

No balun is necessary to match this antenna to 75-ohm coax cable. We have tried it directly connected to the TV set via cable or via a VHF/UHF diplexer such as the model made by Hills. In both cases the performance was very good.

The cable inner conductor is terminated to one side of the dipole via a plated 6BA screw with washers and nuts to lock the connection. The shield and outer cable itself is clamped to the other side of the dipole with a short clamp made from scrap aluminium secured with two 6BA screws with nuts and lockwashers.

The whole cable termination should be protected from the elements with a suitably sized plastic jar lid cut to fit snugly over the cable. The assembly is then sealed and fixed in place with silicone sealant. To prevent strain on the cable it should be secured to the boom and mast with plastic cable ties.

We also suggest that the ends of the booms and reflector assembly be sealed to stop whistles from the wind. This can be done by stuffing the ends with paper and then sealing them flush with epoxy resin. Alternatively aluminium centres can supply Delrin plugs to suit.

To protect the whole antenna from the elements, especially if you live by the seaside, we suggest it be painted with an etch primer and finished with an aluminium loaded paint such as British Paints "Silvar".

Our tests indicate that the prototype antenna had a performance which was at least as good as, if not slightly better than the benchmark antenna, the Hills TC18/B4, at least as far as SBS channel 28 signals in Sydney are concerned. The prototype antenna appeared to have slightly more gain and slightly better front-to-back ratio. (For reference, the Hills TC18/B4 has a claimed gain of 14.7dB and a front-to-back ratio of 30.7dB. For those not in the business of making their own, it is a very good antenna.)

Bill of materials

3 metres of 19mm square section tubing with 1.5mm wall thickness
5 metres of aluminium strip, 3 x 10mm cross-section
600mm of 1.5mm thick aluminium, 44mm wide
Six dozen pop rivets or galvanised self-tapping screws
2 U-bolt pipe clamps to suit mast
2 75mm long galvanised 4mm diameter bolts and wingnuts to suit
2 tubular spacers to suit bolts
6BA screws, nuts and lockwashers

Miscellaneous

Scrap 1.5mm and 3.2mm thick aluminium, epoxy adhesive, scrap Lexan, paint as specified in article.

605 3½ DIGIT MULTIMETER

New replacement for YF1100. See specification tables below for details

Cat. Q11035 .... **$79.95**

705A 3½ DIGIT MULTI/CAPACITANCE METER

See specification table below for details

Cat. Q11040 .... **$119**

605 & 705A SPECIFICATIONS

Capacitance

Range	Resolution	Accuracy 605	Accuracy 705A	Test Signal	Max Input
2nF	1pF	NC	3.5% + 4	400mV rms	3V DC/peak AC on all ranges
20nF	10pF			512 Hz 40mV rms	
200nF	100pF				
2000nF	1nF				
20μF	10nF				

AC Current

Range	Resolution	Accuracy 605	Accuracy (50-500 Hz) 705A	Burden Voltage	Overload Protection
200μA	100nA	NC	1.2% + 4	0.3V max	705A: 0.2A fuse up to 250V; 605: 2A fuse up to 250V; 10A range not fused
2mA	1μA	1.2% + 4			
20mA	10μA				
200mA	100μA				
2000mA	1mA	2% + 4	NC		
10A	10mA	1.5% + 4	1.5% + 4	0.7V max	

Resistance

Range	Resolution	Accuracy (Hi) 605	Accuracy (Hi) 705A	Open Voltage	Overload Protection
200Ω	100mΩ	1% + 2	1% + 2	HiV: 3.5V LoV: 0.25V	250V DC/rms on all ranges
2KΩ	1Ω	0.8% + 2	0.8% + 2		
20KΩ	10Ω				
200KΩ	100Ω				
2000KΩ	1KΩ				
20MΩ	10KΩ	2% + 4	2% + 4		

DC Voltage

Range	Resolution	Accuracy 605	Accuracy 705A	Input Impedance	Overload Protection
200mV	100μV	0.5% + 1	0.5% + 1	10MΩ on all ranges	1000V DC/peak AC on all ranges
2V	1mV				
20V	10mV				
200V	100mV				
1000V	1V	0.8% + 1	0.8% + 1		

AC Voltage

Range	Resolution	Accuracy 605	Accuracy (50-500 Hz) 705A	Input Impedance	Overload Protection
200mV	100μV	1% + 4	1% + 4	10MΩ on all ranges Capacitance 1000pF	750V rms on all ranges except 200mV AC ranges (15 seconds max above 250V rms AC)
2V	1mV				
20V	10mV				
200V	100mV				
750V	1V	2% + 4	2% + 4		

DC Current

Range	Resolution	Accuracy 605	Accuracy 705A	Burden Voltage	Overload Protection
200μA	100nA	NC	1% + 1	0.3V max	705A: 0.2A fuse up to 250V; 605: 2A fuse up to 250V; 10A range not fused
2mA	1μA	1% + 1			
20mA	10μA				
200mA	100μA				
2000mA	1mA	1.5% + 1	NC		
10A	10mA	1% + 1	1% + 1	0.7V max	

NC = Not Connected

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 $79.95

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
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- 1/2" high contrast LCD
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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 $109

2K OHM MULTI METER

11 Ranges, pocket size.

SPECIFICATIONS
11 RANGES
DC VOLTAGE: 0-10-50-250-1000 volts 2000 ohms/volt
AC VOLTAGE: 0-10-50-250-1000 volts 2000 ohms/volt
DECIBELS: -10 to +22dB in four ranges
OHMETER: 0-10 k/ohms, 0-1 mega-ohms
DC CURRENT: 1-100mA

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SPECIAL, ONLY $21.50

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Plastic boxes with aluminium tops, and available in four sizes. Very popular for projects and very economical!

H10101 150x90x50mm	***$ 3.25***
H10102 195x113x60mm	***$ 4.50***
H10103 130x68x41mm	***$ 2.75***
H10105 83x54x28mm	***$ 1.95***
H10110 120x65x38mm	***$ 2.95***
H10112 120x65x38mm (Metal top)	***$ 2.95***

MINI UTILITY CASE

Features a clear plastic lid for instant inspection of contents. Up to five, adjustable lower compartments plus a self elevating upper tray for smaller items.
Dimensions: 110 x 210 x 43mm.

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IC STORAGE CASE

Electro static charge proof plastic IC case with conductive sponge.
Dimensions: 75 x 130 x 19mm

Cat. H10095 **NORMALLY $8.95**
SPECIAL, ONLY $7.95

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Featuring a powerful 6000 r.p.m. motor, this lightweight (113gm) drill is ideal for many jobs. Perfect for PCB work! Has a 0.8 to 1.2mm chuck and 1mm drill bit.
Requires 12V 1 AMP (use with M19010)

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MF353 (3½" DRIVE)
Double sided, double density, 1 M/Byte unformatted, 80 track per side.
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MF351
3½" Standard size disk drive Single sided, double density.
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Slimline 8" Disk Drive. Double sided Density No AC power required. 3ms track to track. 1.6 Mbytes unformatted, 77 track side 10s/su10 bit soft error rate.
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Case & Power Supply to suit
Cat. X11022 **$159**

M4854
Slimline 5¼" disk drive. Double sided, double density. 96 track/inch 9621 bit/inch, 1.6Mbyte unformatted 3ms track to track access. 77 track/side.
Cat. C11904 **$350**
Case & Power Supply to suit
Cat. X11011 **$109**

M4853
Slimline 5¼" disk drive. Double sided, double density, 1 Mbyte unformatted. 3ms track to track. 80 track/side, 5922 bits/inch.
Cat. C11903 **$260**

M4851
Slimline 5¼" disk drive. Double sided, double density 500K unformatted. 40 track/side. Steel band drive system.
Cat. C11901 **$219**
Case & Power Supply to suit
Cat. X11011 **$109**

M4855
Slimline 5¼" disk drive, double sided, double density, 96 track/inch 2.0 Mbytes unformatted.
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- Power Unit 240 V AC
- Temperature controlled iron. 24 V AC
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- Can be left on without fear of damaged tips!

The best is always worth having.

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AA NICADS (ROCKET BRAND)

Save up to 50% off the regular price of $2.80!

1-9	10+	100+
$1.75	**$1.65**	**$1.40**

RITRON 19" RACK CASE

Tremendous Value! Dimensions 480(W) x 134(H) x 250(D)mm.

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The best and by far the quickest way to erase tapes, cassettes and computer disks! Reduces noise levels below recorders own erase head level. On/Off switch located in handle 240V AC operation.

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DIGITAL SPEEDO/ DIGITAL TACHO/ SPEED ALERT

- Digital readout (LED) for both tacho and speedo.
- Alarm with sound at variable preset speed.
- Audible beeper and visual indicator.
- In built light indicator for night illumination.
- Designed for 12 volt negative earth electrical systems.
- Speedo: 0 - 199kph
- Tachometer: 0 - 9900kph
- Speed alert: 40 - 120kph
- Complete with mounting hardware.

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ARLEC SUPER TOOL

A versatile 12V electric tool for

- Sanding
- Engraving
- Grinding
- Polishing
- Cutting
- Drilling
- Milling
- Erasing, etc.

Features:
Operates on safe, low 12 volts from mains electricity via AC adaptor (supplied). Light and easy to handle with touch switch and lock for continuous running. High torque motor, 10,000 R.P.M. Can drill 2mm holes in steel. 2 year guarantee.

Contents:

- 12V Super Tool
- Plugpack AC adaptor
- 1 spherical milling cutter
- 1 wire brush
- 1 grinding wheel
- 4 drill bits, 0.6, 0.8, 1.0, 1.2mm
- Set of 5 chuck collets
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SPECIAL, ONLY $44.95

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Use these quality, all metal, Piezo tweeters for great top end sound in your band speakers, disco sound system, etc. Rated at 30 watts RMS, in a system they will handle over 100 watts RMS.

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Impedance: 8 ohms
Rating: 30 watts RMS
Response: 1.5kHz - 14 kHz
Dimensions: 102 x 267 x 177mm
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This month only $39.95

Size: 3" x 7"
Impedance: 8 ohms
Rating: 30 watts RMS
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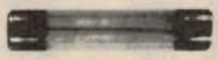

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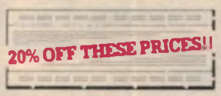

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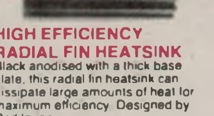

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- Detachable 6 inch earth lead
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- IC test tip
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Rise Time: 10:1 position less than 1.4ns nominal

Switch Function:

(a) 10:1 attenuation +/- 1%, with oscilloscope of 1 Mohm input resistance

(b) 1:1 attenuation with bandwidth of 10 MHz approx.

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Input Capacitance: 16pF typical depending upon oscilloscope input capacitance

Compensation Range: oscilloscopes of 15 to 60 pF input capacitance

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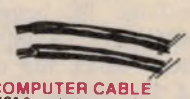

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ADC CD-100X compact disc player

ADC is a new brand on the Australian market as far as compact disc players are concerned although older readers will recall the popular ADC cartridges of about a decade ago. The ADC brand is now applied to a range of graphic equalisers and this compact disc player, which is made in Japan.

As with many CD players on the market now, the ADC CD-100X is not unique in the slightest. It is finished in black with grey lettering and it is a front drawer loading machine. Dimensions are 341mm wide, 293mm deep and 88mm high and weight is 3.3kg.

The control panel for the machine has a fairly busy appearance due to the number of labels but the control line-up is fairly standard. There are 10 pushbuttons in all, with functions as follows: Play/pause, Stop/open, Skip forward, Skip back, Forward, Reverse, Memory Enter/set, Memory clear, Repeat and Time remaining. As well, there is a power pushbutton on the left-hand side of the panel, just below the disc drawer.

The rear panel is bare apart from the RCA output terminals, the mains voltage selector and the power cord. The machine is labelled as being "double-insulated" and is fitted with a sheathed two-core flex and moulded Australian-style 2-pin plug.

Removing the top cover reveals a spacious plated steel chassis substantially occupied by a large PC board. There are also vertically mounted boards behind the front panel and on the right-hand side of the chassis. Most of the circuitry is contained in three large integrated circuits, made by Sony and Hitachi. The ADC is a 16-bit machine with a single digital-to-analog converter and a seventh-order passive filter.

The CD player mechanism has a very pliant suspension and has an interesting clamp system on the underside of the chassis. This employs a plastic clamping piece and two screws, plus a nylon locking screw.

Transit clamping screws for most compact disc players are a nuisance because they are bound to be lost once they are removed for playing. The ADC player solves this problem by providing a new position for the clamp and transit screws when in the playing mode.

In this way, if you have to pack up the player for transport, you don't have to search for the screws and clamp. They are right there on the chassis, together with instructions stamped into the metal. Other CD player manufacturers would do well to come up with a similar solution.

When the player is turned on, the small vacuum fluorescent display shows a "1" to indicate that it is alive. Then pressing the Play/pause or Stop/open button causes the drawer to slide open ready for a disc. Pressing one of the same two buttons then causes it to close, ready to be programmed for play. Alternatively, if Play is pressed the music will start almost immediately.

It is also possible to push on the disc drawer to make it retract, a good feature which prevents mechanical abuse.

Playing features of the ADC are fairly standard for most machines. The only facilities it really lacks are audible fast forward and reverse, and index programming which most people don't use anyhow.

Performance

Most of our tests on the ADC CD-100X were made with the Technics SH-CD001 and an AWA noise and distortion meter which has a steep rolloff 20kHz filter. This latter feature is important in making some of the measurements.

Frequency response turned out to be very flat, even for a CD player, with virtually no deviation at all from 20Hz to 5kHz. Above 5kHz there is a very slight rise in the response to +0.6dB at 15kHz and then dropping back to 0dB at 20kHz. Many players are down by as much as 2dB at 20kHz so the ADC machine stands out for this parameter alone.

Separation between channels was also very good with figures of 92dB at 100Hz, 93dB at 1kHz and 80dB at 10kHz (worse channel figures in each case).

In the same vein, linearity test results were outstanding with no error at −70dB, +0.2dB at −80dB and +2dB at −90dB. We were able to measure these

results in spite of a residual 44.1kHz signal at −78dB with respect to 0dB level. (We were able to remove this from the measurements with the distortion meter's 20kHz filter.)

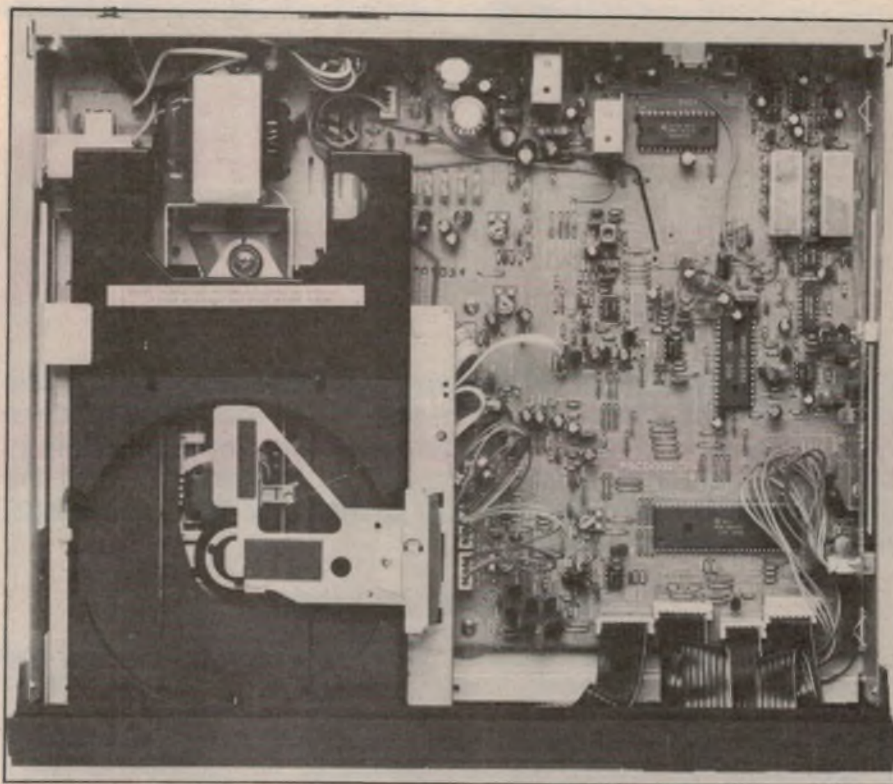
Total harmonic distortion results were also very good with the results being around .006% for frequencies up to 1kHz. Above this point the distortion rises gradually until it reaches .027% at 15kHz. Above there the THD figure rises more rapidly to 0.3% but these figures are clouded by the 44.1kHz sampling artefacts in the distortion products.

Checks on the tracking performance of the machine using the Philips No 4A test disc gave it a clean bill of health. It sailed through all the tests with not so much as a hiccup. And the machine also managed to load and play most of the tracks on our badly scratched sample disc which is a pretty good result. Some machines can't even load the contents of this particular disc, let alone play any of the tracks.

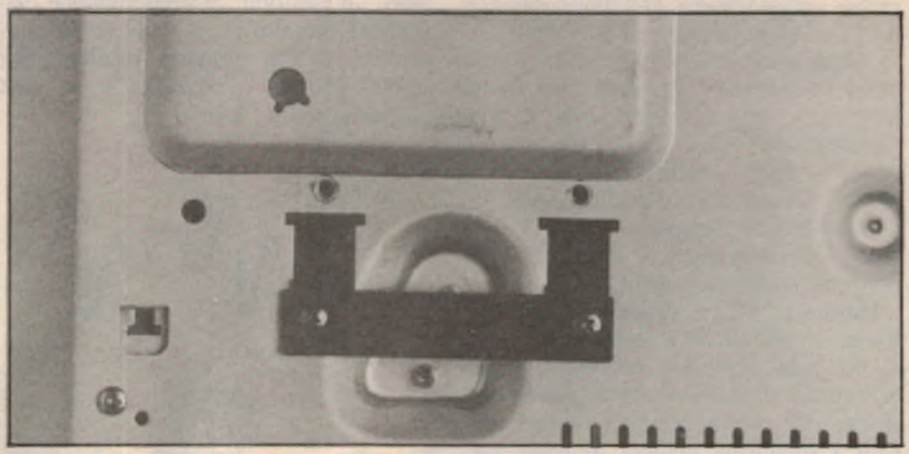
Nor was the ADC overly susceptible to shock and jarring. We judged that it was quite immune to sideways jarring but somewhat less so to jarring the top panel of the case. Overall though, it was good.

Having said all that, the machine sounds particularly good too. Compared with many other machines, which have that slight rolloff at the top end, the CD-100X has a very clean and extended top end. We have to recommend it as a very good all round machine.

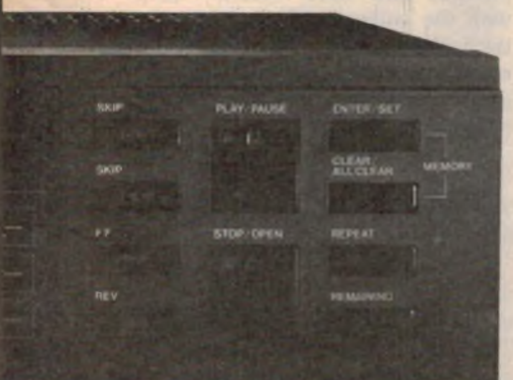
Recommended retail price of the ADC CD-100X is $599.00. For further information and demonstration, contact hifi stores, Jaycar Electronics stores or the Australian distributor, Concept Audio Pty Ltd, 98 Old Pittwater Road, Brookvale, NSW 2100. Phone (02) 938 3700. (L.D.S.)



Inside the CD-100X — most of the circuitry is mounted on a large PC board.



The suspension clamping system employs a plastic clamping piece and two screws, plus a nylon locking screw (top left).



SPECIFICATIONS

Frequency response	±0.8dB (10Hz to 20kHz)
Total harmonic distortion	.004%
Signal-to-noise ratio	96dB or more
Channel separation (1kHz)	90dB
Output level	2V RMS at 600 ohms
D-A conversion	16 bit linear
Filter	passive 7th order
Error correction	CIRC dual system
Dimensions (W x H x D)	341 x 88 x 293mm
Weight	3.3kg

An introduction to hifi Pt.4

CARTRIDGES & STYLI EXPLAINED

For fifty years or more, phonograph records have been a vital part of domestic sound systems and, while their dominance is now threatened by the digital compact disc, they are likely to be around for quite a few years yet. In this chapter, and the one to follow, we examine the technology of conventional records and record players.

by NEVILLE WILLIAMS

In practical terms, the so-called "black disc" has a longer history than any other item in a domestic sound system. The basic principle dates back to pioneers like Edison, Berliner, Bell and Tainter, who were offering their phonographs, gramophones and graphophones for sale before the turn of the century.

"Graphophone", along with many other such names, has long since been forgotten but "phonograph" and "gramophone" are still with us as generic nouns signifying a record player. Of the two, "phonograph" — abbreviated to "phono" — is the one most commonly used in the context of domestic audio equipment.

However, while modern, high-performance phono decks have their roots in the past, they are nevertheless the end result of decades of dedicated research and development, topped off with a significant content of space-age precision and technology.

Before discussing the major components in a modern, quality phono deck, it may be helpful to look at the record groove itself — a source of wonderment to many: how can a groove in the surface of a disc capture and store sound, especially sound as complex as that of a symphony orchestra?

The record groove

The answer to that question follows on from the closing paragraphs of Part 1, dealing with sound waves. We pointed out there that multiple pressure waves from a sound source, whether simple or complex, add up to a single pressure resultant at any one instant at any given point in a sound field.

The resultant varies continuously, depending on the instantaneous sum of the individual components. In a soundfield, an eardrum, or a microphone diaphragm, vibrates in response to the constantly varying pressure resultant (or sound pressure "envelope") at that particular point.

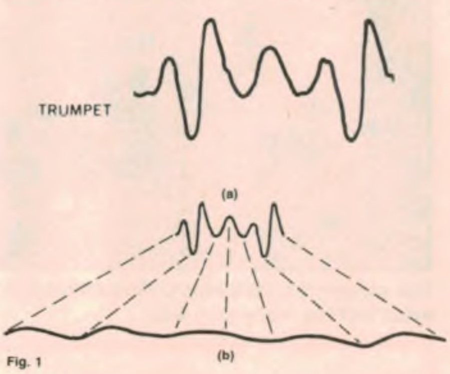


Fig.1: (a) represents a few cycles from the sound pressure envelope of a trumpet; (b) suggests how the same waveform might look as the segment of a groove in a laterally recorded disc.

Fig.1(a), reprinted from this earlier section, depicts a few cycles from the sound pressure envelope of a trumpet. Imagine this being picked up by a microphone and fed to a recording head inscribing a lateral (sideways modulated) groove in the surface of a master disc.

Fairly obviously, the groove deviations would be essentially proportional to those of the source signal but, to be physically traceable by a playback stylus, they need to be suitably adjusted in amplitude and elongated by virtue of groove speed, more or less as depicted in Fig.1(b).

When that same fragment of groove is replayed, the original signal (1a) will be recovered — hopefully along with the rest of the trumpet solo — to be fed to an amplifier and loudspeakers and enjoyed by all!

In short, a record groove can logically be regarded as a graph of a sound pressure envelope, not drawn on paper, but inscribed as a wriggly spiral, hundreds of metres long, in the surface of a disc. The more complex the source signal, the more complex the pattern of deviations in the groove, and therefore the more complex the sound pressure pattern ultimately radiated from the loudspeakers.

Groove size, shape

In the era of mechanical reproduction, the groove and "needle" geometry had to be sufficiently rugged to provide adequate drive for an acoustic diaphragm and horn system. However, with the widespread adoption of "electric" pickups and amplifiers in the '30s, a less cumbersome system became possible, although it did not actually emerge until after the war.

Fig.2 indicates the relative size of the "coarse groove" geometry (a) used in 78rpm shellac discs and (b) that adopted for "fine groove" LP vinyl records.

Coarse grooves were originally played with steel "needles" designed to wear to the shape of the groove while playing. Towards the close of the era, they gave way to "permanent" styli with a hemi-

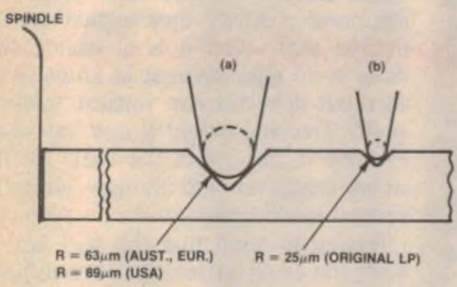


Fig. 2

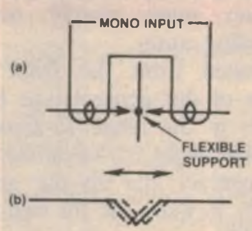


Fig. 3

Fig.2: (a) depicts a "coarse" (78rpm) groove being played by a hemispherical jewel tipped stylus; (b) indicates the relative geometry of the groove and stylus adopted for the original LP discs.

Fig.3: In a mono recording, groove modulation is purely lateral, the depth of the groove remaining substantially constant. Compare this diagram with Fig.4f (below).

spherical jewel tip, as shown, commonly ground to a radius of 63μm (0.0025in).

By contrast, fine groove technology called for a tip radius of (initially) 25μm (0.001in) and a much lower tracking force (or weight) on the stylus — down from 30 grams or more to five grams or less.

Apart from the advantage of longer playing time and lower noise, the new standards encouraged progressive refinement of both recording and replay equipment, in terms of wider frequency response, lower distortion and greater dynamic range. Further impetus was provided by the subsequent introduction of stereo recording and playback.

45/45 stereo system

And that raises the question as to how it is possible to record two separate audio signals in the one groove, representing the left and right stereo channels.

Fig.3 depicts the situation with ordinary mono lateral recording. The cutting stylus is driven from side to side (a) by the incoming audio signal such that the groove (b) deviates to the left and right of its unmodulated path, the depth remaining substantially constant.

For mono playback, the head and arm must be free to follow slight undulations or eccentricities in the disc or turntable but the stylus system itself needs only to sense lateral groove deviation, generating a single, mono output signal as it does so.

By contrast, stereo LP recording and playback, introduced in the late '50s, uses the so-called "45/45" configuration. As indicated in Fig.4(a), it involves twin drive systems for the cutting stylus, each mounted at 45-degrees to the horizontal, and a complementary 45/45 mechanism in the playback head.

If signal drive is confined to the left channel (b) only the inner wall of the groove is modulated. Conversely, signal to the right channel only modulates the outer wall of the groove (c).

With different signals applied simultaneously to both channels, different modulation patterns appear on the respective walls. Depending on the instantaneous relationship of the drive signals, the stylus may move sideways, upwards or downwards, with the groove being modulated both laterally and vertically (d).

For stereo playback, the process is reversed, with the pickup stylus assembly responding to modulation on either or both walls and generating separate left-channel and right-channel signals.

Stereo-mono compatible

In practical recording situations, sound sources near the centre of the stereo sound field may produce similar signals in both channels, particularly at lower frequencies. Depending on the phase relationship of the cutter drive circuits, these "common mode" signals could cause the cutter to move either vertically (e) or horizontally (f).

Standard recording practice requires that "common mode" or "centre stage" signals produce lateral deflection of the cutter (f) equivalent to normal mono (Fig.3b). This ensures a basic compatibility such that a mono cartridge can play a stereo disc, and vice versa, the signal content being normal in each case, except for the absence of stereo information.

(Note that a mono cartridge, used to

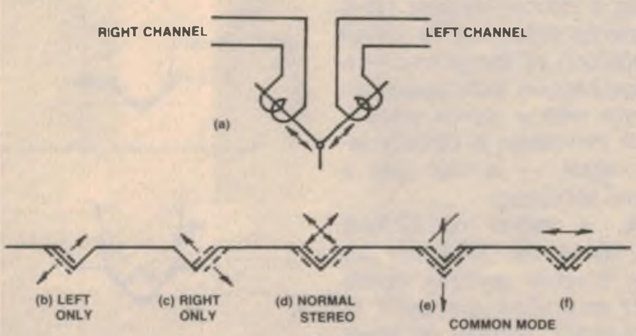


Fig. 4

Fig.4: With a 45/45 stereo system (a), vertical as well as lateral modulation is evident in (b), (c) and (d). A special situation arises with identical signals in both channels, resulting in (e) and (f).

Cartridges & styli

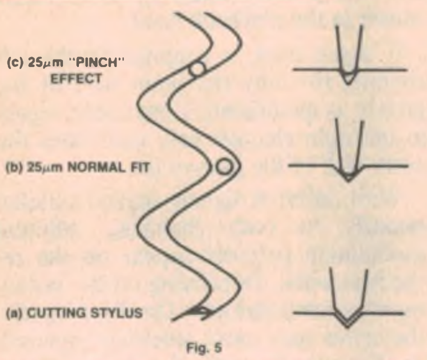


Fig.5: When a cutting stylus (a) is moving sideways, it cuts a narrower groove, forcing a spherical tipped stylus (b) towards the top of the groove as at (c) — described as "pinch" effect.

play a stereo record, should have sufficient vertical compliance in the stylus suspension to allow it to track the vertical modulation, and so avoid damage to the groove.)

Playback styli

In the '50s, the task of mass producing affordable, properly ground and polished jewelled styli, with a 25μm tip radius, was a daunting one but manufacturers learned to cope, first with sapphire and later with diamond, which is harder and more wear resistant.

With the introduction of stereo, and consequent closer attention to groove shape, it became desirable to use a tip radius smaller than 25μm, partly to ensure better tracking of fine (high frequency) groove modulation and partly in an effort to counteract "pinch effect", which can occur where the groove narrows, during lateral deviation of the wedge-shaped cutting stylus. (Fig.5a).

In traversing a narrow segment (c) a 25μm spherical-tip stylus can be forced up on the shoulders of the groove — a secondary consideration with mono cartridges but not with a stereo system, where vertical movement is directly interpreted as signal — in this case a spurious second harmonic.

In practice, a radius of 12.5μm (0.0005in) is about the minimum for spherical tips, because anything significantly smaller may allow the stylus to touch the rounded bottom of some grooves, resulting in noise due to debris, and/or distortion due to "skating" effects. Even 12.5μm is suitable only for cartridges able to operate with a very low tracking weight, because of accelerated tip wear and the risk of compressing fine groove serrations — described as "dynamic" distortion.

Nowadays, as a more forgiving figure for modestly priced spherical tips in modestly priced cartridges, most manufacturers favour a minimum radius of about 17.5μm (0.0007in).

Multi-radius styli

Seeking a more effective answer to both pinch effect and tracking problems, designers subsequently came up with the bi-radial or "elliptical" concept — the first step towards a 3-dimensional contour more closely resembling a recording cutter.

Viewed from the front (Fig.6a) a stylus of this general type has a major radius in the range 15-23μm, but with possible slight modifications to increase the contact line up the groove walls, and/or to keep the tip well clear of the bottom.

From above, the section within the groove is a slim oval (Fig.6b) with shoulder radii in the range 2.5-5μm, resulting in a stylus less prone to pinch effect and also better able to follow high frequency groove modulation — therefore exhibiting lower "tracing" distortion.

To take proper advantage of the elliptical contour, manufacturers adopted the practice of so arranging the stylus suspension that the axis of stylus movement and the alignment of the stylus shoulders was tilted forward relative to the vertical by a uniform 15 degrees — a figure later amended to 20 degrees. This is now an industry standard for the so-called "vertical tracking angle", observed by cartridge and record manufacturers alike.

The "Shibata" stylus, especially devised for the abortive 4-channel CD-4 system, pioneered the technology for a whole range of even more specialised styli, with small radius shoulders but a front profile intended to fit more snugly against the sides of the groove, as illustrated in Fig.6c.

High performance styli of this general type are variously described as "line contact", "lineal contact", "fine line", "contact line", &c, and they may be produced in diamond tipped form (Fig.6d) or as "nude" or "naked" (whole) diamonds (6e). But they have one thing in common:

The more specialised their shape and the more critically they exploit groove fit, the more vital it is to ensure that there is no misalignment in terms of either left-right tilt, or vertical tracking angle. Tracking weight is also important because it can affect the "set" of the stylus cantilever and thereby alter the vertical tracking angle.

Having in mind that the styli are almost too small to see, it is not difficult to appreciate that such requirements place extreme demands on the precision of the cartridge and playing arm, and on the operation of the mechanism as a whole. It is on this kind of precision that the performance of a top quality record player depends.

Frequency characteristic

In the recording process, the groove is normally inscribed in the surface of the master disc by a magnetic cutting head, as implied in Figs.3&4. The signal(s) to be recorded are fed to windings which are part of a magnetic circuit in the head and the resulting field, varying in response to the audio signal(s), causes the stylus to vibrate in sympathy,

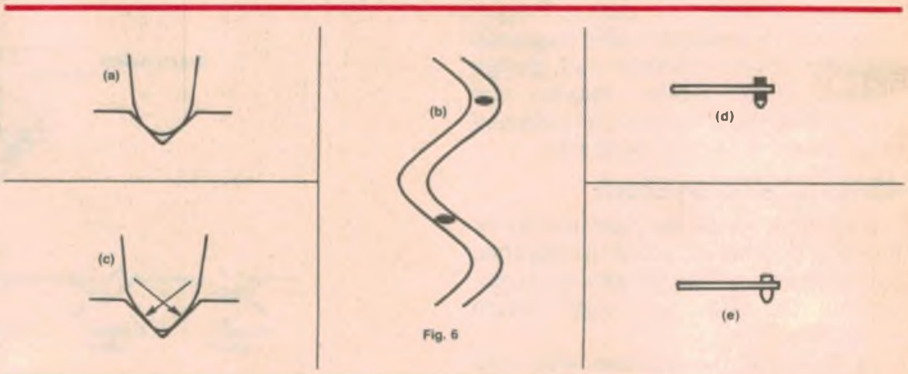


Fig.6: An elliptical stylus (a) largely overcomes pinch effect (b). Shibata or similar styli (c) provide a longer contact area with the groove walls. Styli may be jewel tipped only (d) or "nude" (i.e. whole) diamonds (e).

Cartridges & styli

modulating the groove as it is inscribed.

By nature, a magnetic recording head exhibits what is termed a "constant velocity" characteristic, such that the amplitude of the groove modulation tends to vary inversely as the signal frequency. Double the frequency and the amplitude is halved; halve the frequency and the amplitude doubles.

Because this would lead to excessive amplitude at low frequencies and inadequate groove modulation at high frequencies, engineers normally modify the frequency response of the head drive amplifier(s) to counteract the constant velocity characteristic and so achieve a convenient level of modulation at all frequencies.

As a result all phono recordings have an intrinsic frequency characteristic which has to be taken into account in the replay system. A complete article could be devoted to the subject of recording characteristics used over the years but, fortunately, the vast majority of LP recordings conform to the "RIAA" (Record Industry Association of America) characteristic, either in its original or a slightly modified form.

In fact, a recording head compensated to the RIAA characteristic exhibits something fairly close to a "constant amplitude" response, producing a groove deviation which remains substantially constant with frequency. We shall be saying more about this later.

Phono cartridges

In the 78rpm era, the transducer components were often built into the actual pickup arm but, with the greater precision and higher expectations associated with fine groove records, the preferred approach was to mount them in a separate cartridge.

Over the years, phono cartridges have been designed around a variety of basic principles — Capacitor, FM, Magnetostriction, Optical, Semiconductor, Strain gauge, &c. but, while interesting in themselves, they attracted only limited support. Nowadays, the vast majority of cartridges fall into two main categories: piezo and magnetic.

Piezo cartridges

"Piezo", short for "piezoelectric", exploits the characteristic of certain (notably crystalline) substances to produce a voltage between opposite faces when subjected to pressure or stress. In a phono cartridge, the stress is provided by the stylus assembly, while the resultant voltages are sensed by tiny foils bonded to the relevant faces.

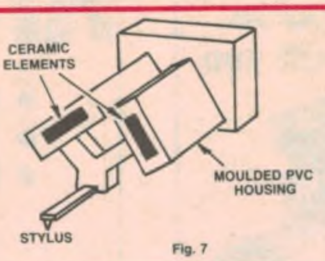


Fig.7: The physical construction of a typical ceramic cartridge — able to be mass produced reliably and cheaply but not well suited to true hifi requirements.

Early model piezo ("crystal") cartridges used tiny slabs of crystalline Rochelle salts. They were superseded by cartridges using specially processed barium titanate ceramic elements. While their output level was somewhat lower, they were much more durable, particularly at high levels of temperature and humidity.

Fig.7 illustrates one of many possible configurations for a stereo "ceramic" cartridge. A flexible suspension supports the stylus assembly, permitting the stylus to track the modulation while, at the same time, applying stress to the ceramic elements.

By nature, a piezoelectric cartridge exhibits a constant amplitude response, its output voltage being proportional to the amount of deflection, irrespective of frequency. Since, as noted earlier, an LP recording is recorded to a substantially constant amplitude characteristic, a ceramic cartridge will recover from it a substantially "flat" signal.

This makes it possible for a ceramic cartridge to be used without a frequency compensating preamplifier — but only in medium fidelity equipment. "Substantially" flat is not flat enough for a good quality system!

In addition, the need to perform "work" on the ceramic elements adds stiffness to the stylus movement, effectively reducing its "compliance". This calls for a fairly high playing weight to ensure that it tracks the groove and that, in turn, necessitates a more rugged stylus and assembly, leading to a higher effective tip mass, poorer transient response and the added likelihood of resonance effects in the passband.

Designers have made resolute attempts to compensate or otherwise upgrade crystal and ceramic cartridges to full hifi standards but without notable success. They remain a convenient medium-fi component although, even in that area, they are facing increased competition from mass produced magnetic types.

Magnetic cartridges

Essentially, magnetic cartridges involve a small permanent magnet, the components necessary to form a magnetic circuit, and the coils across which the signal voltages are developed.

Depending on the design, movement of the stylus may be transmitted to the magnet (MM, moving magnet system), to some element of the magnetic circuit (VR, variable reluctance) or to the coils (MC, moving coil). All have been used successfully in good quality cartridges.

All magnetic cartridges exhibit a constant velocity characteristic, such that the output signal voltage tends to vary

MM & VR magnetic phono cartridges — typical parameters #

Weight of cartridge	3.5*-11gm
Equiv. stylus tip mass	0.3*-0.7mg
Rated frequency response	20Hz-20kHz/30kHz*
Freq. response tolerance	± 1dB*, ± 3dB.
Output, 1000Hz, 5cm/sec	2.0mV-5.0mV*
Channel separation, 1000Hz	20dB-30dB*
Channel balance, 1000Hz	1.5dB*-2.0dB
Dynamic compliance, 10Hz	20-40* μm/mN
Recommended tracking force+	10mN (1.0g)*-20mN
Load resistance+	47k-100k ohms
Total shunt capacitance+	200pF*-500pF

MC cartridges also, except for output impedance & voltage.
+ Follow manufacturer's recommendation.
* Denotes preferred end of quoted range.

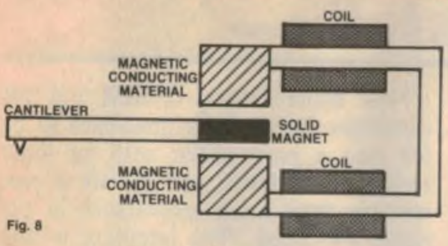


Fig. 8

Fig.8: Illustrating the moving magnet system. For simplicity, only one pair of coils, for one channel, is shown. The induced magnet system is an elaboration of this same principle.

directly with frequency: double the frequency and the output tends to double; halve the frequency and the output is likewise halved.

When playing an LP record, with its substantially constant amplitude characteristic, a magnetic cartridge will generate a signal with a rising treble and a falling bass response. Magnetic cartridges therefore need to be used with a compensated preamplifier — in fact, one exhibiting a response which is the converse of the RIAA recording characteristic. (See Fig.2b&c in the previous chapter).

Moving magnet system

Fig.8 depicts, in highly simplified form, the operation of an MM (moving magnet) type cartridge. A tiny magnet, mechanically coupled to the stylus cantilever, moves physically in the space between the pole faces, modulating the magnetic field and inducing signal voltage in the associated coils.

In a stereo cartridge, there are actually four pole faces and two magnetic circuits set at 90-degrees to each other and at 45-degrees with respect to the horizontal, respectively sensing modulation from the left and right groove walls.

The size of the moving magnet involves a compromise between output signal level, and the degree by which a more powerful (and heavier) magnet would increase the effective moving mass at the stylus tip. This could limit the response to transients and, as well, aggravate mechanical resonance effects.

The "induced magnet" concept offers a way around this difficulty by using a deliberately small or virtual moving magnet but supplementing its field with a powerful fixed magnet. While minimising the original problem, however, an extra magnet can add to the all-up weight of the cartridge, complicating arm resonance effects in the sub-bass region.

Variable reluctance

Fig.9 closely resembles Fig.8 but illustrates the variable reluctance approach, as expressed in Ortofon's VMS (variable magnetic shunt) type cartridge.

In broad terms, reluctance can be regarded as the equivalent in magnetic circuits of electrical resistance, limiting magnetic flux. An air gap in a magnetic circuit introduces considerable reluctance; modifying the air gap in a periodic fashion will vary the reluctance and

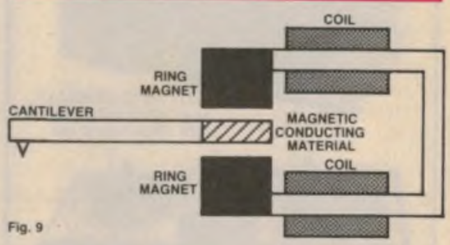


Fig. 9

Fig.9: In a variable reluctance cartridge, the magnet and coils are fixed but movement of part of the magnetic circuit modulates the magnetic flux, inducing a voltage across the coils.

therefore the flux, inducing voltages across the associated coils.

In the base of the VMS cartridge, a thin-walled armature of conducting material, attached to the cantilever, modifies the magnetic field created by a ring magnet, generating a signal voltage across the coils. Ortofon claim that their tiny tubular armature has less mass than a moving magnet, leading to improved high frequency and transient response.

Alternatively, in their MMC (Moving Micro Cross) variable reluctance cartridges, Bang & Olufsen (B&O) use a tiny flat armature attached at right angles to the end of the cantilever, and bridging the faces of four pole pieces on which are mounted the four coils.

Resonance, loading, &c

The natural resonance of the stylus system in moving magnet and variable reluctance cartridges is usually somewhere in the range of 15-25kHz. In terms of ultimate performance, the higher figure is to be preferred but it comes at a price: exotic (and more costly) technology, involving both the cartridge and the associated player, and increased vulnerability to misuse.

In most affordable quality cartridges, a resonance somewhat below 20kHz is tolerated, but subject to both mechanical and electrical damping. Mechanical damping has to do with the design of the cartridge; electrical damping with the coils and how they are terminated.

Because the coils in a moving magnet or variable reluctance cartridge are fixed, they can involve a relatively large number of turns, in the quest for adequate output signal voltage. However, with a coil inductance of typically 500 millihenries consideration has to be given to the capacitance of the pickup output leads and the input capacitance and resistance of the associated preamplifier.

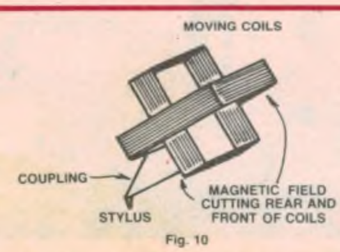


Fig.10: At the heart of a moving coil cartridge is a pair of coils driven by the stylus. In many MC cartridges, the stylus and cantilever are not user replaceable.

Most manufacturers of MM and VR cartridges design them nowadays to be fed into a preamplifier with an input resistance of 47kΩ, and specify a permissible total shunt capacitance in the range 200-500pF. The intention is that the electrical and mechanical characteristics should complement each other to produce an acceptably flat treble response.

Moving coil cartridges

At the heart of a moving coil cartridge is a pair of coils, as in Fig.10, to which is attached a cantilever and stylus. The coils are so positioned in a magnetic field that each one senses the modulation on a particular groove wall.

To minimise the moving mass, most MC cartridges use coils with a relatively small number of turns, resulting in low inductance, low impedance and only about one-tenth the output voltage of an MM or VR type cartridge.

With rare exceptions, MC cartridges cannot be fed successfully into the "Phono" sockets of a normal hifi amplifier. Early practice was to use them in conjunction with a special step-up transformer but the preferred method, nowadays, is to use a pre-preamplifier stage, either an outboard unit, or one built into the more deluxe amplifiers.

Over the years, MC cartridges have built up a virtual "cult" following, which credits them with a unique "sweetness" and "openess". In terms of published performance parameters, however, they differ little from the other types, except in respect to the output arrangements.

Magnetic fields

Last but not least, two matters should be mentioned which are common to all magnetic cartridges.

Since they involve magnetic circuits and coils, they are sensitive to stray external magnetic fields, especially those from unsuitable mains energised turntable drive motors. One mark of a well designed cartridge is effective internal shielding to isolate it, as far as possible, from external magnetic fields from any source.

The other point has to do with the field from the cartridge's own internal magnet. It is important that the cartridge does not interact with external ferrous components, if only because it can affect the playing weight when used with a ferrous turntable. EA

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by JOHN CLARKE

We have really excelled ourselves this time. This new amplifier is so good it is almost embarrassing.

Recently, quite a few readers have asked us to update the very successful Playmaster Twin Twenty-Five and Forty-Forty amplifiers. These were probably the most popular and reliable stereo amplifiers we ever published and they were very easy to build. Sure, readers were impressed with the recent Playmaster Series 200, 100 watt/channel amplifier but it was a no-holds-barred design possibly too ambitious for many tastes; and too big for many wallets.

So we set out to design a replacement for the above-mentioned amps, using a lot of the experience gained in designing the Series 200. First, it had to be easier to build — much easier than the Series 200 but still without any shielded cable wiring, indeed with as little wiring as possible. That meant a single board design with everything on it, including RCA input sockets and all the power supply, except for the power transformer.

At the same time, we did not want to incorporate CMOS signal switching, as we did in the Series 200. The need for all those buffer stages, to keep distortion as low as possible, plus the additional logic circuitry, means that the design becomes rather complicated.

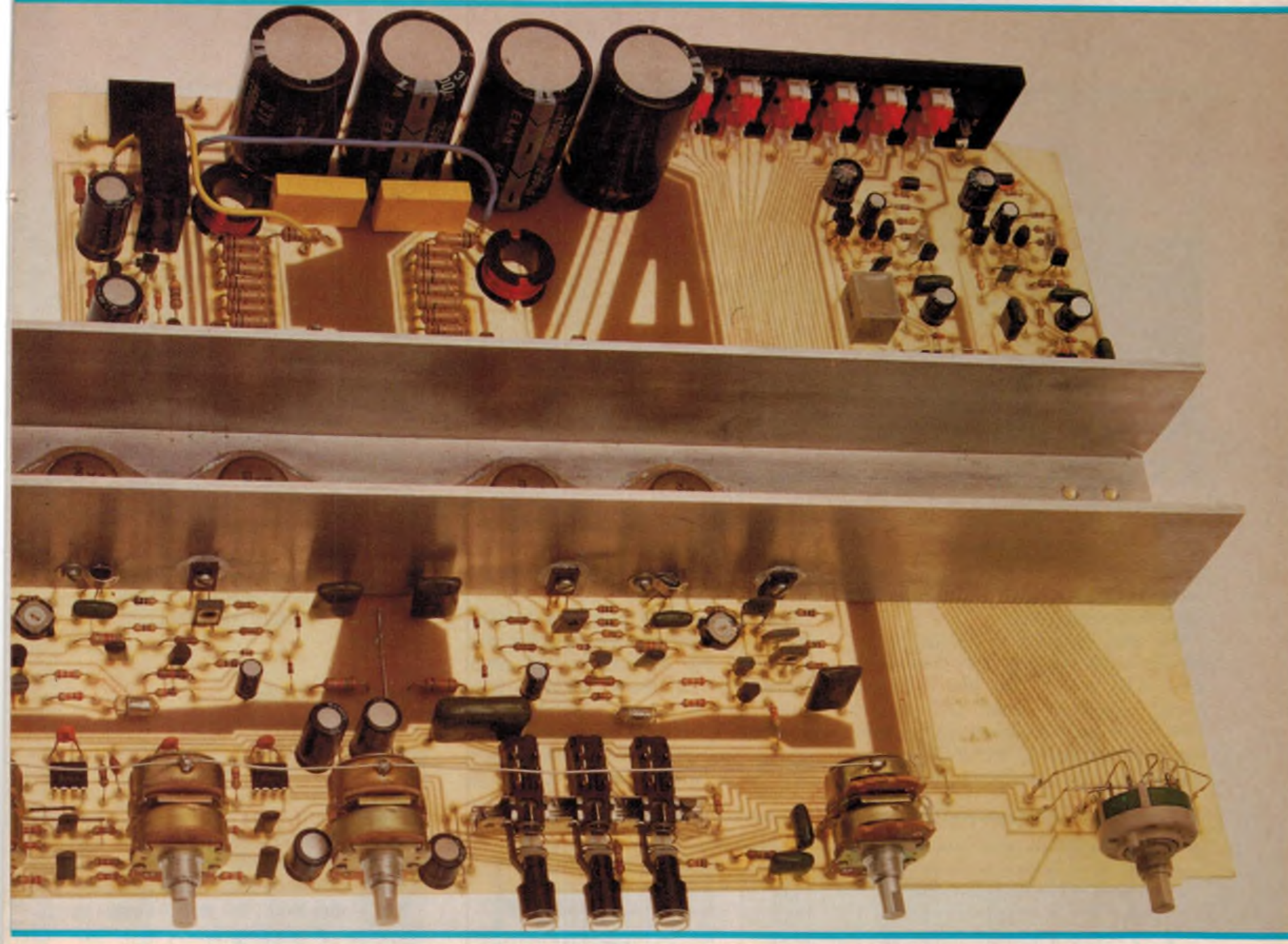
This new amplifier had to be simple, use no shielded cable for the input wiring and yet we wanted the basic specs to be at least comparable with the Series 200. Could it be done?

We started out by deciding that we would not use power Mosfets. While they do have their advantages, they have a big drawback in that they require a high quiescent (no-signal) current. That means that they have to dissipate quite a lot of power at all times. They get hot.

Mosfets also have higher dyanimc losses than bipolar transistors and so require bigger heatsinks. We wanted to use a U-shaped channel heatsink which would run across the width of the amplifier and be mounted directly on the printed circuit board. With Mosfets that would be unworkable. So we selected the most rugged bipolar transistors available at a reasonable price: MJ15003 and MJ15004.

These enabled us to design a very rugged output stage which is able to deliver very high currents and quite surprising amounts of power.

As far as the shielded cable wiring was concerned, we took the simple way out. Don't have any cables at all. Just



run the conductors from the high level inputs across the printed circuit board to the control circuitry at the front. And in between the signal conductors run earth conductors to keep crosstalk to a low value.

We pinched the basic layout concept from the Luxman L-215 amplifier. After all, why re-invent the wheel? The concept is elegant and eliminates the need for shielded cable, which is very tedious to wire into place.

The concept of no shielded cable works because all hifi program sources such as CD players, tuners and cassette decks have high level signals of around 500mV to 2 volts and they have low impedance outputs. That means that electrostatic signal pickup by the unshielded signal lines on the board tends to be swamped out by the low impedances and high signal levels.

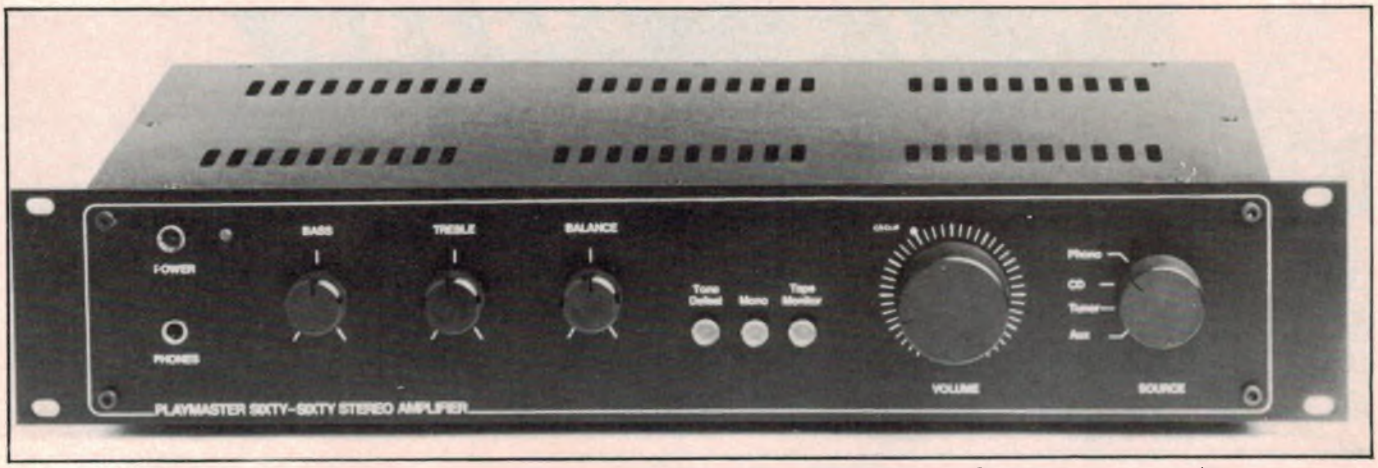
Of course, it wasn't quite as simple as that in practice. We discovered that earthing arrangements for the individual signal paths were very critical when it came to consistently achieving the very low distortion figures that we eventually obtained. We had to ensure that we obtained essentially the same distortion results no matter which set of inputs was selected and whether or not the tone controls were in or out of circuit. That proved to be quite tricky to achieve.

We also discovered that we could not use wirewound emitter resistors in the power amplifier stages because they radiated substantial energy into the nearby input tracks. This caused high distortion at the higher frequencies and at high output powers.

Features of the new amplifier

- ☆ 60 watts per channel with both channels driven into 8-ohm loads
- ☆ Very low noise on phono and line level inputs — better than CD performance.
- ☆ Very low harmonic and intermodulation distortion
- ☆ Excellent headroom
- ☆ Tape monitor loop
- ☆ Tone controls with centre detent and defeat switch
- ☆ Mono/stereo switch
- ☆ Toroidal power transformer
- ☆ Easy-to-build construction
- ☆ Very little wiring

Playmaster amplifier



The Playmaster Sixty-Sixty is built into a rack-mounting case and matches the styling of our new Playmaster Stereo AM/FM Tuner.

That problem was solved by using several paralleled carbon resistors for the emitter resistors and keeping them at right angles to and as far from the input tracks as possible.

We also specified a toroidal transformer which has very low hum radiation. And it turns out that since the power amplifiers draw less current under no signal conditions, there is even less hum radiated by this 160VA transformer than the toroidal transformer in the Playmaster Series 200. The net result is an even better noise performance than the Playmaster Series 200. That's the embarrassing part.

The final product is a very refined, simple high performance amplifier that challenges the performance of many commercial amplifiers, whether integrated models or even higher priced preamplifier and power amplifier combinations. And the price? That's the best part. At the time of writing it looks as though it will go on sale for quite a bit less than $250.00.

In real dollar terms it is much better value than the $89 price of the Playmaster Twin Twenty-Five amplifier ten years ago.

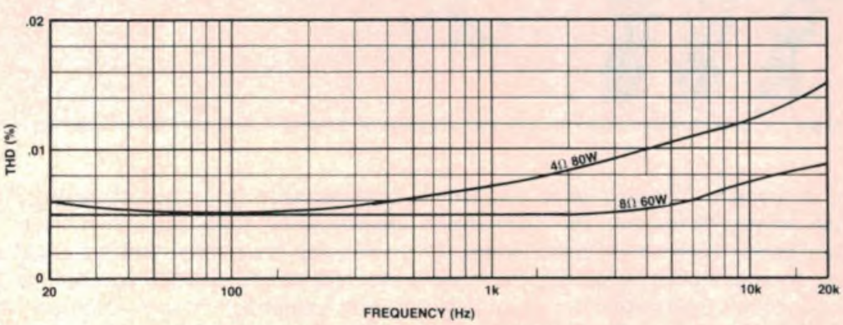


Fig.1: graph showing total harmonic distortion (THD) versus frequency (see text).

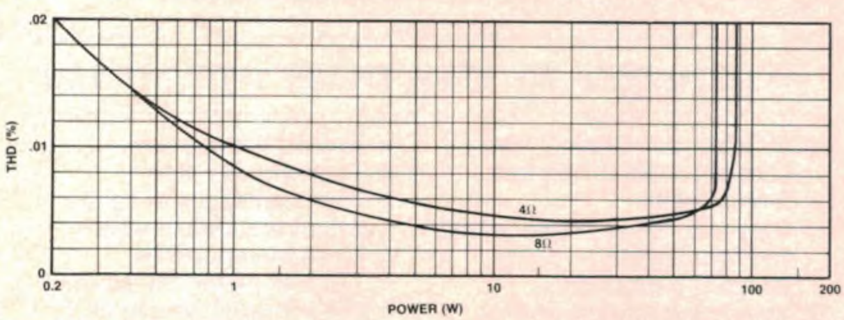


Fig. 2: THD versus power output for 4Ω and 8Ω loads at 1kHz. The apparent increase in THD below 10W is due to the increasing effects of residual noise.

Specifications

To put it into a nutshell, we have given this amplifier a continuous rated power of 60 watts per channel, with both channels driven. But it is capable of delivering a great deal more power than that. For example, when just one channel is driven, the power output at clipping is 74 watts into an 8-ohm load.

Into 4-ohm loads, the power output at the onset of clipping is 72 watts per channel with both channels driven and 88 watts with one channel driven. For short term power capability (music power), as measured by the Institute of High Fidelity specification IHF-A-202, the new amplifier can deliver 105 watts into an 8-ohm load for a single channel, and no less than 153 watts into a 4-ohm load under the same conditions. For an amplifier with a nominal rating of 60 watts per channel, that is an excellent performance.

(This IHF test for music power involves using a 1kHz +20dB toneburst superimposed on a constant 1kHz signal. The tone burst is 20 milliseconds long at a rate of two bursts per second.)

Rated harmonic distortion of the amplifier is less than .01% for all powers up to 60 watts per channel into 8-ohm loads, over the frequency range from 20Hz to 20kHz. For 4-ohm loads, the rated distortion is less than .015% for all powers up to 70 watts per channel,

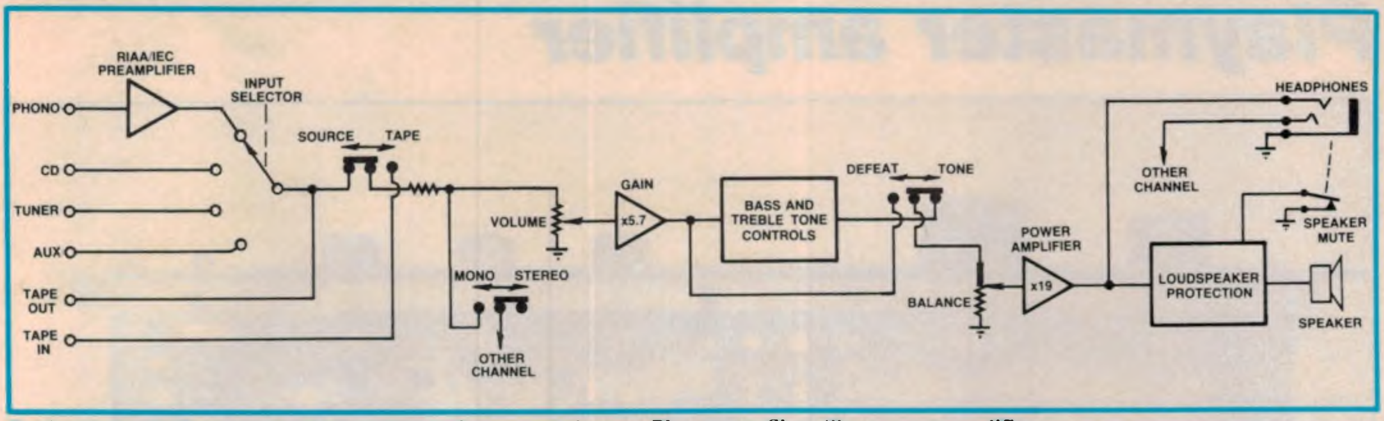


Fig.3: this block diagram shows the relevant features of the new Playmaster Sixty-Sixty stereo amplifier.

for the same frequency range.

At normal listening levels though, the distortion will typically be much lower, at around .005%. We have plotted graphs of total harmonic distortion (THD) versus power into 4-ohms and 8-ohm loads at 1kHz to give some idea of this trend. Note that the THD is shown as rising for powers below 10W but this is due to the increasing effect of residual noise rather than an actual increase in harmonic distortion.

PERFORMANCE OF PROTOTYPE

POWER OUTPUT	**One channel**	**Both channels**
4 ohms	88W	72W
8 ohms	74W	62W
Dynamic power (IHF-A-202)		
4 ohms	153W	120W
8 ohms	105W	95W
(all measured with 240VAC regulated supply)		

HARMONIC DISTORTION
less than .01% for all powers up to 60W into 8Ω loads
less than .015% for all powers up to 70W into 4Ω loads
(see graphs)

INTERMODULATION DISTORTION
less than .01% for all powers up to 60W into 8Ω loads
less than .012% for all powers up to 80W into 4Ω loads

FREQUENCY RESPONSE	
Phono inputs	RIAA/IEC equalisation within ±0.5dB from 40Hz to 20kHz
Line level inputs	−0.5dB at 20Hz and −1dB at 20kHz
CHANNEL SEPARATION	
(measured at 60W)	10kHz 66dB
	1kHz 75dB
	100Hz 79dB
(undriven inputs loaded with 1kΩ)	
INPUT SENSITIVITY	
Phono inputs at 1kHz	4.3mV
Overload capacity at 1kHz	140mV
Line level inputs	270mV
HUM & NOISE	
Phono (with respect to 10mV at 1kHz)	89dB unweighted, with typical moving magnet cartridge
High level inputs (with respect to 270mV)	103dB unweighted with 20Hz to 20kHz bandwidth
TONE CONTROL	
Bass	±12dB at 50Hz
Treble	±12dB at 10kHz
DAMPING FACTOR	
at 1kHz	>80
at 30Hz	>80
STABILITY	unconditional

Hum & Noise

Hum and noise figures for the amplifier are among the best we have seen in any amplifier. For all the line level inputs, the new Playmaster is actually better than any currently available compact disc player, with a signal-to-noise ratio of better than 103dB with respect to maximum sensitivity and full power.

Such a high figure really doesn't mean much to the average listener. In practical terms, it means that with a CD player plugged in, turned on, but with no music playing, and with the amplifier volume control turned right up, no sound will be heard from the loudspeakers. And that applies even if you place your ears right up against the speaker cones! It is really that quiet.

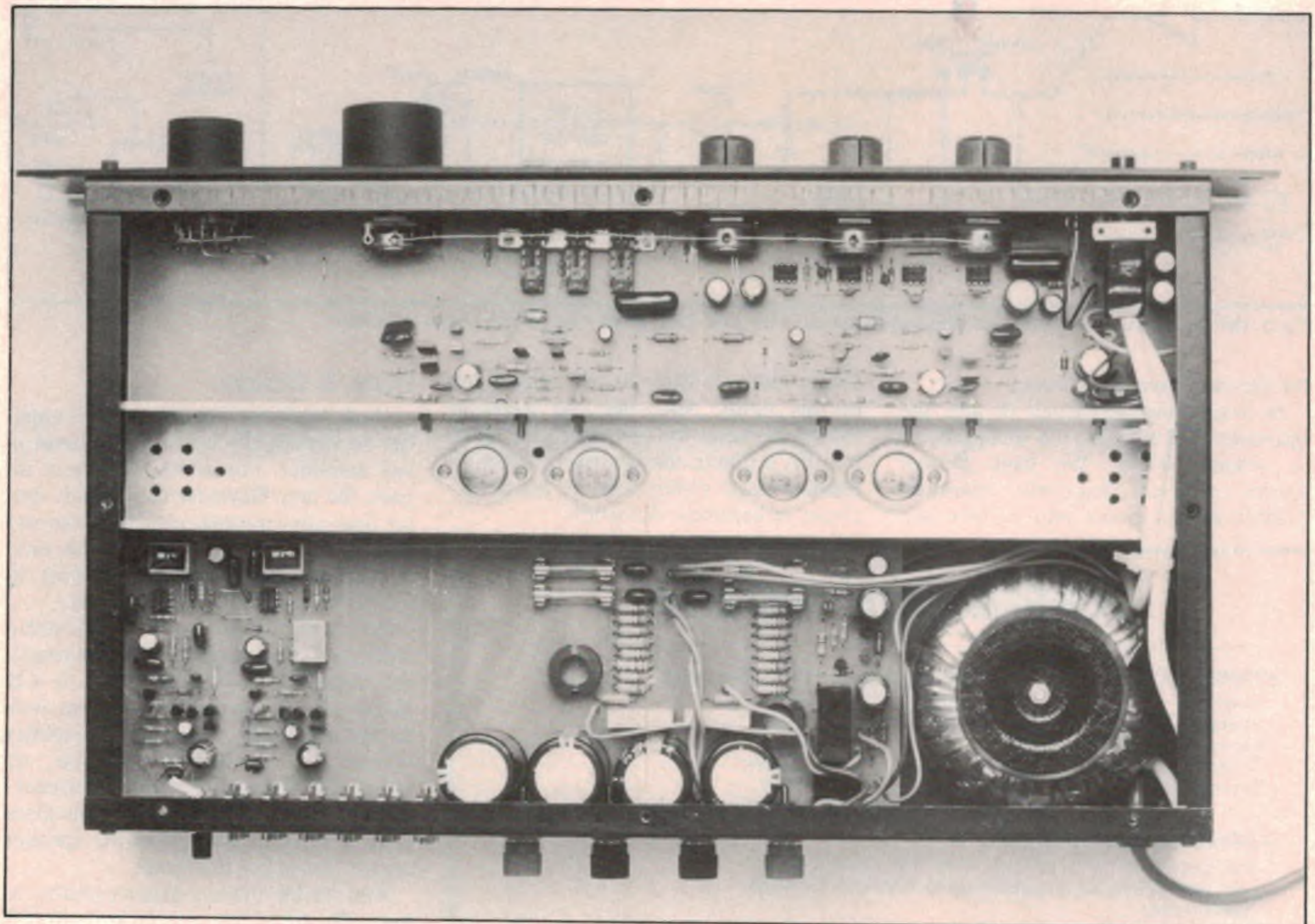
And for the moving magnet phono inputs, the signal-to-noise ratio is no less state-of-the-art at 89dB with respect to 10mV at 1kHz. These noise figures are unweighted by the way, which means that they are even better than the weighted figures used by some manufacturers.

Amplifier facilities

We have kept the operating features of the new Playmaster as simple as possible, to keep costs to a minimum and to simplify the design. That means that we have omitted switching for two pairs of speakers and comprehensive dubbing facilities for two cassette decks. We have also not included a muting switch which is a nice but seldom-used feature and moving coil cartridges are not catered for.

So the facilities are basic without being spartan. There are four sets of inputs, one for a moving magnet cartridge, and three line level sources: compact disc player, tuner and Aux (hifi VCR, musical instrument or whatever). There is also a tape monitor loop for connection of a cassette deck or

Playmaster amplifier



This interior view emphasises just how easy construction really is. Note the U-shaped heatsink running across the PC board.

graphic equaliser.

Unlike some commercial amplifiers, notably from England, we have included Bass and Treble controls. But if you don't like tone controls you can switch them completely out of the circuit with the Defeat switch. Not that it makes any difference to the measured distortion figures but there you are. You can have tone controls or you cannot. The choice is yours. You pay for them anyway.

So if you have a look at the front panel of the amplifier you will see that it has the normal knobs for Volume, Balance, Bass, Treble and Input Selector. There are four pushbutton switches, for Power, Mono/stereo, Tone defeat and Tape monitor.

There is also a stereo headphone socket which disconnects the speakers when the phones are plugged in.

Only one set of loudspeakers is catered for. The terminals for these are heavy-duty binding post-cum-banana terminals.

Overload insurance with CD players

Since the amplifier is so quiet, there is a risk that people will turn up the wick unreasonably before playing a compact disc. That brings with it the risk of blowing your loudspeakers as soon as the disc begins to play. To avoid that, we have marked the setting on the volume which corresponds to full power at the maximum CD 2V signal level.

The mark is an approximate guide only but if you turn the volume control beyond this setting you run the risk of over-driving the amplifier and perhaps blowing your speakers. So, it's included as an insurance feature. Ignore it at your own risk.

Another feature of the potentiometer controls is their smoothness and inclusion of detents. The volume control has 41 detents which makes it easy to repeat a wanted setting. Similarly, the tone controls and balance control have a centre detent to make it easy to find the normal "flat" or centre setting.

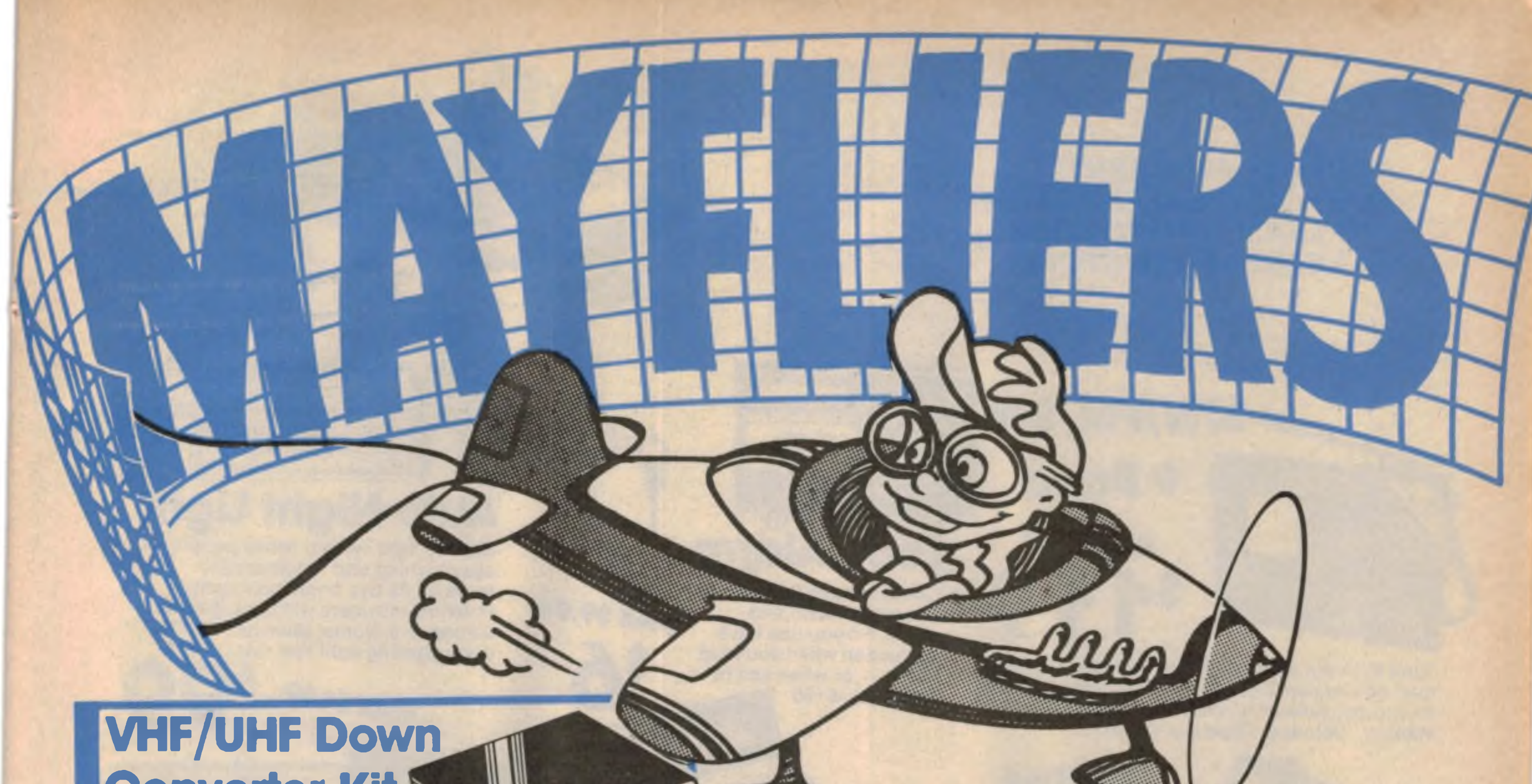
The pots are specially sourced from Japan and we strongly recommend that all suppliers use pots of equivalent quality. They really do make an important difference to the feel of the amplifier.

Overall size of the amplifier is 483 x 88 x 254mm which is the same as a standard two-unit high rack-mounting chassis.

Circuitry

In essence, the circuitry is the core of the Playmaster Series 200 but without the CMOS switching, logic circuitry and 20Hz rumble filtering. The power amplifier is also very similar to the Playmaster Series 200 but uses complementary bipolar power transistors in a Darlington configuration rather than MOSFET devices.

Next month, we shall publish and describe the complete circuit of the new amplifier.



VHF/UHF Down Converter Kit

$69.50 NEW FOR '86

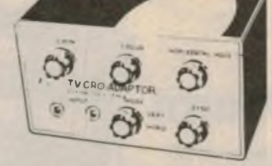
Now view UHF transmissions without the expense of buying a new TV set. It's essential for the new Ch-28 and poor VHF reception areas serviced by UHF. Measuring a mere 93x40x25mm, this easy to assemble module plugs into antenna socket. Using a lower end VHF channel, it covers UHF bands 4 and 5 (526-820MHz). All you need is a UHF antenna and presto... a whole new world of TV enjoyment!
Cat K-3236

VHF 2m 'Yagi' Antenna Kit

$89.95 NEW FOR '86

Excellent value for the 2m amateur. Brilliant 12dBd gain provides that all-important extra range. Pre-drilled to eliminate tuning hassles... so you can install it in no time!
Cat K-6297

Turns Any Old TV Into A CRO!

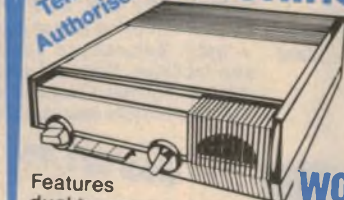


$34.50

Real money saver for all hobbyists! This sensational CRO adaptor kit converts that old black and white (or colour) TV set into a fully functional 300kHz oscilloscope. Provides excellent display at low frequencies. Only requires a 100mV for full screen deflection. Kit comes with complete components and instructions.
Cat K-3060

Dual Tape Answering Machine

Telecom Authorised



WOW!

Features dual tapes for convenience, remote beeper for message retrieval from any other phone (anywhere in the world!) and much, much more.
Great machine?
You bet!
Cat F-6136

$269

MEMORY PHONE WITH MUSIC!

Sensational value for a 12-number memory phone with a host of features. Last number re-dial and mute buttons PLUS 'music' function which entertains callers waiting on line
Cat Y-1184

Telecom Authorised

$49.95

VZ-300

VALUE!

Our popular VZ-300 colour computer offers 16K RAM colour and sound. The whole family can use it for budgeting, education and games.
Cat X-7300

$99

Expansion Module

Just so it doesn't forget! Take your VZ-300 memory from 18K to 32K units. You'd hardly need any more.
16K module
Cat X-7306
$84.50

Joysticks and Interface

Add new dimensions to your games with these super responsive joysticks. Comfortable lightweight and easy to operate. Cat X-7315
$49.50

Data Cassette

Store your programs and data for later retreival! This deluxe recorder is made just for the VZ-300. Plugs straight in. Cat X-7310
$69.50

DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS DICK SMITH ELECTRONICS

STOCK AVAILABILITY... TO AVOID DISAPPOINTMENT PLEASE PHONE YOUR NEAREST DSE STORE.

MW/FM/SW 9 Band

WAS $139

$119

Tune in to the world brilliantly with this incredible dual conversion 9-band receiver. Offers superb sensitivity, selectivity, interference rejection and stability. Colossal value! Cat D-2837

Lock Alarm

Combines the features of a security chain and alarm. So you can have protection when you're at home — or when you're out. Cat L-5155

WAS $9.95

$6

Auto Night Light

Superb light system sense people approaching and automatically turns on its two bright spot lights. Potential intruders will think there's someone at home. Ideal as a front door greeting light too! Cat L-5170

WAS $149

$99

Philips X/Over 2 Way Speakers

Use in your own design for a two-way speaker system, Ideal cross-over characteristics. Cat J-1022

WAS $1.00

25¢

Economy Control Module

The lowest price alarm module around — but it features pro quality circuitry and facilities. Both n/o and n/c inputs, suits all normal detection devices and has one minute alarm period. Cat L-5060

WAS $29.95

$25

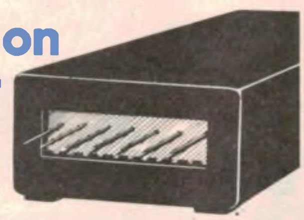
Home Satellite TV

Home Satellite Television by Rick Cook & Frank Vaughan 326 pages. If you're thinking about your own station or just curious this one has the answers. Cat B-1840

WAS $15

$10

Negative Ion Generator



You've heard all about Negative Ion Generators and their benefits, buy the kit and find out what it's all about. Many commercial units run from the mains, but our kit is safe — it runs on 12V DC, which also means that you can put one in your car. Cat K-3335

WAS $24.50

$19.50

Glass sensor alarm

Compact, simple to install sensor guards both large and small glass areas . . . a deliberate impact instantly triggers an alarm. Ideal for shop fronts or home glass sliding doors and windows. Features adjustable sensitivity control. Cat L-5165

WAS $29.95

$20

The World Of Satellite TV

What an amazing book! Covers just about everything you'd ever need to know about satelite TV. Cat B-1842

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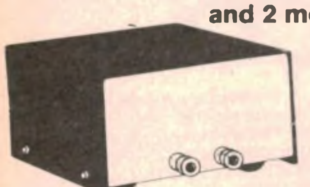
$10

13.8V Power Supply

Ideal for smaller amateur transceivers and 2 metre rigs



WAS $42.50

A big 5 amps continuous rating and 6 amp peak (depending on the heatsinks used) from this supply. Comes with all components, PCB, etc, but no 'hardware'. Build it Cat K-3449

$35

Appliance Alarm

Protect your VCR, your stereo, your TV . . . anything! Just plug them into this alarm: and if some light-fingered Louie tries to lift your loot, look out! The alarm soon suggests he change his mind! Cat L-5052

WAS $69

$50

Understanding DC Power Supplies

Covers every-thing from introduction to rectifiers to switch mode supplies. Cat B-3623

WAS $19.50

$12

DISCONTINUED

BARGAINS!!!

1000 Pieces Mixed Components

No we haven't made a mistake, and yes we might be crazy but we must clear this stock — ¼W/.5W/1W/resistors, electro caps/trimpots/green caps/ceramics and more. All assorted values in one bag. That's less than $0.01¢ each - Be quick limited stock - never to be repeated.
Cat R-9000

$9.95

Water Resistant Carry Bag

Anyone who owns a Walkman or other Walkie-type stereo or AM/FM radio knows the hassles: get them wet and they tend to stop. Bad news if you like sailing, Fishing. Or just mucking around near water. Solve the problem with this water resistant carry bag.

Cat A-4010

WAS $9.95 **$6.95**

Guide To RTTY

Contains a comprehenive listing of commercial, aeronautical, maritime, press, embassy, UN and military RTTY activity.
Cat B-2070

WAS $9.95 **$7**

Expo Turntable With Cartridge

WAS $19.50 **$14.95**

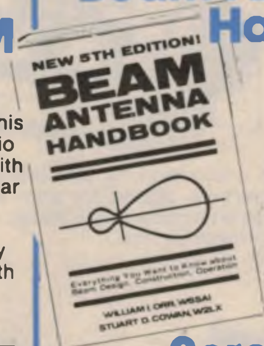
12v turntable with ceramic cartridge — it's a wipe out bargain price. Cat J-1060

Personal AM/FM Stereo

Fantastic sound! This AM/FM stereo radio comes complete with famous quality Mylar headphones. Compact and lightweight it's easy to move around with you. Cat A-4001

WAS $29.95 **$24.95**

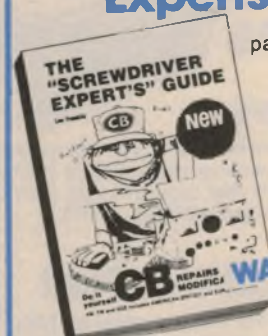
Beam Antenna Handbook



Correct beam dimensions 6 to 40 metres. Are 40 metre beams worth the effort?.
Cat B-2306

WAS $14.50 **$10**

Screwdriver Experts Guide



Franklin — 97 pages. The do-it-yourself CB repairs and modifications manual for the CB freak with NO electronics knowledge!.
Cat B-2324

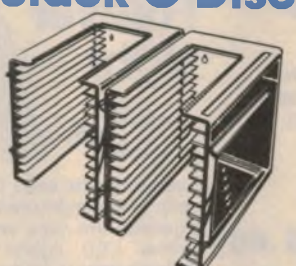
WAS $14.50 **$10**

Speakers 7x5 W/Grill

4 ohm replacement speakers, oval shape. Cat J-1025

WAS $6.95 **$4.75 Pr**

Stack-O-Disc



Holds 24 compact discs, ideal storage unit to protect your discs. Cat C-3900

WAS $19.95 **$16.50**

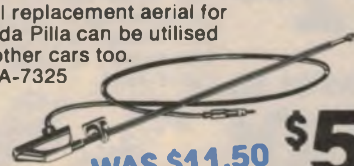
Car Speaker DSE Door Mount

40w. max.
3 way door mount speaker system.
Cat A-7055

WAS $49 **$39 Pr**

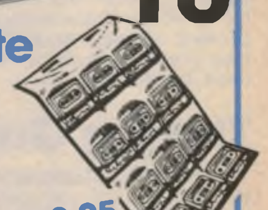
Car Aerial

Ideal replacement aerial for Mazda Pilla can be utilised for other cars too.
Cat A-7325



WAS $11.50 **$5**

Cassette Carry Pouch

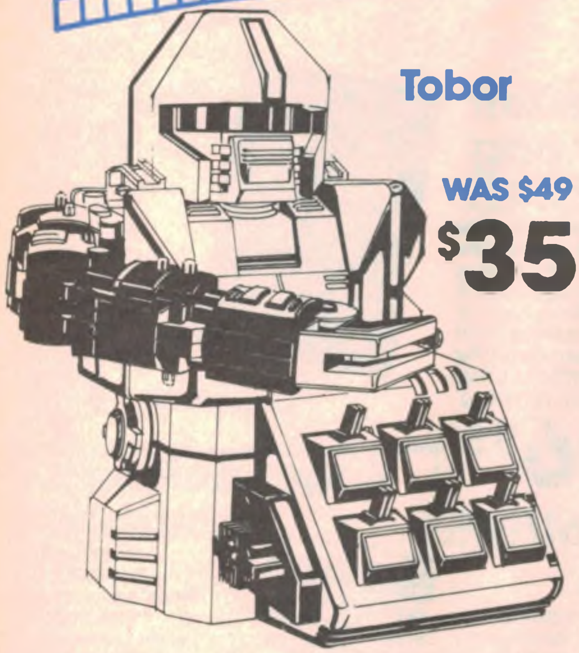


$8.75 WAS $19.95

Wow! Now take a swag of your favourite tapes anywhere with this superb carry pouch! Holds up to 12 tapes. Pouch rolls up into a convenient 'pack anywhere' shape. Features adhesive tape for car dash mounting. Cat C-3820

NOT ALL STOCK AVAILABLE AT ALL STORES — TO AVOID DISAPPOINTMENT PLEASE PHONE YOUR NEAREST DSE STORE.

SELLOUT!



Tobor

WAS $49

$35

Amazing robot with a fully working arm and claw. Six separate control levers for raising his arm, open and close his claw. He can lift objects (up to 100g).
A great introduction into robotics.
Cat Y-2065

Instrument Case

SAVE $15

$19.95

WAS $34.95

What a case! It will make any grotty project look a mil
dollars! With multi-way tilting bail to hold case at a
angle, has rubber feet too! Dress up your project. Bu
coloured, size 210(w) x 270(d) x 73(h).
Cat H-2525

'Giant' Rubber Feet

WAS .60¢

20¢

Excellent value! And very practical for hobbyists' needs. Place under project cabinets to prevent slipping, scratching table surface. Also provides ventilation for power projects. Pk/4. Cat H-1738

The Big Guns

WAS $5.95

$2.50

The incredible Molon reluctance synchronous 230 volt motors. Heavy duty cast-iron outer casing, they're quality manufactured in USA. Cat J-1016

Power Plant!

WAS $1.50

50¢

Wow! Quality Matsushita brand (ie National Panasonic) 13.2 volt DC motors. With 2.5mm shaft, they're 45mm in diameter and ideal for those larger projects. Cat J-1018

High Range Level Controls

$3

WAS $3.95

Whether you have ready built speakers, or you're making your own speakers, this fader will give you the control you need over the sound from your system. Dual concentric, heavy duty wire wound elements ensure proper loading of the crossover and amplifier at all times.
Cat C-7212
•High Power handling capacity •Attractive & easy to mount •Latest flush design •Fully sealed front and back-no air leaks! • 2dB calibration markings •Available with either high or midrange labels.

Bicycle Computer

WAS $39.50

This incredible high precision bicycle computer is a useful and fun accessory for the pleasure rider, serious competitor or exercise enthusiast.
Suits any bike with standard spokes.
Cat Y-3010

$30

Forever Light

WAS $14.95

Everyone who sees this is amazed! Solar cells keep rechargeable cells topped up. Squeeze the case and a high brightness yellow LED lights! Gives more than enough light to find a keyhole, etc. And it comes complete with keychain.
Cat Y-1075

$11.50

Test Lead Set

Ideal for the hobbyist! This deluxe test lead set will have all you should need for the workshop or toolbox. Screw in any of the 14 adaptors and plugs and you will see that it's truly versatile.
Cat W-4526

WAS $8.45

$6

TOOLS HALF PRICE

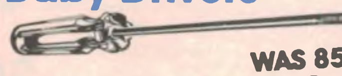
Phillips

WAS $1.95

Phillips head screw driver: 125x5x85x 18mm. Cat T-4050

95¢

Baby Drivers



WAS 85¢

For light electrical work: 50x49x11mm. Cat T-4080

40¢

WAS $1.00

Ideal for general purpose work: 75x 4.5x73x16mm. Cat T-4085

50¢

Heavy Driver

WAS $2.25

Tough driver for heavy-duty jobs: 125x6x90x 25mm. Cat T-4100

$1.10

Alignment Tool

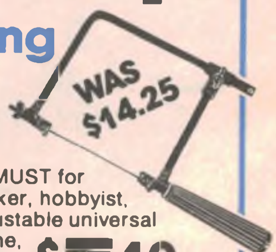
Screwdriver Type

WAS $1.75

Plastic screwdriver with steel spring tip: 100mm. Cat T-4510

$1.85

Piercing (Fret) Saw



WAS $14.25

An absolute MUST for the modelmaker, hobbyist, etc. Fully adjustable universal type saw frame, complete with 3 blades.
Cat T-4965

$7.10

Saw Blades

When you need replacements there is a choice of three special SKS alloy blades in packs of 12:
Extra Fine: Cat T-4966
Fine: Cat T-4967
Medium: Cat T-4968

$1.35

WAS $2.75

Stingray HF Marine Transceiver

SPECIAL PRICE PACKAGE DEAL
— fitted with 2182kHz complete with 2182 whip and base!

NEW FOR '86

$2495

THESE PRODUCTS AVAILABLE ON ORDER IF NOT IN STOCK IN ANY STORE.

Quality performance and ease, it's all here with the Stingray! This powerful 100W SSB marine transceiver will handle any of the marine channels with ease. Suitable for all HF marine frequencies including emergency club, chatter frequencies, etc. Why settle for second best? Very heavy construction makes it a rugged workhorse — so you can count on it in a crunch! Plug-in frequency cards give you single knob selection over the 2-30MHz range so selection is childs play. Comes complete with mounting hardware and mic — just take away and fit in a day!

Just look at these value for money features:
- 100W SSB
- Suitable for any marine channels
- 2.30MHz range
- Plug-in frequency cards for single knob selection and much more! Cat D-1410

NORMALLY $2499 just for the transceiver

Antenna Tuning Unit

NEW FOR '86

$699

— Suitable for use with longwire or backstay antennae etc. for maximum range

Say goodbye to all those antenna matching hassles, once and for all! The Stingray Antenna Matching Unit can match your transceiver to any antenna without fuss or bother. Why waste time adjusting equipment when you can be out there having a good time?
You'll get maximum performance from your transceiver with minimum risk of damage from high SWR. Operates over the 2-30MHz range. Get the most from your transceiver — your safety depends on it!
Cat D-1412

Stingray Noise Blanker/Mute Card

Accessory for Stingray HF Marine radio. Effectively reducing annoying background noises. Easily plugs into transceiver. Cat D-1414

$199

T.V. Antenna Bargains!

Stingray Loaded Whip Antenna

2182KHz loaded whip that puts a 'sting' into marine communications. Operates on the international marine distress frequency. Cat D-1418

IDEAL BACKUP ANTENNA **$199**

UHF/VHF Antenna

Here's one antenna to suit both UHF & VHF. High gain with corner reflector for top UHF performance is ideal for fringe areas. Cat L-4018
7.5dB gain

$89.95

Combined UHF/VHF

Why put up two antennas when one antenna will give you both UHF and VHF signals? One of our most popular antennas.
Cat L-4020
6dB gain

$69.95

Ghost Buster Antenna

Live to close a signal source? Picture quality reduced by excessive ghosting! Here's the answer: DSE's amazing Ghost Buster! Cat L-4023

$99

Indoor Antenna

If you're lucky enough to live in a strong signal area, you'll probably get by with one of these spiral antennas, even with colour.
Cat L-4010
300 ohms impedance

$9.95

Rabbit Ears...

When an outdoor antenna isn't possible or connecting a second TV set is too much trouble, count on the good old rabbit ears... the indoor antenna that sits on your TV set. Cat L-4015

$16.95

BITS 'N' PIECES BARGAINS FOR YOU!

7400 Quad 2 input NAND gate	Cat Z-5010	Was 50¢	Now 30¢
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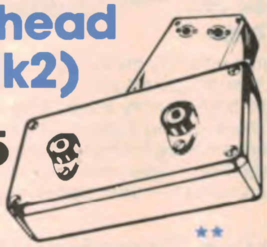

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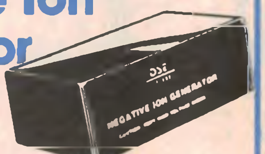

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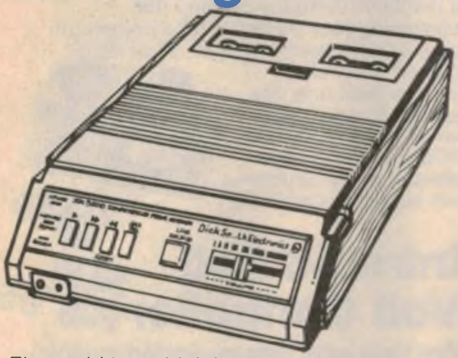

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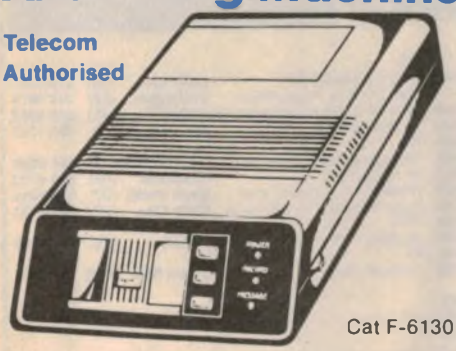

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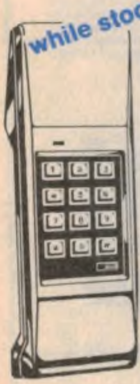

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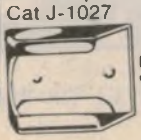

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Thanks For The 'Memory'

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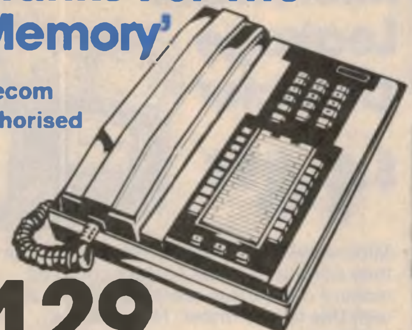

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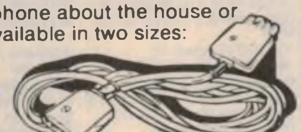

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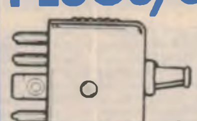

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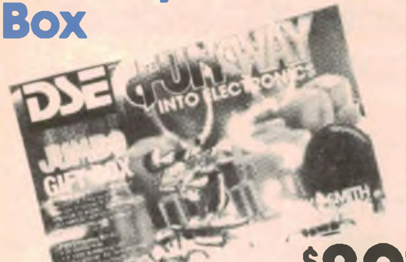

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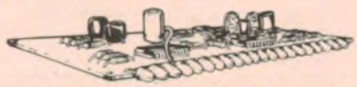

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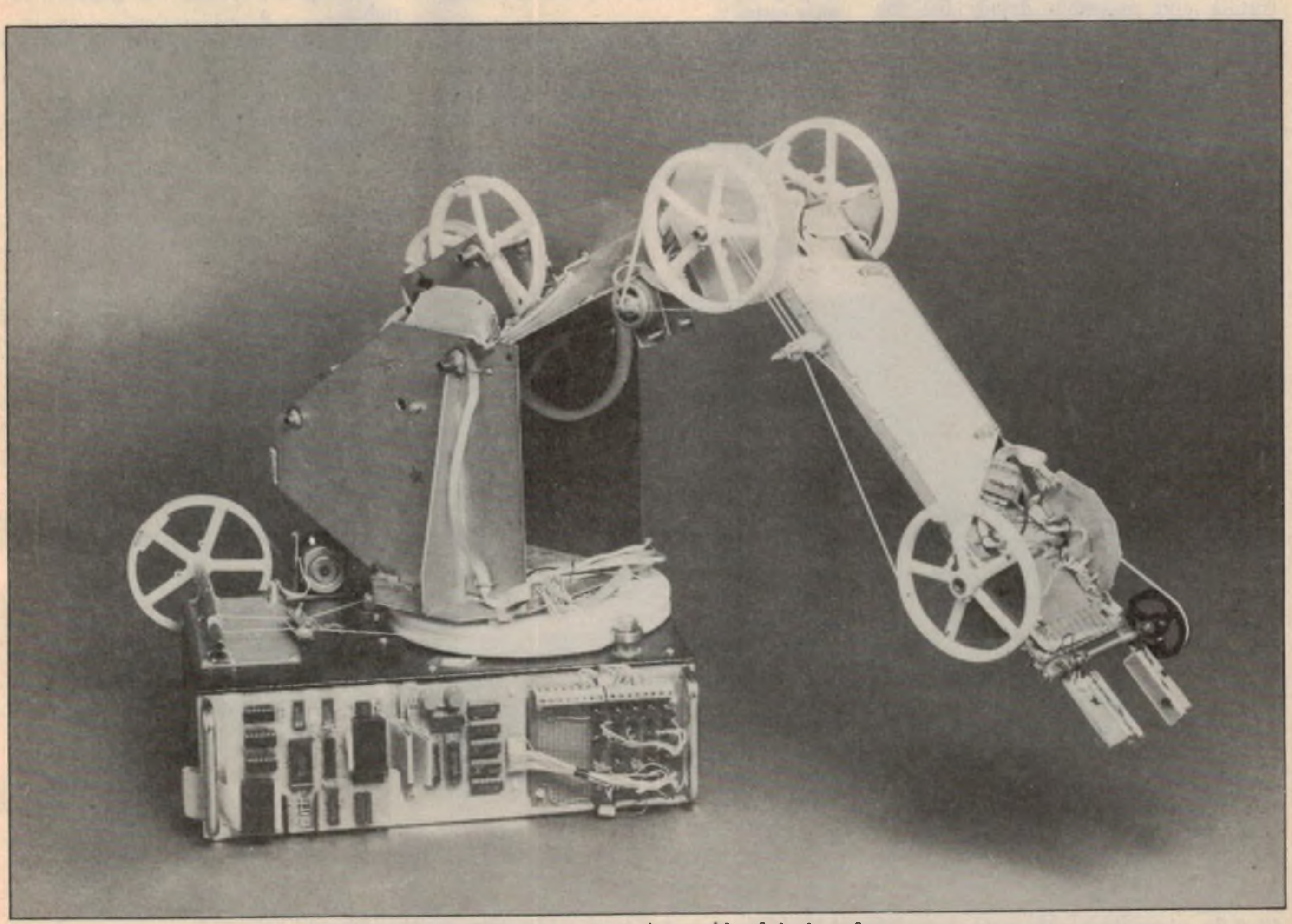
Algernon

a low cost robot for any 8-bit computer Pt.3

Here's the third and final article on Algernon, the low cost robot fabricated from copper clad phenolic board. In this, we wrap up details of the circuit assembly and review the control program.

The development of this project by the designer, Ray Pakalns, together with the sponsoring company, Jaycar Electronics, has proved to be a much larger undertaking than was initially foreseen. It is only now that the amount of work necessary to complete the project has been realised.



This photo shows the original prototype with the PCBs mounted on the outside of the base for access.

Algernon

Finally though, the development work on Algernon is complete, at least as far as the mechanicals and the interface details for the Microbee are concerned. But it is clear that the project has lots of potential for further development to allow it to be interfaced with other 8-bit computers. There is also a lot of scope for software development, to suit it to various computers and to produce a variety of operating routines.

At the time of writing this final article, Ray Pakalns has just completed the comprehensive assembly manual for the project. It is a very creditable production running to over 80 foolscap pages in which every facet of the project is discussed. This manual will be available on its own from Jaycar stores at the very reasonable price of $10.00. This gives all the information needed to build the robot except for the copper patterns of the sensor discs and circuit boards.

Included in the manual are the full cutting and assembly details for the various copper clad sections of the robot and we can well imagine some constructors buying just the manual, the essential PC boards and some of the hardware such as the dial drive pulleys and motors and then building the rest of the robot completely from scratch.

We certainly wish that we could have had access to the manual when we assembled our prototype because it answers so many questions that we had to resolve the hard way, by trial and error.

Ray Pakalns has also written a preliminary program in Basic to put Algernon through a series of simple movements, controlled via the Microbee. Ultimately, Jaycar will be supplying a more refined version of this program, written largely in machine code. This will greatly increase the operating speed of the robot which otherwise tends to be on the leisurely side.

With the simple routines on the supplied program it will be possible for constructors to develop their own operating programs to put Algernon through complex routines.

A facility to control the speed of each motor is also included in the supplied program, with speeds 0 to 9 available. The lowest setting means that the motor will only creep in a series of short pulses, while the speed of the highest setting is determined by the load and gear ratio.

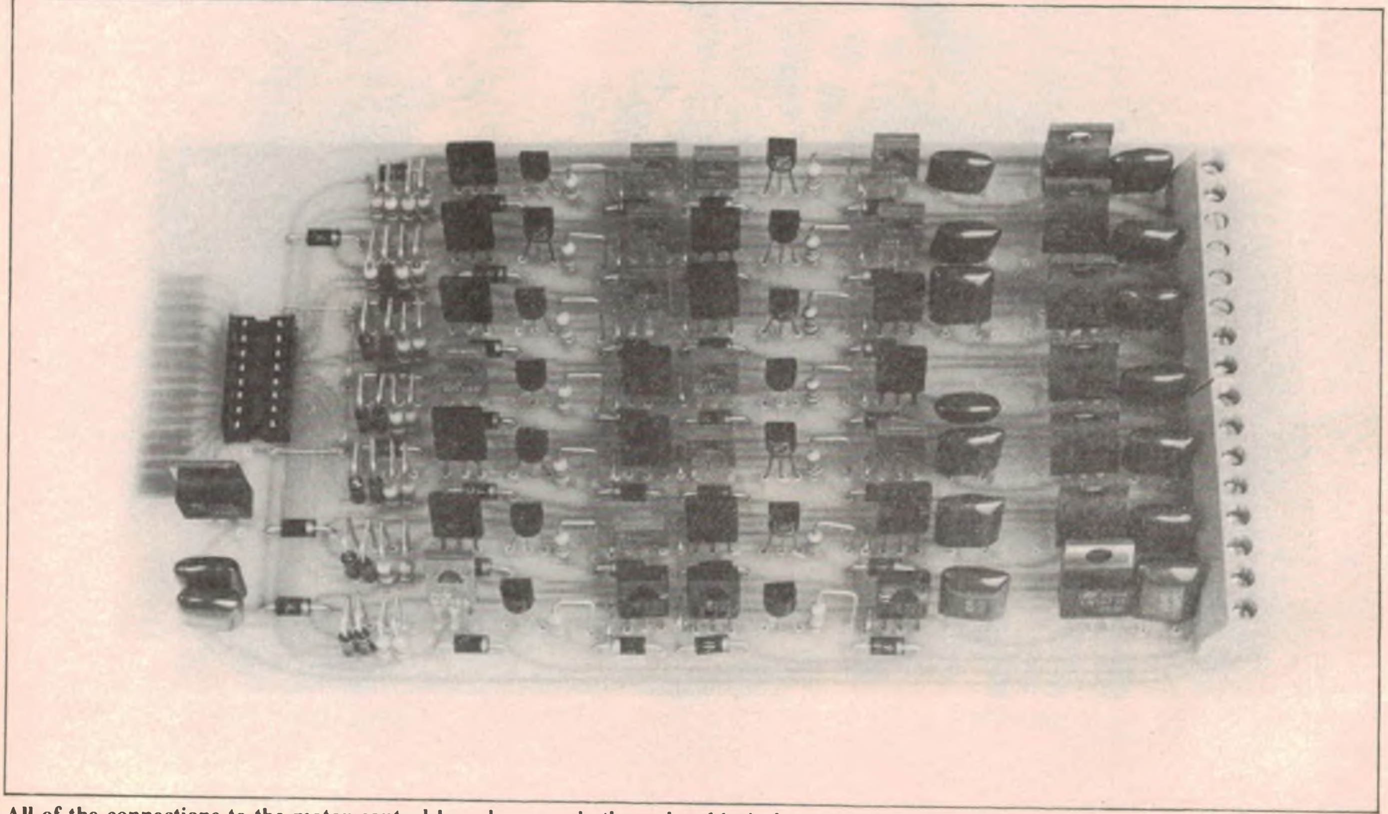
In setting a sequence of movements, the programmer must manually operate the robot to every required position in the sequence. This is done via the Microbee keyboard.

At each desired position, operating the "S" (store) key of the keyboard memorizes the position. What is memorized is the coded data from each of the sensor discs. As the data for most of the discs is picked up through three pin contacts, it is possible that one of the pins may be between pads on the disc. This would lead to an invalid input. The program will not permit this, causing the joint to shuffle minutely until a proper code is generated.

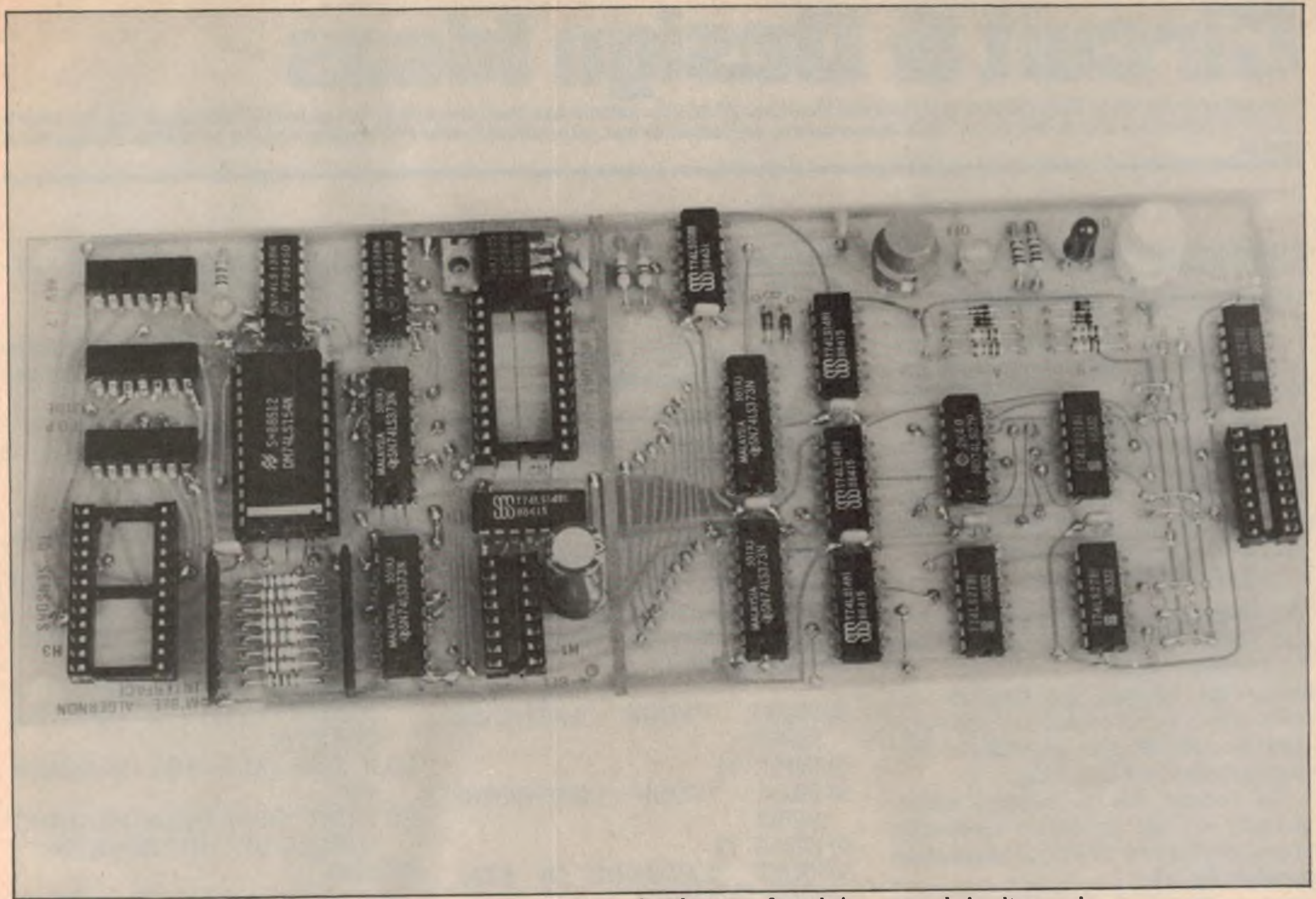
An initial program written to make Algernon pick up a small box brought to light an interesting problem. The eight-bit gripper sensor did not have sufficient resolution to grasp the box properly. The robot attempted to close the grippers too tightly, so that eventually, the rubber band drive acted as a clutch, with the motor continuing to spin.

The problem here was due to the fact that the program did not have any conditional statement. It could look at either the gripper position or the tactile sensor output, but it could not combine data from both. The net result was that it attempted to close the grippers too tightly.

With the final program, this problem will be solved with a control sequence which will close the grippers to the specified position unless the tactile sensor output is tripped.



All of the connections to the motor control board are made through a 16-pin header and a 16-way terminal block.



The interface board includes interlock circuitry to prevent forward and reverse from being engaged simultaneously.

Interface and control circuits

The interface and control circuits are reasonably straightforward. Since the Microbee performs all the decoding and sequencing, the Algernon electronics are only needed for buffering, interlock and power.

There are actually two PCBs which must be built up for the robot — one is the power board with the motor drive transistors and the other is the interface circuit. The interface board is the more complicated of the two, being a double-sided board measuring 224 x 90mm. Two main functions are performed by this board, multiplexing the coded sensor information and latching motor control.

Without multiplexing, the amount of wiring and circuitry required would otherwise get out of hand. As it is, an 8-bit data bus is shared by five sensors.

Multiplexing is performed by a 74LS154 4-line to 16-line decoder. Depending on the 4-bit input code, one of 16 outputs will be enabled. Only 13 of the 16 outputs are used in the standard robot: three outputs are connected to each of the waist, shoulder and elbow sensors; two are connected to the wrist; and one each to the gripper and touch sensors.

It is advisable to wire the robot as per the manual to avoid erroneous multiplexing signals. With the correct wiring, the computer, via the 74LS54, sequentially enables all of the sensor wipers.

Data is fed via eight diodes on each sensor disc to the data bus. This is connected directly to the Microbee parallel input bus. The program analyses the input data and performs the necessary calculations to determine each sensor position.

The Microbee control signals are latched by two 74LS373 octal Tristate latches. Two of these are needed to latch the 16 control lines.

To prevent forward and reverse from being engaged simultaneously for each motor, the latched outputs are fed through an interlock circuit. This consists of three 74LS14 hex Schmitt triggers in conjunction with three 74LS27 triple 3-input NOR gates.

The low speed options on the board are provided by two oscillators each built around 74LS14 Schmitt triggers. By tailoring the component values the particular duty cycle can be selected to suit any requirement. Each of the low speed options can be used with up to three of the motors. Keyboard controls are used to select the required low speed mode.

The motor control board (180 x 95mm) is single sided. It has 42 transistors and eight regulators, not to mention a few other parts. The board is rather neat, with all of the components set out in rows. Further, connections are made either through a 16-pin header or 16-way terminal block.

Our version of the Algernon had the interface board on the outside of the metal box to allow access. The recommended method though is to mount the boards inside the box — it's a lot neater.

The circuits of the interface and control boards are fully detailed in the manual described above. Although a low cost robot, the design has certainly meant a big investment in time and money. We think it will be very popular with computer enthusiasts.

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

Computer program aims beam antennas

Just what is the distance between your station (or receiver) and the station you're working or receiving? No, not the road distance, the direct shortest distance which shows up on a Mercator Projection map as the Great Circle Distance. What heading would the beam best be set at? Both questions are answered by this program.

The relevant formulas are:

(1) Distance (in 'degrees of latitude') = arc cos[sin lat_tsin lat_h + cos lat_t cos lat_hcos(lng_h – lng_t)]
where the latitude and longitude of your site are abbreviated lat_t and lng_t, and the latitude and longitude of the station heard by lat_h and lng_h.

To convert this to nautical miles, multiply by 60; to statute (ordinary) miles, multiply by 69.375; to kilometres multiply by 111.

(2) Beam heading = arccos (((sin lat_h – (cos(distance 'in degrees') x cos lat_t))/(sin distance 'in degrees') x cos lat_t)))

If the sine of lng_t – lng_h is <0, then hdg = 360° – hdg calculated.

Eastern longitudes and southern latitudes are entered as negative values, western longitudes and northern latitudes as positive.

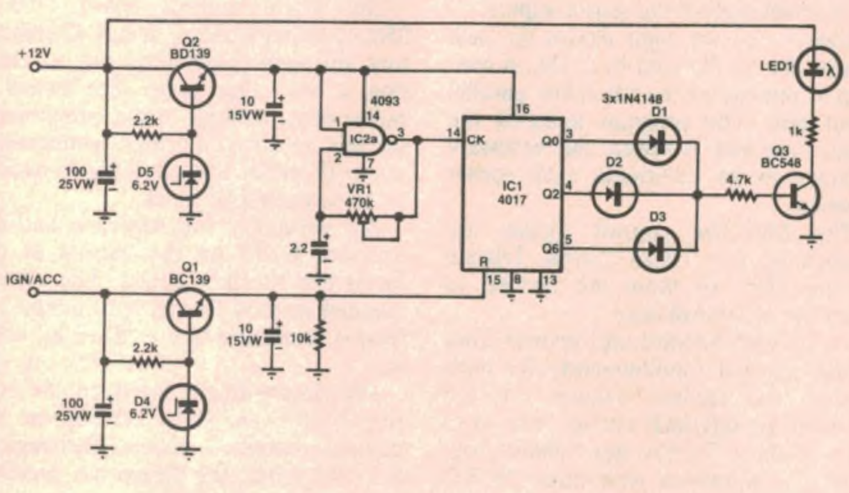
There are many 'dialects' of BASIC, the language most home computers accept so, if the program which follows isn't accepted by your computer, consult its manual to find which instructions it doesn't understand!

```
10 PRINT "YOUR LATITUDE NOW?"
20 INPUT T1
30 PRINT "YOUR LONGITUDE NOW?"
40 INPUT T2
50 PRINT "LATITUDE OF STATION HEARD?"
60 INPUT H1
70 PRINT "LONGITUDE OF STATION HEARD?"
80 INPUT H2
90 REM enter latitudes and longitudes in degrees and decimally-divided degrees.
100 LET DD = ARCCOS [(SIN T1 x SIN H1) + (COS T1 x COS H1 x COS (H2 — T2))]
110 PRINT "DISTANCE IS:"
120 PRINT (DD x 60 "NAUTICAL MILES"
130 PRINT (DD x 69.375) "STATUTE MILES"
140 PRINT (DD X 111) "KILOMETRES"
150 Let HD = ARCCOS (((SIN H1 — (COS DD x COS T1)) / (SIN DD x COS T1)))
160 If SINE (T2 — H2) <0 GOSUB 500
170 PRINT "BEST BEAM HEADING SHOULD BE "HD" DEGREES"
180 END
```

I. Compton,
Richmond, S.A.

$20

Burglar alarm deterrent flasher



Most burglar alarm flashers simply flash on and off with a duty cycle of about 50%. If you want something a little different, this circuit will do the job — when activated, the lamp flashes twice, then once, then twice and so on.

IC1 is a 4017 decade counter and is clocked by Schmitt trigger oscillator IC2a with frequency set by trimpot VR1. Assuming power is applied, the Q0, Q2 and Q6 outputs of IC1 pulse high in turn. These outputs are ORed by diodes D1-D3 and drive transistor Q3 to flash the LED.

Q2, in conjunction with zener diode D5, provides a regulated 5.6V supply for the CMOS ICs. Q1 and D4 work in a similar fashion. When the ignition switch is turned on, pin 15 (reset) of IC1 is held high and the flasher is disabled.

P. Howarth,
Gunnedah, NSW.

$15

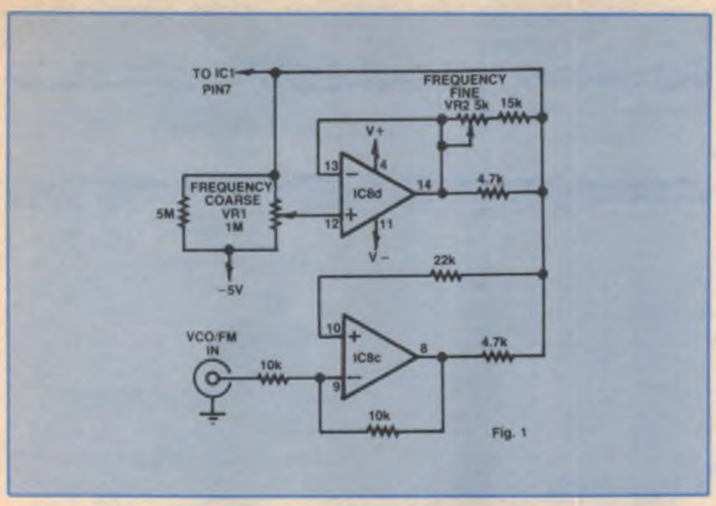


Fig. 1

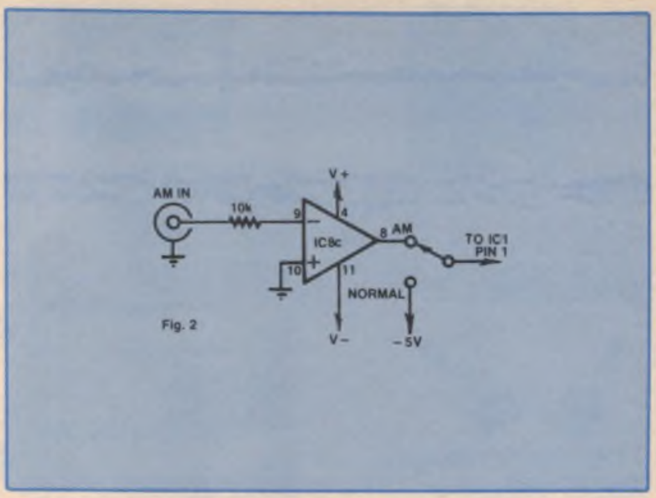


Fig. 2

FM and AM modulation for the EA Function Generator

These two circuits allow frequency or amplitude modulation of the output of the EA Function Generator (April 1982).

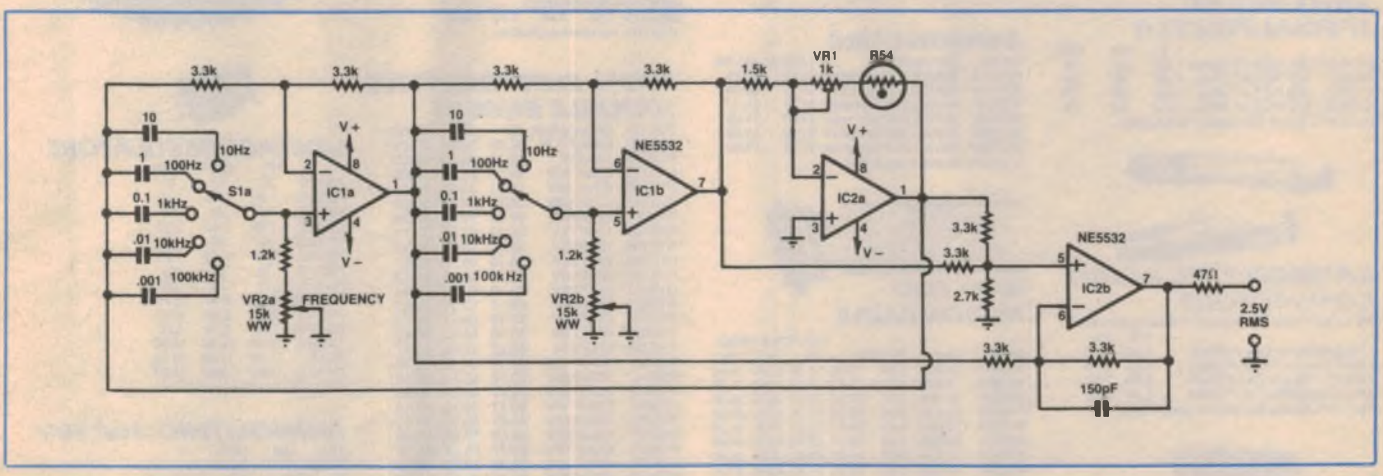
Basically, Fig.1 and Fig.2 are modifications of the Function Generator Enhancement described in June 1984. In each case, op amp IC8c buffers the variable voltage source for the FM or AM input.

In the frequency modulation circuit (Fig.1), the coarse frequency control circuit is modified to compensate for the removal of IC8c. The coarse and fine controls still operate in a similar manner to those in the original enhancement circuit, but with the added facility of the FM input.

The amplitude modulation circuit (Fig.2) uses IC8c to buffer input voltage signals to the AM modulation input of the function generator chip, IC1. A single-pole 2-position switch enables or disables the AM input.

B. Paterson,
Glen Iris, Vic.

$15



High performance audio generator

This simple sine wave oscillator has performance superior to all but the most expensive commercial units. It covers the frequency range from 1Hz to 100Hz and there is no amplitude bounce when the frequency is varied. Total harmonic distortion is less than .005% from 20Hz to 20kHz, and less than .0015% at 1kHz.

The circuit is based on one that appeared in *Wireless World*, February 1982. Phase shifters IC1a and IC1b, together with inverting stage IC2a, form a sine wave oscillator, while IC2b cancels the third harmonic generated at the output of IC2a due to the non-linearity of the R54 thermistor.

The frequency is adjusted by means of VR2 which is a 15kΩ dual-gang wirewound trimpot. Double-pole rotary switch S1 provides the range switching.

The unit should be powered from well-regulated ±12V supply rails while multiturn trimpot VR1 should be set for a 2.5V RMS output. Note that NE5534 ICs can be used if the NE5532s are hard to get. All resistors and capacitors should be 1% types if possible.

Phil Allison,
Summer Hill, NSW

$25

Editor's note: in practice, a 15kΩ dual-gang wirewound potentiometer may be difficult to obtain. A conventional pot should not be substituted, however — its tracking accuracy will not be good enough. One way around the problem is to substitute two strings of 1% resistors for the potentiometer elements, and to switch these into circuit to provide a range of spot frequencies using a 2-pole multi-position rotary switch.

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R15462	10uF 25V PCB RB	0.05	0.04
R15482	22uF 25V PCB RB	0.06	0.05
R15521	47uF 16V PCB RB	0.07	0.06
R15522	47uF 25V PCB RB	0.08	0.07
R15581	1000uF 16V PCB RB	0.21	0.20
R15582	1000uF 25V PCB RB	0.28	0.25
R15591	2200uF 16V PCB RB	0.39	0.33
R15592	2200uF 25V PCB RB	0.55	0.50
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W11274 24/.20 GREEN

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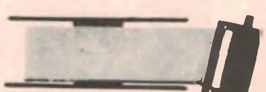
W12726	28AWG 26W per metre	$1.60	$1.50
W12734	28AWG 34W per metre	$1.90	$1.80
W12740	28AWG 40W per metre	$2.20	$2.00

Plus 20% tax where applicable



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W12620	20 Way	2.20	29.50	28.00	26.50	20.00
W12625	25 Way	2.50	32.50	29.00	28.50	25.00
W12626	26 Way	2.60	34.00	32.00	29.00	26.00
W12634	34 Way	2.80	44.00	42.00	39.00	34.00
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R15415	1uF 63V	$0.07	$0.06	$0.05
R15422	2.2uF 25V	$0.07	$0.06	$0.05
R15424	2.2uF 50V	$0.06	$0.05	$0.04
R15425	2.2uF 63V	$0.07	$0.06	$0.05
R15432	3.3uF 25V	$0.07	$0.06	$0.05
R15435	3.3uF 63V	$0.07	$0.06	$0.05
R15442	4.7uF 25V	$0.07	$0.06	$0.05
R15443	4.7uF 35V	$0.08	$0.07	$0.06
R15445	4.7uF 63V	$0.07	$0.06	$0.05
R15461	10uF 16V	$0.07	$0.06	$0.05
R15462	10uF 25V	$0.07	$0.06	$0.05
R15463	10uF 35V	$0.07	$0.06	$0.05
R15465	10uF 63V	$0.07	$0.06	$0.05
R15481	22uF 16V	$0.07	$0.06	$0.05
R15482	22uF 25V	$0.08	$0.06	$0.05
R15483	22uF 35V	$0.08	$0.07	$0.06
R15484	22uF 50V	$0.09	$0.08	$0.07
R15502	25uF 25V	$0.07	$0.06	$0.05
R15505	25uF 63V	$0.10	$0.08	$0.07
R15512	33uF 25V	$0.08	$0.07	$0.06
R15521	47uF 16V	$0.09	$0.08	$0.07
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R15543	220uF 35V	$0.25	$0.23	$0.20
R15545	220uF 63V	$0.26	$0.24	$0.22
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R15555	330uF 63V	$0.34	$0.30	$0.28
R15561	470uF 16V	$0.16	$0.13	$0.12
R15562	470uF 25V	$0.23	$0.20	$0.18
R15563	470uF 35V	$0.30	$0.28	$0.26
R15564	470uF 50V	$0.00	$0.00	$0.00
R15565	470uF 63V	$0.44	$0.39	$0.36
R15581	1000uF 16V	$0.25	$0.22	$0.20
R15582	1000uF 25V	$0.35	$0.30	$0.28
R15583	1000uF 35V	$0.45	$0.40	$0.36
R15591	2200uF 16V	$0.45	$0.40	$0.36
R15592	2200uF 25V	$0.65	$0.60	$0.50
R15593	2200uF 35V	$1.20	$0.91	$0.75
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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
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R15893	1000uF 35V	$0.70	$0.65	$0.55
R15894	1000uF 50V	$0.00	$0.00	$0.00
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R15913	2500uF 35V	$1.10	$1.00	$0.90
R15914	2500uF 50V	$1.30	$1.20	$1.00
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P12064 26 Way Card Edge Con	3.55	2.95	2.20
P12066 34 Way Card Edge Con	3.95	3.50	2.30
P12068 40 Way Card Edge Con	4.50	3.90	3.50
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P12104 26 Pin Socket	2.65	2.45	2.00
P12106 34 Pin Socket	2.75	2.55	2.15
P12108 40 Pin Socket	2.95	2.75	2.25
P12110 50 Pin Socket	3.50	2.95	2.50

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Q10502	MU45 50-0-50uA	6.95	6.75	6.50
Q10504	MU45 0-100uA	6.95	6.75	6.50
Q10505	MU45 0-50uA	6.95	6.75	6.50
Q10510	MU45 0-5A	6.95	6.75	6.50
Q10518	MU45 0-1A	6.95	6.75	6.50
Q10520	MU45 0-20V	6.95	6.75	6.50
Q10535	MU45 VU	7.95	7.75	7.50
Q10530	MU52E 0-1mA	9.95	8.35	
Q10533	MU52E 0-5mA	9.95	8.35	
Q10538	MU65 0-50uA	9.35	8.95	8.75
Q10540	MU65 0-1mA	9.35	8.95	8.75
Q10550	MU65 0-100uA	9.35	8.95	8.75
Q10560	MU650 0-20v	9.35	8.95	8.75

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Cat No.	Desc.	10+	100+	1000+	100K+
Z10135	IN4148	0.03	0.02	0.015	.013
Z10105	IN4002	0.04	0.03	0.03	.025
Z10107	IN4004	0.05	0.04	0.03	.025
Z10110	IN4007	0.10	0.06	0.05	.040
Z10115	IN5404	0.18	0.14	0.09	0.08
Z10119	IN5408	0.20	0.16	0.10	0.09

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6116P-3	$ 3.00	$ 2.90	$ 2.20	$ 2.00
2716	$ 4.90	$ 4.50	$ 4.25	$ 4.00
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	$11.00	$10.00	$ 9.00	8.00
6264	$ 5.50	$ 5.00	$ 4.50	$ 4.00
2764	$ 6.00	$ 5.00	$ 4.50	$ 4.00

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8088	19.00	18.00	15.00	14.00
8155	3.90	3.75	3.50	3.00
8156	3.50	3.30	2.90	2.50
8212	1.90	1.70	1.50	1.00
8224	2.40	2.00	1.90	1.50
8226	1.90	1.70	1.50	1.00
8237A	35.00	31.00		
8253	3.90	3.70	3.50	3.00
8255	4.00	3.50	2.90	2.00
8257	3.90	3.50	3.00	2.50
8259	3.90	3.50	3.30	2.70
8237A	35.00	31.00		
8279	3.90	3.50	3.30	2.70

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TRANSFORMERS

Cat No.		1-99	100+	1000+
M12851 240V 12-6V CT 150mA	2851	2.50	2.25	1.90
M12155 240V 6-15V 1A tapped	2155	4.80	4.10	3.70
M12156 240V 6-15V 2A tapped	2156	6.35	6.15	5.95
M16672 240V 15-30V 1A tapped	6672	6.35	6.15	5.95
M12860 240V to 15V C.T. at 250mA	2860	3.00	2.50	2.30

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PACKED $5.25/1000
TAPED AND BOXED $5.25/1000
$5.00/1000 10K LOTS
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Cat No.		1-99	100+	1000+
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R15137	.0012uF	0.06	0.04	.036
R15138	.0015uF	0.06	0.04	.036
R15140	.0022uF	0.06	0.04	.036
R15142	.0033uF	0.06	0.04	.036
R15143	.0039uF	0.06	0.04	.036
R15145	.0047uF	0.06	0.04	.036
R15146	.0056uF	0.06	0.04	.036
R15147	.0082uF	0.06	0.04	.036
R15148	.01uF	0.07	0.05	.045
R15150	.015uF	0.07	0.05	.045
R15152	.022uF	0.07	0.05	.045
R15154	.033uF	0.07	0.05	.048
R15155	.039uF	0.07	0.05	.045
R15156	.047uF	0.08	0.06	.055
R15157	.056uF	0.08	0.06	.055
R15158	.068uF	0.08	0.06	.055
R15159	.082uF	0.08	0.07	.055
R15160	.1uF	0.09	0.08	.07
R15162	.15uF	0.11	0.10	.09
R15164	.22uF	0.15	0.14	.13
R15165	.27uF	0.16	0.15	.14
R15172	1uF	0.70	0.55	0.50
R15176	2.2u	1.20	1.10	1.00
R15178	3.3uF	1.50	1.20	

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NICADS

Cat No.		1-99	100+	250+	500+
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Desc.	10-99	100+	Desc.	10-99	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	2.50	2.20
BU208	2.50	2.20	2SD350	2.75	2.40
BU326	1.95	1.70			

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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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	10+	100+	1000+	10K
8 Pin	.08	.07	.06	.05
14 Pin	.10	.09	.08	.07
16 Pin	.11	.10	.09	.08
18 Pin	.12	.11	.10	.09
20 Pin	.13	.12	.11	.10
22 Pin	.14	.13	.12	.11
24 Pin	.15	.14	.13	.12
28 Pin	.19	.17	.15	.14
40 Pin	.25	.24	.22	.20

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R164585	8000uF 75V	6.00	5.90	5.80
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P12246 16 Way Unprot Header	1.35	1.20
P12250 20 Way Unprot Header	1.45	1.25
P12256 26 Way Unprot Header	1.50	1.40
P12260 30 Way Unprot Header	1.75	1.65
P12264 34 Way Unprot Header	1.95	1.75
P12270 40 Way Unprot Header	2.25	1.95
P12275 50 Way Unprot Header	2.75	2.50
P12280 60 Way Unprot Header	2.95	2.75

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R.A HEADERS

	1-9	10+
P12241 R.A. 10Way Unprot Head	1.45	1.30
P12247 R.A. 16Way Unprot Head	1.55	1.40
P12251 R.A. 20Way Unprot Head	1.65	1.45
P12257 R.A. 26Way Unprot Head	1.70	1.50
P12261 R.A. 30Way Unprot Head	1.95	1.85
P12265 R.A. 34Way Unprot Head	2.15	1.95
P12271 R.A. 40Way Unprot Head	2.45	2.15
P12276 R.A. 50Way Unprot Head	2.95	2.70
P12281 R.A. 60Way Unprot Head	3.15	2.95

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Cat No.	Description	1-99	100+	1000+
P10900	DB25 Plug	1.30	1.20	1.00
P10901	DB25 Socket	1.40	1.30	1.20
P12210	Centronics Solder	3.50	3.15	2.50
P12200	Centronics Crimp	6.00	5.50	5.00
P10880	DB9 Plug	1.30	1.20	0.90
P10881	DB9 Socket	1.40	1.30	1.00
P10890	DB15 Plug	1.30	1.20	0.90
P10891	DB15 Socket	1.40	1.30	1.00
P10902	DB25 Cover	.80	.65	.55

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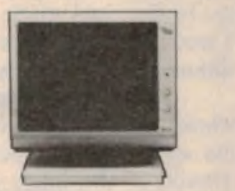

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Errors and Omissions Excepted.

The case of the mystery chassis

Once upon a time identifying who made a particular chassis was quite simple; AWA sets were made by AWA, HMV sets by HMV, Philips sets by Philips, and so on. But not these days. Many sets carrying well known brand names are now fitted with chassis made by quite different companies. And knowing who makes what to go in which cabinet is often quite important for the serviceman.

As you can imagine, that little homily was prompted by a recent experience which I am about to relate. But the story has another claim to fame. In past issues I have described intermittent faults of long standing, some of which have taken — literally — years to find. On one occasion I think I suggested that one of these must constitute some kind of record. And, while I can't remember the exact details, I have a feeling that this story will break that record, whatever it was.

But to get back to the "Who makes what" situation. My first encounter with this set was some four years ago and, at that time, I had yet to sort out all the ramifications I am about to relate. Had I known then what I know now I would have saved myself a significant amount of time and effort.

The set was owned by a lady whom I had not met before. She rang me and explained that she was having trouble with her colour TV set, adding that she had bought it a couple of years previously from a nearby dealer who, incidently, has since gone out of business. She described the set as a General Electric model which the salesman had told her was made by Rank Arena and that, in fact, it was the same as the Rank Arena 2601. This didn't surprise me because I knew that a lot of GE sets at that time used a Rank chassis.

She went on to explain that the set had gone completely dead, but that it had given a lot of trouble in the past of an intermittent nature. Basically, the set would simply refuse to start at switch-on, but would usually come good at the second or third try, and might then run for several hours. At other times it would simply shut down spontaneously and would need several tries to get it going again. Several servicemen had attempted to fix the trouble, but without success.

When I finally came face to face with the set in the lady's lounge room, I found it to be a GE model TC63L1; a type number which I had not heard of until then. But it was a 63cm model and I was quite prepared to encounter a Rank 2601 chassis.

It was a bit of a shock, therefore, when I looked into the back of the cabinet and realised that, not only was it nothing like a 2601 chassis, but that it was nothing like any chassis I had seen before. What was more, I could find nothing on the chassis to indicate who had made it. All I did determine was that it was made in Singapore.

The only thing to do in these circumstances was to contact the local GE distributors, first to identify the chassis and then, hopefully, obtain some clues as to the likely cause of the fault, assuming that someone else had already encountered it. In fact, the distributors proved to be most helpful, and set an example which some other distributors could well emulate.

H stands for Hitachi

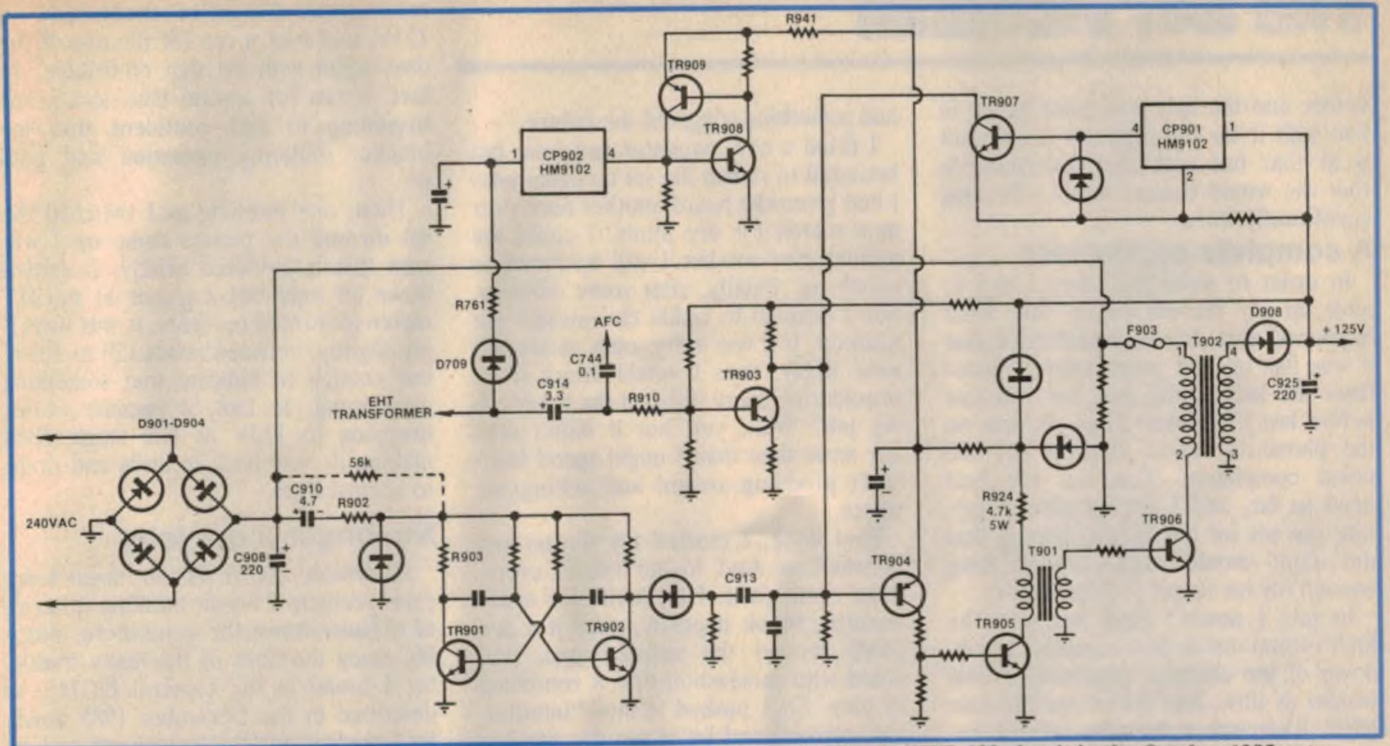
It turned out that the chassis was made by Hitachi and, more specifically, is almost identical with the Hitachi CWP-139 which I dealt with in the October 1985 notes. However, at that time the chassis was new to me. I also learned that the GE model number, on sets using the Hitachi chassis, normally carries a suffix letter "H" or "S", indicating where the chassis was made. The "H" indicates Hiroshima and the "S" Singapore.

And, for what it is worth, all the larger chassis, i.e., 56 and 63cm, made by Hitachi for the GE label are made in Singapore; only the smaller sizes are made in Japan. In fact, as far as I can determine, there are no 56 and 63cm sets marketed under the Hitachi label; they all carry the GE trademark. All of which adds up to a rather complex set-up, but it may be worthwhile keeping in mind.

Having sorted out the origin of the beast I was able to obtain a circuit and service data and, with the set on the bench, make an initial appraisal of the fault, at least in general terms. As I more or less expected, it transpired that the power supply was shutting down — or refusing to start — although the exact reason had still to be determined. (At this stage readers may find it helpful to refer to the October story, particularly the explanation of the power supply operation and the manufacturer's suggested test routine.)

I went through these various tests, even though the intermittent nature of the fault made it unlikely that I would find it this way. In fact, all I learned was that one of the tests, that of running the power supply unloaded, was the surest way to destroy the main chopper transistor, TR906. So I was back to square one.

At this point I appealed directly to the GE service department. And, again, they proved most helpful. Further, from their ready response, it was fairly obvious that this was not an isolated case. More specifically, it was almost certainly a dry joint situation, the problem



This skeleton circuit of the GE-TC63L1 power supply is almost identical with the Hitachi CWP-139 circuit in the October 1985 notes.

being, of course, to find it. However, they were able to nominate a number of places where these were most likely to occur.

The first general area was on the power supply board itself and involved a number of heavy duty resistors which, in an effort to improve the dissipation, are mounted clear of the board by some 10mm. And, to improve the rigidity of the mounting over that provided by the pigtails alone, they are supported by small metal tubes. These are a few millimetres in diameter and are passed through holes in the board and soldered to the copper pattern.

The pigtails are then passed through the tubes and, I suspect, are supposed to be soldered direct to the copper pattern, so that the tube serves purely as a mechanical support. In practice the pigtails are inserted in the tube, trimmed short on the copper side, and soldered to the inside of the tube.

Unfortunately, a good soldered joint of this kind is not easy to make, particularly with the heat limitations imposed by the printed board. As a result, they had proved to be a consistent source of trouble and the service department's advice was to remove each resistor and remake the joints thoroughly.

The second suspect area was on the deflection output board and, specifically, involved two resistors, R721 (390Ω) and R722 (4.7Ω), both in the base circuit of the horizontal drive transistor, TR704. Not only were these particularly prone to having dry joints, but they also suffer the disadvantage of being almost completely hidden underneath a heatsink on which is mounted the horizontal output transistor, TR707.

I thanked the technician for his advice and, thus armed, returned to the attack. First I tackled the transistors on the power board, resoldering the pigtails inside the tubes, using plenty of heat and a little mild flux to help things along. In fact, I found no evidence of any actual faults in this area, but reasoned that remaking them was a worthwhile precaution.

Unfortunately, this did nothing to improve the situation, the fault being just as much in evidence as before. So I removed the horizontal output stage heatsink assembly and checked R721 and 722. And this was a different story; anyone with half an eye could see the dry joints, though why these two resistors were prone to this fault so consistently remains a mystery. Anyway, I resoldered them, re-fitted the heatsink, and tried again.

And this time the set came good. I had given the lady a loan set so I took the precaution of running the set for about three weeks, during which time it didn't so much as flicker. I considered the point proved and returned the set, but took my usual precaution of advising the lady to contact me immediately if the trouble re-appeared.

I heard nothing more about the set for something like 18 months, by which time I had more or less forgotten all about it. Then the lady was on the phone reporting that the set had once again developed an intermittent fault. So I organised another loan set and brought the offender back into the workshop.

This proved to be a totally frustrating exercise. I kept it for several weeks but nothing I could do during that time would induce the fault to appear. Finally, realising that Murphy had the whip hand, I returned the set to the customer, explained the situation, and suggested that she try to live with it until the fault became worse or, better still, the set failed completely.

For richer for poorer . . .

The lady was quite happy with this arrangement because the fault, when it did show, was easily cured. She had found that all she had to do was switch the set off, then on again, and it invariably came good. So we left it at that and, although I had made out a docket when the set came in, I put it to one side and made no charge.

Apparently I didn't make this point clear to the lady and, after a couple of months, she rang to find out what she owed me. (I wish some of my other customer's were as honest!) I explained that I hadn't felt justified in charging in the circumstances, seeing that I had not really achieved anything, then asked her how the set was performing.

It appeared that it was still much as

before and the lady was quite happy to live with it for the moment. So we left it at that but with the understanding that she would contact me if it became significantly worse.

A complete breakdown

In order to write this story I had to look up my records to be sure what happened next, but they confirmed that it was just on two years before I heard from the lady again, and this was just before last Christmas. Then she was on the phone to report that the set had failed completely. This was the best news so far, and I lost no time in getting the set on the bench, hoping that the fault would stick around long enough for me to get to grips with it.

In fact I needn't have hurried. The fault turned out to be a complete breakdown of the chopper transistor, TR906 which, in turn, had taken out the fuse F903. That was a bit of a setback because, whatever the intermittent fault was, it was certainly not what I had just found. There was also the important question as to just why TR906 had failed. Had it simply died of old age, or had something triggered the failure.

I fitted a new transistor and fuse, but hesitated to switch the set on again until I had given the board another once over in a search for dry joints. I could see nothing obvious but I still hesitated to switch on. Finally, after some deliberation I decided to tackle the intermittent head on. If it was a dry joint, as seemed most likely, then I would attack it by re-soldering every joint on the board. A big job? Well, yes, but it didn't take any more time than I might spend fruitlessly prodding around and getting nowhere.

That done, I crossed my fingers and switched on. And, lo and behold, everything came good. I let it run for a few minutes, shook it gently, gave it a few prods around the suspect area, and noted with satisfaction that it continued to play. So I pushed it into "intermittent corner" and let it run for the rest of the day.

It survived this test and the next morning I connected a meter to the HT rail, which runs at 125V in this model, then turned it on again. Everything came good, the meter sat steadily on 125V, and I let it run for the rest of the day, again with no sign of trouble. In fact, it ran for several days and I was beginning to feel confident that my blanket soldering operation had paid off.

Then, one morning as I switched the set on and the picture came up I was sure that it juddered briefly. It settled down all right but a glance at the HT meter confirmed my fears; it was wavering slightly, between about 120 to 125V, but enough to indicate that something was wrong. In fact, it became worse, dropping to 113V at one stage, then making its way back in dribs and drabs to normal level.

No longer a dry joint

Convinced that it was no longer a dry joint problem I began thinking in terms of a faulty transistor somewhere, possibly along the lines of the leaky transistor I found in the General GC145, as described in the December 1985 notes. So I reached for the freezer can and attacked each transistor in turn. The result was totally negative; it made not the slightest difference.

So, if it wasn't thermal, was it mechanical; a hairline crack for example. I left the set running and attacked the board with a substantially insulated prod, the sort of thing with which one can exert considerable pressure on a suspect component without fear of producing short circuits or shocks.

This didn't seem to achieve anything and finally, taking my courage in both hands — and putting one of them in my pocket — I very gingerly began wiggling the various heavy duty resistors between my fingers, while the set was running. Again I didn't seem to be getting anywhere, at least initially, but when I came to R924, a 4.7kΩ, 5W resistor feeding the collector of TR905, things started to happen.

I exerted rather more pressure! F903 went out in a blaze of glory!

The first wiggle produced no effect but at the second try, when I exerted rather more pressure, there was a sudden splat and fuse F903 went out in a blaze of glory. Nor was I surprised to find that the horizontal output transistor, TR906, had again been destroyed.

At this stage I wasn't quite sure what had happened except that the little support tube at one end of the resistor now appeared to be slightly loose, but I wasn't sure whether this was a real fault or one that I had created by being too heavy handed. On the other hand I was beginning to get some kind of a picture as to the possible cause of the original TR906 failure.

I pulled the board out and examined the print side in detail. I half expected to find that I had broken the copper pattern, but the real situation was quite different. As I have already mentioned I had been over the board and remade every joint, so it was something of a shock to discover that the solder adhering to the tube had broken away from the copper pattern. Yes, it was a dry joint, but one in which the solder had flowed out smoothly over the copper, giving every indication of a perfect joint.

Removing the solder from the tube uncovered the copper pattern to which the solder should have adhered, revealing the coating of black oxide. Just why this had happened is not clear, but it was obvious that the solder had never taken to the copper pattern or, if it had, in such a minute area that it eventually fractured and created a typical intermittent condition.

I carefully scraped away the oxide until I had bright copper, tinned it, then re-made the joint. I checked the joint at the other end by deliberately removing the solder, or as much as would come away, and satisfied myself that this one was OK. I checked all the assemblies in the same way and found two more joints in exactly the same condition.

I repaired these, fitted a new TR906, a new fuse, and put everything back together. The set came good when I switched it on, and continued without so much as a flicker for the next couple of weeks. Then, satisfied that I had really found the fault, I returned it to the customer. That was many weeks ago and a quick check as I finish off these notes confirms that it is still going with no sign of trouble.

I think I have really fixed it this time.

But why did the fault cause TR906 to fail? It seems virtually certain that the sudden open circuit in the supply rail to TR905, and the inductive load in this circuit (T901) generated a substantial spike as the magnetic field collapsed. This appeared in the secondary winding, was applied to the base of TR906, and the rest is history.

With hindsight . . .

There are several lessons to be learned from this story. The first one, I'm sorry to say, is that your serviceman was not as adept at uncovering dry joints as he thought he was! With hindsight I was reminded of some advice proferred to me many years ago, by a mate in the (then) PMG's telephone section. "The surest way to check a soldered joint is to try to remove the solder. If it is a good joint, you won't be able to."

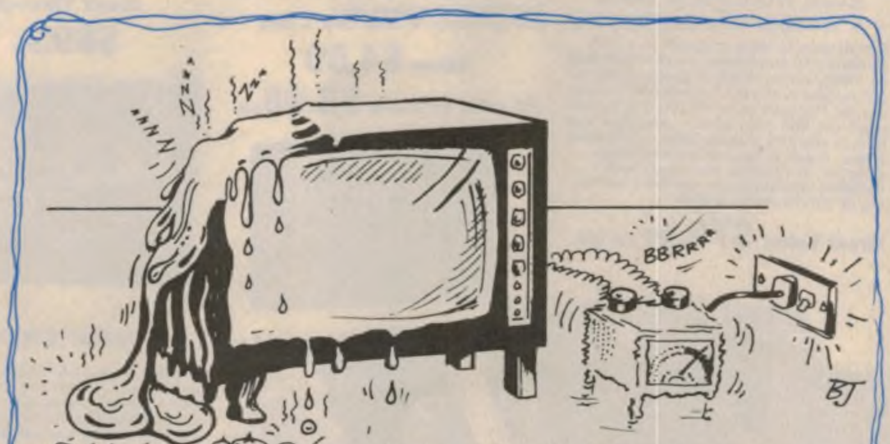
Sound advice indeed.

The other lessons are more general and simply amount to the fact that these particular chassis, under whatever brand name you find them, are prone to these dry joint problems. I earnestly suggest that my professional readers make a note of these faults and file them with the appropriate manuals. Also, it would seem to be a wise precaution if these sets, whenever they are encountered and for whatever other reason, are checked out thoroughly in these potentially troublesome areas.

And, finally, a further general comment about this type of power supply. In many cases where one suspects a likely flashover situation or other destructive fault, it is a wise precaution to power the set via a Variac, increasing the input voltage gradually until possible signs of distress were noted. But this is not possible with this circuit, which depends on the sudden application of voltage to C910 and its charging action to drive the multivibrator kick-start circuit and get the horizontal output stage working.

Fortunately, there are a couple of ways in which one can cheat. One is to fit the 56kΩ starting resistor, shown dotted in the circuit, which will drive the multivibrator section continuously. The other is to increase the voltage from the Variac in steps, the set being switched on in the normal way after each setting has been selected.

So there it is. One way and another I have managed to collect what I feel is a lot of valuable information about these sets. I hope others will benefit from it.



Increase voltage until signs of distress are noted.

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Output Level 130db **A 0083**

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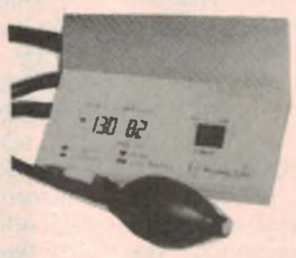

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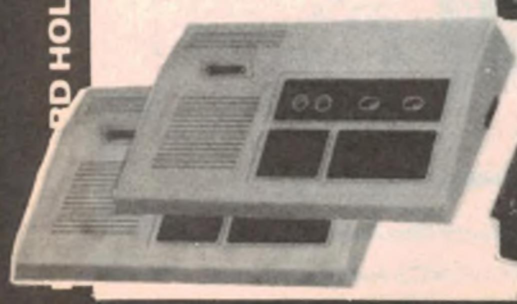

Microtek Microwave Detector
$19.95

High level leakage of hazardous radiation from the Microwave oven may occur due to damage or wear of sealing surfaces, the door, the door hinges or the door latches. Microtek is designed to detect the microwave leakage and to display the relative radiation strength on a level meter. Should the radiation reach a dangerous level, qualified personnel should be called upon for thorough checking and repair. It can detect radiation as low as 0.1 milliwatts per square centimeter. **A 0900**

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At our direct import price you can afford to fit several through the house for security of your possessions and "peace of mind" for all the family.

Operates from 9V battery (not supplied) (Alkaline type recommended for long service life).

Literally dozens of uses e.g. on the swimming pool gate when used with a weather protective shroud. **S 5315**

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Solar Cell Module
.4V at 450mA

Great experimenters Solar Module. Connect in parallel or series as you wish. Terminal strap enables easy interconnection to other cells. **A 0210**

Value $4.50
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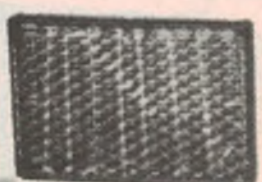

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New Ultra Sonic Home/Office Alarm System

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 among book shelves etc.

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Exit Delay	30 - 35 secs.
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4 Sets Reed Switches for Window/Doors
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Now there is no excuse for not Protecting yourself, your family and all your hard earned possessions!

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Out performs our main competitors system which, incidently sells at around $50 more for the comparable system and accessories.

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Brilliant New Solar Array at an amazing price. Yes, for less than $90 we now have just the handiest Solar Modules available (Why pay our competitors $239 for a measly 3 additional watts?? Superb for Powering or Charging 12 - 15 Volt circuits - Now there's now excuse for that flat Car, Boat or Caravan Battery. Solar Cells are fixed to a fibre board, front covered with tough EPS and rivetted into stainless steel frame. **Cat No. A 0220**

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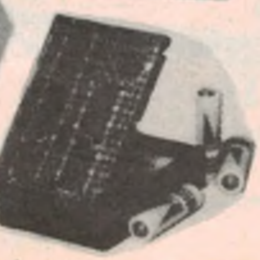

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Professional Megaphone PA
20 Watts Max.Power with In-Built Whistle

A new product for 1986, our A 1990 Megaphone PA is quite simply one of the finest around irrespective of price. This is an extremely sturdy unit with a quality in-built 20 watt (max) low distortion amplifier. **Another Secret** of the fine performance is the incorporation of a noise cancelling micrphone - the result is a surprising level of gain available **without feedback** even when used indoors in relatively confined spaces.

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100 Amp Jumper Leads
Superb Quality

These are the real McCoy. Extra heavy duty 100 Amp capacity. **Get a set for your car today. A 3011**

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Infra Red Movement Detector

With Interchangeable lens for corridor or wide angle detection

The Infra Red or IR detector for short is basically a high gain passive tuned receiver of a particular IR band. The heart of the unit consists of a high gain lens (antenna) which has a "Commutated" field of view. Its reception pattern is comb-like, but highly tuned to the IR wavelength of human bodies. When a human passes within proximity of the pickup area, the lens will selectively pick up IR radiation and then not. Movement across the pickup area will result in a series of pulses sent to a detector circuit. IR detectors are very reliable as they do not transmit and will not respond to non heat radiating objects.

Features:

- Lens simply 'snaps' to either **wide angle** (range 40 feet) for normal use or **Normal angle** (range 80 feet plus) for corridor applications.
- Snazzy integral mounting bracket allows corner 90 deg. mounting as well as normal surface mount (This is a fantastic feature as these work best in corners and are visually unobtrusive)
- 12V DC Powered
- Built-in test lamp
- Alarm output SPDT 30V 1a

S 5301

$89

Piezo Ceramic Speakers

Piezo Ceramic Speakers offer several advantages over conventional speakers, as • No bulky magnet structure • no voice coil • No crossover network required • excellent transient response • Extremely low distortion • High impedance-as Piezo appears as capacitive rather than inductive load • Light weight • High power capability - All speakers are capable of handling in excess of 150 watts and can be configured to handle much, much higher.

Round Tweeter

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

$6.95 4 Up **$15**

Motorola KSN 1025A

177.8 x 82.6mm Rectangular Piezo Horn Speaker suitable for HiFi and Sound Reinforcement. Full 90° Dispersion Angle • **Freq.Res:** 1.9 to 40KHz • **Sens:** 100db @ 2.8V **C 6140**

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Rectangular HIFI-PA Piezo

144.8 x 54mm Rectangular Piezo Horn Speaker suitable for HiFi and Sound Reinforcement. Full 90° horizontal dispersion angle • **Freq.Res.** 3 to 40KHz • **Sens:** 110db @ 2.8V **C 6120**

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Data Tape

The criteria for data tape is of course, very exacting with many computers available today. Our D 1141 data tape is in our humble opinion one of the finest available today — anywhere! O.E.M. customers, Mytek Computing is reporting 96% success rate with High Speed Data Dubbing. This is of course quite phenomenal when one considers the dubbing speed is 30 times normal. **D 1141**

1—9	10—99	100 Up
1.74	**1.45**	**1.25**

New Generation Calculators

Direct from the Importer

Our **COMPEX** Printing/Display Calculator is just the shot for the office. The feel and response of the keys is both light and positive, an essential characteristic in our view. More than favourably compares with others costing $50 or $60 more.

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Uses 4 x AA Batteries or Altronics Adaptor M 9001 **$9.95** Additional.

Superb Printer/Display Calculator for the Office

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Amazing Price

RS-232 Surge Protector

The RS-232 surge protector is used to protect RS-232 ports from the possibility of costly damage from large voltage peaks caused by lightning or other power problems. The surge protector used Metal-Oxide Variators (MOV) to protect pins 2,3 and 7. It has one male and one female connector with all 25 pins connected straight through and with MOV's connected between pins 1 and 2, pins 1 and 7. The MOV's will suppress any voltage above 26 volts without affecting the normal RS-232 voltage levels. The MOV's are capable of handling one joule of energy and 250 amps peak current. **D 1510**

$19.50

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. All 25 pins of each connector go to the 25 solder pads. By custom wiring these pads, many different interfaces can be built: null modems, pin reversers, etc. Also a cable can be connected to tap signals from the RS-232 line. **D 1520**

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High Definition Computer Monitor

New Micron Series 3

There are a number of low cost 'Hobbyist' monitors around these days at prices unheard of a year or so ago. However, they all suffer from poor to medium definition or resolution—hence eye strain becomes a real headache. The situation has all changed with the release of the superb **Micron Series 3.** Non glare, naturally, and screen character resolution well worthy of mating up with top end personal or professional computers.

• 1050 lines resolution at centre screen • 22 MHz band width • Video input impedance switch allows networking use.

Specifications:

Screen—Green phosphor **Front Controls**—Power On/Off, character brightness/intensity, display centering **Rear Controls**—Background intensity, vertical and horizontal adjustment etc. **Input Impedance** Switch 75/10K **Bandwidth**—10Hz-22MHz **Resolution**—1050 lines minimum at centre screen. **D 1115**

Green Non Glare $199

Null Modem

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 **D 1530**

$9.95

RS-232 Mini Tester

This Tester indicates the presence of all important interface lines by LED illumination when signal is active. All 25 pins are connected straight through. **D 1500**

$19.50

Desk Mounted Lamp Magnifier

Only
$169

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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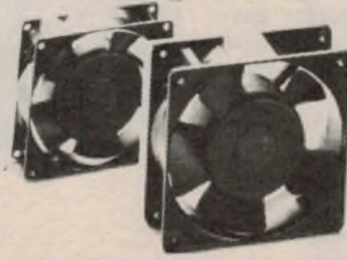

Fan Finger Guards

F 1022	(for 80mm Fan)	$1.50
F 1032	(for 110mm Fan)	$1.50

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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Listen to your favourite CDs on tape

Compressor for compact discs

Ever tried to record a compact disc on a conventional cassette recorder? Unless your deck has dbx, you're not in the race. Even those machines with automatic level control cannot cope with the wide dynamic range of compact discs. That's where our CD Compressor comes in.

by COLIN DAWSON

We've designed this Compressor to meet a number of different purposes. For example, you may love your collection of 'Dire Straits' compact discs but what happens if you want to listen to the same tracks on your Walkman-style cassette player when you go for a run? Or what about playing tapes in your car?

The basic problem is that a cassette deck cannot successfully record the wide dynamic range of a typical compact disc. Even if it has Dolby B noise reduction, it will not be able to cope. If it has Dolby C noise reduction it will be somewhat better but only a deck with dbx noise reduction will come close to coping with the full dynamic range of a CD.

That's okay for recording but when you're listening on the run or in a car barrelling down the expressway, you don't want high dynamic range anyway. You need a lot less. If you're pounding the pavement, you're not going to be interested in pianissimo passages anyway. And the average car is so noisy at speed that it drowns out the soft parts of the music.

So if you are going to usefully record and listen to cassette tapes made from compact discs, you'll want a compressor; a circuit to make the soft passages louder and the loud passages softer. That's what our compressor does.

Ideally, the compressor would operate so that: (1) the volume control for playback is set to the same level for a compressed tape as an uncompressed one, ie, the average volume would be about the same; (2) the quiet passages should be increased in level, sufficient to overcome typical car background noise; and (3) the loudest passages should be reduced in level so that they do not cause distortion or discomfort to the listener in a car.

Our design meets these objectives successfully while keeping distortion to low levels, with a relatively simple, low-cost circuit. Naturally, there is some compromise which mainly applies to very low level signals.

Some classical passages have sections so quiet that they are barely audible, even in an ideal listening environment. Amplifying these sufficiently to overcome the noise of your turbo-charged horsies under the bonnet is not practical. Therefore, our design has a maximum gain of +9.2dB for small signals (a voltage gain of about 3).

For the loudest passages, the circuit has a maximum signal attenuation of −14.5dB (a voltage loss of about 5.3). This should take the sting out of the really loud sections.

Overall, the circuit reduces the dynamic range of the music by 9.2 +

The input and output RCA sockets are mounted on the front panel of the metal case.

14.5dB, or about 24dB. This is enough to allow just about all compact discs to be satisfactorily recorded on just about any cassette deck.

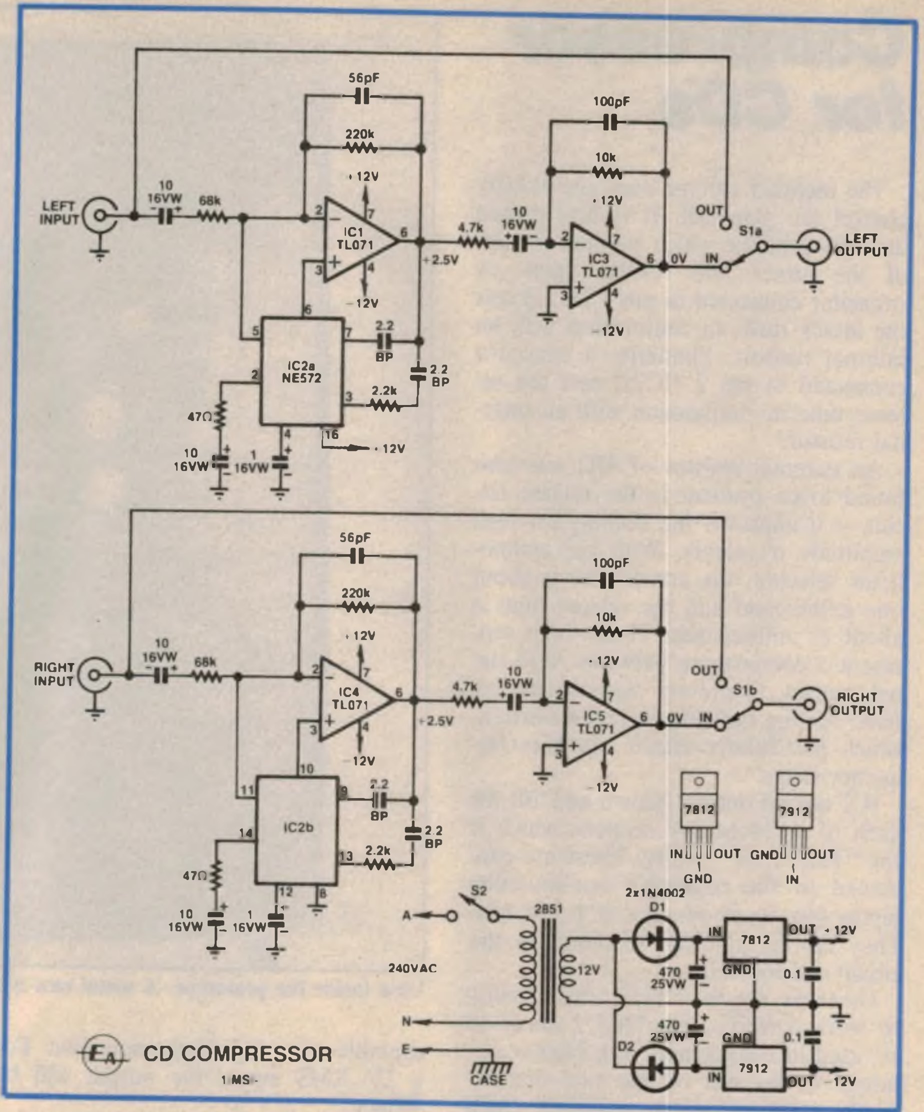
Circuit Description

Heart and soul of the compressor is the Signetics NE572 compandor chip (IC2). The device can be used either as a compressor or expander, hence the contraction "compandor". In fact, the NE572 has two independent compandor sections. Most commonly, this allows the device to be used in stereo applications, but it would also be useful in communications systems. One section would be used as a compressor for outgoing signals and the other to expand incoming signals.

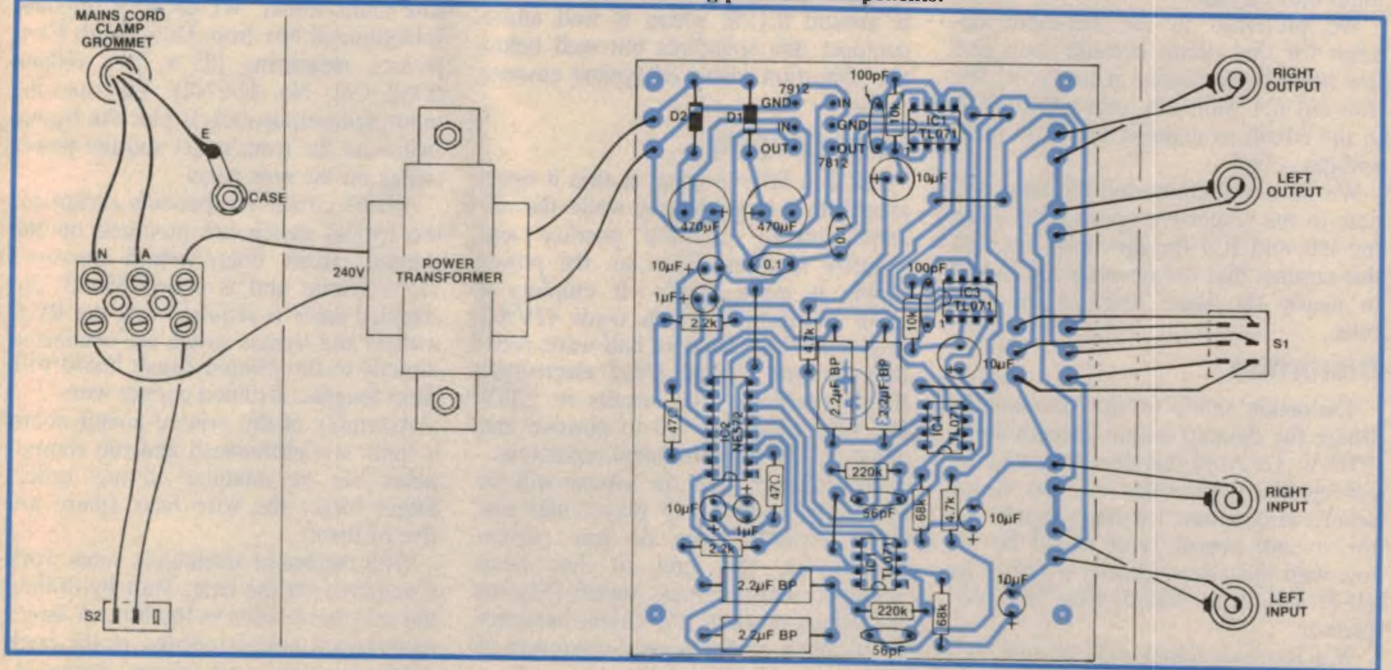
The compandor is essentially a variable transconductance cell. This means that it is basically a resistance which varies in proportion to a control voltage.

For a compressor circuit, the resistance is inserted into the negative feedback path of an op-amp, so that it can control the gain of that op-amp. Refer now to the circuit diagram which shows both channels.

The control voltage is derived directly from the op-amp output signal. The output signal is fed into a rectifier inside the compandor chip (pin 3 for the left channel — we shall refer only to the left channel for most of the circuit description). The resultant voltage varies in proportion to the output signal amplitude.



Below: the parts layout and wiring diagram. Take care when installing polarised components.



Compressor for CDs

The rectified voltage does not directly control the gain cell. It is first passed through a buffer which permits control of the attack and release times. A capacitor connected to pin 4 (IC2a) sets the attack time, in conjunction with an internal resistor. Similarly, a capacitor connected to pin 2 (IC2a) sets the release time in conjunction with an internal resistor.

An external resistor of 47Ω was also found to be prudent in the release circuit — it improves the stability for high amplitude transients. With the components selected, the attack time is about one millisecond and the release time is about 10 milliseconds. These times represent a compromise between good signal control, to prevent signal transients from beating the system, and distortion, which particularly affects the bass frequency range.

IC2 has an output (pins 6 and 10) for each of its respective sections which is the "THD trim" facility. These are connected to the respective non-inverting inputs (pin 3) of op-amps IC1 and IC4. They can be adjusted to minimize the circuit's distortion.

However, for the "THD trim" facility to work correctly, the NE572 needs to be used in conjunction with bipolar op-amps. It depends on the fact that bipolar op-amps draw relatively high input bias currents.

We preferred to use Fet-input op-amps for this circuit because they give low noise performance at low cost. We also did not want any user-adjustments in the circuit to make it simple to build and get going.

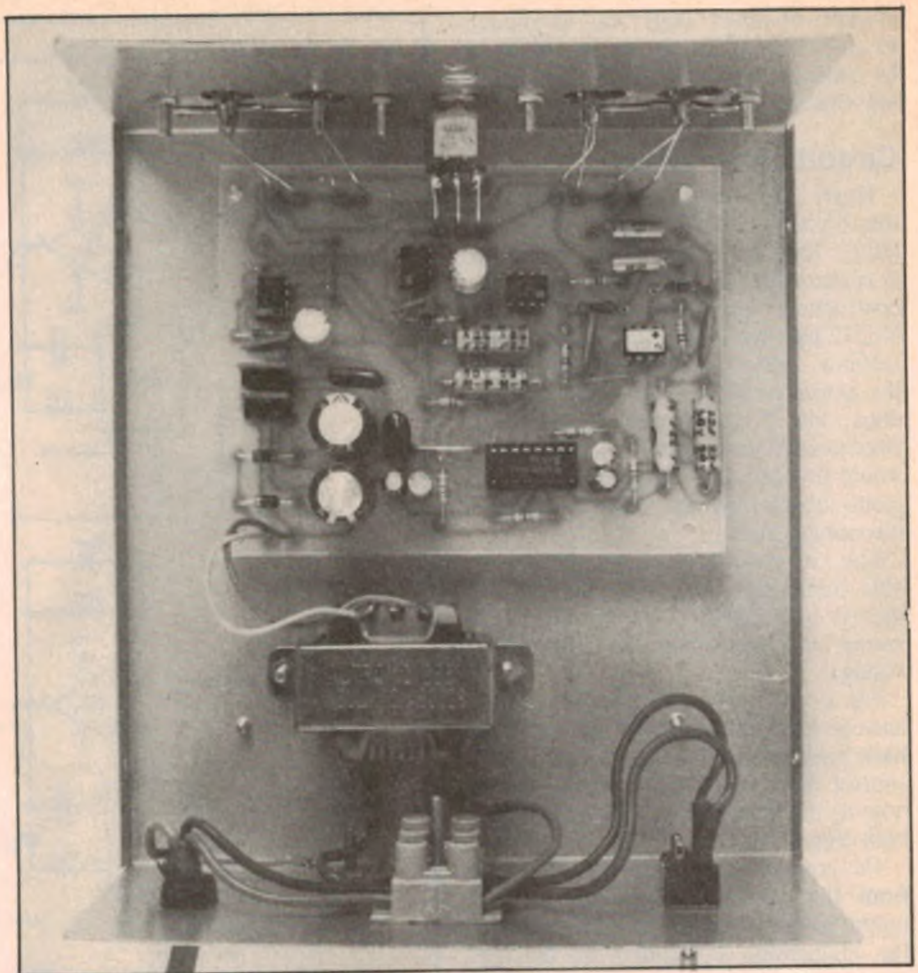
We have still connected the trim outputs to the respective op-amps (IC1 for the left and IC4 for the right) because this ensures that the op-amps are biased to nearly the same level as the gain cells.

Distortion

Distortion tends to rise dramatically where the op-amp output exceeds about 400mV. To avoid this situation, we have set up the compressor so that it has severe attenuation for large inputs. As the overall output level would be too low with this characteristic, a gain stage (IC3) has been added after the compressor.

IC3 has a nominal gain of just over two, to provide the circuit with an acceptable overall gain characteristic. For a 2V RMS input, the output will be 370mV.

The resulting distortion of the circuit is around 0.15% which is well above compact disc standards but well below the distortion levels of typical cassette decks.



View inside the prototype. A metal case is necessary to provide adequate shielding.

Power supply

IC2 is a little unusual in that it operates from a single supply while the op-amps require balanced positive and negative supplies. Even so, the power supply is quite simple. It employs a small transformer which feeds 12VAC to positive and negative half-wave rectifiers D1 and D2 and 470μF electrolytic filter capacitors. This results in ±17V DC rails which are fed to positive and negative 12V three-terminal regulators.

We envisage that the circuit will be set up between a CD player and cassette recorder more or less permanently. To this end, it has been equipped with a bypass switch (S1). In the bypass position, the circuit need not be switched on for normal operation of the associated equipment.

Construction

The circuit must be built into a metal box to provide good shielding and a safe mains earth. We chose a standard folded metal box from Dick Smith Electronics, measuring 185 x 70 x 160mm (DSE Cat. No. H-2744). This has the input and output sockets plus the bypass switch on the front panel and the power switch on the rear panel.

All the circuit components except for the bypass switch are mounted on the printed circuit board which measures 115 x 88mm and is coded 86ms3. No shielded cable is required and the RCA sockets and bypass switch are connected directly to the printed circuit board with short lengths of tinned copper wire.

Assembly of the printed circuit board is quite straightforward and the components can be mounted in any order. Don't forget the wire links (there are five of them).

With the board assembled, some work is required on the case. Start by drilling the necessary holes in the box. A large, oval-shaped hole is needed in the back panel for the cord clamp grommet,

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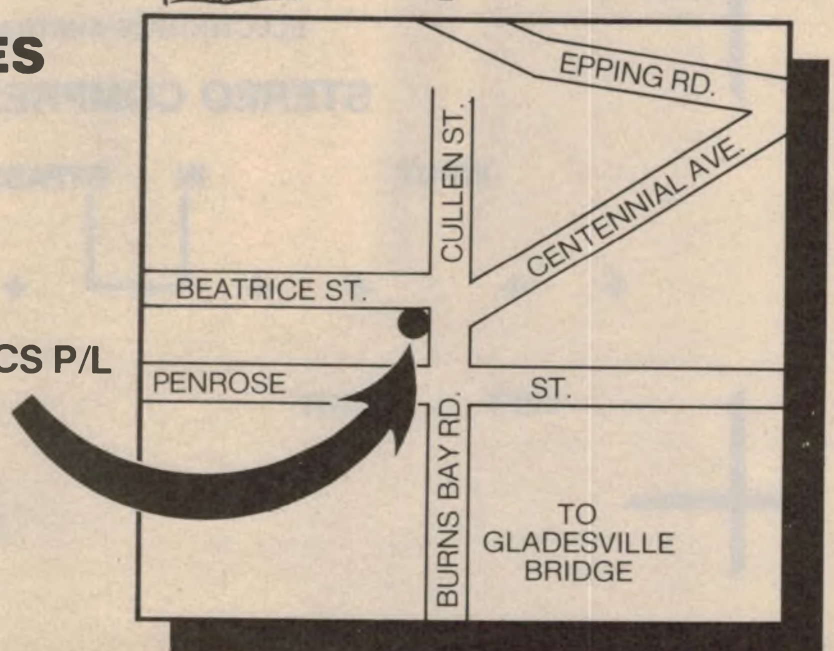
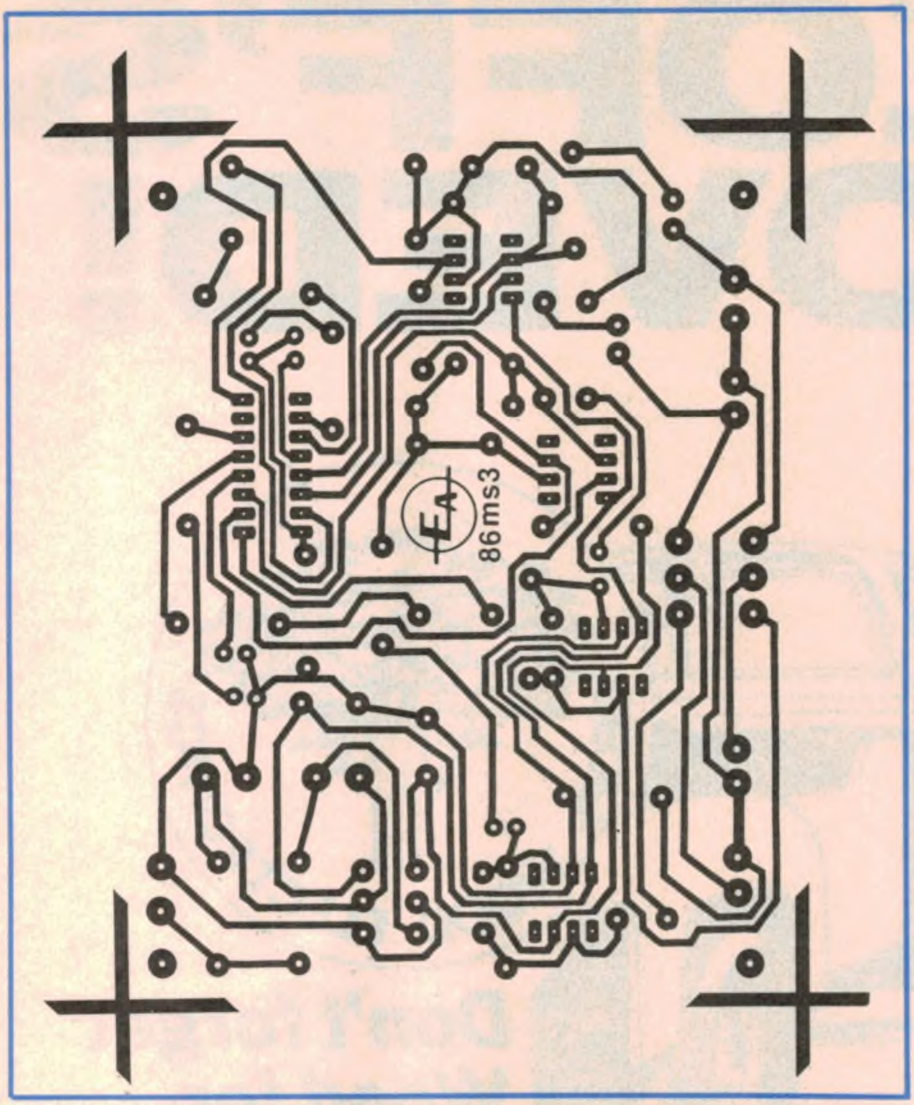




Compressor for CDs

along with one for the power switch (S2), two for the terminal block and one for the earthing point.

Other holes which must be drilled are: two for the transformer mounting screws (in the base, towards the rear of the box); four for the PCB mounting screws — keep the PCB towards the front of the box; one on the front panel for the bypass switch (S1) and four others for the two-way RCA sockets.

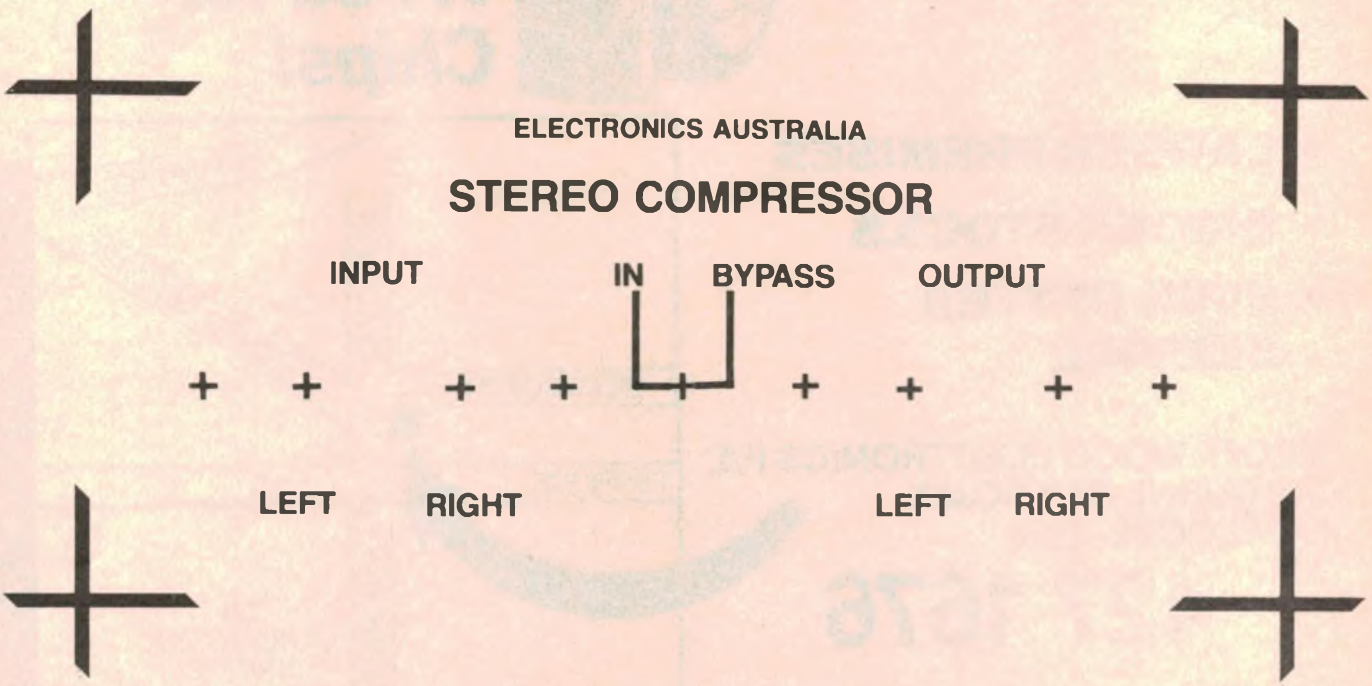
We opted to use a pair of two way RCA sockets on the front panel. The single type aren't really suitable as they are difficult to isolate from the front panel.

Power on

When all assembly work is complete, check all your work thoroughly against the wiring diagram. With your multimeter switched to a low "ohms" range, check that the earth pin of the power plug is connected to the chassis. Check also that both the active and neutral wires of the power cord are isolated from the rest of the circuit and chassis.

Now give the circuit a power up test without anything else connected to it — just in case. Assuming there are no sparks, smoke or other disturbing phe-

At left is an actual size artwork for the PCB while below is the front panel artwork.



nomena, check the voltages listed on the circuit diagram. Pin 6 of IC3 and IC5 should be within a few millivolts of 0V.

Now connect your CD player to the inputs of the compressor and your cassette deck to the compressor outputs.

The CD player to cassette recorder set up should work irrespective of whether the compressor is turned on or not, provided that it is switched to bypass.

Next, with the circuit powered up, switch the circuit in. If it's working OK, the loud passages should be reduced in volume, compared to when the bypass function is selected, and quiet passages should be louder.

If there is no sign of signal compression, an incorrectly installed electrolytic would be a likely cause. EA

PARTS LIST

- 1 metal box, 185 x 160 x 70mm, DSE Cat. No. H2744 or equivalent
- 1 12V transformer, Ferguson PF2851 or equivalent
- 1 printed circuit board, code 86ms3, 115 x 88mm
- 1 3-core mains cord and moulded plug assembly
- 1 3-way mains terminal block
- 1 single pole, single throw (SPST) mains switch
- 1 double pole, double throw (DPDT) switch
- 2 2-way RCA panel mounting socket strips
- 2 1cm pieces of heatshrink or spaghetti tubing (for mains terminals on transformer)
- 1 metre of tinned copper wire
- 4 5mm PCB stand offs

Semiconductors

- 1 NE572 stereo compandor IC
- 4 TL071, LM351 FET input op-amps
- 2 1N4001 diodes
- 1 7912 −12V regulator
- 1 7812 +12V regulator

Capacitors

- 2 470μF 25VW PC electrolytics
- 4 10μF 16VW non-polarised axial electrolytics
- 6 10μF 16VW PC electrolytics
- 2 1μF 16VW electrolytics
- 2 0.1μF greencaps
- 2 100pF ceramics
- 2 56pF ceramics

Resistors (¼W, 5%)

2 x 220kΩ, 2 x 68kΩ, 2 x 10kΩ, 2 x 4.7kΩ, 2 x 2.2kΩ, 2 x 47Ω.

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UTOPIATRONICS: The supplier hobbyists dream about!

FORUM

Conducted by Neville Williams

Wouldn't it be wonderful if electronics suppliers kept in stock, for an indefinite period, all the individual components hobbyists might need to build magazine projects that took their fancy. A Victorian reader would like us to transform that dream into renewed reality, with a stroke of the editorial pen.

To be sure, he doesn't express it in those terms but, in effect, he'd like us to turn the clock back to that Utopian period, when projects could remain current for years; when components were readily available off the shelf and able to be dispensed cheaply over the counter, to suit the whims and resources of individual buyers.

Many projects were indeed built up over a lengthy period in those halycon days BK (Before Kits) with parts swapped, or scrounged, or picked up on paydays, on the way home. But things have changed (for the worse). Says our correspondent:

I have been a regular reader of EA for many years and I must voice my disappointment at the direction the magazine has taken in the last year or so.

I'll use the new Playmaster tuner as an example. For many months, I have been looking forward to this unit, although I suspected that it would be a "buy a kit or forget it" project, like so many others lately.

In my circle of friends I know of three who would like to build the tuner but no one will do so for one reason: we can't afford to lay out $400 in one hit for a kit. Surely we are not the only ones in the land who can't lay out big dollars for kits based on articles from a magazine ostensibly aimed at enthusiasts and hobbyists.

I have built many highly complex projects from other magazines, one section at a time, with no large one-time outlay, eg computer-controlled frequency meter, preamplifier and power amplifier, parametric equaliser, &c. I am certainly not the only one who would prefer to build from an English rather than an Australian magazine.

I invite you to name one reasonably complex project described in EA recently that has PCB artwork, component suppliers, drilling details, &c.

I sincerely hope that EA changes back to the old ways because what was once a great magazine has been reduced to nothing more than a collection of kit manufacturing instructions.

When a group of hobbyists say "I hope another magazine brings out something as good as this tuner", it must tell you something! N.M. (Rosebud, Victoria).

I can't deny that there has been a change in the content of some of our constructional articles but N.M. is wide of the mark if he believes that it is simply the result of a gratuitous change in editorial policy, or that it has occurred only in the last year or so.

In actual fact, the face of hobby electronics has been changing steadily over the past twenty years and magazines worldwide have had to adapt to it. Some haven't made it and have simply disappeared!

I know because, for much of that time, I was in the hot seat right here at EA.

For this magazine, the process began in earnest with the changeover to solid state technology in the '60s. Previously, the pace of technological development, and the currency of magazine projects, had largely been keyed to the introduction of new valve types — a very formal and unhurried procedure with a long lead and lag time.

But, suddenly, valves were out and transistors were in, being introduced, modified, superseded or abandoned in short order — at the whim of individual companies jockeying for a market share.

The longevity of magazine projects dropped from years to months and would-be constructors found themselves having to buy the parts when they were available, or risk missing out altogether. That still applies; neither magazine, nor stockist nor constructor can gamble on some particular components being available this time next year.

Competition from imports

It was in the same formative solid state era that the Japanese electronics industry got moving, and flooded our market with mass produced test instruments, portable radios, audio equipment and amateur gear that looked the part, worked well, and cost less to buy than the components needed to build them!

It also had a profound effect on hobbyist attitudes and on licensed amateurs in particular.

Many simply settled for the built-up product but even inveterate home constructors were no longer content with the tradtional "home-made" look; they demanded a PC board, chassis and case, and a fully finished front panel to lend a professional touch.

Faced with the need to order and stock these as special items, it was logical for suppliers to want to sell them only as part of a kit; either that or not bother with them at all!

As it happened, most would-be constructors seemed rather to like the idea and we had no end of complaints from readers about having to chase up individual parts for projects that, for some reason, had not been advertised in kit form!

Really, it has little to do with us, apart from awareness that packaged kits were becoming popular. Our self-appointed task was to design and describe the project. How the parts were sold was more a matter for the vendor and customer.

Company project kits

What about articles based on designs and kits originated by individual suppliers?

Our early policy was simply to review them if requested, but not to feature them, as it were, in competition with our own laboratory projects, in which all advertisers were free to share.

But there came a time when readers began asking about projects which, for one reason or another, we could not reasonably cope with. Some involved activities — model aircraft, boating, &c — which were beyond the scope of currently available staff. Others called for custom built hardware which would not be accessible to regular parts suppliers.

Yet a suitable project was often available in kit form from one source or another. To check out and feature such a kit would obviously assist those readers who might want to build it, while also interesting others who would merely like to read about the technology involved.

I personally made the decision at that time to change our policy, in order to broaden our coverage into areas which we could not hope to cover ourselves without a totally uneconomic increase in laboratory staff.

That was many years ago and, since then, we have checked out and featured a wide variety of projects from overseas and local sources, with the idea of drawing them to the attention of would-be constructors and of enlightening those who merely like to read about such things.

The 100W VHF Linear Amplifier in the March issue is a recent example.

If, as a reaction to N.M.'s letter, we face a chorus of protest against such articles, I guess that Editor Leo Simpson will have to reconsider that earlier decision!

The Playmaster tuner

As it happens, the AM/FM stereo tuner which is the focus of N.M.'s letter was born and bred in EA's own laboratory, after a gestation period of something like twelve months.

In terms of man hours, it was an extremely costly project but we had the satisfaction of being able to present it as literally the best AM/FM stereo tuner we had ever handled or measured. Moreover, the ultimate kit price of $399 is both modest and attractive when compared with the cost of less highly specified commercial tuners.

Reading N.M.'s letter, one wonders how people get on who want to buy a good quality commercial tuner, or anything else around that figure, to use with $1000-worth or more of domestic hifi equipment?

They certainly wouldn't have the option of buying it a bit at a time. I guess that they'd have to arrange for a bank loan or buy it on credit card. If I might borrow N.M.'s phraseology, the Bankcard and Visa card symbol at the bottom of the Jaycar advert for the tuner kit "must tell you something".

Fragmented construction

Before writing this, I made a point of discussing with John Clarke, who did most of the work on the tuner, the idea of building it up in segments, as a way of spreading the cost. He was not impressed either from a technical or monetary point of view.

He pointed out that, in such a project, a great deal of care is necessary to ensure that there is no mutual interference between the AM and FM tuner functions and the control of display logic system.

Having decided upon a practical, slimline presentation, it made good sense to concentrate most of the components on a single, large PC board, as a way of ensuring a fixed and proven layout. He would feel much less confident, he said, about a design involving a number of smaller boards which could be shuffled around and interconnected at the whim of individual constructors.

In any case, what could be temporarily omitted apart, perhaps, from the AM or FM section? It would be a tedious way, indeed, to delay spending a few dollars.

John also stressed that the tuner contained specialised components that are not normally available through parts suppliers and that are, in any case, likely to be very expensive if ordered on a one-off basis.

When a company such as Jaycar decide to "kit up" for the tuner, they have to "take a punt" on the number of tuners that may be built and place firm orders for all the special components and hardware.

Having "stuck their necks out" for perhaps thousands of dollars, a practical company could hardly be blamed for trying to optimise their investment by reserving the components primarily for their own complete kits.

As for Utopiatronics, I fear that it is likely to remain a nostalgic dream. What do you think?

P.A. loudspeakers

Now for a change of subject: After writing three complete articles on small-scale public address systems, it could be somewhat frustrating to be reminded, however courteously, that you had completely overlooked an important aspect.

A letter to hand about P.A. amplifier systems is brief and to the point:

Dear Neville,

I read you articles on public address systems with great interest but was surprised that you did not make even a passing mention to low level loudspeaker

FORUM – *continued*

systems; ie multiple loudspeakers, each operating at a low power level and each speaking directly downwards.

These have been in use for a number of years and have proved to be useful in halls with awkward acoustics. Although they do not have the directional effect of front located systems, they can give a very even spread of sound. It is often more important to be understood than to be heard from the right direction.

Also, the microphone can be used directly under the speakers right throughout the hall, with less feedback problems than many other systems.

They are particularly effective in halls with low ceilings or highly reverberant acoustics.

I will be interested to hear your comments on this system and why you omitted to mention it in your articles.

N.T. (Laverton, Vic).

While it is true that I did not specifically mention dispersed loudspeakers, the omission was conscious rather than accidental. Indeed, the concept was implicit in the reference, on pp22/23 of the November issue, to large scale professional line source systems involving up to a dozen high powered drivers.

In particular, I had in mind a pair of such systems that were installed many years ago in the Sydney Town Hall, high above the platform but effectively camouflaged by the massive pipe work of the grand organ.

Sydneysiders with a long memory might recall that, prior to the installation of the line source systems, dispersed loudspeakers were used, with downward inclined back-to-back pairs attached to the pillars supporting the galleries, and serving the floor level audience on either side. Other dispersed loudspeakers served the galleries.

In the huge, reverberant sandstone building, the multiplicity of sound sources could — and often did — add up to complete sonic confusion, with every syllable turning into a 2- to 3-second event. It presented particular problems with loud-talking, fast-speaking orators.

Substitution of an up-front line-source system at least helped to keep the direct and amplified sound in step and to beam the latter towards the audience rather than have it re-echoing from the lofty, domed ceiling.

Some large and architecturally complex cathedrals are still served by dispersed systems — or dispersed line source systems — but with the added refinement of digital delay units and local amplifiers. The idea is to keep the amplified sound heard by listeners more or less synchronised with sound emanating from the source, or from loudspeakers closer to the source.

Come to think of it, an interesting article could be written on this general subject but, of course, it is in a world apart from the small-scale system we were talking about in the Sept/Oct/Nov issues.

In churches and halls?

In truth, I cannot recall ever having seen a dispersed loudspeaker system in a local church or concert hall. Nor could any of the people I asked, when N.T's letter came to hand.

For sure, you find them in department stores and supermarkets, in travel terminals and waiting rooms, in restaurants and coffee lounges but rarely, if ever, in churches or up-front presentation type situations.

As someone pointed out: walk into a club and you'll generally find a dispersed loudspeaker system being used for announcements and mood music. But, when a stage act comes on, they invariably use up-front sound reinforcement.

As N.T. suggests in his letter, it is vital to be understood but perhaps the directional qualities of the amplified sound are more important than he allows for. Rather than alternatives, they may both be imperatives.

There's one other very practical point: dispersed, downward facing loudspeakers can be installed most conveniently in structures with relatively low, false ceilings, with both lights and loudspeakers being mounted on ceiling panels flush with the undersurface.

Suspended from high ceilings, they would be unsightly, while mounting behind full, fixed ceilings could expose the cones to damage from wind gusts (or rodents, &c) in the roof space, unless individually boxed in.

Because of such considerations, the dispersed loudspeaker idea (branded by one acquaintance as the "Woolworths' system") was not mentioned in the series but N.T. might still have a point. There could be highly successful installations out there that we didn't allow for — or there could be failed systems.

CUSTOM ICs

In today's highly competitive market one of the biggest problems facing companies is the protection of their product designs. If product designs can be easily copied, other companies will soon do it. One way around this is to design the product with custom ICs. This article is a survey of the Australian custom IC market, describing the different types of custom ICs and how they are produced.

by TERRY AYSCOUGH

Introduction

Following the introduction of standard 54/74 Series TTL and other IC families in the mid 1960s, equipment designers were able to select from a wide range of economical "off the shelf" building blocks for use in both analog and digital systems. As experience and confidence developed, electronic circuitry was called on to perform increasingly complex and difficult tasks. This resulted in bigger and better printed circuit boards, which sometimes housed hundreds of standard ICs.

A reduction in the 'chip count' was promised in the early 1970s when large scale integration (LSI) technology became available. But it was soon found that the larger, more powerful devices, tended to have rather specialised, narrowly defined applications and lacked flexibility when compared to combinations of smaller devices.

Then the microprocessor was introduced and was hailed by many as the ideal solution, combining impressive power with highly adaptable signal processing capability. Subsequent experience has shown that software costs can be excessive. The micro is also disadvantaged by having to absorb some of its own processing time and power to support internal operations.

And while a few applications for medium and large scale microelectronic devices such as telecommunications, consumer goods or the automotive market may need production runs extending into hundreds of thousands of devices, the vast majority of ICs are utilised in low volume products. This is particularly true in a country such as Australia, where users demand access to the latest technology, but equipment production runs are limited by the small market size.

Now, a new range of IC devices has quietly emerged from humble beginnings way back in 1971 and is becoming a very significant part of the semiconductor scene. These devices all have one feature in common; they allow the designer to specify how signals are handled within the chip. This is done either by physically changing connections within the IC, specifying final interconnections before the chip is packaged or by partial or full involvement at the pre-fabrication design stage.

We will take a brief look at the main technologies involved and review some of the options and facilities which they offer. We hope it will also give the future user, whether he be an uninitiated designer, beleaguered service technician or blissful button-pusher, a clearer idea of these exciting new developments.

Terminology

The whole area of custom ICs is confused by an abundance of names, abbreviations and jargon. Terminology varies, not only from one region of the world to another, but also between suppliers from the same country.

The first name tag which needs sorting out is the generic term for the whole range of customer controlled, specified or designed ICs. Readers will come across labels such as Custom Designed ICs, Custom-Specified ICs, User Designed/Programmable ICs, etc. The name Application Specific Integrated Circuits (ASICs) seems to be accepted and used by most of the major microelectronics suppliers in Australia and is the terminology adopted for this article. Fig.1 shows how ASICs can be further classified into a number of distant family groups.

Device families

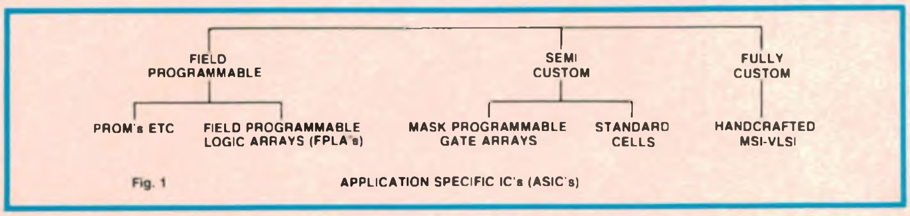


Fig. 1

The lefthand side of Fig.1 covers devices having functions which can be changed after they have been purchased fully packaged and tested from the manufacturer. These are known as field or user-programmable ICs.

Programmable read only memories (PROMs) come in a variety of types. Some can be programmed by applying special input signals and may be erased and re-programmed as required. The reader will probably be familiar with names such as Erasable Programmable ROM (EPROM), Electrically Alterable ROM (EAROM), and so on. Memory devices of this type decode the input signal and then use an OR matrix to provide the required outputs in a predefined truth table relationship. The characteristics of PROMs and the applications for which they are best suited set them apart from other ASICs. As they are also fully covered in most publications dealing with microelectronics, we will not spend further time discussing them here.

The second family of devices shown on the left in Fig.1 are the field programmable logic arrays (FPLAs). With these ICs, the manufacturer produces a standard fully packaged chip, which has a large number of inter-connections covering all probable customer requirements. The user 'programs' the device to obtain the desired architecture by injecting carefully controlled pulses of current through selected pins. These pulses melt internal fuse links, disconnecting unwanted functions.

The middle sections of Fig.1 show two further families of devices under the general heading of semi custom.

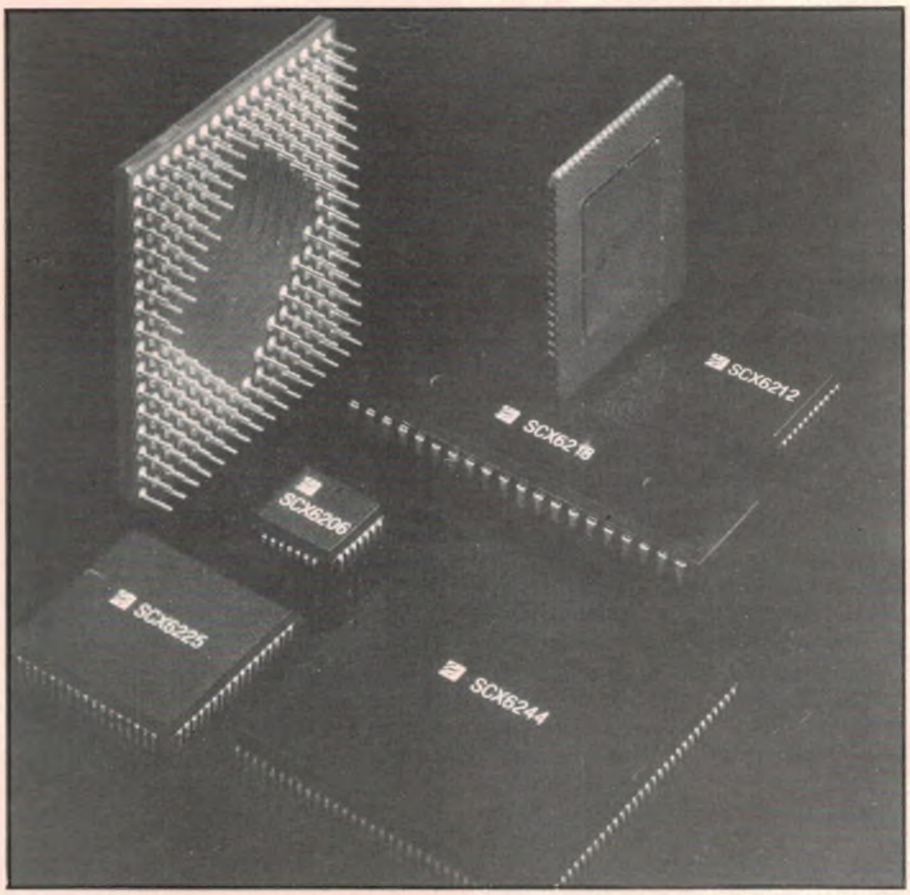
Mask programmable gate array chips, like FPLA chips, are produced to a standard format, but the final processing which would inter-connect components to form gates or gates to form logic arrays is not completed. When a customer wishes to purchase a quantity of devices, the exact logic required is specified and the IC manufacturer designs a suitable chip wiring layout to provide this. The standard format chips then have final masking and etching operations carried out, which leaves metal tracks selecting and inter-connecting sections as required.

With the standard cell family of semicustom devices, there is no pre-fabrication of chips. Detailed designs for a large number of tried and tested logic elements or cells such as gates, flipflops, op amps, and so on, are stored in a computer 'library'. When the user specifies the logic functions required, complete chip designs with suitable interconnections are assembled and evaluated by a complex software program. When satisfactory results are indicated, the computer prepares a full set of masks to fabricate the IC. From this point on, the processes are similar to those for an 'off the shelf' product.

American literature often classifies standard cell ICs as custom products, but in Australia they are generally considered to be in the semi custom group.

The righthand side of Fig.1 shows fully custom devices. In this case, the customer and IC manufacturer get together and develop a no-compromise design, in which every detail, down to individual components on the chip and pin connections on the package, are tailored to meet a specific application. Such devices are often said to be 'hand crafted', for reasons to be covered later.

Figures 2 and 3 take a brief look at current IC technology and some readers may like to update their knowledge in this area before moving on for a detailed review of each device family.



National Semiconductor have a 2-micron gate array family with 600 to 6000 gates in packages up to 172 pins. These ultra-fast devices have gate propagation times below one nanosecond and have reduced chip cost by virtue of being made on 6-inch wafers. (Photo by courtesy of National Semiconductor (Aust) Pty Ltd.)

Field programmable logic arrays

A field programmable logic array consists of a number of gates, buffers and sometimes various types of flipflops plus chip-enable facilities and so on. A small FPLA device might have provision for about 10 inputs and 4/6 outputs. Larger arrays might provide up to 22 inputs and 10 outputs. Most FPLAs come in a 20 to 28-pin package.

Some of the smallest devices currently available contain the equivalent of 150/300 2-input gates, whilst the largest devices offer up to 5000 gate equivalents. Device time delays are typically 15 to 35 nanoseconds and chip power consumption runs from 0.5 to 1.0 Watt.

Manufacturers' literature uses a variety of names to describe FPLAs. Some examples are fuse (or field) programmable logic devices (FPLDs, FPLs or PLDs); Programmable array logic (PAL — Monolithic Memories Inc) and Integrated fuse logic (IFL — Philips/Signetics). Some FPLAs contain clocked bistables, etc, and these are often termed programmble logic sequencers (PLSs) rather than PLAs.

The majority of present day FPLAs use TTL logic elements with nichrome fuse links in the inter-connecting circuitry. A user programs the chip to meet his specific requirements by passing current between certain pins. This permanently burns out selected links, but leaves others intact, providing the architecture required. The construction of a typical nichrome fusible element is shown in Fig.4.

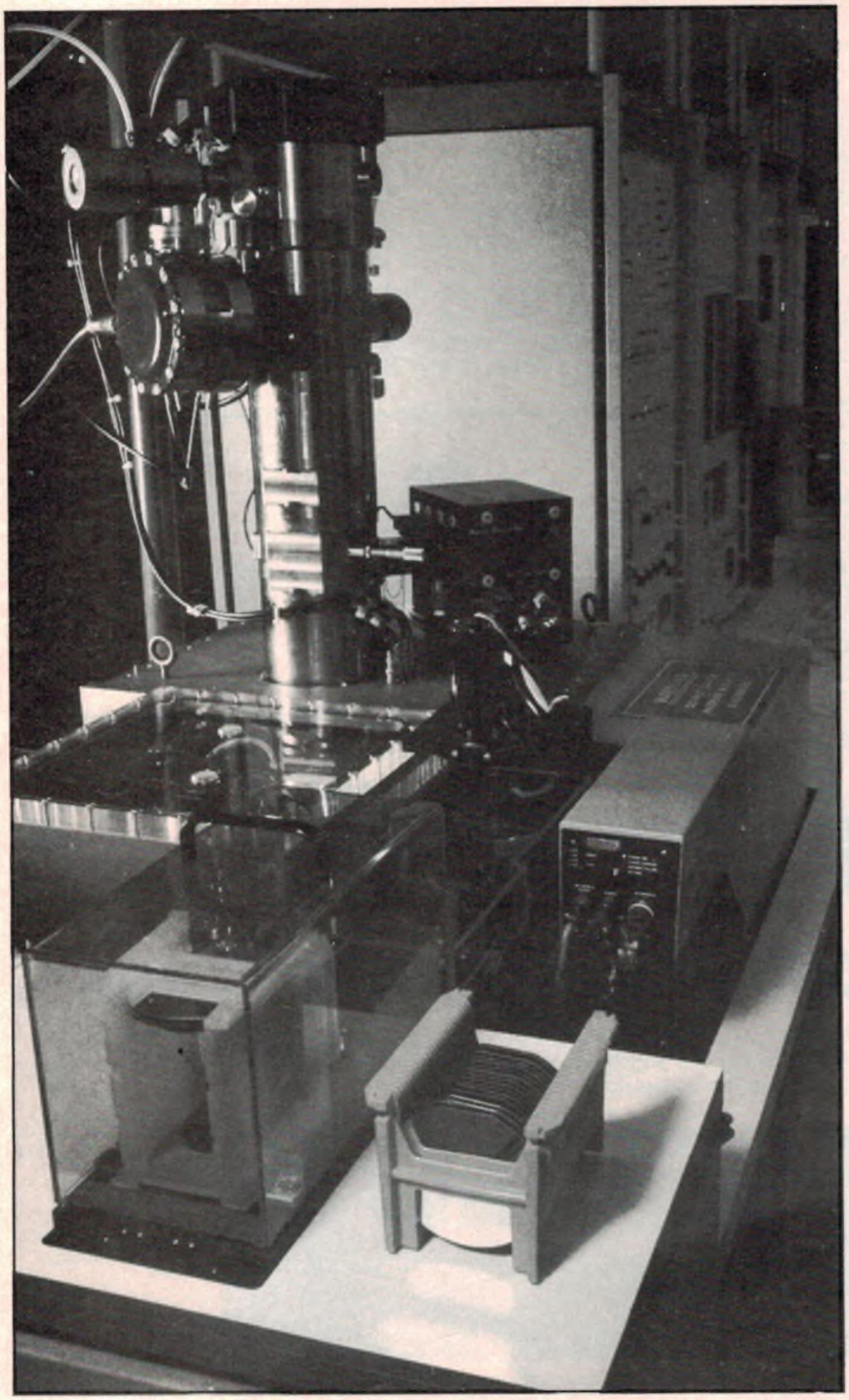
A simple illustration of how circuit functions can be altered by fuse links is provided in Fig.5. The exclusive OR gate has an input signal supplied to A and output is taken from Z. B can be either high or low depending on whether fuse F is intact or blown.

The truth table shows a normal ex OR input/output relationship.

If the fuse F is intact, input B of the ex-OR gate remains low and reference to the truth table shows that input and output signals are always indentical. The circuit is thus operating as a non-in-

By blowing a fusible nichrome link in the interconnecting circuitry, gates in a field programming logic array can be configured as inverters or buffers.

Fig. 4



Texas Instruments' E-beam process can be regarded as akin to a souped-up electron beam microscope. The high power beam is used to directly write the patterns onto resist-coated wafers. (Photo by courtesy of Texas Instruments.)

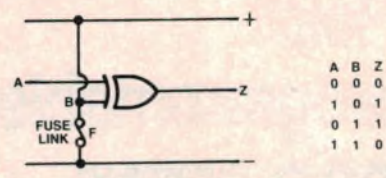


Fig. 5 FUSE SELECTABLE BUFFER/INVERTER

verting buffer. If fuse F is open circuit, B will go high and the truth table shows that input A and output Z will now have opposite polarity. In this condition, the circuit operates as an inverter. This system is often used to allow selection of input or output polarities on FPLAs.

By using FPLAs as an alternative to 'off the shelf' SSI or MSI devices, equipment designers gain a number of advantages.

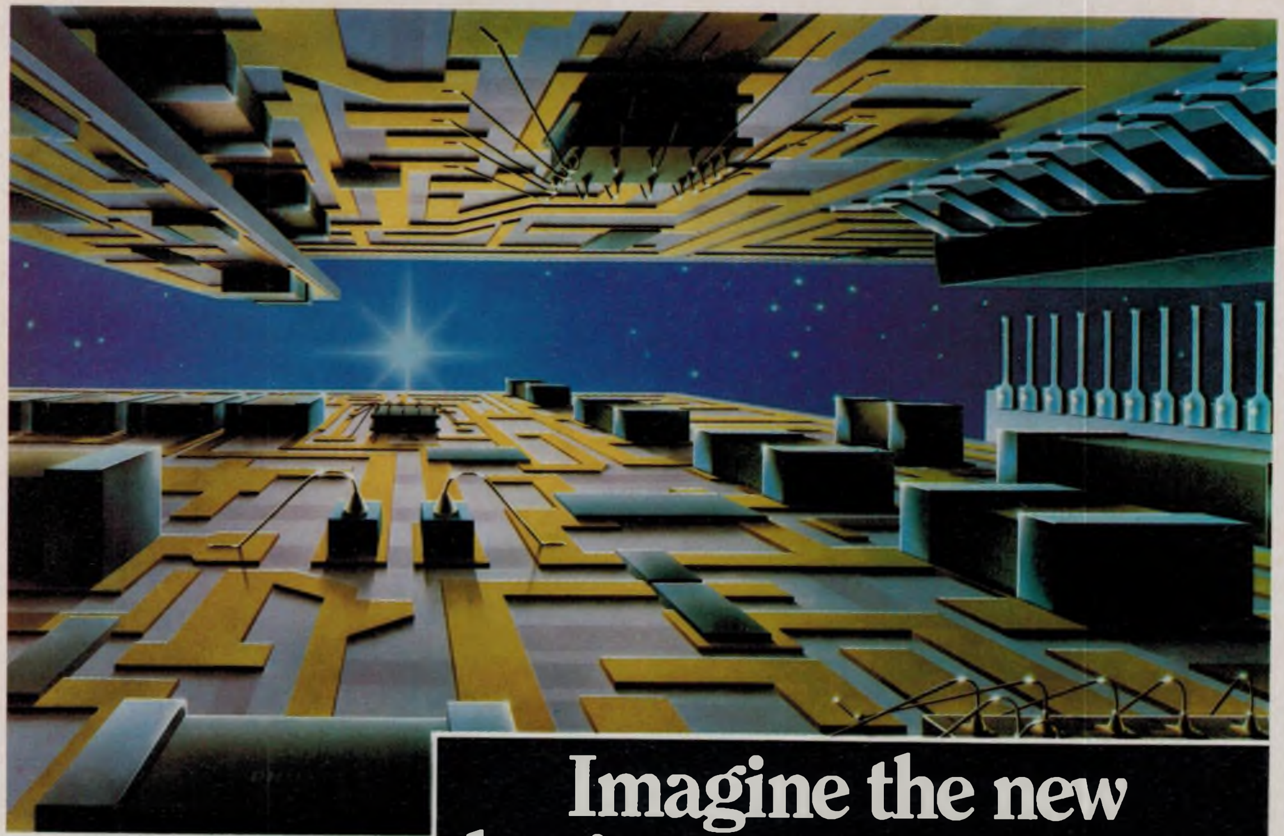
Firstly, FPLAs offer more flexibility for the designer to implement the logic required, without being left with large numbers of half-used ICs. In a typical application an FPLA will replace between 5 and 30 standard logic ICs.

The use of FPLAs gives the equipment designer increased control over system architecture, encouraging unique and competitive approaches. A personal computer with a relatively simple software program can be used to map out the fuse pattern required in a few hours. When the pattern is known, actual programming of the device takes only a few seconds. This makes it fairly easy to experiment with and evaluate different solutions to a logic problem, or to modify and update programming during equipment production runs.

A typical FPLA programming software package offered by Philips/Signetics goes under the acronym AMAZE, which stands for "automatic map and zap equations".

FPLAs also have the big advantage that the programming used is known only to the equipment manufacturer, thus keeping innovative designs secret and making them difficult to copy.

Because a semiconductor manufacturer can produce and stockpile FPLA ICs in the same way as standard devices, there are worthwhile economies of scale. Advanced Micro Devices of California have recently extended this concept by replacing a range of 13 first generation field programmable devices with a single, more flexible, second generation product.



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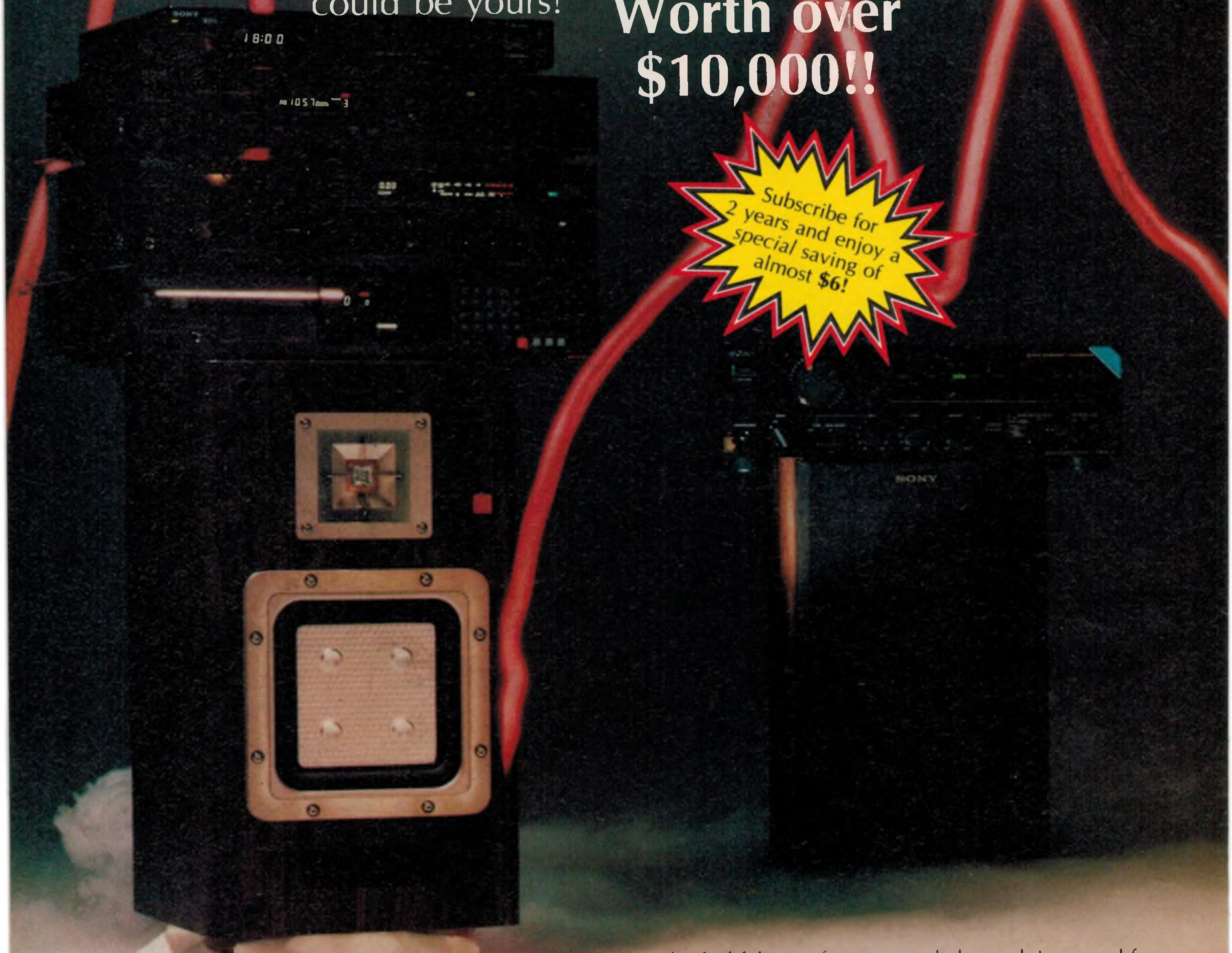

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The exciting prize draw is also open to all subscribers who renew before the closing date. If the prize is not claimed within 12 months, a second draw will be run.

Mask programmable gate arrays

In Fig.1, the group of technologies labelled semi custom are divided into two sub-groups, mask programmable and standard cell. Now let us take a closer look at the first of these sub groups.

Mask programmable devices, like FPLAs, incorporate a wide variety of gates, buffers, registers, etc, but sometimes also include additional functions such as Schmitt triggers, oscillators, op amps and occasionally, RAM.

The major difference between mask programmable ICs and FPLAs, from the user point of view, is that with mask programmable devices the selection and interconnection of elements can only be undertaken at the device manufacturer's plant. This means that lead times become typically 4 to 8 weeks, rather than the hour or two for FPLAs, and economic quantities are about 10 times greater, starting at about 50 and extending to several thousand units.

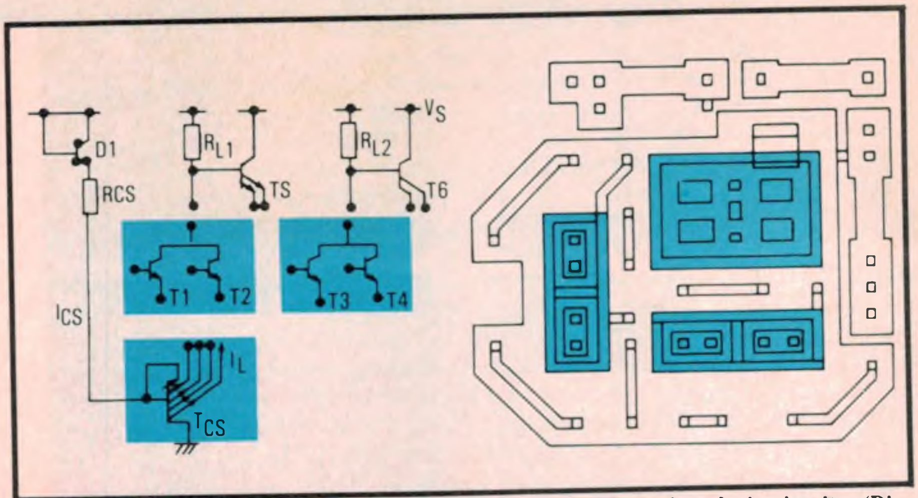

Fig.6 shows how cells can be connected together to provide various logic circuits. (Diagram by courtesy of Ferranti Electronics Ltd.)

When ordering a new device an equipment designer specifies the basic IC characteristics he requires, either by providing a logic schematic, by using appropriate design-capture software on his own personal computer or through computer aided design (CAD) work station facilities at a manufacturer's design centre. Companies offering full local CAD facilities include AWA Microelectronics in Sydney and NSD Australia (National Semiconductor Technology) in Melbourne. Several other IC manufacturers make available CAD software for use on customer's own PCs or plan to introduce local workstation facilities in the near future. The use of high speed data links for communications between local workstations and mainframe computers in design centres around the world is also becoming commonplace.

When a satisfactory design has been achieved, the stored information is used to drive a computer aided manufacturing (CAM) sequence, which produces the one, two or sometimes three masks required to complete the chip.

Gate arrays

Mask programmable devices are variously known as uncommitted logic arrays (ULAs), master slice arrays or simply gate arrays. Monolithic Memories market devices called hard array logic (HAL), which are masked versions of their PAL IC's, covered in the previous section. In this case, fuse programmed versions of the chip can be used to develop and verify the design.

A gate array chip is usually laid out with orderly rows of circuit elements (cells) occupying the central areas and interface circuits and connecting pads around the edges. The cells may be made up of separate components such as transistors and resistors, which can be wired up as required to provide different functions, or ready wired to perform standard operations such as NAND and NOR gates, etc. The former are often known as uncommitted component cells and the latter as uncommitted functional cells.

The English company, Ferranti, was one of the pioneers of mask programmable gate array technology and their chips incorporate both uncommitted component and functional cells. Fig.6 shows a cell containing separate components in both circuit symbol and silicon layout form. It will be seen that by suitably interconnecting the components, a variety of functions such as two 2-input NOR gates, etc, can be created.

Fig.7 shows a second Ferranti cell, in this case a fully wired Schmitt trigger circuit. This is used as an input interface and is located at the edge of the silicon chip. Note the ground, VCC and other bus connections, plus the large lead connecting pad for the input signal.

Present day mask programmable gate arrays utilise a whole range of semiconductor technology, extending from TTL and ECL to NMOS and CMOS. At the moment CMOS is favoured for most new products, especially where the latest device geometries of 2 microns or less, giving improved chip densities and operating speeds, can be used to advantage. The future for bipolar devices

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seems to be in more specialised areas such as combined analog/digital chips, difficult interface situations, etc.

E-beam scanning

An interesting technical development offered by Texas Instruments (TI) is a process called "E-beam scanning". Instead of preparing one or more photographic masks to determine the metallisation pattern on a chip, TI use electron beam scanning to directly write the pattern onto resist-coated silicon wafers. This process is claimed to reduce the time betwen verified chip layout and supply of tested prototype ICs to only two weeks. The process is done in Bradford, UK, so Australian users might need to add a few more weeks for freighting, customs clearance, etc. A minimum order quantity of 300 devices is required.

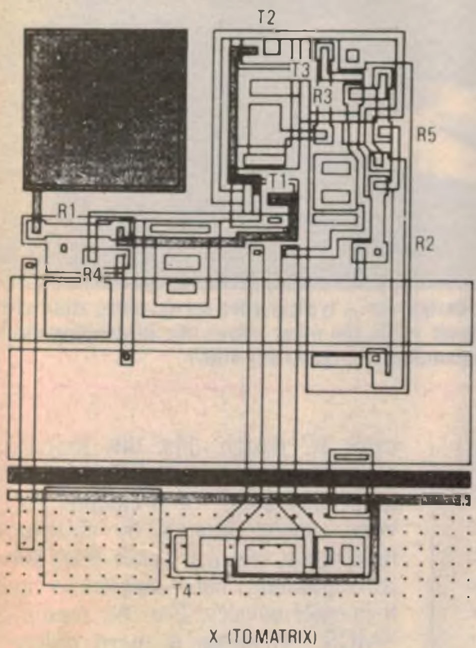
Programmable gate arrays represent a major growth area for the world micro electronics industry. Typical mask programmed ICs can contain the equivalent of between 350 and 10000 two input gate circuits. When it is realised that a modest 700 gate equivalent chip could replace up to 40 standard ICs, the economics of using three devices in medium volume applications becomes obvious.

Disadvantages of mask programming include under utilisation of the silicon chip area and degradation of potential device speed.

On an average mask programmed chip, only 80/90% of available function cells are used. In addition, wide spaces must be left between each column to allow for the maximum possible number of interconnecting leads. Both problems waste space and result in larger than necessary chip sizes.

Device speed can suffer because long parallel interconnecting leads will create additional stray capacities and these have to change or discharge before logic levels can change.

Both of these problems are taken care of by standard cell technology which is the second semi custom approach shown in Fig. 1.



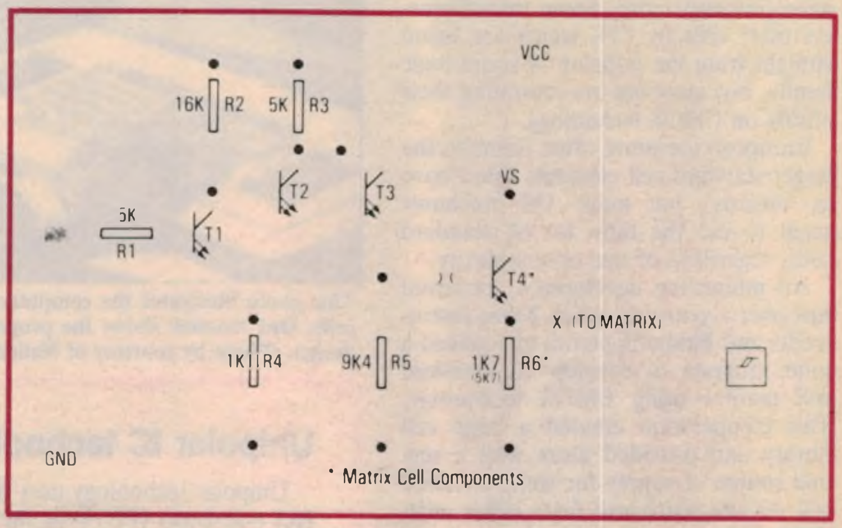


Fig.7 Uncommitted logic arrays use standard peripheral and matrix cells to produce virtually any wanted circuit configuration. These two diagrams show how a Schmitt trigger is configured. (Diagrams by courtesy of Ferranti Electronics Ltd.)

Standard cell ICs

In preceding sections we have seen that with FPLAs, the manufacturer can produce and stock a fully completed IC and with mask programmable devices, an almost completed chip, before the customer comes along. With standard cell technology, no processing of silicon takes place until a design, which fully meets the customer's requirements, has been developed and finalised.

The semiconductor manufacturer has available a "library" of tried and tested designs for the various circuit elements which make up a modern digital or analog IC. These might range from simple resistive dividers for providing bias voltages, through to the conventional types of gates and then to D-to-A converters. This library of circuit elements and associated specifications is held in a computer file.

An equipment designer wishing to order a standard cell IC will start by following similar procedures to those already outlined for mask-programmed arrays. Logic schematics may be developed and captured by a relatively simple software program running on the user's own PC. However, library access, circuit element layout and inter-connection, performance simulation and verification all require the facilities of more powerful CAD equipment which may only be available at a manufacturer's design centre. The equipment designer then faces the choice of becoming deeply involved in CAD procedures or handing over his design at the logic schematic level for implementation by the IC manufacturer's expert engineers.

When each digital or analog circuit element is implemented in silicon, it will occupy a certain minimum area on the chip. Smaller circuit elements are normally assembled in vertical columns with bus connections running up and down. Efficient layout of the chip requires that elements have a common width, although height may vary as required to fit in all the necessary components.

Each circuit element thus has a small rectangular compartment or area on the chip to itself and this is known as a cell. Fortunately, most of the world's semiconductor industry seem to have agreed on the single term 'standard cell' to describe this technology.

A check through IC suppliers' brochures and data sheets show typical libraries containing 100 to 200 standard cell designs, with most promising further additions in the near future. Cell functions listed include capacitor and resistor arrays, gates of all varieties and sizes, multi-bit storage and shift registers, counters, multiplexers, op amps, oscillators of various types, blocks of ROM and RAM and even a complete microprocessor core. Some manufacturers offer cells in TTL which are taken straight from the popular 74 series logic family, but most are concentrating their efforts on CMOS technology.

European literature often refers to the larger standard cell elements listed bove as 'macros', but many US brochures seem to use the term for all standard cells, regardless of size or complexity.

An interesting development occurred just over a year ago, when Texas Instruments and Philips/Signetics announced a joint program to develop the standard cell market using CMOS technology. This co-operation created a large cell library and provided users with a second source of supply for some standard cell devices purchased from either company.

Standard cell ICs are available with processing power ranging from about 500 to 10000 equivalent 2-input gates which is similar to present day gate arrays.

Although the use of standard cells streamlines the design process, each IC must be fabricated from the ground up. This means that CAM costs can be significantly higher than for mask programmed gate arrays. The higher front end costs are compensated for by more efficient use of the chip however, and savings in the silicon area can result in the overall cost per gate being about 30% less than for comparable arrays. These savings become very significant when production runs of several thousand ICs are involved.

On the minus side, increased complexity at the CAD and CAM stages consumes time as well as money and designers may have to wait 3/4 months before tested prototype ICs are available.

This photo illustrates the computer-aided design for a typical gate array using standard cells. One monitor shows the proposed circuit while the other shows the developing chip design. (Photo by courtesy of National Semiconductors (Aust) Pty Ltd.)

Unipolar IC technology

Unipolar technology uses field effect transistors (FETs) as the active elements. Originally the FETs were of the metal oxide insulated gate type and although these are now being superseded by oxide isolated silicon gate types, the name metal oxide semi conductor (MOS) is still used.

FET's may be of the N-channel or P-channel enhancement or depletion mode type. Depletion mode operation requires a gate voltage of opposite polarity to the drain/source voltage, which complicates IC design. For this reason, most designers favour enhancement mode operation. In N-channel devices current flow is by electron movement, which is faster than the corresponding hole movement in P-channel devices. For this reason, NMOS technology is more widely used than PMOS.

The construction of a typical N channel enhancement FET is shown in Fig. 3(a). Note that construction of a P-channel FET is similar (Fig. 3(b)) except that all doping (P-type or N-type) and supply polarities are reversed.

With the development of large

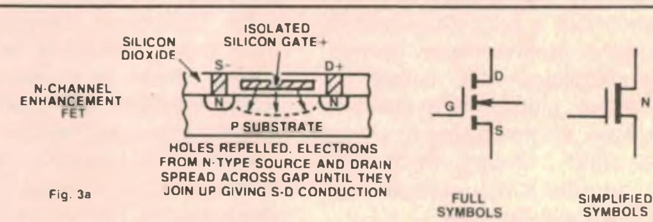


Fig. 3a

Fully custom ICs

Fig.1 might suggest that there is a clearly defined boundary between standard cell and full custom technology, but this is rarely the case in practice. Basically, a device is described as full custom when some or all of the functional circuit elements are designed from square one. Design work of this type would always be done by using a sophisticated CAD system and this would probably also access files containing details of previously successful macro cell designs. There would be little point in disregarding this information and re-inventing the wheel each time a new IC was designed.

Fully custom or handcrafted designs need not contain any of the compromises or technical expedients available in array and standard cell designs. Electrical parameters can be chosen to suit the specific application, chip layout can be optimised to give high device speed, minimum cost per gate or exceptional reliability and packaging can be purpose designed to fit in with equipment requirements.

This ability to get the maximum possible from available technology is resulting in the emergence of some clearly defined roles for fully custom devices.

The very efficient utilisation of chip area means cutom ICs can provide the lowest cost per gate figures obtainable. This is only true if the high initial development costs are amortised over a large number of units however, and VLSI custom devices come into their own economically when production runs exceed 100,000.

There are a number of highly specialised applications, particularly in the medical and defence areas, where standard or semi-custom technology cannot provide the necessary performance. Medical applications such as implanted pacemakers, need ICs with extremely low power consumption and exceptionally high reliability. Defence electronics must also be highly reliable and capable of surviving mechanical shocks, extremes of temperatures and other forms of abuse which would cause normal devices to wilt and die.

Fully customised ICs also offer total security of design and this is important, not only in military, but also increasingly in commercial applications.

One of Australia's leading IC custom design and fabrication facilities is provided by AWA Microelectronics at North Ryde, near Sydney. AWA have been designing and manufacturing ICs since 1965 and now provide a well equipped Client Design Centre, supporting gate array, standard cell and full custom CAD activities. Equipment includes a VAX 11/785 mainframe computer, Daisy workstations and very impressive Calma full colour high definition graphic displays.

When a client approaches AWA Microelectronics to have an IC designed and manufactured, an applications engineer is assigned to advise and liaise until final completion of the project.

The customer's logic design can be fed into the CAD system as either a schematic diagram or in Boolean Algebra form. The first phase is to simulate, debug and verify the logic design. When this has been done, a floor plan of the chip is developed and modelled with

---

scale and very large scale integration (LSI and VLSI) devices, it became necessary to further reduce power consumption. The answer was provided by complementary MOS (CMOS) designs.

In typical CMOS circuits, N and P-channel enhancement mode FETs are used together. The circuit of Fig. 3(c) shows a simple gate arrangement. A high input on A will turn T1 off and T2 on, which takes the output low. A high input on B will turn T3 off and T4 on, again taking the output low. Lows on both inputs will cause T1 and T3 to conduct but will keep T2 and T4 off.

Note that whatever the combination of input signals, one of the lower transistors T2 or T4 or both of the upper transistors T1/T3 will be off. This means there is never a steady current path between the positive, and negative supply rails and power is only consumed for a brief period during switch-over when both transistors are on.

CMOS is rapidly becoming the industry standard, replacing NMOS and in some applications, bipolar technology. Speed and efficiency are being improved by progressive scaling down of device geometrics, with 2-micron structures as the current state of the art.

Despite its slightly greater complexity, development and fabrication costs for CMOS are now competitive with other IC technologies and early problems with temperature stability and linearity in analog circuits have been overcome.

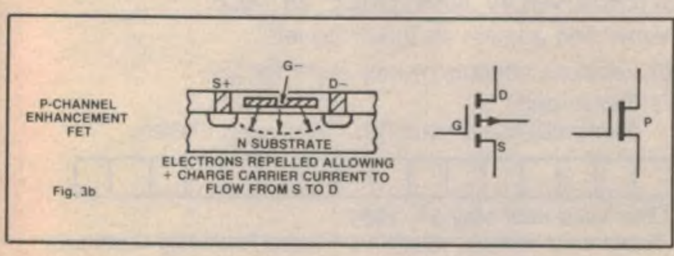


Fig. 3b

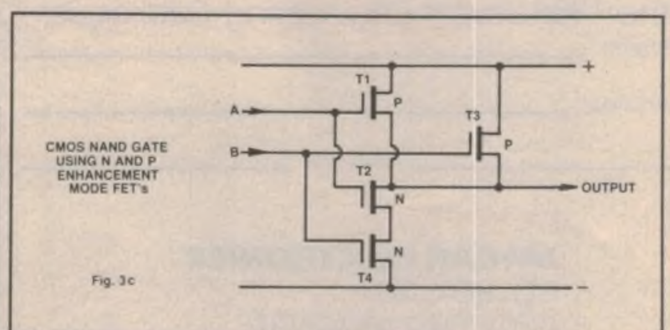


Fig. 3c

critical situations due to physical layout being highlighted and corrected.

The software then analyses the selected design without regard to the specifications, to find out what the actual performance will be and ensures that this meets or exceeds the customer's requirements. Finally, suitable acceptance test routines are developed for use when the device is in production.

It is encouraging to find that although CAD software contains all known design rules for laying out a chip, it is often possible for a skilled engineer to intervene and further improve the chip utilisation or performance. This technique is called 'massaging' a design and gives meaning to the term 'hand crafted' which is often used to describe full custom ICs.

AWA have complete semiconductor production facilities on the same site as the Design Centre in North Ryde. They claim this minimises delays due to communication problems between design and manufacturing and as a consequence can provide a customer with prototype ICs within four weeks of a design being finalised.

Until recently, the major semiconductor technology for VLSI devices was NMOS but increasing use is now being made of CMOS. Bipolar is also available for analog applications and CMOS and bipolar can be mixed on the same chip if required.

Some interesting applications for AWA custom ICs include medically implanted cardiac pacemakers and bone growth simulators, hearing aids, telephone switching, data modems, security systems, Barra anti submarine sonobouys and a military calculator.

Fully custom ICs suffer from the slow and costly CAD/CAM design sequence and this excludes them from low volume applications where time and cost are critical. For really high volume applications and for specific areas where ultimate performance is required they have no equal.

Bipolar IC technology

Most integrated circuits utilise either bipolar or unipolar technology. A few combine both technologies on the same chip. In bipolar systems, the active elements are forms of junction transistors.

Transistor transistor logic (TTL) is probably the best known bipolar technology. Originally introduced in the early 1960's it has developed through many phases. With standard TTL, the switching transistors operate in either a saturated or cut off mode. Storage effects in saturated transistors caused standard TTL to be rather slow for some applications, so a range of ICs with minimum value collector and emitter resistors was introduced. These devices were known as high speed TTL. The use of low value resistors increased current consumption and heat dissipation became a problem as larger more densely packed chips were developed.

Where speed was not important, high value resistors could be used, giving reduced power consumption. This resulted in a range of devices known as low power TTL.

Many present day TTL products incorporate Schottky diodes which have a forward voltage drop about half that of a silicon junction. If a diode of this type is connected across the collector/base junction of a bipolar transistor, as shown in Fig. 2(a), it will be non-conducting when the junction is in its normal reverse biased state. If the base current rises sufficiently to saturate the transistor, the collector voltage falls below the base voltage and the Schottky diode starts to conduct. Diode conduction occurs long before the collector voltage can fall sufficiently to forward bias the collector/bias junction and transistor saturation is prevented.

Schottky diodes are easily built into the collector/base junction when a bipolar transistor is fabricated on a silicon slice as shown in Fig. 2(b). A wide range of devices incorporating various forms of Schottky technology are available under names such as Schottky-clamped TTL, Low Power Schottky TTL, Advanced Schottky TTL and Advanced Low Power Schottky TTL.

Another form of bipolar technology avoids the problems associated with saturation by using transistors biased to operate in their mid conduction region.

Logic signal inputs are applied to groups of transistors which share a common emitter resistor. When one transistor turns on, it takes the common emitter line high which biases the others off. Current is thus steered from one transistor to another and the total current taken by the circuit remains roughly constant and well below any one transistor's saturation level. This technology is called emitter-coupled logic (ECL) and variations include buffered ECL and emitter-emitter logic (E^2L).

ECL provides some of the fastest operating speeds obtainable but does have quite high power consumption. Its main application is in medium and large computers.

A third major bipolar technology is called integrated injection logic (I^2L) or sometimes merged transistor logic (MTL). Here the output transistor's load is incorporated in the input of the following gate, so that unused output collector circuits do not have unnecessary current flowing through them. The low power consumption of I^2L/MTL makes it particularly suitable for LSI and VLSI applications.

Recent variations of I^2L/MTL include Integrated Schottky Logic (ISL) and Schottky Transistor Logic (STL), etc.

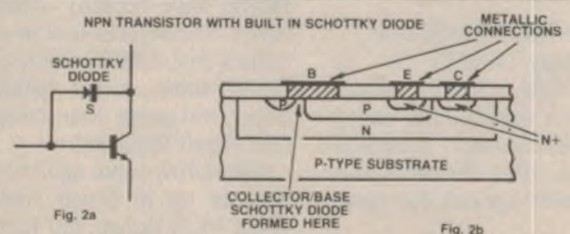
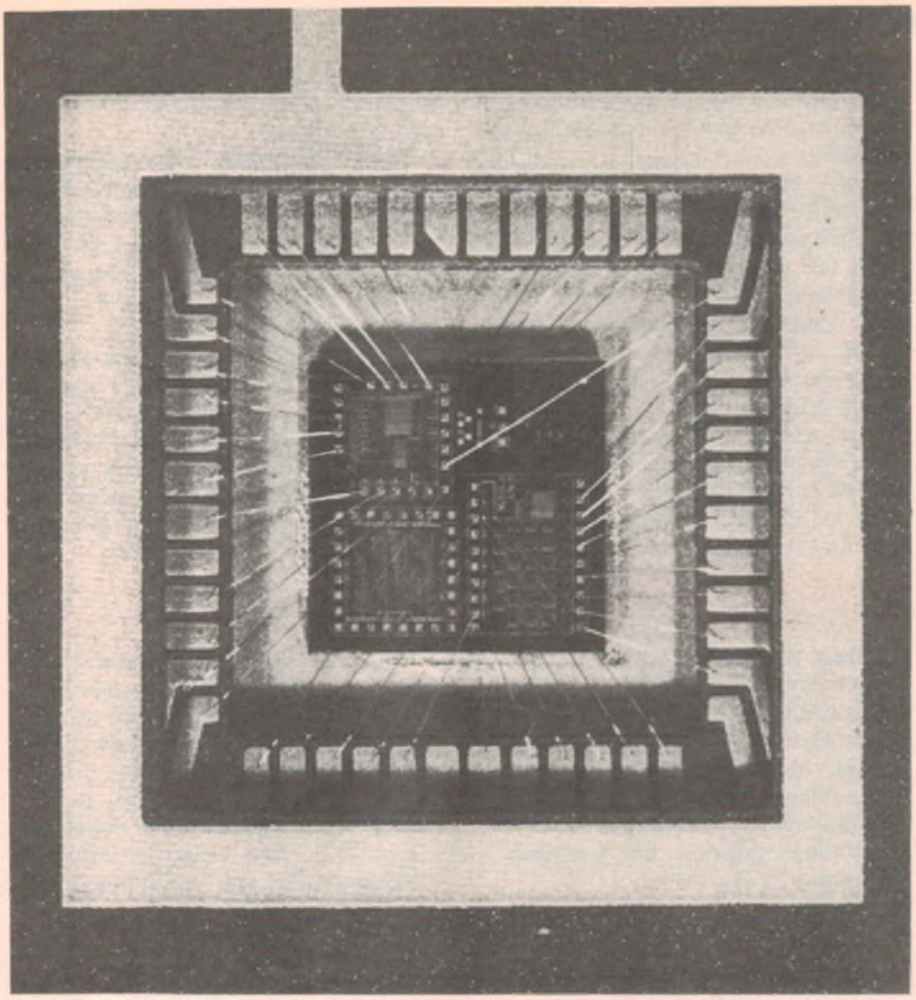


Fig. 2a
Fig. 2b



Future trends

There seems to be almost complete agreement within the microelectronics industry that ASICs will be the major growth product over the next 10 or 15 years. This trend may be accentuated in Australia because locally designed equipment normally has a low production volume and we have seen that field and mask programmable devices can be ideal in this situation. Opinions differ on the speed with which ASICs will replace 'off the shelf' ICs, but estimates of a 50% market share by the year 2000 are not unusual.

There is also general agreement that CMOS will become the mainstream technology for both 'off the shelf' and ASICs over the next few years. Some experts predict that 80% of devices produced by the end of this decade will be CMOS. Device geometries of one mi-

This is a multi-project chip developed by the Joint Microelectronic Research Centre. Four independent circuit functions are incorporated on the 6mm square chip.

Local R & D

Most of the world's large microelectronic companies have their own well equipped research and development departments to ensure that products retain a competitive position in the market place. Despite this heavy-weight presence however, there is still ample opportunity for smaller organisations and individuals to come up with innovative ideas or ingenious solutions to problems in both the hardware and CAD/CAM software areas.

In Australia, the Royal Melbourne Institute of Technology (RMIT) and the University of New South Wales (UNSW) formed an organisation called the Joint Microelectronics Research Centre (JRMC) in 1982. Funding was by a Commonwealth Special Research Centres Grant.

Work on semiconductor materials and processing at JMRC has included investigation of ion implantation and annealing, plasma etching, gallium arsenide fabrication problems, etc. On the software side, JMRC have developed advanced CAD techniques with applications in the gate array, standard cell, multi project chip and custom VLSI areas. It is hoped that some of this new software will be marketed commercially during 1986.

Multi-project chips, produced at the centre, provide a very economical way of fabricating prototype ICs, as 10 or 15 totally different designs can be incorporated on a single silicon wafer. NMOS technology was used originally, but JMRC have recently collaborated with AWA Microelectronics to produce Australia's first CMOS multi project chips. Fig.10 shows a six millimetre square chip, containing four completely separate circuit functions.

About five years ago, A CSIRO team was set up in South Australia to develop VLSI design and fabrication capabilities. This work culminated in the successful production of a chip containing the equivalent of over 100,000 transistors.

Following on from this success, a commercial company called Austek Microsystems was established in Adelaide. Funding was provided by the AIDC and private investors in the US, UK and Australia. The company now also has offices in California and Singapore.

Austek's main efforts are concentrated on developing a range of high performance VLSI devices for specialised applications in the computing area. These include high performance arithmetic chips, application and specific memories and co-processors.

In addition to standard products, Austek also undertakes full custom design work for individual clients. Recent projects have included a 50,000 transistor correlator chip for the CSIRO's new radio telescope, a high speed image processing IC for Vision Systems Ltd and a sophisticated 2 micron logic chip for a US computer company.

·cron are promised for the end of 1986 and this will further increase operating speed, reduce chip size and power dissipation and improve production yield. Bipolar technologies such as ECL are expected to survive into the next century, but their applications will become increasingly specialised.

Fig.11 compares standard logic and the various ASIC technologies in six areas of particular interest to potential users. The figures given are based on an amalgum of information from many sources and are not representative of any one supplier.

From the users' viewpoint, there are still some problems to be solved before ASICs can be regarded as ideal devices.

Procurement times of three to four months for standard cell ICs and perhaps over a year for full custom devices are not always acceptable in a fast moving and competitive industry. Overseas suppliers may always be at a disadvantage in this respect and it is good to see increasing interest in the provision of local design and fabrication facilities.

Cross-licensing

An equipment manufacturer is often reluctant to 'put all his eggs in one basket' and depend upon a single supplier for key components such as ICs. This is because a strike, major fire or financial collapse at the manufacturer's plant, over which the user has no control, could stop production and put him out of business. The solution is to second source all critical components, but this is not easy with ASICs, due to variations in technology between suppliers and the confidentiality of designs. Tentative moves towards cross licensing have already been made by some manufacturers, but broader second sourcing arrangements are required before major users in fields such as consumer goods or automotive electronics become completely happy with the new technology.

The development of bigger and better ICs over the past 20 years has resulted in packages having more and more lead out pins. The photograph on page 76 shows a selection of current in-line, pingrid and chip carrier packages to illustrate the point. Connections are one of the few remaining causes of poor reliability in modern electronic equipment and efforts are usually made to minimise their number. Custom design can offer a solution to this problem, as we shall see in a moment.

The growth of production and interest in ASICs could not have occurred without associated improvements in CAD/CAM systems. Software for PC and mainframe applications is now becoming more readily available, cheaper and easier to use. This trend seems set to continue and work stations may soon be a normal part of almsot every electronic design lab. If sophisticated workstations are widely provided, it could help reduce the procurement time problem mentioned earlier.

The IC industry expects all areas of ASIC technology to expand, but many experts believe standard cell technology will be the major growth area. They also predict that the boundary between library cell and full custom design will become increasingly blurred, with the possibility of the two technologies merging in a few years time. The spread of workstation facilities would obviously encourage these trends.

The standard cell library approach has been likened to a system designer selecting devices from a data book and then planning the layout of a printed circuit board to support and inter-connect them. For many future applications, the designer can expect to put a complete system on a single chip. This avoids the need for complex inter-connections with other sections of circuitry and helps solve the IC pin problem mentioned above.

It seems that in some equipment, the familiar PCB with its separate IC s and discrete components may soon be disappearing, to be replaced by a single ASIC package, plus power supply.

Fig.11. COMPARISON OF STANDARD LOGIC AND DIFFERENT ASIC TYPES

	Standard logic families	Field programmable logic arrays	Gate arrays	Standard cells	Fully custom
Semiconductor technology	All types	Mainly bipolar	TTL, ECL, NMOS, CMOS	Mainly CMOS	Some NMOS but becoming mainly CMOS
IC design expertise required	None	Minimal	Moderate	Moderate/High	High
Typical development/ procurement time	Immediate	Hours	4/8 weeks	3/4 months	3/18 months
Minimum/ maximum quantity	Not applicable	5/1000	50/10,000	50/50,000	5000 (special applications)/ one million plus
Sources	Many	Several	Usually only one	One or two	One
Equivalent 2 input gate size	4/40	150/5000	350/10,000	500/10,000	Up to 25,000

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Joint Microelectronics Research Centre, University of New South Wales, Sydney.

Motorola Semiconductor Products, Sydney.

Philips Electronic Components and Materials (Philips/Signetics), Sydney.

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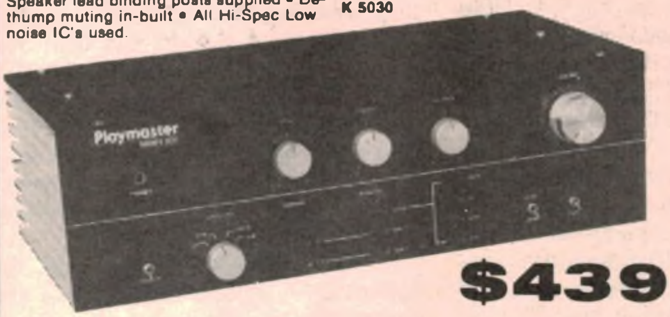

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Fully Built and Tested K 6754 $269

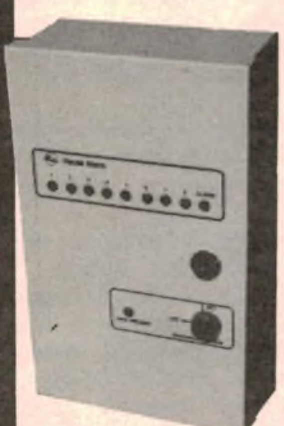
Check Appliances And Electrical Wiring
Megohm Meter
(1985 Successor to the "Megger")

It uses a transistor inverter to produce a regulated 1000V DC supply which is applied to the insulation under test. Insulation resistances between 2M Ohm and more than 2000 Ohm can be measured **K 2550** (See EA July '85)

$49.95

Super Low Price on Famous EA 8 Sector Alarm System Kit
(See EA Mag. Jan '85)

$119.50



Features:
• Alarm has 8 separate input circuits - 8 sectors can be monitored independently.
• Each input circuit is provided with an indicator LED and a sector On/Off switch.
• Individual sector isolation allows the user to have some areas of the premises habited while others remain protected e.g. Inside Off/Outside On.
• Inputs accept both normally closed and normally open sensors.
• Two inputs provided with an entry delay between 10-75 seconds)
• Internal trip warning buzzer—alerts owner/occupant of pending alarm operation—great for the "forgetful" amoungst us. This buzzer is pre-settable between 5 and 55 seconds prior to Alarm.
• Unique circuit detects automatically when any N/O or N/C loops are either open circuit or dead short. **e.g. someone trying to bridge reed switches etc.**
• Switched output can be used to send a silent alarm through an auto-dialler circuit or similar.

K 1900	(without Back Up Battery)	$119.50
S 5065	(12V 1.2AH Backup Battery)	$22.95

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3 - 50 Volt at Up to 5 Amps

Designed by Electonics Australia, this supply has been one of our most popular throughout 1985. Our superb 1986 version incorporates the lates refinements and is now housed in an attractive, tough "ABS" Instrument case. This **all new** compact version has been made possible by the use of a high efficiency Toroid Power Transformer.

So you win four ways - Less heat, less weight - Greatly enhanced appearance and easier to build - **Remember the Altronics Kit is fully drilled and punched.**

Brilliant Switch Mode High efficiency design by the Design Team at Electronics Australia.

10 Turn Output Voltage Control Option
(K 3300 is normally supplied with standard pot)

K 3301 ______ **$12.50**

Auxiliary + And -12V Output Terminals Option
(Fixed Outputs Independent of Variable Main Output)

K 3302 ______ **$12.50**

$149.50 K 3300

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BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008 999 007 FOR NEXT DAY JETSERVICE DELIVERY

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Ideal for Parties, Shop Signs, Display Windows, special lighting affects etc.

Combination Colour Organ and Light Chaser. Four channel colour organ. Internal microphone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portionof frequency spectrum concerned). Four chaser modes forward and reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc. **K 5800**

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The Ultimate in Vehicle Protection

Uses Microphone Sensing to Guard Against Tampering and Vandalism.

The lates '**State of the Art**' Vehicle Security System. This ETI design provides protection that could save you a fortune. Strategically placed resonance microphones detect any tampering with your vehicle e.g. Lifting of a door handle, scratching of a coin etc.

- Auto Arming with Exit and Entry delays
- Dash Mount status indicator
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- Inc. circuitry to monitor any failure of dash warning lights.
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The "Pest-Off" generates frequencies between 23KHz and 64KHz. Claimed to be the best for driving off most vermin.

Altronics Kit Includes • Strong "ABS" Case • Efficient Piezo Tweeter • Screened Front Panel **K 1600**

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Widen your Stereo Image

This fantastic circuit increases the difference between the two channels thus actually making music sound "Wider". Therefore the stereo effect can be percieved although speakers are relatively close together.

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$89.50

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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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CD ROM —
high density computer storage

That little silver CD platter which has revolutionised home audio is now set to do the same for home and business computer information storage. CD-ROM, the (almost) twin brother of the hifi audio compact disc, has now appeared in Australia.

by STEWART FIST

The storage of computerised reference data — dictionaries, encyclopaedias, technical and scientific research papers — is where CD-ROM's impact will initially be but it is also likely to eventually revolutionise the distribution of computer programs, from video games to business application programs.

Just as computers proved to be a universal information manipulating machine with applications that now pervade all phases of modern life, CD will likely become the universal information storage medium. You need large-scale storage to complement the faster computer technologies; without this storage the potential of the chips are limited.

CD-ROM is not a new invention so much as the logical extension of audio CD, and both are digital derivatives of the video LaserDisc developed by Philips many years ago. You may believe that videodisc is long dead as a consumer technology, but LaserDisc is still being sold for video information systems, technical training and education, and for videogames.

The problem with videodisc was that it replayed video only, so it failed to push recording magnetic tape out of the living rooms of the world. But the lack of the ability to record hasn't limited the technology's application in hi-fi audio, and it should prove to be only a partial limitation with computers and data.

From the time when LaserDisc first appeared in the late '70s, it has been apparent to many that the technology offered a phenominal packing density for storing information of all sorts. On a standard 30cm LaserDisc you can find between 54,000 and 90,000 frames of full-colour video with accompanying sound. The difference in frame numbers depends on whether you spin the LaserDisc turntable at a constant speed (CAV or Constant Angular Velocity), or whether you slow it down when the laser-head is tracing the periphery of the disc (CLV or Constant Linear Velocity) and therefore pack in more images.

The LaserDisc used a frequency modulation technique to handle analog video signals, and although it is generally accepted that you need about one million bytes of binary information to reproduce a good quality colour video screen, you can't just do a straight mathematical conversion and assume that the LaserDisc has the potential to store 90,000 million bytes (90 gigabytes) of ASCII-coded data.

In practice it has been found that the analog LaserDisc can hold about 5 gigabytes — which is impressive enough — and in fact one English company called Laser Data actually produces a LaserDisc with this data storage capacity.

But generally it was found that the videodisc suffered too high an error rate for it to be useful for computer program storage. A glitch in video replay just puts a spot on the TV screen, but a glitch in a computer program or data could send a company bankrupt.

The audio Compact Disc took the manufacturing, reading and tracking technology from LaserDisc, but used digital techniques and much smaller (12cm) discs. It also has too high an

Sony have three CD-ROM drives with a capacity of 540 megabytes. Also available are interface cards for the IBM PC/XT.

Developed in the UK, this "electronic book" system can store up to 600 megabytes of information in any combination of text, pictures, graphics, sound or software. It is based on the Philips version of the CD-ROM.

error rate for direct use as a computer storage device, although it is acceptable for text where an occasional mispelled word doesn't matter.

So Philips and Sony put their heads together over the development of the CD-ROM. This required higher mechanical and electrical standards, and included better error-checking circuits to overcome the data-integrity problems. CD-ROM has an error rate of one in 10^{12}, which is only one error in every million million bytes read.

But Sony and Philips weren't alone in seeing the potential of the basic CD digital audio technology for computer applications. A number of computer companies in the US banded together to work on a rival device they called O-ROM (Optical Read-Only-Memory) which has still to appear on the market.

To date, these companies still haven't managed to agree on more than the basic standards for O-ROM, so it is unlikely to be a serious competitor for CD-ROM in the next couple of years. And there are a number of good marketing reasons why it might not appear at all.

CD-ROM is downwardly compatible with the CD audio; both use spiral tracks which start at the disc centre and extend outwards. In both cases the turntable speed varies from 230rpm to 530rpm to maintain a constant head-to-disc reading speed; the Constant Linear Velocity (CLV) technique.

Large capacity

CLV maximises the amount of information that the discs can store — 8.4 blocks (each of 2 Kbytes) per rotation on the inner tracks, and 19.5 blocks/rev on the outer — which makes the 12cm discs capable of storing 540 megabytes.

That's about 54 times the average hard-disc, 540 times the best of the double-sided floppies, or 2-3000 times most single-sided floppy discs. In paper terms, it is the equivalent of 150,000 pages of printed text — a pile of A4 paper about 15 metres high — or a complete set of a large encyclopaedia!

The O-ROM developers are taking a different line which reveals their computer orientation. They opted for circular, rather than spiral tracks, since they were not worried by the need to remain compatible with CD audio players. They also chose to keep the turntable speed constant (CAV at about 500rpm) in order to improve the access time. With CLV technology you are always waiting for the mechanical turntable to speed up or slow down before the appropriate data can be read.

Faster access

The value of using CAV over CLV is apparent when you compare the access and transfer rates of the two systems. CD-ROM is slower in finding information when it jumps tracks and it can transfer data at only 150 kilobytes per second. O-ROM is quick in finding data and nearly triples the CD transfer rate at 400 Kb/s.

O-ROM is not all that much slower at transferring data than many magnetic hard-discs — which was obviously a major reason why the computer group chose the CAV approach. But there's always a trade-off; the use of a fixed angular speed means that the O-ROM disc will hold only 200 megabytes of information as against the 540 Mb of CD-ROM. The rotational speed must be chosen to suit the most inefficient track.

The battle between the two rival systems is not likely to be won on technical grounds, but on market-place considerations and here CD-ROM has a clear lead. It has already been standardised, and the standard is widely accepted. Companies like National, Hitachi and Denon have joined Philips and Sony in manufacturing disc players, and many other computer groups (like Digital Equipment Corp.) have signed agreements to sell versions of the players under their own brand names.

The main marketing advantage of CD-ROM, however, must arise from the fact that it is compatible with CD-audio. Both Philips and Sony expect to have dual-purpose ROM/audio players on the market within the year, and the inclusion of short bursts of full-colour video won't be too far down the track.

There's also the fact that CD-ROM is using the tried and tested mechanical and optical systems of LaserDisc and CD-audio. These are already in production and have been through the problem phases of development and early consumer use. Sony are already promoting a player (the CDU-5002) which they claim will have a mean-time-between-failures of 10,000 hours.

For these reasons CD-ROM should be considerably cheaper and probably more reliable than O-ROM, and the "CD" name will have that vital factor of consumer confidence. It is a pretty hard combination to beat — and anyone who bets against the combined marketing power of Sony and Philips better have a vastly superior product.

CD-ROM players in the States are expected to sell for between $US300 and $US1000, which will translate to at least twice this amount in Australian dollars. The discs themselves will be priced according to the value of information they contain, rather than being related to production costs.

A new automated disc factory in the UK is said to be able to replicate CD discs for £3 (three English pounds) each, not counting the cost of the mastering process. On average it costs about $5,000 to produce the master 'stamper' from a correctly formatted half-inch computer master tape.

On the software side there are already a number of companies well advanced in producing the information for discs — although CD-ROM has raised new and unexpected problems in copyright and its effect on competitive services.

A number of the major on-line database suppliers (Dialog, Orbit, BRS, Compuserve and The Source) have already signalled that their data will be available on discs this year, but some see the CD-ROM as a major threat to their services. Some are attempting to test out the marketplace without putting more than a toe into the water, and some can't decide whether CD-ROM is just a replacement for the on-line technology, or something quite new and different in the marketplace.

The Commonwealth Agricultural Bureaux, for instance, which is a UK clearing house for agricultural information, has already moved over part of its activities into CD-ROM. CAB abstracts nearly a quarter of a million articles and agricultural reports each year from magazines, journals and research papers all over the world, and it costs about $70 to $100 per hour (all up) to search through this information on-line from your computer in Australia.

By contrast one CD-ROM disc can now hold a full year of CAB abstracts, and the disc also carries the BASIS program that your computer needs to search the special varied inverted indexes of keywords. These inverted indexes traditionally occupy almost as much disc space as the original abstracts themselves if the full-text of each abstract has been indexed for easy searching.

At present CAB have priced their CD-ROM service at $5000 for a two-year subscription, with the discs updated and exchanged monthly — so it is aimed at libraries and agricultural research establishments only. The pricing level has obviously been chosen to prevent competition with their on-line database, and it bears no relationship to the cost of production of the discs themselves.

It would be a fair guess to say that CAB don't want to pioneer the use of home computers and CD-ROM players by the millions of farmers around the world, but this must be a future possibility. When it does happen the cost per subscription will probably drop to the $100 to $200 level.

Encyclopaedia

Groliers of New York have already taken this more innovative marketing approach, by producing a consumer CD product. They have translated the 21 volumes of their Grolier's Academic American Encyclopaedia to one single disc, and priced the disc at $US199 — less than half the price of their paper volumes.

The 21-volume encyclopaedia already sells for $450, which is reasonable considering that there's probably nearly $100 worth of paper alone in these, plus the printing, transport, storage and retailing costs. It is here, in the provision of home and business references, that the value of CD is most readily apparent.

Grolier's disc only holds about nine million words, plus a 155,000 word index and the searching program. You can find the information you are seeking in either a "browse" or "word-matching" mode. "Browse" gives you a wide range of related topics around your subject of interest, while "word-match" uses a key-word search procedure which selects out all articles containing the word you specified.

The disc-based program takes, on average, about five seconds to find any subject, and is claimed to work with most of the popular brands of microcomputers.

At present the Grolier's encyclopaedia only holds words, so there is plenty of room later for computer graphics and illustrations. The company says that it is working on this and may be able to add sound and music in relevant sections at a later stage.

These 'multi-media' developments aren't entirely new or confined to the ROM version of CD. It is not generally known that the normal CD audio system includes additional storage space that can be used for text or graphic information — for example, the words of a song, or supporting graphics and animation. The information is read-out by the player, and with the right machine it can be displayed on an inbuilt LCD screen or via a linked monitor.

CD map system

There is an electronic map and guidance system for your car called CD-Carin which combines sound, text and graphics capabilities to store the information normally found in conventional maps and guide books.

You can selectively access all kinds of route, location or touristic information. The computer is able to plan the most efficient route across a city, telling you where to turn at every road junction through a speech synthesiser.

The trial unit already on the road in Holland also picks up data about traffic flow, broadcasts in HF so the driver can avoid traffic jams. Philips plan eventually to link Carin with the American Navstar satellite to provide totally accurate navigation plots.

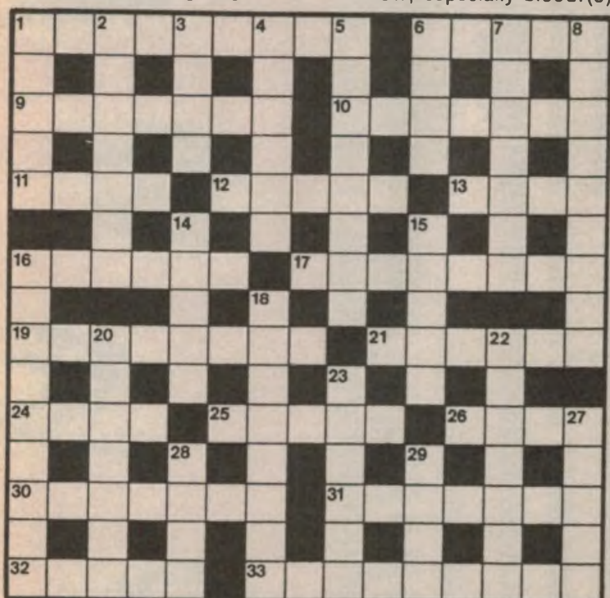
It's not hard to see that the whole spectrum of relatively 'static' reference information that we use — encyclopaedias, dictionaries, histories, biographies, medical references, legal precedents, scientific research abstracts, patents, technical, scientific and medical journals, telephone directories, and a thousand and one other more specialised publications can all be transferred to CD with a minimum of problems, and made available usually at considerably less cost than the paper version.

Whichever way you look at it, the CD-ROM looks like being another big success for the CD format.

MAY CROSSWORD

DOWN

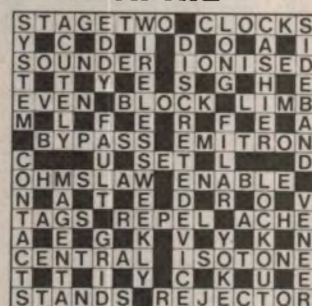
1. Former fanciful medium. (5)
2. Parts of headphones. (7)
3. Form of air traffic. (4)
4. Ozone. (6)
5. Joint inventor of the bipolar transistor. (8)
6. First in, first out. (4)
7. Role of car speaker! (7)
8. Instrument that measures speed of fluid flow, especially blood. (9)
14. Degree of signal strength. (5)
15. Name of a signalling lamp. (5)
16. Device that alters an electronic parameter. (9)
18. Restore battery potential. (8)
20. Region on a graph indicating constant output. (7)
22. Utter data for recording. (7)
23. Automotive system usually checked electronically. (6)
27. Game with computer application. (5)
28. Threaded rod. (4)
29. Property of electron. (4)



ACROSS

1. Elementary particles. (9)
6. Control unit. (6)
9. Type of oscillator. (7)
10. Said of computer, etc, with limited access. (3-4)
11. Obtain computer data. (4)
12. Moves to next channel. (5)
13. Prefix to "ware" in computer jargon. (4)
16. Electronic device. (6)
17. Possible LED output. (3-5)
19. Two-channel system. (8)
21. This provides tight security for your EA magazines! (6)
24. Pot-like device. (1-3)
25. Said of a component with a linear resistive characteristic. (5)
26. Possible label for a current mode switch. (2-2)
30. Kind of speaker. (7)
31. Term indicating coherance. (2-5)
32. Golfer's circuit. (5)
33. Graduates. (9)

SOLUTION FOR APRIL



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4015	4043	4161	40014
4016	4047	4194	45112
4017	4049	4503	6802
4018	4051	4510	6821
4019	4066	4511	6845
			6850

U21630	Z80ASIO	ADC0804LCN
U21720	F9001DC	FD1791(8876)
	XR8038	

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SUPER IC SPECIAL 6264
1-9 $6.50 · 10-99 $5.50 · 100+ $5.25

SUPER IC SPECIAL 6802
1-9 $5.00 · 10-99 $4.75 · 100+ $4.50

ICL7106	19.50
ICL7116	19.50
ICL7117	21.50
ICL7611	6.95
ICL7660	5.90
ICM7211	12.50
ICM7216A	48.50
ICM7216B	44.50
ICM7224A	21.50
ICM7226A	48.50
ICM7227A	19.95
74S	
74S00	.60
74S02	1.00
74S03	1.00
74S04	1.00
74S05	1.50
74S08	1.00
74S09	1.50
74S10	1.00
74S11	1.00
74S15	1.80
74S20	1.20
74S22	1.50
74S30	1.00
74S32	1.00
74S37	1.70
74S38	1.70
74S40	1.20
74S51	.80
74S64	1.20
74S65	1.20
74S74	1.30
74S86	1.60
74S109	2.50
74S112	1.30
74S113	1.30
74S133	1.20
74S134	1.40
74S135	1.30
74S138	3.30
74S139	3.30
74S140	1.90
74S151	3.10
74S153	2.00
74S157	3.10
74S158	3.10
74S160	5.90
74S161	5.90
74S162	7.90
74S163	7.90
74S168	11.50
74S169	11.50
74S174	4.50
74S175	4.50
74S181	8.50
74S182	3.40
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74S197/82S91	4.90
74S201	9.90
74S214AN	P.O.A.
74S225	10.90
74S226	7.90
74S240	6.90
74S241	6.90
74S244	9.90
74S251	3.90
74S253	4.90
74S257	3.30
74S258	3.30
74S260	2.90
74S274	POA
74S275	POA
74S280	5.90
74S281	POA
74S283	7.90
74S287	4.90
74S288	4.90
74S299	13.90
74S301	13.90
74S314	POA
74S330	POA
74S331	POA
74S373	9.90
74S374	9.90
74S381	9.90
74S387	3.30
74S412 8212	
74S428 8212	7.90
74S470	9.90
74S471	9.90
74S472	9.90
74S473	9.90
74S474	9.90
74S475	9.90
74S482	11.90
74S489	7.90
74C	
74C00	.50
74C02	.60
74C04	.60
74C08	.80
74C10	.80
74C14	1.40
74C20	.80
74C30	.80
74C32	.80
74C42	1.90
74C48	2.50
74C73	1.40
74C74	1.70
74C76	1.90
74C83	2.90
74C85	2.30
74C86	1.50
74C89	8.90
74C90	1.90
74C93	1.90
74C95	2.00
74C107	1.20
74C150	6.50
74C151	2.20
74C154	6.00
74C157	3.75
74C160	1.90
74C161	1.90
74C162	2.00
74C163	2.00
74C164	2.00
74C165	2.50
74C173	1.90
74C174	1.90
74C175	1.90
74C192	2.00
74C193	2.00
74C195	2.00
74C200	14.00
74C221	2.75
74C240	3.75
74C244	3.95
74C373	4.75

74C374	4.45
74C901	3.00
74C902	2.50
74C903	2.50
74C904	2.50
74C905	15.00
74C906	2.90
74C907	2.90
74C908	2.75
74C910	14.00
74C911	12.50
74C912	12.50
74C914	4.50
74C915	1.00
74C917	15.50
74C918	2.90
74C920	12.50
74C921	12.50
74C922	7.90
74C923	7.90
74C925	9.90
74C926	9.90
74C927	9.90
74C928	9.00
74C929	9.50
74C930	2.75
74C932	2.50
74C941	2.50
74C989	8.90
74LS	
74LS00	.35
74LS01	.40
74LS02	.40
74LS03	.40
74LS04	.60
74LS05	.60
74LS08	.40
74LS09	.80
74LS10	.60
74LS11	.80
74LS12	.80
74LS13	.90
74LS14	.80
74LS15	.80
74LS19	.90
74LS20	.50
74LS21	.90
74LS22	.90
74LS24	.90
74LS26	.90
74LS27	.90
74LS28	.90
74LS30	.40
74LS32	.70
74LS33	.70
74LS37	.70
74LS38	.80
74LS40	.80
74LS42	.60
74LS47	1.00
74LS48	1.00
74LS49	1.80
74LS51	.70
74LS54	.80
74LS55	.80
74LS63	2.80
74LS73	.60
74LS74	.80
74LS75	.80
74LS76	1.00
74LS77	1.00
74LS78	1.10
74LS83	.70
74LS85	.60
74LS86	.80
74LS90	.80
74LS91	.80
74LS92	.60
74LS93	.70
74LS95	1.20
74LS96	1.20
74LS107	.90
74LS109	.60
74LS112	.70
74LS113	.70
74LS114	.80
74LS122	1.30
74LS123	.90
74LS125	.80
74LS126	1.20
74LS132	1.50
74LS133	4.90
74LS136	1.50
74LS138	.80
74LS139	.80
74LS145	2.10
74LS147	2.50
74LS148	1.90
74LS151	1.20
74LS152	1.95
74LS153	1.00
74LS154	2.95
74LS155	1.00
74LS156	1.50
74LS157	1.10
74LS158	1.00
74LS160	1.00
74LS161	.80
74LS162	1.50
74LS163	1.10
74LS164	.90
74LS165	1.00
74LS166	2.55
74LS169	2.45
74LS173	.90
74LS174	.90
74LS175	.80
74LS181	4.00
74LS190	1.50
74LS191	1.20
74LS192	1.20
74LS193	1.20
74LS194	1.20
74LS195	.90
74LS196	.90
74LS197	1.75
74LS221	2.00
74LS240	1.90
74LS241	1.90
74LS242	1.90
74LS243	1.90
74LS244	1.50
74LS245	2.60
74LS247	1.30
74LS248	1.50
74LS249	1.60
74LS251	1.50
74LS253	1.20
74LS257	.70
74LS258	1.20
74LS259	1.50
74LS260	2.50
74LS266	1.20
74LS273	1.95
74LS275	6.90
74LS279	.60
74LS280	2.60
74LS283	1.50
74LS290	1.50
74LS293	1.30
74LS295	1.75
74LS297	6.50
74LS298	1.20
74LS299	3.90
74LS320	3.95
74LS321	3.95
74LS322	6.75
74LS323	6.50

74LS324	2.20
74LS326	2.20
74LS327	2.20
74LS352	2.20
74LS353	2.20
74LS354	3.95
74LS365	1.00
74LS366	1.00
74LS367	.60
74LS368	1.00
74LS373	1.90
74LS374	1.90
74LS375	1.00
74LS377	2.15
74LS378	1.20
74LS379	1.90
74LS386	1.00
74LS390	1.80
74LS393	1.80
74LS395	2.00
74LS396	2.50
74LS398	3.00
74LS399	1.90
74LS424	5.50
74LS440	5.50
74LS441	5.50
74LS442	5.50
74LS443	5.50
74LS445	2.20
74LS446	5.50
74LS447	1.90
74LS448	5.50
74LS449	5.50
74LS490	3.20
74LS540	5.95
74LS541	3.95
74LS621	2.75
74LS622	2.75
74LS623	5.95
74LS629	5.95
74LS640	3.95
74LS642	2.75
74LS643	2.75
74LS644	2.75
74LS645	2.75
74LS668	1.75
74LS669	1.75
74LS670	2.75
74LS673	12.55
74LS674	12.55
74LS690	3.95
74LS691	3.95
74LS692	3.95
74L693	3.95
74LS696	3.95
74LS699	3.95
CDP	
CDP1802	10.50
CDP1864	17.50
CPU	
6502	15.00
6502A	15.00
6522	15.00
6522A	15.00
6532	14.00
6545	19.50
6551	12.90
6800	6.00
6802	7.00
6808	12.50
6809	10.00
6810	3.50
6821	5.50
6840	6.50
6845	12.50
6847	3.50
6850	7.90
6860	19.50
6875	15.00
Z80CPU	5.00
Z80ACPU	5.00
Z80BCPU	12.00
Z80P10	4.50
Z80AP10	4.50
Z80CTC	5.50
Z80ACTC	5.50
Z80DMA	16.00
Z80ADMA	16.00
Z80AS10	13.00
Z80S10	13.00
AD570	69.50
AD590	9.50
AD7524	17.50
AY-3-8910	14.50
AY-3-2513	14.50
MSM5832	16.50
MM58174	19.50
MM5303	7.50
MM5309	14.50
MM5369	4.95
LH0002	9.50
LH0042CH	9.50
LH0070	9.50
LH0071	9.50
TL061	1.50
TL062	2.90
TL064	4.90
TL071	1.20
TL072	2.90
TL073	3.20
TL074	4.90
TL081	1.90
TL082	2.50
TL083	2.90
TL084	3.45
TL494	4.90
TCA220	9.50
TCA280	4.50
TDA1024	2.80
TA7205P	3.90
TEA1002	17.50
UAA170	5.95
UAA180	3.75
LM10CH	7.50
LM301	.50
LM301H	1.50
LM302H	6.50
LM305H	1.50
LM307CN	1.00
LM308	1.00
LM308H	1.80
LM309K	1.90
LM310N	3.20
LM310H	3.20
LM311	1.00
LM311H	1.80
LM317T	2.50
LM317K	4.50
LM318	4.90
LM324	1.00
LM325	4.50
LM326	4.50
LM329DZ	.90
LM3442	1.90
LM3352	2.20
LM336 2.5V	2.95
LM338K	12.50
LM339	1.20
LM348	1.80
LM349	1.60
LM350K	10.50
LM351N	1.00
LM353	2.50
LM358N	2.40
LM357	2.40
LM358	1.40
LM361	3.50

LM377	4.90
LM378	3.95
LM380 8 pin	1.80
LM380 14 pin	1.90
LM381	3.50
LM382	3.50
LM383	3.90
LM384	3.50
LM386	1.95
LM387A	3.95
LM387	2.00
LM390	2.95
LM391	2.90
LM393	1.00
LM395T	9.95
LM399K	22.50
LF398	5.90
NE544	6.50
NE555	.40
NE556	1.20
NE668	6.00
NE560	4.60
NE567	2.00
NE570	5.90
NE571	5.90
NE592	6.90
NE594	9.50
LM709-14	1.50
UA710CN	1.00
LM711	1.20
LM723	.75
LM723CH	1.50
LM725	4.75
LM733	1.50
LM739	2.75
LM741	.60
UA747	1.30
UA748	1.00
MC1310	9.50
MC1312	7.95
MC1314	7.95
MC1315	8.95
MC1327	7.95
MC1350	1.95
MC1408L8	7.50
MC1437	4.95
MC1445	5.95
MC1456	1.95
MC1458	1.20
MC1468L	21.50
MC1469R	6.90
MC1488	1.20
MC1489	1.20
MC1494	8.40
MC1495	8.90
MC1496	2.50
LM1596	3.00
MC1648	8.90
LM1812	10.50
LM1830	3.90
LM2907	3.90
LM2917 8 PIN	4.90
LM2917 14 PIN	4.90
MN3001	17.50
CA3028	2.00
CA3046	1.90
CA3056	6.50
CA3059	5.95
CA3080	1.90
CA3086	1.90
CA3100E	7.95
CA3130E	2.20
CA3130T	2.95
CA3140E	2.20
CA3140T	2.95
CA3240E	11.95
CA3401	1.00
CA3900	1.20
CA3905	1.75
CA3909	2.95
LM3911	2.95
LM3914	5.90
LM3915	5.90
LM3916	5.90
LM3999Z	2.60
RL4136	1.95
RC4145	20.90
RC4194	3.90
MM5369	4.95
SCR & TRIACS	
SC141D	1.90
SC141E	1.95
SC142E	2.95
SC146D	2.85
SC150D	4.95
SC151D	2.95
SC152D	6.90
C103YY	.90
C103B	.90
C106B	.90
C122D	2.50
C122E	2.95
C260D	8.50
C260E	9.90
2N2646	1.20
2N2647	2.50
2N6027	.90
TRANS	
AC125	1.20
AC126	1.20
AC127	1.20
AC128	1.20
AC187	1.50
AC188	1.50
AC149	3.40
AD161	2.90
AD162	2.90
AF118	2.90
BC107	.50
BC108	.50
BC177	.60
BC178	.60
BC179	.60
BC182L	.40
BC212	.30
BC318	.30
BC320	.40
BC327	.30
BC328	.30
BC337	.40
BC338	.40
BC546	.40
BC547	.20
BC548	.20
BC549	.20
BC550	.40
BC556	.40
BC557	.20
BC558	.20
BC559	.20
BC639	.50
BC640	.50
BCY70	1.90
BCY71	1.90
BD139	.60
BD140	.60
BD201	.90
BD232	.90
BD233	.90
BD235	.90
BD236	.90
BD237	.90

BD238	.90
BD262	1.20
BD263	1.20
BD437	1.50
BD488	1.50
BD647	1.80
BD648	1.80
BD677	1.80
BD681	2.00
BD682	2.00
BDV64B	3.90
BDV65B	3.90
BDX63	6.50
Y96 (BUX 80)	4.90
BDY97 (BUX 80)	4.90
BF115	1.50
BF167	1.20
BF173	1.20
BF177	1.20
BF180	1.20
BF182	.80
BF183	.60
BF184	.60
BF198	.60
BF199	.60
BF200	1.20
BF245	1.50
BF337	1.50
BF338	1.90
BF458	1.00
BF459	1.00
BF469	1.20
BF470	1.20
BF494	.90
BF495	.90
BFW10	1.50
BFW11	1.50
BFW16	1.50
BFY50	1.20
BFY90	1.90
BFX90	1.50
BU126	2.50
BU208	4.90
BU326	3.90
BUX80	4.90
MFE131	2.90
MFE3001	9.90
MFE3003	6.95
MJ413	5.90
MJ802	7.50
MJ901	4.50
MJ1001	3.90
MJ11011	9.90
MJ11015	14.50
MJ11016	14.50
MJ15003	6.50
MJ15004	6.50
MJ15024	10.00
MJ2501	8.90
MJ2955	2.50
MJ3001	8.00
MJ4032	12.50
MJ4502	6.90
MJE340	1.50
MJE350	1.90
MJE371	2.90
MJE521	2.50
MJE700	3.50
MJE800	2.90
MJE2801	3.95
MJE2955	4.80
MJE3055	3.90
MJE13005	5.90
MJE13007	7.90
MJE13009	12.50
MPF121	2.50
MPF131	2.50
MPSA05	1.00
MPSA06	1.00
MPSA10	1.00
MPSA12	1.00
MPSA13	1.00
MPSA14	1.00
MPSA20	1.00
MPSA42	1.00
MPSA43	1.20
MPSA55	1.00
MPSA56	1.00
MPSA63	1.00
MPSA65	1.00
MPSA92	1.00
MPSA93	1.20
MPF102	.80
MPF103	.90
MPF105	.80
MPF106	.90
MPF109	.90
MPSL01	1.50
MPSL51	1.50
MPSU02	1.75
MPSU52	1.90
MPSU56	1.75
MP131	1.75
MRF221	19.50
MRF237	5.90
MRF238	29.50
MRF245	53.50
MRF455	37.00
MRF475	12.50
MRF603	19.50
MRF641	49.00
MRF646	53.00
MRF901	2.90
MPF131	1.90
TIP31A	.70
TIP31B	.70
TIP31C	.75
TIP32A	.70
TIP32B	.70
TIP32C	.75
TIP41C	1.50
TIP42A	1.40
TIP42C	1.50
TIP49	1.90
TIP50	2.20
TIP53	2.50
TIP111	1.50
TIP112	1.50
TIP116	1.50
TIP117	1.50
TIP120	1.50
TIP122	1.50
TIP125	1.50
TIP127	1.50
TIP145	3.40
TIP2955	1.50
TIP3055	1.50
2N301	4.00
2N697	1.00
2N918	1.00
2N1304	1.00
2N1613	1.20
2N2102	1.90
2N2219	.90
2N2222A	1.00
2N2369	1.00
2N2484	1.00
2N2646	1.95
2N2647	3.95
2N2894	1.00
2N2904	1.10
2N2905	1.10
2N2906	1.10
2N2907	1.10
2N3019	1.90
2N3053	.90
2N3054	1.90

2N3055	1.00
2N3096	1.20
2N3109	1.90
2N3251	1.90
2N3302	1.90
2N3440	1.80
2N3441	2.90
2N3442	3.50
2N3563	.30
2N3564	.30
2N3565	.30
2N3566	.30
2N3567	.30
2N3568	.30
2N3569	.30
2N3638	.30
2N3640	.30
2N3641	.30
2N3642	.30
2N3643	.30
2N3644	.30
2N3645	.30
2N3646	.30
2N3702	1.20
2N3704	1.40
2N3739	4.50
2N3771	5.50
2N3772	5.70
2N3773	5.90
2N3792	6.00
2N3819	1.20
2N3866	2.95
2N3904	1.00
2N3906	1.00
2N4030	1.50
2N4032	2.20
2N4033	2.20
2N4036	2.50
2N4121	1.50
2N4123	1.50
2N4236	1.90
2N4237	1.90
2N4248	.40
2N4249	.40
2N4250	.40
2N4258	.50
2N4355	.50
2N4356	.50
2N4360	1.00
2N4401	.30
2N4402	.30
2N4403	.30
2N4416	1.90
2N4427	3.90
2N4918	2.90
2N5088	1.00
2N5089	1.00
2N5139	1.20
2N5179	1.20
2N5190	2.50
2N5191	3.30
2N5192	3.10
2N5193	2.50
2N5194	2.95
2N5195	3.30
2N5210	1.50
2N5245	1.50
2N5303	8.50
2N5401	1.50
2N5457	1.00
2N5458	.90
2N5459	.90
2N5461	.90
2N5462	.90
2N5485	.90
2N5486	.90
2N5489	14.50
2N5590	26.50
2N5591	29.50
2N5641	19.50
2N5656	2.50
2N5770	.30
2N5777	1.50
2N5830	.30
2N5831	.30
2N5873	1.40
2N5874	1.70
2N5944	15.50
2N5945	18.50
2N5946	19.50
2N5961	1.90
2N6027	1.00
2N6049	1.90
2N6080	21.50
2N6083	26.90
2N6084	37.90
2N6122	1.90
2N6125	1.90
2N6130	1.90
2N6133	1.90
2N6256	14.50
2N6259	13.50
2N6274	29.50
2N6378	4.90
2N6425	4.50
2N6578	4.90
3N201	1.50
2SA683	1.50
2SC2028	3.95
2SC2029	3.95
2SC2166	4.95
2SC1730	1.95
2SC1969	6.30
2SC1973	3.95
VN88AF	3.95
2SC372	1.85
2SC495	2.95
2SC710D	1.95
2SC73	1.95
2SC900F	1.95
2SC945A	1.95
2SC1014	2.50
2SC1017	1.95
2SC1018	4.95
2SC1061	2.85
2SC1096	2.85
2SC1173	2.85
2SC1226	2.95
2SC1306	6.30
2SC1419	2.95
2SC1449	1.95
2SC1674	1.95
2SC1307	6.90
2SD288	3.95
2SD325	2.95
2SD350A	4.80
2SD525	3.95
2SK45	3.95
2SJ49	7.95
2SJ56	12.50
2SK134	7.95
2SK176	12.50
1N4002	.15
1N4007	.20
1N5404	.30
1N5408	.40
0A47	.80
0A90	.50
0A95	.50
5082-2800	2.85
5082-2811	4.95
HLMP6620	5.95
BRIDGES	
1.5 AMP	
W005	.50
W02	.40
W04	.50

8AMP	
BPC602	2.90
KBPC604	3.50
KBPC606	4.50
10AMP	
KBPC1002	4.20
KBPC1004	4.90
35AMP	
KBPC3502	5.90
KBPC35014MD	8.50
A3504	6.90
KBPC3510MDA	
3510	9.90
74	
7400	.35
7401	.45
7402	.45
7403	.45
7404	.60
7405	.60
7406	.80
7407	.80
7408	.60
7409	.80
7410	.60
7411	.70
7412	.70
7413	.80
7414	.80
7416	.80
7417	.80
7420	.60
7425	.90
7427	.80
7430	.70
7432	.70
7437	.90
7438	.90
7440	.90
7442	.90
7445	1.00
7446	1.50
7447	1.50
7449	1.20
7450	.90
7451	.90
7473	.90
7474	.70
7475	.70
7476	.80
7485	1.50
7486	1.20
7489	3.90
7490	1.00
7493	1.00
7495	1.00
7497	2.30
74100	1.65
74107	1.20
74109	1.00
74110	1.50
74121	.90
74122	.90
74123	1.00
74125	1.00
74126	1.80
74132	1.00
74139	1.50
74145	1.45
74150	1.50
74151	1.50
74154	1.75
74155	1.00
74161	1.20
74163	1.40
74164	1.20
74165	1.70
74166	1.70
74174	1.45
74175	1.20
74180	1.20
74190	1.00
74191	1.45
74192	1.85
74193	.80
74194	1.10
74195	1.00
74196	1.50
74197	1.50
74221	1.90
74367	1.50
74368	1.50
75107	2.50
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75150	2.50
75154	2.50
75450	1.50
75451	.90
75452	.90
75453	.90
75461	1.50
75462	1.50
75471	3.00
75472	3.00
75491	2.00
75492	2.00
75493	3.00
8121	5.00
8123	4.00
8130	6.95
8131	6.95
8136	6.85
8303	5.50
8304	6.95
82S23	5.95
82S123	6.85
8311	5.95
8641	5.95
8820	6.95
8830	6.95
8832	6.95
8833	6.95
8834	6.95
8835	5.95
1488	1.50
1489	1.50
81LS95	3.75
81LS96	3.75
81LS97	3.75
81LS98	3.75
8T26	3.00
8T28	3.00
8T30	3.00
8T96	1.80
8T97	1.80
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8T14	2.50
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8085	9.50
8086	39.00
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8212	2.90
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8253	7.50
8255	6.50
8257	16.50
8259	6.50

8271	89.00
8272	33.00
8273	65.00
8274	42.50
8275	38.50
8276	28.50
8279	8.50
8282	6.90
8283	6.50
8284	8.50
8286	6.50
8287	6.50
8288	17.50
8741	57.50
8748	65.00
8749	58.50
8755	33.50
8035	6.90
8039	7.90
FD1771	19.00
FD1791 (8876)	39.00
FD1793 (8877)	39.00
FD1795	39.00
FD1797	39.00
WD1691	29.50
WD2143	14.50
WD1931	22.50
WD1933	34.00
WD1983	14.75
WD1993	53.00
WD2123	26.50
WD8250	16.50
TR1602 (S1883)	8.50
TR1863	8.90
COM8116	24.00
BR1941	23.00
CRT8002A	59.90
74HC	
74HC00	.80
74HC02	.80
74HC04	.80
74HC08	.80
74HC11	.80
74HC14	1.40
74HC27	.80
74HC30	.80
74HC32	.80
74HC74	1.10
74HC76	1.10
74HC85	1.40
74HC86	1.10
74HC123	1.40
74HC138	1.40
74HC139	1.40
74HC157	1.40
74HC165	2.50
74HC174	1.40
74HC221	3.60
74HC240	2.50
74HC244	2.50
74HC245	3.90
74HC367	1.40
74HC373	2.90
74F SERIES	
74F00	.79
74F02	.79
74F04	.92
74F08	.79
74F10	.79
74F11	.79
74F20	.79
74F32	.79
74F64	.79
74F74	.88
74F86	1.19
74F109	.99
74F138	1.79
74F139	1.79
74F151	1.79
74F153	1.79
74F157	1.79
74F158	1.79
74F175	2.76
74F181	5.98
74F182	2.73
74F189	7.44
74F190	4.86
74F191	4.86
74F194	2.41
74F241	3.72
74F243	4.34
74F244	3.72
74F251	1.93
74F253	1.93
74F257	1.93
74F258	1.93
74F350	3.44
74F352	1.93
74F353	1.93
74F373	4.84
74F374	4.84
74F399	2.78
74F521	4.22
74F533	4.84
74F534	4.84
MEMORY	
2101	6.90
2102	2.50
2114	2.95
2708	6.90
2716	6.90
2732	7.00
2764	6.90
27128	[illegible]
4116	3.95
4164	3.50
6116	5.00
6264	6.90
58725 (6116)	7.00
2101 (5101)	7.90
(8101)	7.90
5101	7.90
8101	7.90
2532	12.50
OPTO	
4N25	1.50
4N26	1.50
4N27	1.50
4N28	1.50
4N29	1.50
4N30	2.00
4N32	2.50
4N33	2.50
4N35	2.50
4N37	2.50
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MCT2	1.50
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HP5082-2811	4.95

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5mm GRN	.30
5mm ORG	.30
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YEL RECT	.30
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GRN CHRME BEZEL	1.20
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7812KC	2.50
7815UC	1.20
7815KC	2.50
7818UC	1.20
7818KC	2.50
7824UC	1.20
7824KC	2.50
7905UC	1.90
7905KC	3.00
7912UC	1.90
7912KC	2.50
7915UC	1.90
7915KC	2.50
7918UC	1.90
7924UC	1.90
78L05	.50
78L12	.50
78L15	.75
78L18	.75
78L24	.75
79L05	1.20
79L12	1.20
79L18	1.20
79L24	1.20
LM309K (7805KC)	2.50
LM317T	2.50
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LM317HV	9.50
LM323K	7.50
LM337T	3.90
LM338K	10.50
LM350T	6.50
LM350K	8.50
LM396K	22.50
LM396K	18.50
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78H12KC	9.00
78HGKC	9.50
78P05KC	16.50
79HGKC	16.50
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XR2208	6.90
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XR2211	7.45
XR2216	6.90
XR2240	4.25
XR2243	7.95
XR8038	7.50
95H90	8.50
11C90	16.50
LM7555	1.90
LM7556	3.50
MC10116L	1.50
LM13600	3.95
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LF13741H	1.50
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4000	
4000	.50
4001	.50
4002	.50
4006	1.90
4007	.40
4008	1.20
4009	.40
4010	.40
4011	.40
4012	.40
4013	.90
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4016	.75
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4019	.90
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4031	2.85
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4076	1.50
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MC14433	13.90
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4534	8.90
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4572	.75
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4583	1.05
4584	.85
4585	2.10
ANALOG DIGITAL	
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ADC0804LCN	6.50
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DAC0832LCN	5.50
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AY31050	12.50
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WD2793	59.00
WD2795	59.00
WD2797	59.00
LM11CN	2.95
LM1871	5.95
LM1872	5.95
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1MHz	11.50
1.832MHz	7.50
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2.4576MHz	6.50
2.7648MHz	4.90
3MHz	4.90
3.5795MHz	3.90
3.93216MHz	4.90
4MHz	4.90
4.194304MHz	3.90
4.433618MHz	4.90
4.44MHz	4.90
4.75MHz	4.90
4.915200MHz	4.90
4.9562MHz	6.90
5.000MHz	4.90
5.0688MHz	4.90
6MHz	4.90
6.14MHz	4.90
6.6670MHz	4.90
8MHz	4.90
8.867238MHz	4.90
10MHz	4.90
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12MHz	4.50
14.31818MHz	4.90
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16MHz	4.90
18MHz	4.90
18.432MHz	4.90
20MHz	4.90
24MHz	4.90
27MHz	4.90
32MHz	4.90
36MHz	4.90
32.768MHz	4.90

Books & Literature

Massive new amateur radio handbook

THE 1986 ARRL HANDBOOK. Published by the American Radio Relay League, Newington, Connecticut. Soft covers, 700 pages (approx), 276 x 207mm. Illustrated with diagrams and photographs. ISBN 0-87259-063-1.

This latest edition of the ARRL Handbook is truly impressive. Those familiar with issues past will agree that it was a most useful publication, full of useful information to electronic enthusiasts in general and amateur radio operators in particular. If there was any criticism of past issues it could be that they, of necessity, repeated a good number of previously published chapters.

For 1986 though, the ARRL has done itself proud. The new edition is much larger than 1985 and has a considerable number of completely new chapters. There are also quite a few new electronic projects to build and printed circuit board patterns are included. Naturally, these projects mostly pertain to amateur radio but some of them, such as power supplies, are of interest to electronic enthusiasts generally.

All told, there are 40 chapters which are broken up into six sections: Introduction, Radio Principles, Modulation Methods, Transmission, Construction and Maintenance and On the Air. The first four sections are largely devoted to electronic theory while the last two are on the "nuts and bolts" of amateur radio.

At the price of $39.50, the book is a bargain and if you don't already have a previous copy you should get one, whether or not you are an amateur radio operator. Our review copy came from Dick Smith Electronics. (C.R.D.)

Industry reference on process control

PROCESS INSTRUMENTS AND CONTROLS HANDBOOK, THIRD EDITION: by Douglas M. Considine. Published 1985 by McGraw-Hill Book Company, USA. Hard covers, 230 x 162mm, 1766 pages, illustrated with diagrams, tables and photographs. ISBN 0-07-012436-1. Recommended retail price $183.95.

The last Process Instruments and Controls Handbook was published in 1974. In the ensuing 12 years, there have been so many developments in this field that the latest edition, Volume 3, has been virtually rewritten. Over 80% of the material is new or revised.

Content aside, the indexing and referencing is magnificent. The Introduction contains a one paragraph summary of every sub-section in the book — there are 86 in all. Imagine the time saved in locating a topic; no more scanning through dozens of pages to decide whether it's worth reading an article.

The Handbook has one of the most comprehensive indexes this reviewer has ever seen in a single volume — 63 pages in all. In conjunction with a long reference list for each section, this is a valuable feature in locating obscure topics.

Reading through the first section ("Measurement Fundamentals"), the text settles into a comfortable, concise style. This is maintained throughout the book; techniques such as mass spectrometry and continuous nuclear weigh scales are not in the least intimidating.

In general, the Handbook seems to have a sensible balance of textual explanations and mathematical formulae. The development of formulae is not given. Rather, a set of standard equations will be given where needed. For example, the section on cavitation lists "bore diameter" equations for various types of pipes and venturis for rough and smooth surfaces.

In short, this is a text we can highly recommend for anyone studying or lecturing in the area of instruments and control. To state the obvious though, it is expensive. Our copy came from the publisher. (C.R.D.)

Food for active filter feeders

ACTIVE-FILTER COOKBOOK: by Don Lancaster. Published 1985 by Howard W. Sams & Co., Inc. Soft covers, 240 pages. Illustrated with graphs, tables and circuits. ISBN 0-672-21168-8. Retail price $19.95.

Active filters are important building blocks used in modern electronic circuits and this book provides a very comprehensive practical study of the subject. It is in fact one of the standard references on the subject, having been first published in 1975. The passing years have not made it any less relevant although it could have benefited from the inclusion of references to many of the newer types of op amps, such as those with Fet inputs.

The first chapters introduce the basics of active filters, describe the various types, and define terms and concepts. Operational amplifiers are also discussed since these are important for use as the gain block in active filters.

Normalisation and scaling techniques are used throughout the text to simplify the active filter designs.

For each of the low pass, band pass and high pass filter types, designs are given for up to sixth order. Graphs are used to show the response for various damping factors.

The basic equations for each of the filter transfer functions are given but for the non-mathematically inclined it is not necessary to understand these. All the most used response characteristics such as Bessel, Butterworth, Cauer and Chebyshev, are discussed.

Overall, the book is excellent for those wanting information on active filters. It is by no means exhaustive though, and the references at the rear of the book should be useful for readers requiring greater background on the subject.

Our review copy came from Dick Smith Electronics Pty Ltd. (J.C.)

New Products...

Product reviews, releases & services

Tandy 3000 personal computer

Designed around Intel's 80286 chip, the Tandy 3000 personal computer is a 16-bit machine that operates at 8MHz. It is available with the latest MS-DOS 3.1 operating system and is compatible with IBM PC/AT and PC/XT software.

Tandy has designed the computer so that it can use the forthcoming Xenix 5.0 multi-user operating system. This allows the use of multiple display units with a single central processor, thus allowing up to six users to use the system simultaneously and to share common peripherals.

The Tandy 3000 comes with 1/2 M-byte of main memory (512K RAM), and this is exandable to 640K without using an expansion slot. The 3000 is also equipped with a high-capacity 13cm slimline floppy disk drive and a built-in 20 M-byte hard disk drive for fast access to stored data.

There are 10 expansion slots: seven PC/AT compatible, 2 PC/XT compatible and 1 PC/XT compatible half-slot for a serial/parallel adaptor. By using these expansion slots, the main memory can be extended to 12 M-bytes. Disk storage is expandable to include two floppy disk drives and one hard disk drive, or one floppy disk and two internal hard disk drives.

The total internal storage capacity can thus exceed 40 M-bytes.

A wide range of software is available, including programs that are currently being used by the Tandy 2000, Tandy 1000, and IBM PC machines.

For further information contact Tandy Electronics, 91 Kurrajong Avenue, Mt Druitt, NSW 2770. Telephone (02) 675 1222.

Demonstration centre for personal computers

Total Electronics has opened its new demonstration centre for personal computer system's products. The products include the Ericsson-PC, Standard Microsystems' ARCNET Local Area Networking Boards and software, and Memory Controller boards for IBM-PC compatibles, and Intel Corporation's "IDIS" Database Link and their range of Xenix-based microcomputer systems.

The centres are located at 9 Harker Street, Burwood, Victoria and Campbell Street, Artarmon NSW. Currently they house Ericsson PCs linked in ARCNET and IDIS configurations and Intel 286/310 systems running Intel's RCCX realtime multitasking operating system and Xenix operating system.

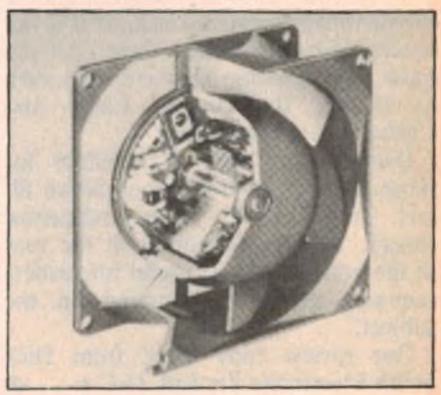
Various applications software packages are also available for demonstration, including the "Open Access' integrated package and the "Attache" financial package.

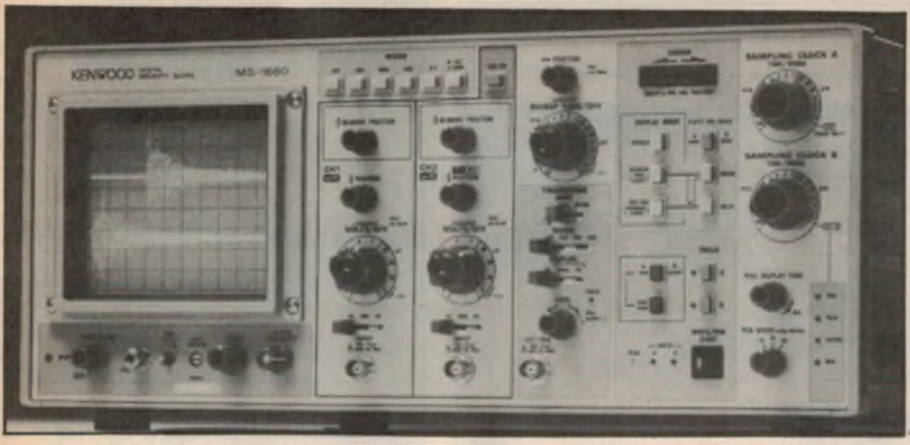
Brushless DC fans

Driven by brushless DC motors with electronic commutation, and equipped with precision ball bearings, PAPST axial fans feature low power consumption, a life expectancy of 35,000 hours at a permissable ambient temperature of 65°C, low noise levels and low EMI and RFI emissions.

The fans are suitable for cooling video terminals and switching power supplies.

For further information contact Adilam Electronics, Suite 7, 145 Parker Street, Templestowe, Vic. 3105. Telephone (03) 846 2511.



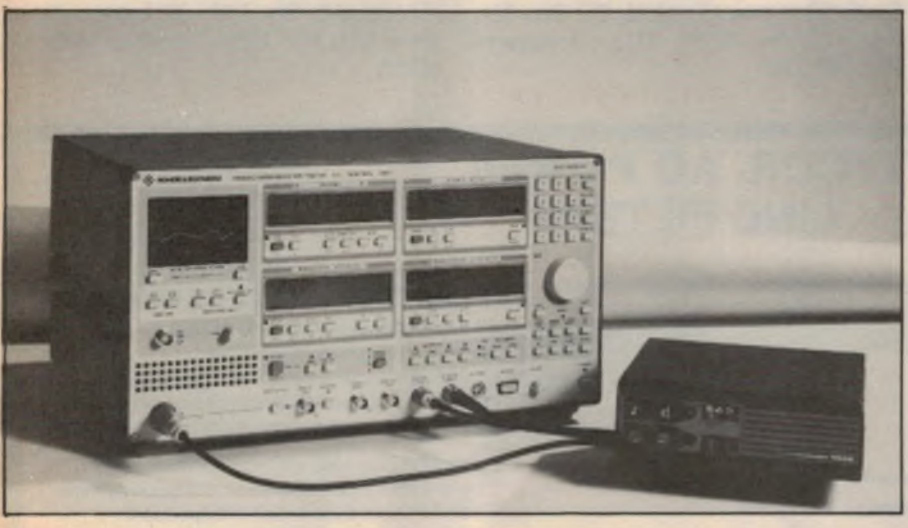


Digital memory oscilloscope

Trio/Kenwood has released, through Parameters, the MS1660 which is a 2-channel 20MHz oscilloscope. One of its features includes the ability to store a signal even when powered off. It features two input channels with an 8-bit by 2048 word memory for each channel and completely independent clocks, enabling easy waveform expansion and compression.

In addition, the MS-1660 features a GP-1B remote control capability, pen free-run mode operation, a cursor display and a battery backed-up memory, as well as the full range of normal oscilloscope functions.

For further details contact Parameters Pty Ltd, 25-27 Paul Street, North Ryde, NSW 2113. Telephone (02) 888 8777.



Radio communications test unit

The CMT Radiocommunications Tester developed by Rohde & Schwarz can be used for both mobile and workshop servicing of transceivers.

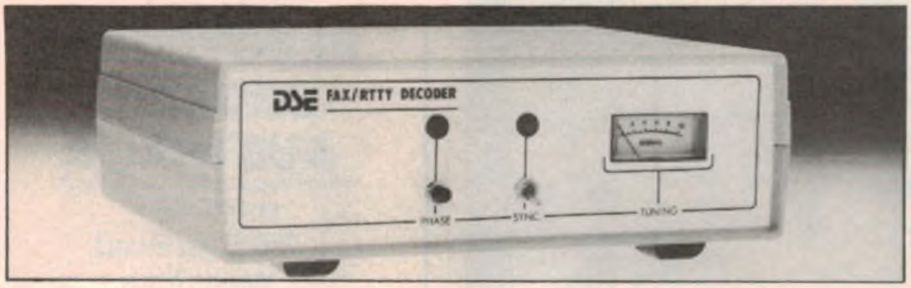
The CMT has complete manual control, fully automatic operation via the autorun control facility, with data logging by printer, or control via the IEEE-488 bus option with the aid of an external controller.

With the four large illuminated displays incorporating digital and analog readouts with high resolution, switch selected range hold and defined scaling plus an oscilloscope screen, the user can see all the test parameters and measured values at a glance and judge their interrelation.

Numerous integrated test routines can be called up and an alphanumeric display is provided for indication of special functions.

A plug in transfer memory for the CMT allows transfer of complete test routines to other testers and enhances the memory capacity. The memory is non-volatile.

For further information contact Rohde & Schwarz, 13-15 Wentworth Avenue, Darlinghurst, NSW 2010.



Fax 7 decoder for CAT computer

Dick Smith Electronics Pty Ltd has introduced a new Fax and RTTY decoder for the CAT computer. It comes in kit form and can be used with a shortwave receiver and a CAT (or compatible) computer.

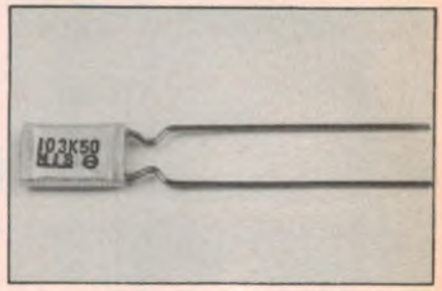
The Fax 7 RTTY Decoder accepts frequency-shift-keyed (FSK) tones from an HF receiver, decodes these into bit serial data and applies this to the computer.

Once connected, the computer can display wide-shift commercial radioteletype (RTTY) on the screen and, optionally, on a printer. Alternatively, it can display facsimile (FAX) weather pictures on the printer.

Software supplied with the decoder translates the bit serial data into either ASCII characters, or formatted pixel patterns for display on the printer. The decoder also features crystal locked synchronisation which provides skew-free pictures under adverse receiving conditions.

For further information contact Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde, NSW 2113. Telephone (02) 888 3200.

Miniature polyester capacitors



Manufactured in Japan by Nissei Co Ltd, the AMZ miniature polyester capacitor is specifically designed for radial PCB insertion and is supplied on bandolier tape conforming to the 5mm industry standard, lead spacing pitch. This is suitable for most popular radial insertion machines.

The stock range includes capacitance values from .0047μF to 0.47μF in 50V DCW with 10% tolerance. Higher voltages and/or close tolerance 5% types are also available.

For further details contact Soanar Electronics Pty Ltd, 30 Lexton Road, Box Hill, Vic 3128. Telephone (03) 895 0222.

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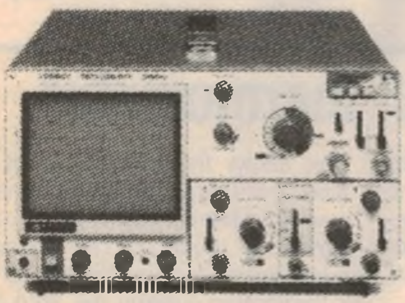
C.D. ADAPTOR
This device allows you to play your compact disc Walkman through your car sound system. ONLY **$32**



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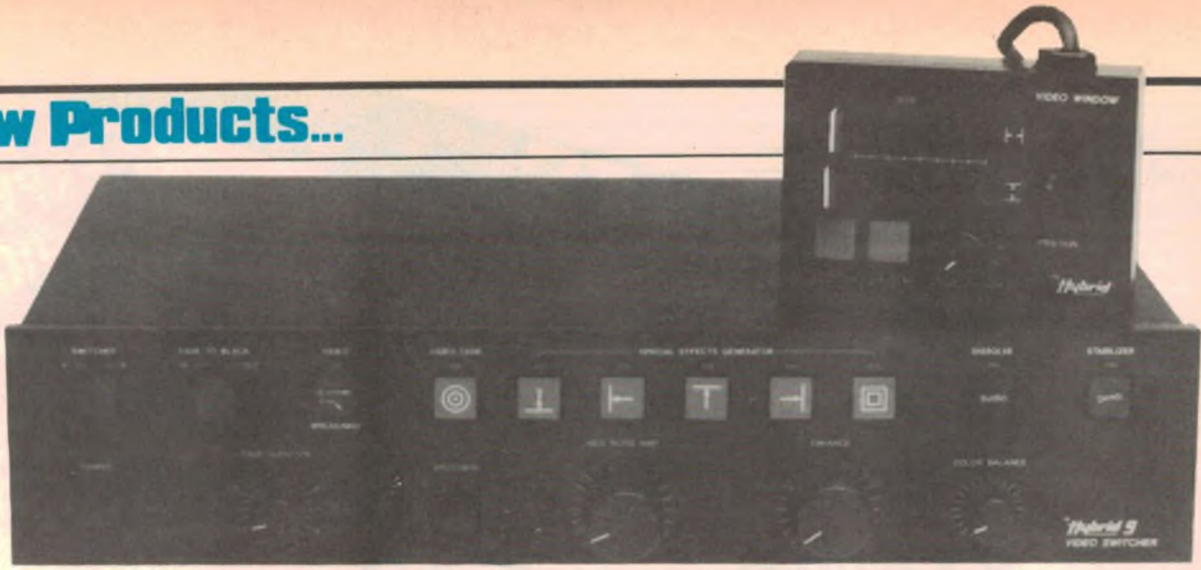


Hybrid-9 Video Switcher

New from Odyl Communications Pty Ltd is this, the Hybrid-9 Video Switcher. This is a special effects unit for domestic and semi-professional video production work. It incorporates a video switcher and fader, video enhancer, audio dissolver and automatic vertical sync stabiliser.

Primarily, the Hybrid-9 is an editing tool and can do many of the fancy video fades and wipes that are routine to the professional video production houses. It can also be regarded as a versatile and highly effective video switcher for connection of two VCRs in a domestic video suite. It has input facilities for two VCRs or any two video sources which could be a VCR, laserdisc player or camera. Associated with these can be two stereo audio inputs so that stereo VCRs can be handled.

The inputs are mixed and faded to provide three separate video outputs and three stereo audio outputs. As well, one of the video/audio outputs may be made available from the RF output which can be on Australian channel 3 or 4.

On the front panel are five buttons associated with the special effects generator which may be used separately or in combination to provide a variety of video wipes from the screen. Thus, you can wipe from left to right or vice versa, upward, downwards or combinations of these.

You can also fade in or out of black and vary the duration of the fade.

The enhancer is supplemented by a "negative noise amplifier" control which counteracts any undue emphasis of snow in the picture. While the literature accompanying the Hybrid-9 does not explain how it works, we assume that it is a high frequency rolloff circuit with adjustable turnover point.

Also available with the Hybrid-9 is the Video Window remote control which plugs into the rear of the main unit. The remote control allows further variations on the video wipe facilities, with windows of varying size which can be moved on the screen via a joystick control.

Recommended retail price of the Hybrid-9 is $1298.00. Further information can be obtained from the Australian distributors, Odyl Communications Pty Ltd, 112 James Street, Templestowe, 3106. Phone (03) 846 3022.

High-power op amp

Packaged in a plastic case similar to the T0-220, Siemens' new TCA1365 power operational amplifier can deliver an output current of up to 3.5 A at a maximum supply voltage of ±21V. The circuit is protected against short-circuiting and thermal overload.

The TCA1365 operates at a junction temperature of up to 150°C and its power dissipation is 13W. During operation the package temperature may range from −25 to +85°C.

Other features include external compensation and integrated protection diodes. One pin of the circuit is electrically connected with the cooling tab.

For further information contact Siemens Ltd, 544 Church Street, Richmond, Vic. 3121. Telephone (03) 420 7204.

Hand-held digital thermometer

Fluke has introduced its first two handheld digital thermometers, the Fluke 51 and 52. This 50 series are simple to operate and are the only handheld thermometers backed by a three year warranty.

They are housed in rugged ABS-plastic cases similar to Fluke 70 Series analog/digital multimeters.

The Fluke 51 is a single input unit while the Fluke 52 features dual inputs as well as scanning and recording modes. They can operate with either J- or K-type thermocouples and offer 0.1% accuracy over an ambient operating range of 18 to 28°C (64 to 82°F).

Both have 0.1°C resolution across the specified range for either thermocouple type.

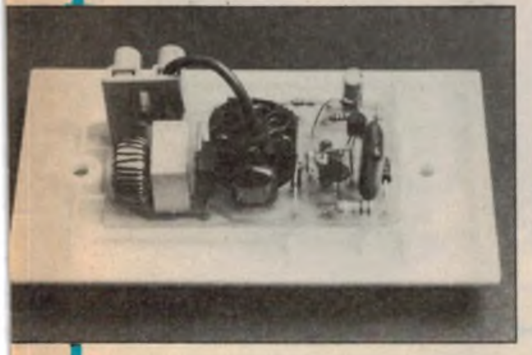
An unusual feature of the series is an offset pot for each thermocouple input. This allows field calibration of a thermocouple-thermometer combination to a specific temperature for increased accuracy, if required. The operator can select for readout in either °C or °F.

Pushbutton controls are used to select all functions, and include a 'reading hold' button which freezes the display. An open thermocouple/wire detection feature is included on all inputs.

A general purpose bead thermocouple is included with the Fluke 51, while two bead thermocouples are supplied with the dual input Fluke 52. Additional bead thermocouples are available as accessories, as are immersion probes, air probes, and piercing (316 stainless steel) probes.

For further information contact Elmeasco, PO Box 30, Concord, NSW 2137. Telephone (02) 736 2888.

Build a 240V lamp saver



Does your house eat lamps? Those expensive downlights and spotlights? Every year, you probably replace quite a few of these lamps at $5-7 a pop. This inexpensive Triac circuit should extend lamp life considerably. It incorporates overvoltage protection and soft starting.

Next month in Electronics Australia

Phone controller for mains appliances

Ring-a-ding-ding! Ting-a-ling, ding-a-ling! Dial your home number and remotely turn an appliance on and off without paying for the phone call. You can turn on outside lights, a spa or an electric blanket. We tell you how to build it in the June issue.

Playmaster 60-60 stereo amplifier

Next month, we will present the full circuit details for our new Playmaster 60-60 stereo amplifier. It outperforms commercial amplifiers costing much more, is delightfully easy to build, and should sell for quite a bit less than $250.

Note: Although these articles have been prepared for publication, circumstances may change the final content.

New Products...

More from Mordaunt Short

Concept Audio Pty Ltd has added new models to its range of Mordaunt Short loudspeaker systems. They are the MS.15 and MS.25Ti, both of which incorporate the unique 'Positec' protection circuitry. This safeguards against an overload or amplifier fault condition, and enables high volume levels to be played without the risk of damage.

The MS.15s have a retail price of $598.00 per pair and can be positioned on either rigid shelves or stands. Their specifications include a 165mm bass unit cone and a 12mm synthetic dome tweeter. Sensitivity is 87dB for 1W at 1 metre, a maximum SPL of 107dB peak, and dimensions of 325mm (H) x 225mm (W) x 172mm (D).

The MS.25Ti has a 200mm bass driver and a 19mm titanium dome tweeter, while sensitivity is specified at 89dB for 1W at 1 metre. The maximum sound pressure level (SPL) is 112dB peak and the system sells for $698.00 per pair.

For further information contact Concept Audio Pty Ltd, 17/98 Old Pittwater Road, Brookvale, NSW 2100. Telephone (02) 938 3700.

Pocket-size digital thermometer

The Mini-Therm Pocket Digital Thermometer (model AD15TH) is a pocket-size digital thermometer measuring 90 x 60 x 25mm and weighing just 97g complete with probe and battery.

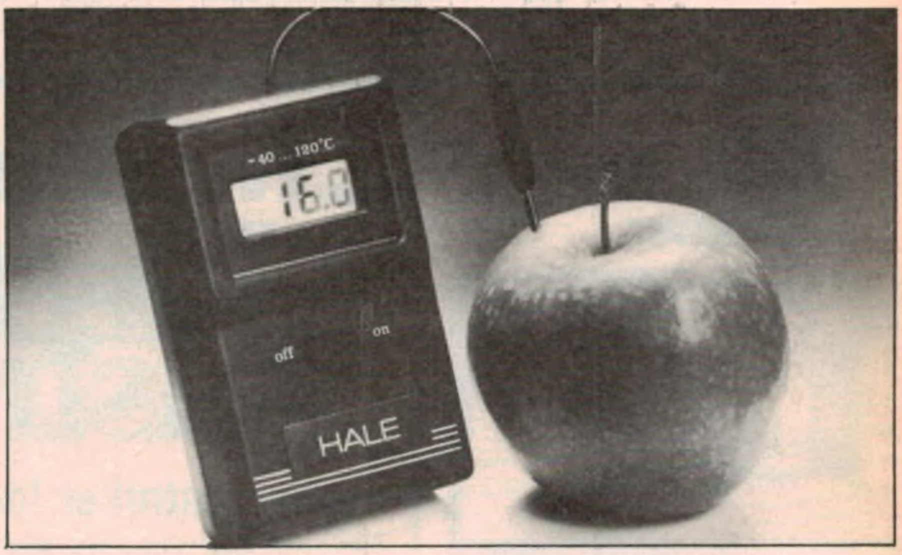
The device is factory pre-calibrated and low in cost. As a general purpose thermometer it covers the most used range of −40°C to +120°C. Resolution is 0.1°C and the unit has a stated accuracy of ±0.3°C ±1 digit.

The read out is by liquid crystal display with 8mm LCD characters and the sensor is a semiconductor type. A 30mm long x 2.2mm diameter probe with an integral lead is also supplied.

The probe has a typical response time of three seconds and has been designed for use in measuring the temperatures of air and gasses and for insertion into soft materials.

A 9V battery is supplied which has a life of typically 1000 hours. An automatic battery check inhibits faulty readings when the battery is low.

For further information contact Warsash Pty Ltd, PO Box 217, Double Bay, NSW 2028. Telephone (02) 30 6815.



Ultrasonic transducers for burglar alarms

IRH Components now carry two Murata high-sensitivity, broadband ultrasonic transducers for use in security applications. Type MA40L1 (PCB mounted) and MA40L2 (phono jack socket) are small in size and very light. Both operate at a nominal frequency of 40kHz. The receiver type has a sensitivity of −65dB/V/UBAR while the transmitter type produces a guaranteed maximum level of 110dB. Capacitance is 1700pF and the maximum input voltage is 20V rms.

Two other types are available for burglar alarm systems and both may be used as transmitters or receivers.

For further information, contact IRH Components, 32 Parramatta Road, Lidcombe, 2141. Telephone: (02) 648 5455.

Information centre

Problem with Teletext Decoder

I am hoping that you can help me with a problem I have with the Teletext Decoder kit (EA, August 1984).

The teletext function works very well with the clock updating on the screen, good graphics and good colours. However, the picture quality is terrible, to the point of being unwatchable.

The picture has interference lines running diagonally across the screen at about 45°. The lines are alternatively dark and light, evenly spaced about 1-2mm apart. As well, there are about 10 vertical bars unevenly spaced across the screen, each about 5mm wide, changing colour from green to a reddish pink quite randomly. These lines stop in a staight line at about 12mm from the bottom of the screen.

In addition, the picture frequently suffers from sideways tearing and loss of vertical hold, the latter occuring only in teletext mode. The interference is present regardless as to whether TV, teletext or mix is selected.

The diagonal interference lines improve considerably when the RF out earth shield is moved slightly to touch the chassis. The vertical lines remain unchanged. However, this improvement does not remain if a jumper lead is clipped from the earth shield to the chassis.

To further complicate matters, this problem only occurs on my 10-year old JVC 7765 AU 48cm TV; the picture on a new Toshiba 147E3A 34cm TV is almost faultless. Only a faint trace of the diagonal lines is evident and there are no vertical lines. There is no sideways tearing, but loss of vertical hold still occurs in teletext mode.

The picture quality is good if the Video Out from the decoder is connected to the direct video input on my JVC (modified as per the EA article in August 1983). This made me suspect the modulator which Dick Smith Electronics replaced at no charge. However, the new modulator didn't change anything.

Using direct video is of no use to me, as the Teletext Decoder is for my deaf sister whose Philips TV (only slightly younger than my JVC) has no video input. The picture quality on the Philips is equally appalling.

I have tried adjusting VR5 and both slugs in the modulator, but all to no avail. I also had a couple of problems with construction. First, the board overlay and assembly instructions show C49 mounted with reverse polarity when compared to the circuit diagram and the actual DC voltage levels present on the circuit. I mounted it opposite that shown on the overlay.

Second, the audio level was muted in the TV mode and broke through in the teletext mode at a very high and distorted volume. I had to change R80 to 22kΩ to cure that. (G.F., Duffy, ACT).

● The RF modulator supplied with the Teletext Decoder kit is a high quality unit, so there's no reason to substitute a different type. In fact, the original unit is capable of supplying a first rate picture.

From your description of the fault, it's possible that the interference is due to radiation from the Teletext Decoder finding its way into the RF front end of your TV set. Make sure that the lid is on the chassis and that it has been screwed down. This measure should provide adequate RF shielding.

If that doesn't do the trick, try connecting a 0.1μF bypass capacitor between chassis and the metal case of the modulator. Also, keep the Teletext Decoder and the TV set as far apart as practicable.

Parts for Car Stereo Amplifier

I am writing regarding the 100W Car Stereo Amplifier published in August and September 1985. My problem is that I have been unable to obtain the Neosid iron powder ring cores, types 17-131-10 and 17-137-10. I have contacted Siemens and Philips but they do not recognise the part numbers.

I would be very pleased if you could tell me where I can buy these parts — preferably in Melbourne. (D.S., Lilydale, Vic).

Driveway Sentry false triggers

I originally bought the 1982 version of the Driveway Sentry, but encountered difficulties. When the MK.2 version was published in March 1985, I duly pulled the first project apart, bought the necessary parts, and rebuilt the project.

The problem is that it triggers OK but does not shut off. One can hear the relay clicking but it does not allow the light to go off. By connecting another resistor in parallel with the timing resistor, I can get it to function but this does not give enough time to get from the car to the front door — we have a steep path to climb.

Both LDRs function well and other parts seem to check out — I feel that the problem is with the relay somehow. (H.W., Mt. Eliza, Vic).

● It is almost certain that your Driveway Sentry Mk.2 is being retriggered by the inductive kickback of the relay coil. Diode D5, which is across the relay coil, is included to prevent this. Check that this diode is OK and that it has been installed with the correct polarity.

If D5 checks out, other measures to prevent the circuit from retriggering will be necessary. The first step is to determine whether the problem lies in IC1 or IC2. This can be done by removing D3 from circuit and then triggering the circuit manually by pressing S1.

If the problem persists, IC2 is at fault; if not, the fault lies with IC1.

If IC2 is the cause, try decreasing the value of the 180kΩ resistor on pin 12. Assuming that this cures the problem, replace D3 and check that the circuit can still be triggered by the car's headlights. If not, increase the value of the .033μF electrolytic capacitor between pin 16 and ground.

This same decoupling technique can also be used on IC1, if it is the culprit (the V+ pin for IC1 is pin 14). Also try, increasing the value of the 0.1μF capacitor on pin 1 of IC1 (up to 1μF if necessary).

● Most parts retailers only sell the ring cores as part of a complete kit, and do not carry them as normal stock items. However, you can buy them separately from Phoenix Industrial, 168 Alexander St, Crows Nest, NSW 2065. Phone (02) 438 3966.

Sensor for fuel consumption meter

Recently, I started constructing the analog fuel consumption meter that was featured in your magazine in March 1983. However, I cannot find any stocks of the Moray fuel sensor. Both Jaycar and Rod Irving Electronics assure me that I won't find one in Australia.

Could you please tell me where I can find stocks of the fuel sensor? Failing that, is the Dick Smith fuel flow sensor compatible? (C.C., Waratah West, NSW).

● Jaycar and Rod Irving Electronics are correct — the Moray fuel flow sensor is no longer available.

Although we haven't tried it, the fuel flow sensor used in the Sparkrite car computer and sold by Jaycar should be suitable. However, this unit delivers only one tenth the number of output pulses per litre when compared to the Moray unit. This will upset the calibration of the meter.

To overcome this problem, the PLL circuit will have to be modified from a 64 times multiplier to a 512 times multiplier. To do this, connect pin 3 of IC1 to pin 2 of IC2 (instead of to pin 4) and reduce the .0027μF capacitor between pins 6 and 7 of IC1 to 330pF.

The Dick Smith unit could also probably be made to work, but we are unfamiliar with its output characteristics. It too would probably require some modification to the multiplier circuit.

Modifying the Playmaster tuner

I am really keen to build the FM tuner section only of your new Playmaster Stereo AM/FM Tuner, but with the manual control if possible. Is it possible to provide the varicap tuning voltage from a potentiometer, thus giving manual control? And how would the other unused outputs be terminated; ie the stop and mute outputs. (E.M., Manly West, Qld).

● Without really going into details, it should be possible to build a manually tuned FM-only version of the Playmaster tuner. You would have to incorporate automatic frequency control (AFC) though, otherwise the tuner would drift too much to make it listenable for more than short periods at a time. You would need to take the AFT output of the LM1865 (pin 14) and mix it with the tuning voltage (from a multi-turn potentiometer) in an op amp circuit. You would also need to make the STOP output (pin 16) drive a LED to indicate a tuned condition.

Such a tuner could probably be built fairly cheaply although you may have difficulty obtaining some of the parts such as the varicaps and ceramic filters.

Problem with AM stereo decoder

I write to you in the hope that you may be able to provide me with some assistance with the AM stereo decoder published in the October 1984 issue of your magazine.

I fitted the circuit to my Pioneer TX710 tuner, but am unable to get it to switch to stereo. The signal I get is of good quality (ie, it is noise-free) and the point to which I have connected it has a peak to peak voltage of about 1.5V. I have a 22kΩ resistor in series with the input and have tried increasing C1 to the recommended maximum.

The voltage on pin 19 of the chip is correct. However, the voltage on pin 10 is much higher than you suggest it should be, something in the region of 6.5-7V.

● The 6.5-7V measurement on pin 10 is satisfactory and indicates that the decoder is in lock. To achieve stereo reception, the input IF signal must be correct. We suggest that you monitor the voltage at pin 4 (the level detector output) and adjust the IF signal level to pin 3 by altering the series resistor until a reading of about 2V is obtained.

Capacitors for Playmaster amplifier

I am at present building the Playmaster Series 200 Mosfet Amplifier from a kitset but have run into a few problems. The first problem is the availability of the 2% capacitors. The capacitors supplied with the kitset are greencaps said to have been selected to be within 2% of their nominal value. However, I have found them to be just within 4% of their nominal value which is hardly good enough for a "no-compromise" amplifier.

The second problem concerns a mysterious diode. This diode appears in the component overlay, makes a brief appearance in the photograph of the prototype, but does not appear in the schematic. Since the diode appears to be in series with part of the power supply, I cannot just leave it out.

I am enclosing a copy of the parts overlay with the offending diode marked. Incidentally, I note that this diode is not labelled as are all the other components.

I congratulate you on what is obviously the best electronics magazine available. (M.C., Emerald, Vic).

● Unfortunately, 2% capacitors are expensive and quite difficult to obtain. For this reason, kit suppliers have elected to select capacitors. The alternative is to contact Mayer Kreig & Company, 1 Eskay Rd, Oakleigh, Vic. 3167 (phone 03 579 5722).

The mysterious diode can be a general purpose type such as a 1N4001. It is mentioned in the article in May 1985 and is in series with the supply to the preamplifier. Its purpose is to prevent switch-off thumps.

Problem with the electric fence

I have a query in relation to the electric fence controller described in December 1985.

In the text of the article (p36), it states: "the pulse transformer has a turns ratio of 20:1 and delivers an open circuit output voltage of 4kV etc". To achieve this turns ratio with a primary winding of 20 turns requires a secondary of 400 turns, but the circuit diagram and the text (p37-38) give the primary winding as 20 turns and the secondary as 120 turns — a turns ratio of 6:1.

With a primary voltage pulse of 270V and a turns ratio of 6:1, one would expect an open circuit output of approximately 1.6kV and, with a turns ratio of 20:1, an open circuit output of approximately 5.4kV. Please advise which is the correct turns ratio and also how you arrive at a figure of 4kV for the open circuit output voltage.

Finally, the text indicates that the 1μF output capacitor is charged via a 100kΩ series resistor. This value is included in the parts list, but the circuit and parts layout both show the value of this resistor as 220kΩ. (V.B., Armidale, NSW).

● With respect to the turns ratio, the constructional details and circuit diagram are correct; only the reference to the 20:1 turns ratio in the text is incorrect.

Ostensibly, the 6:1 turns ratio would yield an output voltage of 1.6kV, but due to the resonance effects in the pulse transformer, the actual output is considerably higher. When the ringing is damped by a low impedance load, the output voltage is nearer to the expected value.

The resistor in series with the 1μF output capacitor is correctly shown as 220kΩ on the circuit diagram. While 100kΩ will work in most instances, 220kΩ is to be preferred.

Finally, the diodes in the parts list are incorrectly specified as 1N4002 types. They should, in fact, be 1N4007s as shown on the circuit diagram, otherwise their voltage rating will be insufficient.

Buffer for Centronics printers

Have you ever published a project for a printer buffer for a Centronics type printer? If not, may I suggest it as a future project. (S.S., Port Hedland, WA).

● We have never published such a project but have considered doing so. However, we have not gone ahead with a design since it would be a fairly expensive project requiring quite a lot of RAM, a microprocessor and an EPROM. This brings the estimated cost to around $150 or more.

Also, we are not too sure as to the degree of reader interest. Perhaps other readers may care to comment.

Stereo TV sound receiver

I have a question concerning the article describing the Stereo TV Sound Receiver (EA, March 1985). I would like to know the unit's frequency response.

What confuses me is a reference to TV audio bandwidth. On page 80, under "Australian Stereo TV Transmission Standards", the text states: "the maximum deviation is 50kHz, the pre-emphasis is 50μs and the bandwidth is 40-1500Hz. Should this be 40-15,000Hz?

Is TV audio so poor, as I would have imagined it to be the same as FM sound? (T.O., Perth, WA).

● The text is in error. The audio bandwidth for TV sound is, as you suspected, flat from 40Hz to 15kHz.

Notes & Errata

100W VHF LINEAR AMPLIFIER (March 1986, File 2/TR/62): several words have been omitted from the first sentence in step 4 in the alignment procedure, page 28. The sentence should read: "Temporarily connect the +13.8V supply rail to the cathode of D3 (base of Q3) via a 10kΩ resistor".

CAR DASHBOARD LAMP FLASHER (February 1986, File 32/AU/46): a 1 x 1μF 16VW electrolytic capacitor should be included in the parts list; not 1 x 10μF. The circuit and parts layout diagrams are correct.

VIDEO FADER (January 1986, File 6/TVT/5): the current limiting resistor for the LED is incorrectly shown on the circuit and parts layout diagrams as 2.2kΩ. The correct value is 220Ω.

MUSICAL DOORBELL (May 1985, File 3/MS/117): in the overlay diagram on page 74, notes 5 and 9 are transposed, as are noted 14 and 18. Also the diodes associated with the note shown as 18 have the wrong polarity.

PLAYMASTER SERIES 200 STEREO AMPLIFIER (May 1985, 1/SA/71): a dual-gang linear MN PC-mounting potentiometer (the balance control) should be added to the parts list.

ELECTRIC FENCE CONTROLLER (December 1985, File 3/MS/ 119): there are two errors in the text. The turns ratio of the pulse transformer is 6:1, not 20:1, while the resistor connected to the bridge output is 220kΩ, not 100kΩ. The parts list should be altered to read 2 x 220kΩ resistors, the 1 x 100kΩ resistor should be deleted and the 5 x 1N4002 diodes should be 1N4007 types.

The circuit and parts layout diagrams are correct.

DIGITAL STROBE (March 1986, File 2/MS/64): diodes D3-D6 should be 1000V types, either 1N4007 or equivalent. Also, the 47μF 450VW electrolytic capacitor may be difficult to obtain. A 33μF 450VW capacitor may be substituted without loss of performance.

Finally, a track has been obliterated between two pads on the PCB pattern published on page 48. These pads are associated with the anode of one of the bridge rectifier diodes (D3-D6) and the adjacent wire link. The parts layout diagram is correct while the PCBs sold by parts retailers will also be OK.

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RADIO, TELEVISION and HOBBIES

May 1961

London TV tower: plans to erect the tallest building in London, a 500ft tower to carry micro-wave radio and television links, were announced by the British Postmaster General.

The project, estimated to cost about 1½ million pounds sterling, was designed to obviate the risk of obstruction to television and public telephone services from existing buildings or those planned.

Believing that the new tower would add to London's amenities the Post Office was providing a public observation platform at 450ft. It was hoped that the tower would be completed by 1964.

Non-integrated circuit: a new technique for "shrinking" missile components — to reduce weight and size — is deomstrated by this thumbnail size package which contains a complete amplifier circuit. The amplifier, developed by the General Dynamics Corportion, is part of the infra-red guidance systems of a missile. It is a solid block of plastic containing transistors, resistors and capacitors. It is probably no larger than three eighths of an inch cube.

One handed screwdriver: a new British screwdriver called the "Slotgrip", described in the BBC program "New Ideas", is likely to save mechanics and handymen a great deal of time.

The new tool costs only a few shillings to produce and contains down its spine a piece of metal which automatically twists round when you press down its head.

Wireless Weekly

May 1936

Adults only: the French radio authorities, so it is said, have decided to classify programmes, very much in the manner of the Australian film censor — "for adults only", etc. When the announcer begins an introduction to a program with "Mesdames, Messieurs", the kids must go to bed; when he begins with "Mesdames, Mesdemoiselles, Messieurs", they can stay up; the inclusion of "Mesdemoiselles", ie blushing maidens, means the programmes are in the "U" class for universal distribution.

Cable TV: a new telephone-television service between Berlin and Leipzig uses over 100 miles of co-axial cable, and scanning of 180 lines definition at 25 frames a second. Each city has two public telephone-television offices, at which three minutes' talk costs 3.5 marks.

Short-wave highlights: these were the high spots in the short wave band last night according to our observer: the staccato voice of the Italian dictator, Mussolini, raised high in vehement speech; the voices of passengers in the huge air liner, the Hindenburg, thousands of feet above the stormy Atlantic; last but not least, the voice of our very own versatile editor A. G. Hull sending his greetings from New York.

Cordless guitar: (with a photograph) Ray Olsen, leader of the Blue Five guitar combination, with his radio electric guitar. The notes on each of its six strings are picked up electrically and fed through separate amplifiers in the portable unit. This enables the tone and volume to be controlled as desired, making the instrument especially suitable for orchestral work.

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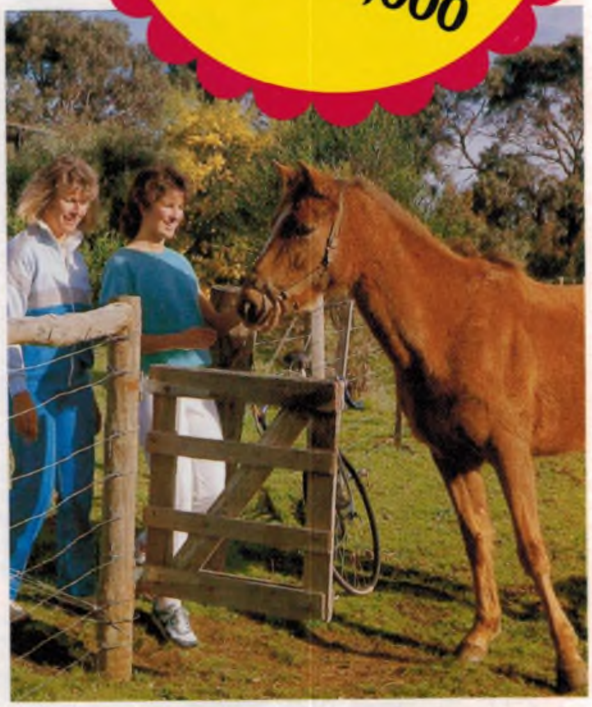

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