AUSTRALIA'S NUMBER ONE ELECTRONICS MAGAZINE

ELECTRONICS AUSTRALIA

48-PAGE ALTRONICS CATALOG

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FEBRUARY 1984
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INTERCOM FOR MOTORCYCLES

IGNITION KILLER FOR CARS

AUSTRALIA'S SOLAR OBSERVATORY

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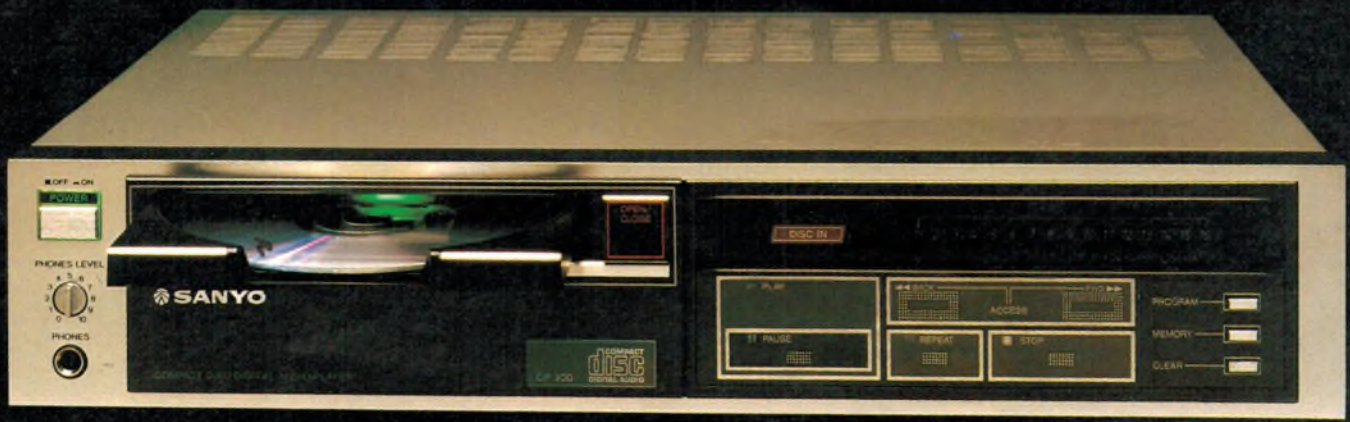
CP 300



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That's Life!

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE

ELECTRONICS AUSTRALIA

Volume 46, No. 2, February 1984

On the cover

Motorcycling is fun, particularly if you build our new Motorcycle Intercom. There are no push-to-talk buttons and the circuit is easy to build (see page 38). Inset shows our new telephone bell extender (see page 46).

Headphone amplifier

This headphone amplifier lets you practise a musical instrument without disturbing the rest of the family, or can be used for foldback. Construction starts on page 68.

PHONE MINDER: *pictured inset on the front cover, our new telephone bell extender will be of special interest to those who suffer hearing problems. It can page an FM receiver or drive a remote loudspeaker and features adjustable tone pitch and volume controls. Details page 46.*

Ignition killer for cars

Based on a 555 timer IC, this cunning antitheft device is cheap, easy to fit, and effective. We show you how to build it on page 54.

Features

Projects and Circuits

Personal Computers

Columns

Departments

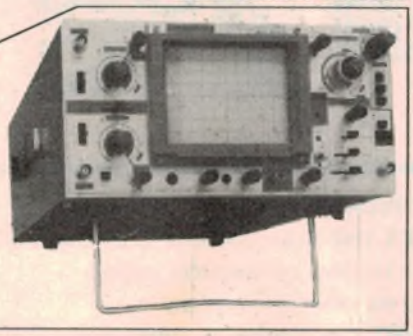
Spectravideo SV-318 home computer

Based on the MSX hardware standard, the Spectravideo SV-318 offers a range of features including high resolution colour graphics, extensive sound effects and a powerful Basic interpreter. Our 4-page review starts on page 100.

FOR PERFORMANCE & VALUE AARON HAS TO BE YOUR FIRST SCOPE CHOICE

All these scopes are dual trace and incorporate the latest features such as high brightness rectangular CRTs.

SIGNAL AND TIMEBASE DELAY



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Editorial Viewpoint

Computers: amending the Copyright Act

Once again the headlong progress of technology has made the law look like an ass. In December 1983 there was consternation among computer companies because of the decision of Justice Beaumont, of the Federal Court, that computer programs were not subject to copyright in Australia.

The decision was the outcome of Apple Computer Australia Pty Ltd vs Computer Edge Pty Ltd and is subject to appeal as we go to press. Apple alleged that Computer Edge's Wombat computer contained three ROM chips which infringed copyright on the operating system of the Apple II computer. (In a similar US case, against Franklin Computers, Apple won but Australian courts never regard US judgments as precedent.)

While many people have now jumped to the conclusion that the decision effectively means that programs on disk or cassette tape are now not subject to copyright that is not necessarily the case unless the appeal by Apple is rejected. Bear in mind also that Apple won its US case on appeal. Second, if the appeal fails, legislation has been foreshadowed which will probably be retrospective. That should prevent widespread copying in the meantime.

Legal people will probably also argue for some time about the judge's interpretation of the intention or lack of intention of Parliament in not covering computer software when it recently amended the Copyright Act to cover films, sound recordings and videotapes. Let's face it, Parliament probably hadn't even thought of the subject of computers and software let alone decided that it should be the subject of separate legislation.

That there should be separate legislation seems fairly clear. Computer software should be protected against copying. After all, copying software without permission is just another form of theft. But amending the Copyright Act may not be the best way of affording software protection. For a start, the period of protection, 50 years after the death of the author, is unnecessarily long. For software, 10 years would be long enough. After that it should be well and truly in the public domain.

The fact that most software is not original or unique would also rule out protection under existing patent law.

Whatever legislation is finally proposed it should be carefully considered and debated. The legislation should not merely seek to correct the situation brought about by the Apple case. If it does we will surely have another case a little further down the track which the law had not envisaged.

Storage in any medium will have to be covered too. In a few years' time we could see widespread use of laser storage devices or other media which have not yet been developed. It would be silly to have software protected only if it exists in the form of listings, disks or ROMS – that would leave the way open for more abuse.

In the final outcome though, any legislation will only be partially effective against illegal copying. It may stop software pirating by companies but it is unlikely to stop copying by individuals. You have only to consider the case of records or videotapes to realise that. Ultimately all software can be copied despite any technical or legal barriers.

Leo Simpson

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it's a known fact – Antennae hold up houses! So get your new aerial today, before your house falls down!

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Sharpen your knowledge and prepare for your theory exam without wasted effort! Concisely explained examples plus many multiple choice questions and answers.
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Dick Smith Electronics

See Page 98 for full address details

A704

News Highlights

Conventional and glass tube collectors on the roof of the Physics Building.

Rheem to make Aust. solar collectors

The familiar shape of solar hot water systems on the roofs of Australian homes is headed for change following a licensing agreement between the University of Sydney and Rheem Australia Ltd.

In the future, buyers of Rheem solar hot water systems may be able to choose sets of glass tubes on their roofs, rather than the all-metal "flat plate" collectors currently in use. The evacuated glass tube collectors use a "selective surface" material developed at the University which is capable of heating to much higher temperatures than normal collectors because it prevents heat escaping from the tube by re-radiation.

The agreement covers plans by Rheem and the University to work together over the year to develop cost effective designs of tubular glass and domestic hot water systems which are suitable for mass production and marketing. If the work is successful, Rheem will make a decision to market the tubular glass collectors later this year.

The head of the Solar Energy Research Project in the School of Physics, Professor Dick Collins, said that the ability of the new collectors to produce heat at quite high temperatures made them suited to industrial processes which require heat up to 150°C. "Indeed, it might seem strange that the collectors are to be used first in the fairly low temperature domestic hot water application" he said.

"The reason is that, for industrial applications, it has been very difficult to identify enough applications to constitute a viable single market. We were therefore forced to look at other areas in order to find markets sufficiently large to encourage a manufacturer to make an investment in commercialisation."

"Over the past two years we have been running evacuated collectors and coventional flat plate collectors side by side in domestic hot water systems, and the results have been surprising. We've found that evacuated collectors can deliver more than twice as much heat per unit area."

Subscription TV for Australia?

The Minister for Communications, Mr Michael Duffy, will be inviting proposals from both private enterprise and the ABC for radiated subscription television (RSTV) services in Australia, although it was important to note that the Government has yet to make a decision on whether RSTV is to be introduced.

RSTV is a service which typically provides programs, such as recently released feature films, to home subscribers for a fee. Subscribers receive transmissions off-air through a special decoder attached to their television sets. Usually they pay a monthly fee for the service.

According to Mr Duffy "cable television cannot be justified at this time. However, RSTV could be a different matter. It is less capital intensive than cable and is able to be transmitted using existing technology.

"Metropolitan RSTV services could be very profitable, but the Government is aware of the need for home entertainment for people in rural areas as well as in the cities.

"The ABC's existing free-to-air television service will become available to all Australians in underserved areas via satellite in the second half of 1985. But a 'pay' service may be the only way to get an additional high quality service to people in places where 'free-to-air' commercial television is not viable."

IBM/Hitachi — final settlement

What appears to be the last word in the IBM/Hitachi copyright dispute is a fairly complex agreement whereby the Japanese company is required to submit details to IBM of any IBM compatible products three months before release. This is to enable IBM to determine if any unauthorised information or technology was used in its production. Provision is made for Hitachi to pay royalties if it is found that any IBM copyright is involved.

Other settlement terms include payment of original court costs by Hitachi, and withdrawal of a cross-action by Hitachi in the Tokyo District Court.

Computers help the handicapped

A new world is opening up to disabled people as the result of home computer systems such as the Acorn microprocessor with accessories and programs specially designed to give the handicapped greater independence and contact with the outside world. Microprocessor packages are being developed specifically to help blind, deaf, dumb and spastic people to work from their own homes.

One system allows deaf and dumb people to make telephone calls. The user types the message into the computer and then dials the telephone number to which the message is to be sent. When the telephone is answered, the encoded message is sent down the line by a synthesised voice. Provided the respondent has a similar system a reply can be relayed, via the telephone line, to appear on the user's screen.

The picture shows a typical arrangement for a deaf person. The operator can see her voice pattern on the screen as she speaks into the microphone and can adjust sound level accordingly. She can relay her message either by speech or data by typing on the keyboard. Replies to her telephone calls can be displayed on the screen and on print out and all conversations can be stored on floppy disk for future reference.

This particular system is by Maincomp Ltd , 1-2 Cambridge Gate, Regents Park, London, NW1 4JN.

US moves to restrict technology transfer

Further manifestations of the United States' increasing sensitivity to free dissemination of technical information have emerged from the Pentagon's Steering Committee on National Security and Technology Transfer. Under new proposals from the Committee the distribution of unclassified papers and attendance at technical and scientific meetings will be closely supervised in an effort aimed at halting the flow of information to the Soviet Union and its allies.

To restrict data flow, documents which are not normally classified by the military will be marked with one of six new categories of dissemination controls. Defence contractors in industry and research would receive copies of documents under most of the controls, but only one of the new categories allows public dissemination of the material. Violations of the controls could lead to the Department of Defence halting progress payments or possibly even cancellation of a contract.

Among other areas, the new controls would apply to research materials from the Department of Energy and NASA, under a monitoring program called METAL, for "Militarily significant Emerging Technologies Awareness List."

The Pentagon committee has also proposed closer control of attendance at meetings sponsored by the Department of Defense. Heads of military branches and local commanders would be allowed to decide whether attendance should be restricted if unclassified information is discussed at a meeting in their area. Guidelines for limiting attendance suggest that "topics relating to militarily critical technologies, weapons, weapons systems, communications security, signals intelligence, computer security, or electronic warfare" should be subject to supervision.

Thorn EMI computers for the Army

Thorn EMI Electronics Australia has been awarded a $5.5m contract to develop the first phase of Project AUSTACCS, the Australian Army Automated Tactical Command and Control System. The competition for this contract included a large number of significant international companies, as well as Australian organisations.

The Thorn EMI Electronics bid included the subcontract services of Software Sciences Limited (its UK-based affiliate) and computing equipments from Digital Equipment Corporation. Contract activity will be at Enoggera Barracks, Queensland, for software and system interation and evaluation, and at Salisbury, South Australia, for hardware aspects and equipment integration. Australian content is high at about 60% and the software team will be largely Australian.

AUSTACCS is the first significant Tactical Command and Control System to be contracted by the Australian Armed Forces for local development. It will enable field commanders rapid access to essential battlefield information. It is likely that export opportunity will exist for the developed system.

Thorn EMI Electronics is well known as a defence electronics contractor, particularly in anti-submarine warfare (Ikara) and sonar (the high performance Mulloka hull-mounted sonar).

News Highlights

Green light for Videotex

The Minister for Communications, Mr Michael Duffy, has given approval to Telecom to establish a national videotex service. The service is likely to be operating towards the end of 1984.

Videotex provides an information service for businessmen and householders. Information is transmitted over telephone lines and is received on a videotex terminal or television set with an adapter. A fee is charged for the information in addition to the call charge.

It is possible for videotex users to interact with a computer. In this way videotex can be used to order and sell goods, undertake various transactions (such as making travel reservations or performing banking transactions) and gain specific answers to technical and other questions.

Telecom would operate the service as well as offer some of its own data such as the Yellow Pages directory, and information regarding Telecom services. It would also provide capacity for information providers including Government and small businesses, and services such as news, weather, games, travel, agriculture, government information and financial data would be available.

The service is expected initially to be capable of working with existing Prestel terminals and data bases now operating in Australia.

Gait and motion analysis

A British firm, Oxford Dynamics Ltd, has developed an advanced system for gait analysis and the study of human biomechanics. Called Vicon, the system processes information from up to seven cameras to present, within minutes, a moving image which can be viewed on the monitor screen (right) from any angle. It is a valuable new research tool for orthopaedic specialists and makes possible the rapid assessment of disabilities at medical clinics. The system will also facilitate research into designs of replacement joints and analysis of actions in sport and robotics.

High definition images are recorded at 50 frames per second. The patient is illuminated by high intensity infrared strobes with a flash duration of two milliseconds. The unseen light is reflected by special passive markers which are stuck to key flexion points of the body as the patient walks or runs through the cameras' field of view.

From the two-dimensional trajectories of the reflected light, captured by two or more cameras, the computer can create mathematically a model of three-dimensional motion measuring the forces, movements and positions of muscles and limbs. Further data can be obtained through force plates built into the laboratory floor and electromyograph signals transmitted from tiny preamplifiers taped over muscles.

Vicon's computer can quickly calibrate the relative positions of the cameras which can be moved to show different views for various complaints.

Prosecution for unauthorised computer access

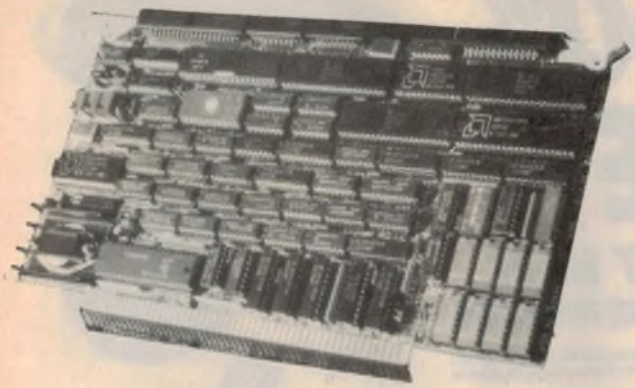
"War Games", the movie in which a hobbyist uses a home computer and telephone to access a military database, has been criticised as "far-fetched", but as recent events demonstrate, it could happen.

In November, Ronald Austin, a 19 year old student at the University of California in Los Angeles was arrested and charged with illegal access to 14 computer systems, including the Department of Defence's advanced research projects agency network, Arpanet.

It should be emphasised that Arpanet is not, in fact, a high security network, but uses the public telephone system to allow researchers throughout the United States to keep track of results in a wide variety of fields. Access to the system involves knowing the correct telephone number, a user identification and a password. In previous cases it has been shown that outsiders obtained passwords from discarded computer printouts.

Department of Defence officials told the LA prosecutor's office that the information obtained was not secret, but of a "sensitive" nature. Austin's arrest followed a tip from officials at the university who noticed that the university's computer system was being tampered with.

Investigators searched Austin's house and seized his computer equipment. He now faces 14 felony charges of "malicious access to a computer system", derived from a California law covering electronic "theft" of information. Possible penalties range from 16 months to three years in prison and a $US5,000 fine on each count.



MORE THAN JUST A CPU

The CPZ-48000 From Intercontinental Micro Systems

A HOST OF USES

The CPZ-48000 will act as more than a CPU. Use it as a multi-user-tasking host, a multi-processing host or a CPU with high speed serial data link capability for network architectures. It will also act as a highly sophisticated single board system.

'SOPHISTICATED SINGLE BOARD SYSTEM' MEANS MULTIPLE FUNCTIONS.

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- ☐ Z-80A,™ 4Mhz Operation.
- ☐ Floppy disk controller (FDC) with onboard data separator. Single or double sided. Single or double density. 8" or 5¼". The choice is yours.
- ☐ Two synchronous or asynchronous serial I/O channels (SIO). One channel can be programmed in direct memory access (DMA), interrupt, or programmable I/O mode.
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- ☐ Memory management unit (MMU). Addresses up to 16 megabytes of system memory.
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FEATURES

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- ☐ Compatible with CPZ-48000 SBCP, any Z-80A based CPU with extended address capability or 16 bit based CPUs complying with IEEE 696.1/D2 bus specification.
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- ☐ Master confiscation of slave memory for diagnostic purposes.
- ☐ Two parallel I/O ports; eight data bits + 2 handshake lines per port.
- ☐ 64 Kbytes of onboard dynamic RAM.
- ☐ Master/slave memory-to-memory transfers under DMA control @ 571 Kbyte/sec transfer rate when used with CPZ-48000 SBCP.
- ☐ Software selectable baud rates.
- ☐ Usable as an intelligent I/O processor in single user systems.

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The model CPS-MX slave processors are Z-80A (4Mhz) or Z-80B (6Mhz) based single board computers compatible with TURBOdos and CP/NET distributed processing operating systems.

CPS-MX slave processors together with an S100 bus master (host) like Intercontinental's CPZ-48000 SBCP, constitute a high performance, high throughput network which can be integrated into most S100 bus mainframes. Master/slave communications take place over the S100 Bus via slave/host bidirectional memory transfers under control of the host processor. In an architecture where the host is the CPZ-48000 SBCP, those memory transfers may take place under direct memory access (DMA) control. The data transfer rate under DMA is 571 Kbytes/sec which is a 300% increase in speed over Z-80A block move rates. Data transfer rates in non-DMA mode are one-half of the maximum transfer rates for I/O mapped slave processors. Data transfer rates in DMA mode are up to one-sixth of the maximum transfer rates of I/O mapped slave processors.

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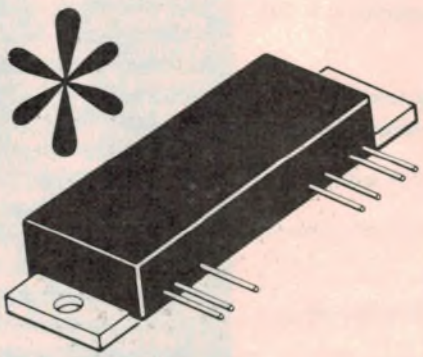

Jaycar has purchased a quantity of genuine Brand New MOTOROLA Brand MHW-710-1 UHF Power Amplifier modules. These units are designed for industrial and commercial FM transmitters!
The unit (pictured) is a rugged, tuned train of RF Power Amplifier transistors featuring thin film gold metal metallization, laser trimmed Nichrome resistors and MOS capacitors. The MHW-710-1 bolts to any flat surface (metal) to assist heat dissipation.
SPECIFICATIONS:
- RF power out @ 12.5V 13 watts - RF power out @ 15V 17 watts!! (Both of the above ratings are likely to be exceeded as Motorola's power ratings are conservative)
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- Frequency band 400-440MHz. Will work to 450MHz and therefore covers the AUSTRALIAN UHF AMATEUR BAND!!
- Circuit diagrams included.

Each MHW-710-1 comes individually packed with full manufacturers data. A manufacturers recommended circuit is included (only a few external components required), as well as a PCB pattern for the circuit. This component makes an ideal base for a "Home Brew" UHF Linear Amplifier! GREAT for UHF Mobile!

SERVICEMEN
The MHW-710-1 has been used extensively in Australian manufactured UHF Mobile 2-way radios. If you own or service a UHF radio that uses this part, now is your chance to grab a spare at an unrepeatable price! The MHW-710-1 sells for A$68 plus tax in the USA.

QUANTITIES STRICTLY LIMITED
To be fair to all, we have limited this offer to 2 per person. Jaycar's scoop offers are so successful that usually hundreds miss out. Even at 2 per customer we will probably run out quickly. Be early to avoid disappointment!
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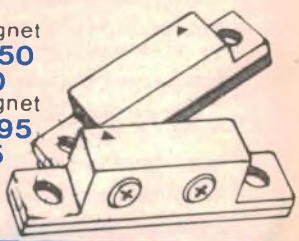

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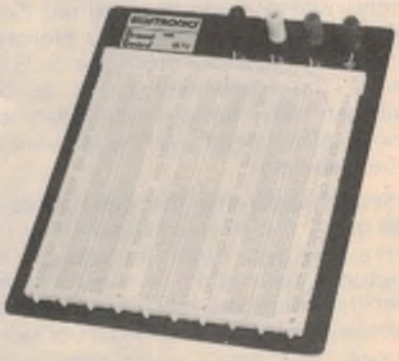

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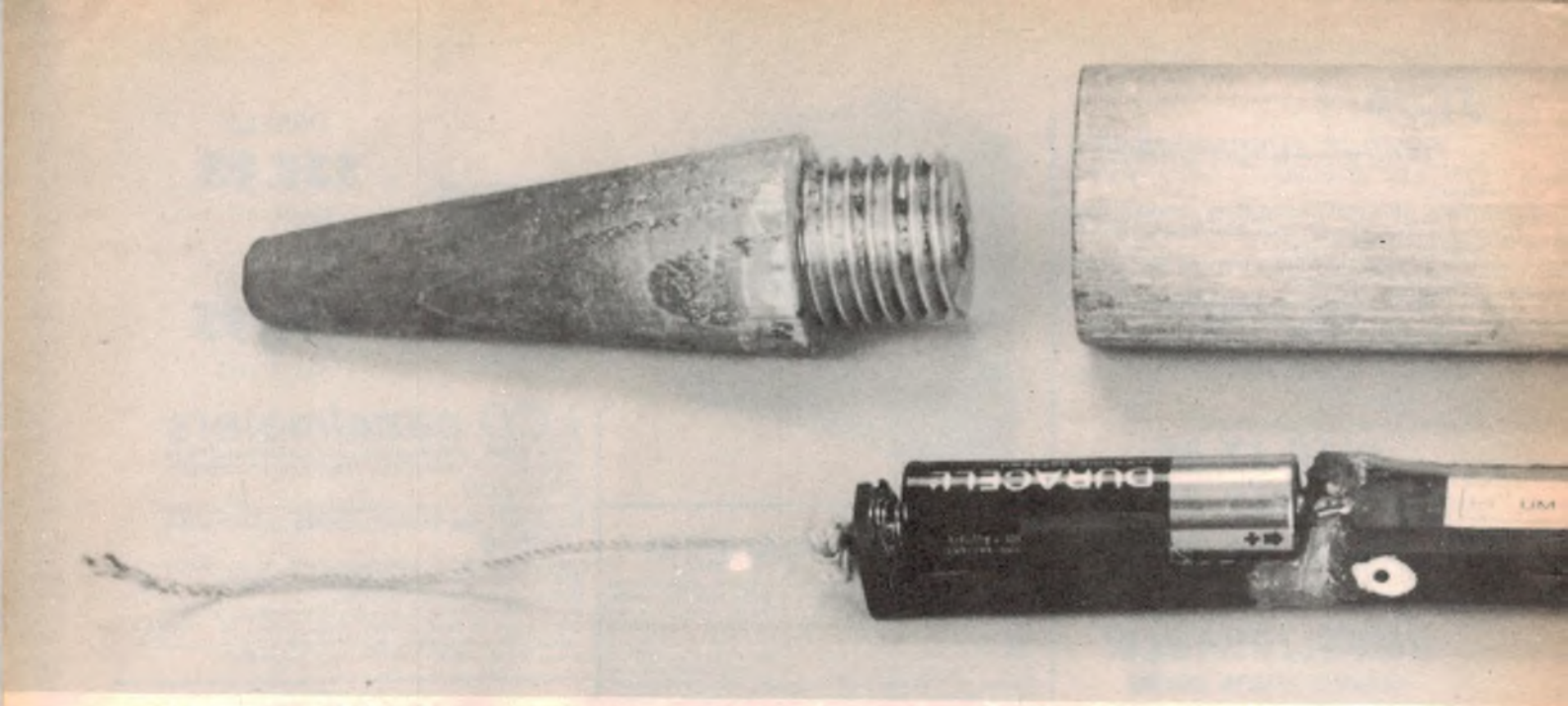

The sound of the big match Microphone

The telephoto lens can take the viewer right up to a batsman's wicket, but capturing realistic sound effects is much more difficult. Sydney TV station Channel 9 has come up with an ingenious solution — a microphone in a cricket stump!

To true cricket lovers the sound of leather on willow is a hallowed, almost sacred one. Whether the game be played on an English village green, an improvised pitch on the hard red earth of the Centre, or a carefully prepared test pitch anywhere from the SCG to Lords, the resounding smack as the batsman belts one to the boundary is a sound guaranteed to stir the blood of all true followers.

Small wonder then that descriptions of the game, first by radio and then by TV, have always been enhanced by capturing this sound to some degree. Not that there was much of a technical problem, even in the early days of radio. A resounding smack would carry to the far corners of the ground and even the relatively crude microphones of the day had no trouble responding to it.

Unfortunately, a good many people refused to believe that this was possible, and insisted that the commentator was faking the sound by tapping the microphone with his pencil. As one commentator at the time remarked: "If anyone really did hit the microphone with a pencil, the noise at the receiver would be deafening."

However, there was some basis for the rumour. Local coverage presented no problems, but descriptions from England came via HF radio circuits which, at best, suffered from static, severe fading, and accompanying distortion. At worst they might not be available at all when they were needed.

To cope with this situation some stations produced "re-creations" of the game; a description by a studio commentator based on brief details telegraphed direct from the ground to the studio and backed up by recorded crowd noises, applause, etc. And the bat-on-ball sound was simulated by tapping a rubber pencil eraser on the table beside the microphone.

All of which simply serves to emphasise the magic of that sound, and the important part it plays in the atmosphere of the game. And, whether everyone accepted the sound as genuine or not, radio microphones continued to capture the sound quite effectively and the same technique carried over into the TV era.

That is, until comparatively recently. When Sydney's Channel 9 became interested in the cricket scene, via the World Series Cricket and the one-day match concept, they felt that something better could be done to capture the atmosphere. Up until that time, the only sounds (apart from the crowd noise) that could be captured were the sound of bat upon ball and the occasional cry of "owzat". Channel 9 also wanted the sound of the bowler's feet, the sound of the ball hitting the wicketkeeper's gloves, and the sound as the wicket is spreadeagled or the batsman rapped on the pads.

At first they tried a highly directional "machine gun" type microphone mounted in the stand and aimed at the action on the ground. This did constitute an improvement, in that it picked up the vital sounds more clearly and helped separate them from crowd and other noises.

But it didn't solve the real problem. This is the descrepency between the sound picked by a microphone in the stand – no matter how "selective" it may be – and the close-up image of the batsman as seen through a telephoto lens.

The main problem is time delay. The sound at the crease takes a significant time to reach the distant microphone;

in a cricket stump

by PHILIP WATSON

long enough to be quite obvious to a spectator. There are also other, more subtle, factors. High frequencies tend to be lost along the way while reverberation and crowd noise also create difficulties.

These factors don't worry the spectator on the spot who can appreciate the distance involved and subconsciously allow for it. Similarly, it is unlikely to worry the TV viewer while ever he is looking at a medium angle view, similar to that seen by the on-the-spot spectator.

But when the telephoto lens takes the viewer to within a few metres of the batsman he subconsciously expects the sound to match the picture; no time delay, a sharp "crack" rather than a dull thud, and appropriate reverberation level.

Unless these criteria can be satisfied the illusion is spoiled.

There is only one practical way to

Software for the Super-80 Computer

The programs are:

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This simulated poker machine keeps a record of your winnings and unlike the real ones, you can set a limit on your losses.

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This program displays or prints out a calendar for any year of the 20th century — and keeps track of paydays!

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Note: this book is exclusive to, and available only from, Electronics Australia, 57 Regent St, Chippendale 2008, PRICE: $4 or by mail order from Electronics Australia, PO Box 163, Chippendale, NSW 2008. PRICE: $5.

Microphone in a cricket stump

overcome such problems; take the microphone to the source of sound. But how do you put a microphone in the middle of a cricket ground without making it disturbingly obvious to the players, or otherwise disrupting the game in general?

Radio microphone

Channel 9's first approach used a small radio microphone operating at around 200MHz and located discretely behind each wicket. The microphone proper, including a small spherical windshield, was only about 20mm diameter. It was mounted on a small ground spike and sat some 35 to 40mm above the ground.

The accompanying transmitter measured 100 x 60 x 20mm and carried an antenna 150mm long. The transmitter, sitting horizontally, was buried in a shallow hole behind each wicket and covered with a patch of artificial turf. Only the 150mm high antenna and the 40mm high microphone remained visible.

It was a reasonably satisfactory arrangement, acceptable to players, officials and the technicians. In fact, from a technical point of view the scheme worked extremely well, picking up not only the various sound effects, but the umpire's decisions, conversations between the players, and, inevitably, the odd rude word or two from players who forgot they were on air!

But it did suffer from the objection that it was visible, and that it was vulnerable. While located in a position where there was least chance of it being trodden on, this possibility could not be ruled out, particularly in the event of fast play involving an attempted stumping.

But the real problem occurred when another channel wanted to use a similar system, meaning that there would be two antennas and two microphones behind the wicket, with the added complication that the new antenna was significantly longer. Possibly wondering where it was all going to end, the players jacked up; there was no way they were going to perform with all that hardware distracting their attention.

This problem, coupled with the admitted vulnerability of the system prompted the Channel 9 technicians, led by Engineering Officer Ian Wyles, to look for a better way of doing the same job.

The solution, viewed in hindsight, may seem to be obvious, but it was a real breakthrough and completely original – put the microphone and associated transmitter in one of the cricket stumps.

It seemed like a brilliant idea but there were a lot of questions to be answered before it became a reality. Was it technically feasible and was there enough room to accommodate all the hardware? Would the equipment stand up to the rough handling often metered out to a humble cricket stump? And, just as important, would the stump, possibly weakened in the process, also stand up the normal wear and tear?

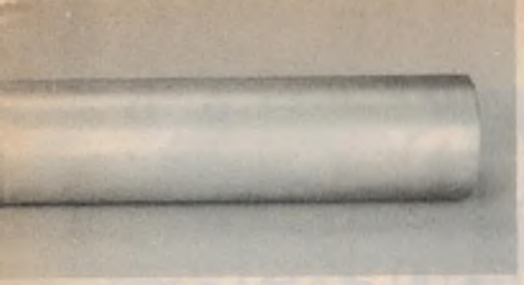
Trial and error

The only way to find out was to try it. A lot of work went into making everything fit – and work – but the end result has proved to be highly successful. Channel 9 technicians produced a miniature transmitter measuring only 60mm long, 18mm wide, and 11mm thick, including the microphone. It operates from a 1.5V alkaline AA cell which occupies about the same space. The complete package measures 120 x 18 x 18mm.

The antenna is about 500mm long, and this includes a small loading coil, the antenna being short for the frequency used. This screws into the end of the transmitter package, while the microphone faces out the side of the package, and lines up with a hole in the side of the stump.

Modifying the stump to accommodate this package is quite a complex process. The stumps are about 35mm in diameter and 710mm long, to which must be added a tapered ground spike about 75mm long. The ground spike is cut off and the stump body bored out to about 25mm for a depth of 170mm, and to about 6mm for a further depth of 500mm – almost the full length of the stump. This 6mm bore is to accommodate the antenna.

The 25mm bore is fitted with an aluminium sleeve of about 2.5mm wall thickness and which runs the full length of the bore. It is tapped with a coarse thread which matches an aluminium plug fitted to the previously removed tapered ground spike. Thus the spike can be screwed back into place, restoring



The aluminium sleeve which fits inside the stump and houses the transmitter. The ground spike screws into this sleeve. Note the microphone hole.

the stump to its original appearance.

The transmitter package, with suitable packing, is made a push fit into the space thus provided, and is orientated so that the microphone peers through the hole in the side of the stump. Thus the transmitter and microphone are at the bottom of the stump with the antenna extending towards the top.

The picture at the head of this article gives a good idea of the set-up. It shows the lower end of the stump, together with the threaded ground spike which screws into the aluminium sleeve. The hole in the side of the stump is for the microphone.

The transmitter and battery assembly is shown alongside it, with the microphone indicated with a white dot. This is to facilitate it being lined up with the hole when fitted into the stump. Note the length of cord on the battery end of the transmitter, which is needed to allow the transmitter to be withdrawn. The battery has to be changed every day, for maximum reliability.

The system works in the 80MHz commercial VHF band and the receiver is a standard commercial FM receiver covering from 76 to 108MHz. It is tuned by means of a phase locked loop and has six memories, more than enough for this application. A minimum requirement is a pick-up stump at each end of the pitch, each on a different frequency. In practice, two pick-up stumps are provided at each end, two in use and the other two, on two additional distinct frequencies, as back-ups.

Two receivers are used, one for each end, with the back-up frequencies in memory so that, in the event of a stump failure, they are available at the touch of a button. The operators fade from one stump to the other as the play moves from bowler to batsman, and also fade them out between deliveries. They also endeavour to anticipate any situation that might give rise to undesirable language (not that our Australian players would ever utter any naughty words).

Output from each receiver, unbalanced, is fed to a simple matching unit which delivers a balanced output at correct line level and impedance. Input to the receivers is from a six element Yagi antenna aimed at the transmitters and, hopefully, away from any interference sources.

As a further precaution against interference it has been found necessary to select different sets of frequencies for different venues, according to distribution of channels already allocated in that area. Part of the setting up procedure, therefore, is to monitor the selected channels for anything up to 24 hours before the start of play.

Clean bowled

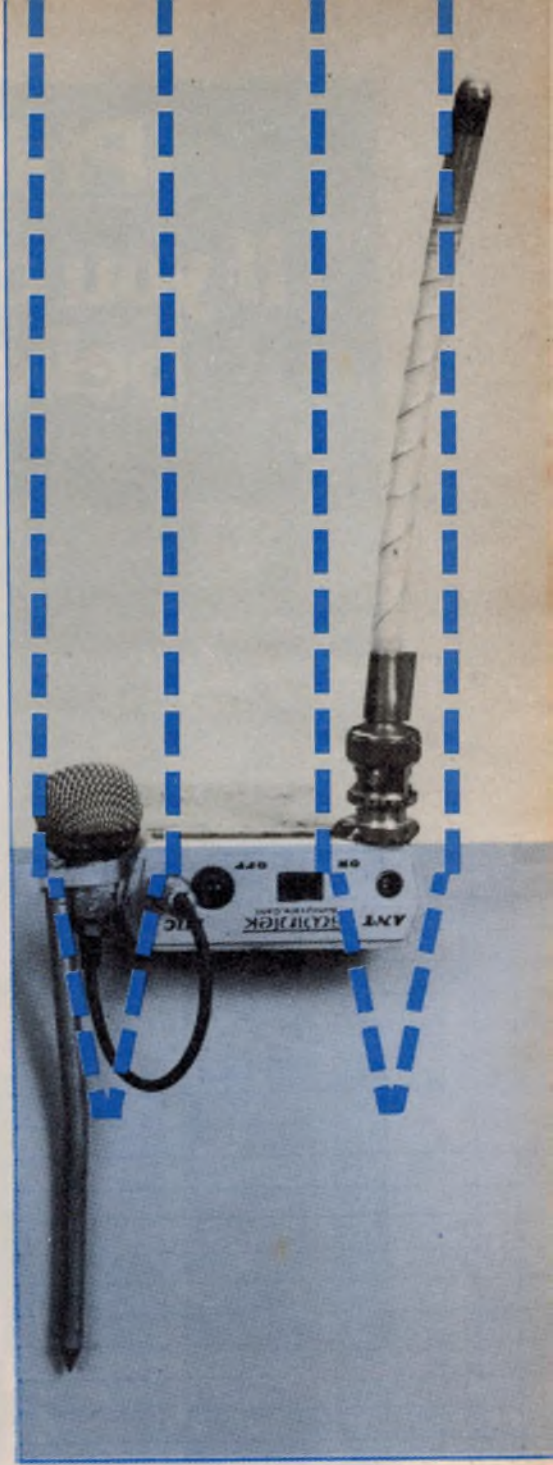
And how do the stumps, and the transmitters, take to being clean bowled? To answer this question Channel 9 technicians used a mechanical cricket ball pitcher capable of delivering a ball at up to 145km/h. Not only did they use it at full bore, but they shortened the range considerably to increase the force still further.

They continued pounding the stump in this manner until something failed. Something did fail eventually, but only after many more direct hits than any stump would be likely to receive in its lifetime. And strangely enough, the failure was in the alkaline cell, the transmitter and the stump itself showing no ill effects. So, for all practical purposes, the set-up appears to be virtually indestructible.

And what of the other channel whose entry into the field spawned the latest development? By arrangement, Channel 9 allows them to use the same signals. They provide their own receivers, do their own mixing, and generally operate quite independently.

So regardless of which channel you favour to cover the grand old game, take note of the sound next time you watch a match and remember that it is as good as it is only because of the ingenuity and imagination of a group of local technicians.

While it may not be a world shattering development, at least it shows that Australians are seldom stumped for a good idea!



Channel 9's original set-up. A miniature transmitter was buried behind the stumps, with only the antenna and the microphone visible.

Bat on ball — 50 years ago

Fifty years ago, in February 1934, the "Wireless Weekly" editorial was urging those concerned to do everything possible to provide a direct coverage of the coming test matches in England.

"When last the Australians toured England a B class station, by arranging a cabled description, over by over, . . . pieced together a description in the studio, by an announcer, to the accompaniment of synthetic sound effects, studio cheers etc.

"But during the coming tour (the public) will be justified in expecting the actual thing; a description from the ground of the match as it is being played. It will want to hear the actual sound of the English public's applause or barracking, the sound of the ball as it is cut to the boundary by Bradman, and perhaps, with fall of each wicket, a word from the batsman to Australia."

From phonographs to Compact Discs, Neville Williams has been involved with recorded music. He was involved with the development of tape recorders and helped organise the first public demonstration of stereo records in Australia. He retired recently after 43 years as Editor-in-Chief of 'Electronics Australia' and 'Videomag.'

Listening to Telarc's version of the 1812 conducted by Erich Kunzel and played on Philips Compact Disc Player has spurred Neville to take up his pen once again.

"One of the most contentious–and demanding–recordings ever produced is Telarc's version of Tchaikovsky's '1812 Overture', played by Erich Kunzel and the Cincinnati Symphony Orchestra.

Tchaikovsky dreamed of a spectacular open-air presentation, with a large orchestra and a brass band, supplemented by live cannon and the bells of Moscow's Cathedral of Christ the Redeemer. Telarc and Kunzel decided to simulate the sound with the aid of modern digital recording.

The basic musical performance was recorded in the century-old Cincinnati Music Hall, using the full resources of the Symphony Orchestra, plus a 12-piece brass band. That alone would have ensured a convincing finale but, to the Soundstream digital master tape, Telarc engineers added the sound of bells from a 100ft-high 4-man carillon in nearby Mariemont, plus 16 thunderous reports from authentic 19th century cannon.

When transcribed to a conventional vinyl LP disc, the resulting groove is so complex that phono cartridges can play it only with great difficulty, if at all. Many styli are dislodged completely by the cannon shots and skip to an adjacent groove.

Yet that same recording can be accommodated easily on the new Philips-created Compact Disc. And what an old-fashioned stylus can trace only with great difficulty, is replayed without the slightest stress by the laser beam in a Philips Compact Disc Player.

For sure, there's more to record enjoyment than the sound of 19th century cannon. But it's nice to know, when you choose to spend an evening with Vladimir Ashkenazy playing Mozart, or "A Night in Tunisia" with Art Blakey, you'll be listening to sound, not from an overworked stylus, but as produced by a tiny, weightless beam of light."

A remarkable recording played on a remarkable machine. This creation of Philips will revolutionise recorded music.

Already many hundreds of titles are available on Compact Disc. New ones are added every month.

Classical, jazz, rock–no matter what your taste, there is a wide repertoire of titles and artists to choose from.

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No wear, no scratches, no deterioration.

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Learmonth Solar Observatory

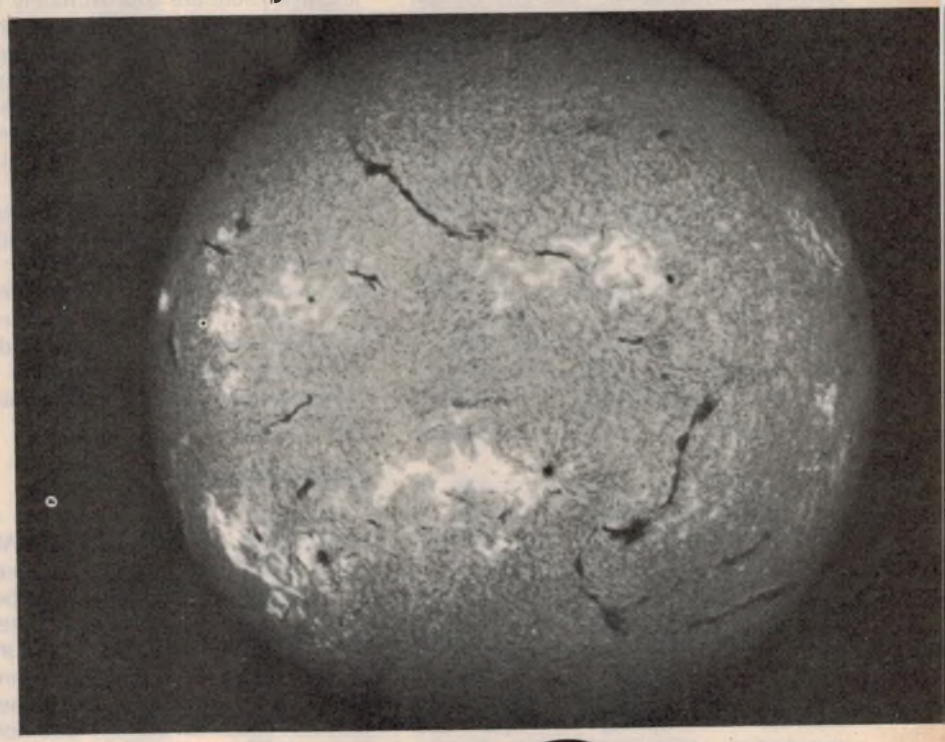
Australia

At right, a general view of the Learmonth Observatory and, below, the 8.5m parabolic antenna which monitors solar output on 245, 410, and 610MHz.

Joint US/Australian observatory monitors solar activity

by JOHN KENNEWELL

Ionospheric Prediction Service, Learmonth Solar Observatory.



Situated about half way down North West Cape, in the remote arid region of northwestern Australia the Learmonth Solar Observatory provides more data on solar activity than any other site in the global monitoring network

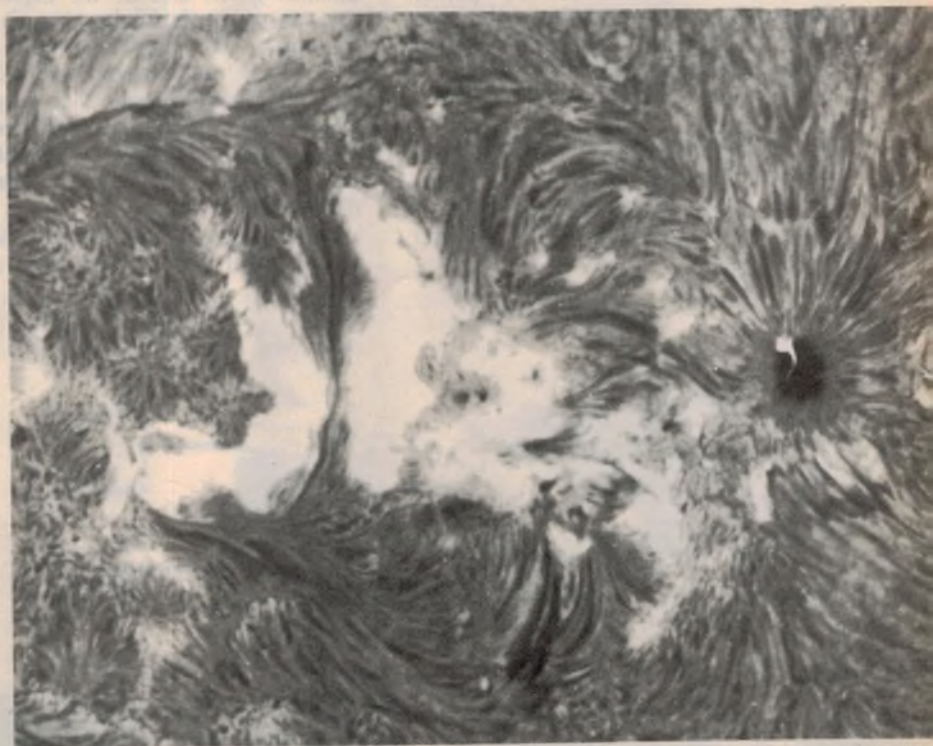
watches the Sun

In 1976 a group of astronomers, engineers, and managers toured the central and western reaches of the Australian continent. They were looking for a site to establish a solar observatory that would eventually form part of a global network to keep a continuous watch on the Sun.

This network, being established by the United States Air Force (USAF), required the placement of optical and radio telescopes at approximately equal intervals of longitude around the world. The site would need to have clear skies for most of the year, and would need to be free from radio-frequency interference. It would need to be logistically supportable. And the quality of the atmosphere was important to ensure good "seeing" for the optical instruments.

These factors were evaluated at several widely scattered sites and a final selection was made: the chosen site was Learmonth, Western Australia. A memorandum of agreement was signed between the Australian and the United States Governments in October 1977.

Located about half-way down the North West Cape, Learmonth boasts a



A full disc view of the Sun is shown at top while above is an enlarged view of the solar chromosphere. A large parallel-ribbon flare is in progress.

Australia watches the Sun

non-operational RAAF base and civilian airport, a prawning industry and, most-importantly, over 3500 hours of sunshine per year. The observatory was built upon a small rise 11 metres above sea-level and overlooks the aqua expanse of Exmouth Gulf in the east. To the west lie the low hills of Cape Range which provide an evening horizon of little more than one degree elevation.

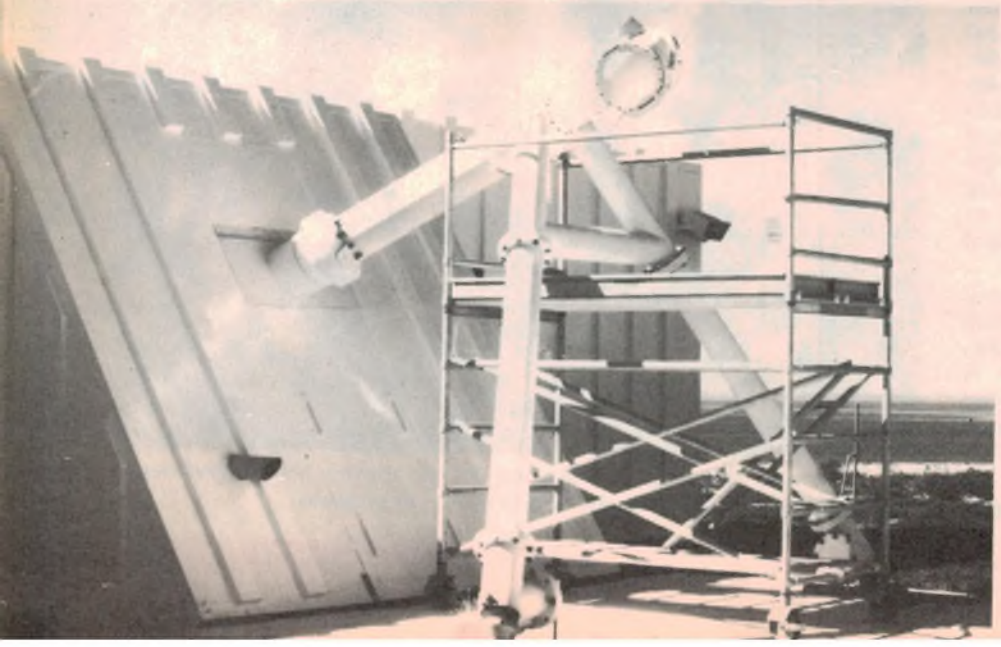
The surroundings are the sparsely vegetated arid red plains so typical of this region of Australia. Rainfall is irregular and averages less than 250mm per year. Winter temperatures are very pleasant although in summer the shaded thermometer can regularly exceed a searing 45°C.

The observatory actually consists of two separate operating facilities – a radio observatory and an optical observatory. Respectively, these form part of the USAF Radio Solar Telescope Network (RSTN) and the Solar Observing Optical Network (SOON). The radio observatory became operational, producing its first data in April 1979, whereas the optical site did not commence operations until August 1980.

The facility is jointly managed by the Australian Department of Science and Technology (DST) Ionospheric Prediction Service (IPS) and the United States Air Force Air Weather Service (AWS). Observatory staff are drawn from the USAF AWS and Communication Command, the US National Oceanic and Atmospheric Administration (NOAA) and IPS. There are approximately 15 staff in all, including six observer/analysts, four maintenance personnel, two AWS officers, one secretary, and two IPS physicists. Local companies and Australian government agencies also perform site and equipment maintenance.

Learmonth observatory is operational seven days a week from sunrise to sunset, and is a real-time patrol observatory. The Sun's output, in both the visible and the radio spectra, is continuously monitored and any significant changes are reported within minutes to forecast centres in Australia and the USA.

The optical telescope protrudes from the south wall and points to the south celestial pole. It scans the northern sky via an angled optical system at the end of the tube.



Solar Patrol

The Sun is a nuclear reactor which makes all life on Earth possible. Without its heat and light, no life would exist and no weather would gird the globe: our world would be a lifeless sphere. But, like all nuclear reactors, the Sun also emits dangerous radiations. Some of these even reach the surface of the Earth and can cause cancer in those not wise enough to adequately protect themselves.

Most of the radiation, however, is thankfully absorbed or deflected by the upper atmosphere and the Earth's magnetic field. But, as our technological abilities grow, and as we expand our activities through the frontiers of space, we must take increasing note of the activity of our nearest star. Satellite systems, manned space flights, ground-based communications, navigation, and geophysical exploration are all affected by phenomena that occur in the solar atmosphere.

The peak spectral output of the Sun lies in the visual and infrared parts of the

electromagnetic spectrum. The output extends, but with decreasing intensity, to very low frequencies (in the radio spectrum) and to very high frequencies [through the ultraviolet (UV), extreme ultraviolet (EUV), and to x-radiations]. The light and heat from the Sun primarily affect the Earth's lower atmosphere (the layers where our weather occurs). The UV, EUV, and x-rays, on the other hand, primarily affect the upper atmosphere. They have sufficient energy (per photon) to ionise the layers of air through which they pass.

The resultant regions of ionisation form what we refer to as the ionosphere, where the free electrons produced can act as a mirror to reflect radio waves. It is this reflection that makes possible long-distance high-frequency communications.

Solar radiation

The various radiations emitted by the Sun are generated at different levels in the solar atmosophere and by different physical processes. The extremely high temperatures and low pressures on the Sun mean that there is no well defined surface. Nothing solid can exist – everything is in the gaseous phase. The lowest region of the Sun that we can see is termed the photosphere. This is where the majority of heat and light energy is emitted. This is also the surface where cooler dark structures (sunspots) form and can be observed.

Two thousand kilometres above this level is the chromosphere where, with suitable selective filters, many interesting

The radio observatory is equipped with 1m, 2.4m and 8.5m parabolic dishes. These monitor eight discrete frequencies from 245 to 15400MHz.

SOLAR PARAMETERS

Solar Radius = 6.96×10^5km = 109 Earth radii
Solar Volume = about 1 million Earth's
Solar Mass = 1.99×10^{30}kg
Mean Density = 1410kg m^{-3} (Water is 1000kg m^{-3})
Surface Gravity = 274 ms^{-2} 27 times Earth gravity
Total Radiation (Luminosity) = 3.86×10^{26} W
Surface Temperature 6000 K (Kelvin or Absolute)
Core Temperature 15 million K
Surface (Photospheric) Pressure 0.01 (Earth) Atmosphere

and changing features can be seen. This is the level at which most significant solar activity is observed and where much of the UV and EUV radiation is generated. Above this is the Sun's outer atmosphere, the corona. This extends to the outer reaches of the solar system, merging indistinctly with the interplanetary medium, forming the solar wind, a continuous stream of atomic particles, which constantly flows outwards from the Sun. In many respects it may be said that the Earth bathes in the Sun's upper atmosphere. The corona is where most of the solar background x-radiation is generated.

Radio emissions are produced throughout the solar atmosphere, with different frequencies corresponding to different levels. High frequencies are generated at low altitudes in the chromosphere while low frequencies are generated some tens of thousands of kilometres out in the corona.

If the Sun were a constant star, always generating a fixed amount of energy, there would be virtually no need for a solar observatory. But it is not. It is a variable star, not so much in the visible and infrared spectra, but certainly in the radio and x-ray parts of the spectrum. The variation in output is sporadic but follows a long-term periodic trend which has an average duration of 11 years (the solar cycle). Over this interval, the number of sunspots visible on the photosphere waxes and wanes (the last maximum was in 1979/80).

In phase with sunspot number, the background radio flux around 3000MHz also rises and falls. Synchronous with this is a change in the EUV and x-ray output of the Sun, and thus we find that the state of the Earth's ionosphere shows a similar change. As the intensity of solar ionising radiations increase, the ionosphere becomes more ionised, more reflective and the range of frequencies available for shortwave broadcasting and communications increase. However, it is not these slowly varying solar energies that cause the disruptions to our radio communications systems.

Solar flares

Active regions are formed on the Sun when concentrated knots of magnetic flux rise from the interior. They first become manifest in the chromosphere as bright hot patches called plage. A little later they develop into sunspot groups visible on the photosphere. The sunspots appear darker because the magnetic field inhibits convection of heat from below. As the complexity in these regions grows, the tension within the magnetic field becomes enormous. Eventually a point is reached where the field lines "snap", re-configuring themselves into a lower energy state and in the process releasing large quantities of excess energy.

These solar explosions (or flares) are more powerful than any known energy release anywhere in the solar system. The total energy released in the largest observed solar flares is about equivalent to the detonation of one million million megatons of trinitrotoluene (TNT). This energy appears in the form of local heat, an intense brightening in the chromosphere, vastly increased radio emissions, and increased quantities and energy of x-radiation. In the low VHF spectrum the radio output of the Sun can increase around 100,000 fold.

As with any explosion, vast quantities of matter are also hurled about. In the form of electrons and protons, this material plasma may attain speeds exceeding the escape velocity of the Sun (620km/s). The plasma may then spiral out into space and reach the Earth within a matter of days or even hours. It is flares such as these that can seriously affect the activities of our technological society.

Such disturbances on the Sun can produce variations in the Earth's ionosphere, magnetosphere and atmospheric density. These can disrupt management of radio frequency communication, radar surveillance systems that either reflect off or pass through the ionosphere, satellite tracking and orbital predictions, and even some electronic equipment on high altitude satellites. Geophysical exploration that uses highly sensitive magnetometers can be totally disrupted by a geomagnetic storm of solar origin.

Such storms can also induce large currents in long power lines and pipelines. This may trip circuit breakers in electrical distribution systems and cause increased corrosion when eddy currents form around impurities. The same storms can also provide us with most magnificent auroral displays.

The most dangerous radiations from the Sun are the high-energy or hard x-rays and the fast protons. The flare x-rays produce a very absorptive layer at the base of the ionosphere and a large flare may render all HF communication useless for several hours. The effect, termed shortwave fadeout (SWF), occurs immediately. Sometime later, high energy protons may arrive at the Earth. These hit the Earth's magnetic field as a shock wave, causing it to wobble and inducing a magnetic storm. It is these protons that are most damaging to man and equipment in space. The x-rays can be stopped by a very moderate amount of shielding but the protons are

Australia watches the Sun

considerably more difficult to handle. A large series of proton producing flares in August 1972 would have resulted in some very sick astronauts had any been on the Moon's surface or anywhere else unprotected by the Earth's atmosphere during this time.

The above descriptions hopefully indicate how vital it is that we maintain a continuous surveillance of the activity at the heart of our solar system. This is only possible through a worldwide network of solar observatories and forecast centres. Satellite x-ray and proton detectors add vital information to the numerous ground stations. In Australia, solar patrol observatories at Culgoora and Fleurs (NSW) and Learmonth (WA) feed data to the IPS Regional Warning Centre (RWC) in Sydney. This centre is also involved in data exchanges between other Regional Warning Centres around the world. From Sydney, IPS issues bulletins on solar activity to around 150 different customers throughout Australia. A recorded information service is also available by dialling (02) 269 8614.

The Learmonth Observatory also sends information directly to both civilian and military forecast agencies in the USA. As well as real-time information, the Learmonth observatory archives vast amounts of data onto magnetic tape. This is eventually deposited in the World Data Center – A (a NOAA facility) in Boulder, Colorado. From here it is available to the worldwide scientific community.

The Sun's radio output is monitored over a large range of frequencies from 30MHz to 15,400MHz. Three separate parabolic reflectors are used to monitor eight discrete frequencies in this range (see Table I). The lowest frequencies, from 30 to 80MHz, are covered by a swept-frequency receiver or spectrograph. This is fed by two wide-band omnidirectional antennae termed semi-bicones. These are arranged in a typical radio-astronomical interfermometer configuration. Signals from one antenna "beat" against the signals from the other, producing peaks and nulls across the frequency range. These peaks and nulls drift with time as the Sun moves across the sky, and enable true solar signals to be readily distinguished from man-made interference.

The 8.5m dish uses a log-periodic feed antenna to cover from 245 to 610MHz. A synchronous motor drives it in track with the Sun from dawn to dusk.

Radiometers

The eight discrete frequencies are operated as radiometers to monitor the integrated radio power emitted over the whole disc of the Sun. The receivers are highly stable and employ dual-gain amplification and detection techniques to achieve a substantially linear output (directly proportional to the input power) over a large dynamic range (sometimes exceeding 60dB). Calibration of the receivers is performed twice daily using gaseous discharge or solid-state noise generator standards. The receiver outputs are digitally sampled once a second (the receivers have post-detection time-constants of one second).

The samples are passed to a Hewlett-Packard 1000 series computer where they are processed, converted to suitable units and displayed on video consoles in both graphic and numerical form. The computer also checks to see whether any frequency has exceeded predetermined threshold levels. If one or more frequencies exceed their tolerance, a burst is declared in progress, alarms sound, and the characteristics of the bursts are encoded into a short message to enable rapid dissemination to the appropriate forecast and warning centres. The computer will also check for telltale spectral signatures that may indicate whether or not a proton producing event is in progress.

Radio emission from the Sun is measured in Solar Flux Units (SFU) where 1 SFU is equal to 10^{-22} Watts per square meter per Hertz. Typical values for background solar output are 10 SFU at 245MHz rising to 500 SFU at 15,400MHz. These values change slowly over the solar cycle. Radio bursts may reach up to 500,000 SFU superimposed on the 245MHz background. It may take only seconds for the solar flux to rise to such a high value. The general criteria to indicate a significant solar radio event is a rise in flux by over 500 SFU on any one frequency. Another important indicator

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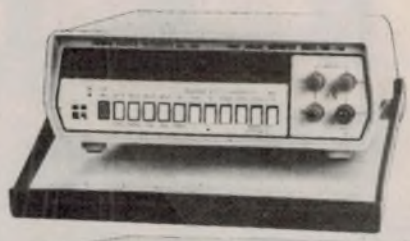

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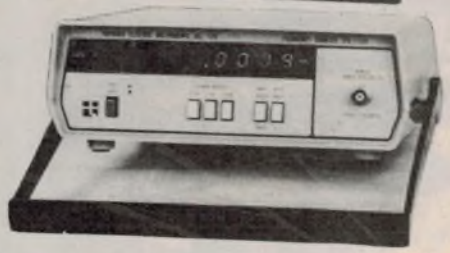

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Australia watches the Sun

Inside the radio observatory. Receiver racks surround the observer's desk which contains the computer consoles and communications equipment.

of a large x-ray event is when the flux on 2695MHz exceeds its background value by 100%.

As discussed previously, it is necessary to monitor a wide range of frequencies in order to detect events at different levels in the solar atmosphere. As a general rule, microwave frequencies tend to provide information on the generation of solar x-rays whereas the low VHF range provides information on the passage of streams of particles in and through the corona out into interplanetary space.

The optical observatory

The heart of the optical observatory is a refracting telescope with a 25cm objective lens. This is not housed in a conventional observatory dome-like structure. Instead, the telescope tube projects from the south wall of a well insulated building, painted brilliant white to minimise heat absorption. The tube, which points toward the south celestial pole rotates in right ascension to follow the Sun as it travels, during the course of a day, across the sky from east to west. Another motion at the top of the tube (this time in declination) allows the objective to follow the Sun as during the seasons it passes north and south of the equator. The tube itself is evacuated to a pressure of less than one thousandth of an atmosphere. This is done to avoid internal convection currents which would ruin the quality of the image. There is enough turbulence in the atmosphere external to the telescope without allowing any internal contribution to be produced from the large amount of solar energy focused by a 25cm lens.

When the focused light arrives inside the observatory building it is split into four paths. One path is used by a photoelectric guiding system to ensure that the telescope stays precisely locked onto the Sun. It is necessary that the computer be able to locate any point on the Sun to within one degree of solar latitude and longitude. This is only possible with very precise tracking. A second light path is used to project an 18cm diameter white-light (unfiltered) image of the Sun onto a drawing board for sunspot analysis.

A third, and in fact the primary light path passes through a lens interchange box which allows for selection of different image sizes (through different magnifications). It may be desirable to examine the whole disc of the Sun, or it may be necessary to look at one particular active region in detail.

Following the lens interchange is an optical filter with a very narrow bandwidth (the filter Q is around 12,000). This filter selects a particular frequency of hydrogen light (λ=656.3

TABLE 1

Antenna	Receivers	Frequencies
8.5m parabola	3 discrete frequency radiometers	245MHz 410MHz 610MHz
2.4m parabola	4 discrete frequency radiometers	1415MHz 2695MHz 4995MHz 8800MHz
1m parabola	1 discrete frequency radiometer	15,400MH
2 semi-bicones	Spectrograph (swept-frequency)	30-80MHz

nanometres) that is generated predominantly in the chromosphere. The output of this filter can be fed to an eyepiece, a 35mm camera, or, as is most usual, a TV camera.

The output from the TV camera is fed to a number of TV monitors and to a video image analyser. This analyser scans observer-selected regions of the solar disc, and produces digital histograms of chromospheric brightness versus area. The digital data are then analysed by computer (the same computer used by the radio observatory) to check for solar flares. If a flare is detected, alarms sound and, as for a radio event, flare characteristics are encoded into a message for rapid dissemination.

Flares, however, are not the only items of interest. The chromosphere shows many interesting topographical features that change rapidly and that give clues to solar-terrestrial interactions. Around every active region is bright material termed plage. If this fluctuates in intensity and/or displays bright points over a few hours, the probability of a flare is high. Huge black ribbon-like clouds of gas are suspended above the chromosphere – balanced by the opposing forces of gravity and magnetic levitation. If these structures, termed filaments or prominences, should become active, erupt, or disappear, a basic change in the magnetic field structure in that area is indicated. This change may eventually propogate through space to Earth and result in increased geomagnetic activity. These and other changes require constant surveillance.

The fourth and final light path feeds a spectrograph and magnetograph. Using both the well known Doppler principle and a lesser known Zeeman effect (the splitting of spectral lines in a magnetic field), this latter instrument can produce contour maps of the Sun's magnetic fields. As it is the magnetic fields that underlie all solar activity (or so we currently believe), these maps are invaluable in forecasting the probability of significant solar activity in the next few hours and sometimes days.

Conclusion

Forecasting solar activity and its terrestrial consequences is in many ways similar to forecasting the Earth's weather. Some phenomena (such as the occurrence of flares) can be forecast only on a probabilistic basis. Other events, such as geomagnetic activity resulting from a large proton flare, or a disappearing filament, can now be forecast with reasonable accuracy, and the extent of interference with the Earth's near-space environment can be estimated. As with weather forecasting, the prediction can, of course, be no better than the observations. Learmonth Solar Observatory plays a vital role in this area. The selection of the site on the northwest coast of Australia has ensured that Learmonth can supply an abundance of good quality data. Lack of clouds in the sky for many weeks at a time permit this observatory to disseminate more solar data than any other site in the global observatory network. Although only in existence for a short time, Learmonth Solar Observatory has already gained a leading position among real-time solar patrol observatories.

Additional reading

Those interested in learning more about our closest star should find the following books a good source of easily digestible information:

"Daytime Star" by Simon Mitton, published by Charles Scribners Sons (New York, 1981).

"The Sun, our Star" by Robert W. Noyes, Harvard University Press (Cambridge USA, and London, 1982).

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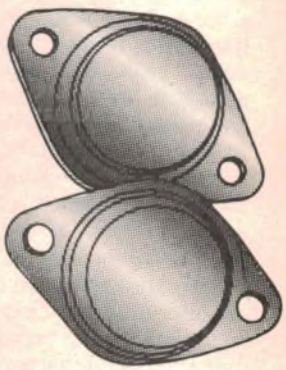

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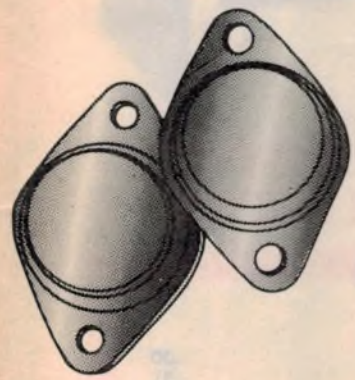

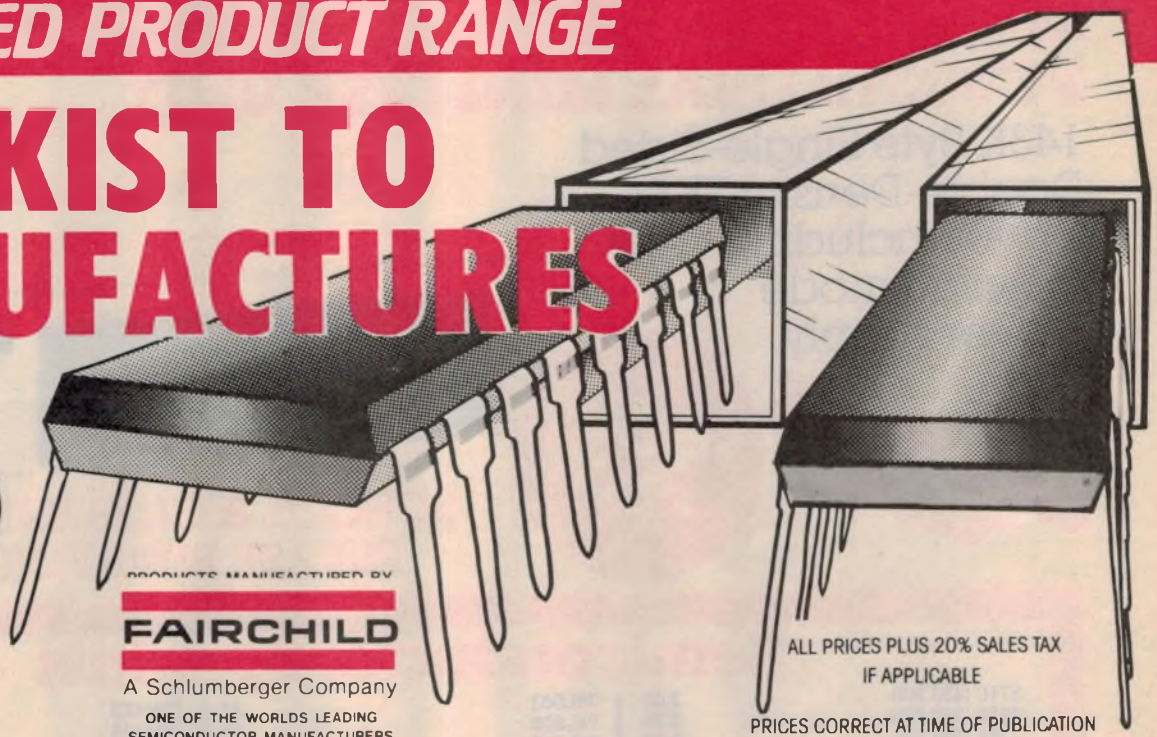

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UA7912KC	1.30	1.20	1.15
UA7912UC	.55	.49	.43
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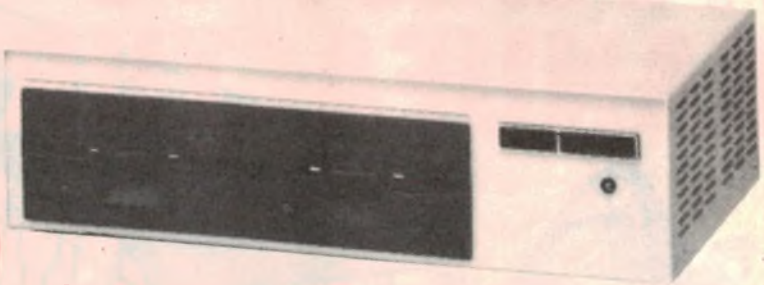

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Human ears, compact discs, dynamic

Like it or not, debate continues about whether our ears can appreciate what technology now provides per medium of the compact disc. What can we appreciate in terms of frequency response, or cope with by way of dynamic range? And are compact discs really any better than what we already have?

FORUM

Conducted by Neville Williams

First, I have a letter from R.H. of Willoughby, NSW, triggered by recent references to the progressive loss of high frequency acuity in aging ears. He observes, by way of preamble, that our curve suggests that his hearing may be down by 12dB at 10kHz – possibly a roundabout way of indicating that he is in the 45-year age group.

But if it be coyness, it is wasted. The second word in his submission surely labels him as a citizen of pre-decimal vintage:

Here's twopenneth for the "old ears" controversy, with several points and a cautionary tale:

(1) The biological end of the audio chain is not a fleshy microphone connected to a spectrum analyser made of grey matter. It could be better imagined as an information seeking, pattern recognising, parallel processor that can selectively use enormous integration times.

In this, we should not be bound by the Holy Writ of St Fourier, which can only describe the real-time availability of signals. In our present state of knowledge, it is not possible to eliminate any hypothetical capability on a priori grounds.

(2) Every human capacity that we have measured improves with active use and, to a great degree, will maintain "tone" with continued use. It would seem improbable that this is not true of the qualities that make up hearing.

(3) More seriously, I challenge the validity of curves usually presented to demonstrate the loss of frequency response with age.

At this point R.H. launches into his "cautionary tale" but, before preceeding, let me comment briefly on his numbered paragraphs.

Those "parallel processors"

The first one outdoes any artificial combination of buzzwords that I have thus far come across. It reminded me of my primary school days in the country when, every now and again, a teacher would do the rounds to check whether we had washed behind our aforesaid "information seeking, pattern recognising, parallel processors".

Mind you, in the case of two or three of the kids, distinguished by rather uncomplimentary nicknames, their "processors" were anything but parallel!

As a group, we had the reputation of being an inattentive lot, rather slow to accumulate in our "thick skulls" the rudiments of the three "Rs". From the teacher's viewpoint, I guess that it could fairly be said that our "processors" did indeed have the capability of "selectively using enormous integration times".

But, to be serious: While my observation about aging ears ("Forum", Oct '83) did come down on the side of measured results, it was only after having considered another point of view. It would indeed be comforting to think that ears could sense sonic information beyond what the graphs indicate, but mere wishful thinking falls well short of being a "hypothetical capability".

I found R.H.'s paragraph (2) unconvincing. My impression, as a layman in such matters, is that the erosion of our bodily functions and faculties with age is, for the most part, inescapable. Use and exercise may modify the process in various ways but cannot prevent it. One might well turn R.H.'s proposition back on himself: why should our hearing be the exception?

No less to the point, hearing is not a faculty that falls into disuse in the physical sense, nor is it in need of "exercise" on that account. Ordinary people are subject to ordinary sounds all day and every day and it is the acuity of ordinary, aurally healthy people that the published curves are supposed to show.

I would assume, however, that R.H. has in mind, not just the "physical" aspect of hearing but also the capacity of the "grey matter" to interpret the information so received. This would run broadly parallel to the ideas of B.F. in the October issue, and would depend heavily on whether the signals in question actually make it through the hearing mechanism – to be available for interpretation.

There wouldn't be much point in debating the high frequency qualities of a compact disc, recorded per medium of a carbon microphone!

But let's proceed to R.H.'s "cautionary tale" which, he feels, should "delight the hearts of all aging sceptics". He says:

Psychologists used to frighten people with graphs displaying average IQ against age. A bold line shows a relentless decline from age 16. This was said to "explain" why no scientist did anything truly creative after the age of 30 (in spite of numerous counter-examples) and it "proved" that 50-year-olds are morons. The inconvenient but evident competence of some of these aged imbeciles was widely believed (by earnest PhD's under 30) to be an expression of ingrained habit, combined with a certain cunning.

The notion was so widely believed that the boards of some corporations handed control of departments over to bright young things straight from Harvard and MIT. Stockholders were later to find the practice unamusing.

But we all know, don't we, that thousands of cerebral neurons die every day – never to be replaced. **Well, we don't know that at all.** *True, there is some shrinkage of brain volume with age; but there is not the slightest shred of evidence to show that this is caused by a loss of significant* **number** *of neurons.*

What of the graph? It is a plot, remember, of the **average** *IQ for each age. If we plot all the data, however, we get a band of points – a band whose boundaries rise in parallel fashion to the age of 16, then diverge. The lower boundary falls steeply to the age of 25, then pulls out for a slow decline all the way into old age. The upper boundary continues to rise to 25 or so, then runs* **without attenuation** *into the 50s, before beginning a gentle decline.*

The lower boundary represents those who leave school and immediately forget which is the business end of a pencil. The upper boundary represents people that seek out intellectual challenge (like us, of course) and busy themselves with obscure disputation!

The relevance of all this to the aging ears debate need not be spelled out. But

range and all that!

there is a further point: should we not be comparing like with like?

Presumably that "average" represents pristine specimens for their age, intermingled with those whose ears have been "rolled off" by vehicles, factories, infections, booze and all sorts of unhealthy habits that fall short of recognisable clinical damage.

In other words, may not age merely offer the opportunity for an accumulation of sub-clinical damage to hearing? Is there any evidence of spontaneous high frequency attenuation with increasing age?

It may just be that some of your correspondents can actually hear what they think they can hear.

Well, thank you R.H. for your interesting remarks and your valiant effort to alleviate the agony of aging audiophiles – in addition, of course, to polishing up your own IQ in the process: adding brightness to your brain; lustre to your lobes; incandescence to your intellect!

But, sadly for your line of reasoning, the curves in our October issue do reflect a deliberate attempt to isolate and present the very evidence you seek of "spontaneous high frequency attenuation with increasing age". This was not made clear in the October issue, although it was indicated in June, when the curves were first presented.

To spell it out, the information used to construct the curves was taken from the book "About Your Hearing" by G. A. Briggs (of Wharedale fame) and J. Moir. They, in turn, credited it to R. Hinchcliffe, of the Medical Research Council who (circa 1959) tested the aural acuity of 326 males and 319 females, all with clinically normal hearing. The results were published in the journal "Acustica", Vol 9 No. 4.

Reportedly, the subjects lived in a rural area of 136 square miles in Dumphriesshire, in south-west Scotland. The curves were based on "clinically normal female ears" which, even in that area, were generally better than male ears, presumably because men as a group tended to be more exposed to "civilisation" noises.

The differences between men and women were shown in a separate table and they are quite substantial. Briggs suggests that, had the tests been conducted in Bradford, where many women work in spinning and weaving sheds, the answer may have been quite different.

In short, the curves which we published in June and October did not, as R.H. supposes, represent some meaningless "average" between aural athletes and aural cripples. They represent a cross-section of women from the countryside of Scotland, free from obvious aural impairment and at risk mainly from the bagpipes!

While I would not necessarily regard that information, or our published curves, as the last word on the subject, present indications are that they do represent a mean of R.H.'s "upper boundary" group. They do not relate to his "lower boundary" group, whose "fleshy microphones" are filled with carbon granules, thanks to vehicles, factories, wars, infections, and booze!

Dynamic range, S/N ratio

To change the subject, I would like to add to remarks made recently on the subject of dynamic range.

I had cause to think about it again, while writing the review, elsewhere in this issue, of the two new compact disc players from Technics. Noticeable in their specifications is the fact that the figures for dynamic range and signal/noise ratio have been raised from the usual "more than 90dB" to "96dB or more". It is interesting that they have been able to achieve figures of that order but what do they mean in practice, particularly in view of my observations last month that a dynamic range of 50-60dB is about as much as we can cope with in a domestic situation?

Thinking about it, I couldn't help but feel that the audio fraternity have become the victim of its own crusading and that the time has come to sort out a few ideas.

Back in the days of 78rpm shellac discs, we used to complain about the audibility of the surface noise during quiet passages. Engineers would explain that they could not raise the level of the music as a whole, because the louder passages would then overload the system. Nor could they simply make the soft passages louder, because music buffs were complaining that the music was already too compressed.

Everybody agreed that greater dynamic range was essential but the same term held a different implication for the respective groups:

- A greater signal/noise ratio;
- A wider dynamic "window" to make recording levels less critical for the engineers;
- Recorded music with a greater difference in level between the loudest and the softest passages.

When vinyl microgroove pressings

appeared on the scene in the late '50s, they were characterised by much lower surface noise, which helped to provide the recording engineers with a wider dynamic window. But it didn't really make life much easier for them, because the music buffs expected recording companies to fill the window with music having a greater diversity of sound level.

Tape went through much the same process, with improved technology lowering the noise floor and increasing the head room, but with the program dynamics always more than ready to occupy the space between — a hifi version of Parkinson's, or somebody's law.

After 50 years of that kind of thinking, the audio industry had come to believe that dynamic range was a bit like money: it was hard tocome by in the first place; you could always make full use of what you had; you could always do with a bit more!

But those assumptions received a setback with the latest generation of vinyl discs. With the benefit of digital mastering and improved technology for cutting and pressing, they offered an all-round improvement in performance, including a further increase in dynamic range.

Reviewers welcomed the improved quality and the reduction in background noise but, for the first time, they baulked at the increased dynamic range of the program material itself. They complained that if the loud passages were set to an acceptable level in the home, the softer passages were barely audible. Or, if the volume control was set to suit the softer passages, other sections became impossibly loud. There were arguments, of course, but the alarm bells were ringing.

It is difficult to put figures to so diffuse a complaint but last month, in discussing Telarc's "1982 Overture", I suggested that, in terms of subjective loudness and the capabilities of domestic amplifiers in domestic settings, things started to get difficult when the difference in level between the "quiet bits" and the "noisy bits" exceeded about 50dB.

In the light of this observation, it was interesting to note some remarks by Peter Burkowitz of Polygram, quoted in a recent issue of "Audio" magazine. Burkowitz suggested that a live symphonic performance may involve a dynamic range of 70dB. A few may even reach 80dB, running from the "noise floor" of a good auditorium (about 30dB SPL) to the loudness tolerance of the audience (about 110dB SPL).

He went on to say, however, that 80dB would be excessive for a home situation, because of the higher noise floor and the practical limits on maximum volume. For attentive listening, he nominates the permissible maximum dynamic range as about 45 to 60dB. Average recordings, according to Burkowitz, have a dynamic range of between 40 and 50dB, making them a good match for the average living room.

An LP pressing, he says, can cope with a dynamic range of 60dB — a figure that I assume would require the program to be slotted accurately into the dynamic window. Specialist manufacturers like Nimbus in Britain and Telarc in the USA go well beyond 60dB.

It is this "60 and over" group of LP recordings which have sounded the warning about program dynamic range, based on subjective loudness, in audiophile homes worldwide. And that brings us back to our earlier question about the real significance of compact disc equipment with a dynamic range and signal/noise rating of "96dB or more".

First off, any such figure can no longer be taken as an indication of the perceived loudness range of the program material. From now on, this will not be determined by recording technology, but by what is appropriate musically, and by the preferences and practicalities of home listening — as discussed last month and set out above by Burkowitz.

More significantly, a wide dynamic range implies a high signal/noise ratio and this is one of the main qualities which should distinguish a digitally sourced compact disc recording. Irrespective of the structure of the recorded sound, be it loud, medium, soft or very soft — percussive or sustained — it should all emerge from a background of silence. Whether anyone could pick the difference between 90dB+ of "silence" and 96dB+ is something you can argue about on the side although, in principle, more is generally to be preferred to less!

But there is another sense in which the 30-odd dB margin in dynamic range between "black" and compact discs is valuable and that is in high amplitude transients, which may not in fact add much to the subjective loudness range of the program. What they do add is a tremendous "impact", "bite" or "presence" to instruments like the piano or acoustic guitar, or to sounds from the percussion section. They tend to be clipped or rounded-off by systems with limited dynamic range and limited "headroom" for peaks.

So what do those 90-96+dB ratings mean?

Well, they signify a system that is capable of bringing you music out of silence, and music complete with those high amplitude transients that will hopefully make it right through to your listening ears.

As we have said, they are no longer any measure of the loudness range of the program. In the longer term, that will be determined by buyer preference, expressed at the cash register. For the present, it will be as already on master recordings made over the past few years — and they should not be too wide of the mark.

S/N Measurement

Incidentally, while on the subject of terminology, there is an interesting distinction to be made between signal/noise figures commonly quoted for conventional and compact disc systems.

In the case of a conventional disc system, it is common practice to measure and quote the signal/noise ratio of the associated amplifier with a 1kHz, 5mV RMS signal applied to the phono input from a source having an effective impedance of 47kΩ. This is intended to simulate a magnetic cartridge tracking a 1kHz groove with a peak amplitude of 5cm/sec. A modern amplifier might typically yield a figure of 75dB, which is interpreted — very loosely — as the S/N ratio of the phono system.

By contrast, we have been talking about figures of 96dB or more for compact disc players, although this is in respect to 0dB or maximum output.

If we revert to the conventional phono system and refer the signal/noise figure to full output, we might decide that the new figure should be for a groove velocity of 50cm/sec — up by 20dB. That would yield a S/N figure of about 95dB, of the same order as for a CD system.

But, while the two figures may look the same at first glance, there is an enormous difference.

The first is the S/N ratio of the amplifier only and takes no account of the noise contribution from the medium; from the signal source through a recording process, the plating and the pressing, through to the vinyl, the playback cartridge, the motor rumble and any possible hum pickup. In that company, the S/N ratio of the amplifier does not mean a great deal.

On the other hand, the 96+dB for a CD player includes the disc and all the before-and-after signal processing as an integral part of the system. In the periods of silence, the system is still fully operational, with the coding telling the laser beam: "no signal . . . no signal . . . no signal . . ." No extra noise is added while the disc is actually being played.

Electronics Australia reviews

Technics SL-P7/8 compact disc players

Technics has just released two new compact disc players — the economy priced SL-P7 and the somewhat more elaborate SL-P8. We had the opportunity to react to them both in a home situation and later to check out their performance in our laboratory.

There is always some uncertainty about what to do next when two comparable pieces of equipment arrive simultaneously in the listening room. The natural inclination is to unpack them both and to end up with a profusion of packaging, equipment, cables, manuals – and impressions – which then have to be sorted into some kind of order.

In this case, we decided on a different strategy: namely to ignore the SL-P8 for the time being and to concentrate our attention on the SL-P7.

Our purpose was to form some judgment as to how effectively the economy model would merge into an existing hifi system; how well it would perform and whether it would be likely to meet the normal expectations of its new owner. Alternatively, whether he/she might later regret that they had not invested in a more elaborate model, while they were about it.

With that in mind, we unpacked the SL-P7, cleared a spot for it on the hifi shelves and proceeded to use it for everyday listening and reviewing.

As with other compact disc players, the SL-P7 arrives with the internal mechanism held firm by locking screws. It must be inverted and the screws released, as per the manual, before it can be used. It can be handled normally in this condition but the screws must be re-locked prior to any further transport.

Physically, the SL-P7 is relatively light and compact, measuring 315(W)x325(D)x88(H)mm and weighing 4.9 kg. As such, it would mate naturally with Technics' "jacket size" linear tracking phono turntables. No less to the point, its modest dimensions would be helpful in situations where hifi shelf space is at a premium.

It has a silver-grey body shell and burnished aluminium panel with black perspex front loading drawer and readout panel, allowing it to merge well with most present-day audio and video equipment.

Looking at the front panel, the push-on push-off power switch is at the top left corner. There is no separate indicator light but switching on brings up the greenish-white fluorescent readout and a green arrow in the Play button. This arrow goes out after a few seconds and will not respond further, if there is no disc in the drawer.

The front-loading disc drawer occupies the upper, left-hand portion of the panel and is controlled by an "Open/Close" pad near its lower right-hand corner. When the pad is pushed, the drawer slides smoothly open, allowing the disc to be dropped in, quite casually, label side up. Pushing the button again closes the drawer, spins the disc rapidly up to speed, and locates the laser head adjacent to the start of the recording, ready to commence play.

In this position, it also registers the number of tracks on the disc that has just been loaded and the total playing time. For example, loading Handel's "Water Music" (Delos D/CD 3010) causes the readout to change from:

0 0.00 to
18 54.12

indicating 18 tracks and a total playing time of 54 min 12 secs; all this, within 5 seconds of pressing the drawer "Close" button.

With a full 2-digit readout, the SL-P7 can read and display any number up to an unlikely 99 tracks.

To the right of the readout panel is a pad marked "Pause", intended primarily for that purpose. However, if held down for more than a couple of seconds, it moves the laser head to the end of the

The SL-P8 is the more elaborate of the two units, comes with infrared remote control.

Technics SL-P7/8 compact disc players

disc, to await any further instruction. After 20 seconds and with no instruction forthcoming, it switches the motor off, effectively doubling as a "Stop" pad.

In the top right-hand corner of the panel is the "Play" pad, which is normally used to initiate play when a disc has been loaded, or to cancel the Pause mode. However, the control logic is so arranged that if pressed during Play mode, it is interpreted as an instruction to recommence play immediately from the start of the disc.

Indeed, one of the surprising things about the SL-P7 is the deftness with which it can execute instructions and modify the disc speed to match the new play situation.

At the bottom right of the panel are two pads for Forward and Reverse "Skip". These can be used in Play, Pause or Stop modes, to skip tracks in either direction, singly, or continuously if the pad is held down. Irrespective of mode, when play resumes, it also always does so, out of complete silence, at the exact starting point of the selected track.

Less obvious than the other four, two narrow pads provide Forward and Reverse "Search" which can be used, during play, to skip rapidly and audibly across large sections of the disc or to nudge the laser head virtually a phrase at a time for purposes of synchronisation. The same levers can be used, in Pause mode, to locate specified index numbers encoded on the disc.

For those who may want continuous music on occasions, a "Repeat" function, just below the readout, allows the player to be set up to repeat a whole side or a selected track indefinitely, without causing record wear.

At the rear of the SL-P7 is the usual mains input and voltage selector, stereo line output sockets, and connections for synchronised operation with tape decks – a facility that may have little immediate use, except with Technics cassette decks fitted with complementary circuitry.

Also on the rear panel is a mysterious multi-pin socket branded "External" and explained as follows in the manual:

"This terminal is provided for system connections with future components. Do not connect any other components to this terminal".

Matsushita won't say any more but rumour has it that it is a provision for future connection to a video monitor, ready for the day when compact discs will be encoded with still pictures or other video style information, accompanying the sound. The possibility exists in the CD format but data presentation standards have not, as yet, been fixed.

In terms of electrical design, information to hand suggests that the SL-P7 has been simplified considerably, compared with the orginal but still popular Technics SL-P10, which sells in Japan for almost twice the price. The SL-P7 uses a more compact optical system and fewer dedicated ICs: 3 for the servo system (the SL-P10 uses 7); 3 LSIs for signal processing (4 in the SL-P10); and 2 CPUs for control functions (3 in the SL-P10).

However, in terms of audio signal quality, current production specifications of all three models are identical and marginally better than most other CD players. All three use full 16-bit linear D/A conversion (Technics are keen to stress this) in association with Technics' "Super Decoding Algorithm". The salient specifications are in the accompanying panel.

Specifications

Frequency response	4-20,000Hz ±0.5dB
Dynamic range	More than 96dB
S/N ratio	More than 96dB
Harmonic distortion	less than .003% (1kHz, 0dB)
Channel separation	More than 90dB
Wow & Flutter	Unmeasurable
Power consumption	30W
Output volts	2V (at 0dB)
Output impedance	330Ω

SL-P7 CD player is easy to use, retails for a very competitive $799.

Lab tests substantially confirmed the specifications for both the SL-P7 and SL-P8 models. The outstanding test result was that for signal-to-noise ratio which was just over the 100dB mark for both models, in both channels.

Harmonic distortion is quoted as .003% at 1kHz at 0dB and as the accompanying graph shows this was the case. However, as the frequency rises the distortion rises although it does not exceed 0.01% for frequencies below 18kHz. At 20kHz, the distortion is much higher at around 0.3% and the distortion residual appeared to be a 23kHz sine wave which we imagine is a product of the filtering circuitry.

Naturally also, as the signal level is reduced the distortion does tend to rise although it does not really start to become significant until the level drops to around 60dB.

Overall the electrical performance of the SL-P7 and P8 models must be regarded as amongst the best of CD players. Acoustically though, there is a different story. Depending on whether a disc is actually being played or not, the transport mechanism on both players emits more than its fair share of noises.

At times we noticed whistles from the mechanism at around 6kHz while at other times there would be rapid clicking noises. Depending on how close you are sitting to the player and what sort of music you may be listening to, these extraneous sounds can be quite distracting.

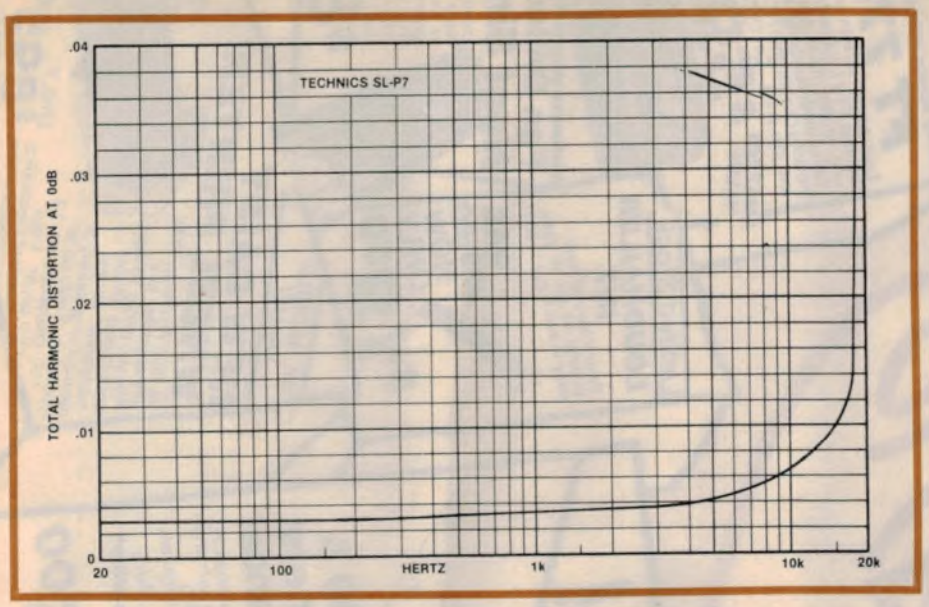
Having allowed for that objection, how did the SL-P7 perform and how did it appeal as an add-on component to an existing hifi system?

The short answer to both questions is: "very well indeed!"

In this reviewer's situation, the small size and modest weight were an advantage. In other situations, with a standard equipment rack and space to spare, the 430mm-wide SL-P8 would probably fit in more naturally. By way of comment, the raised plated lettering on the buttons is smart but its visibility does depend a lot on the way light happens to strike the panel.

More to the point, one didn't have to use the SL-P7 for long to realise afresh just how much more elegant the compact disc system is than any conceivable phono deck.

Switch on, press the Open/close button and the drawer slides smoothly out; drop the disc into the drawer, press the button again and it closes. Within five seconds the player is displaying the number of tracks and the total playing time, and awaiting instructions. In the simplest case, you press the "Play" pad and settle back in your chair. Some time



This graph plots total harmonic distortion against frequency (SL-P7).

later, the music stops, the Play indicator goes out and the unit waits patiently for you to decide whether to recover the disc or to play it again.

Skipping tracks in either direction or selecting tracks is a cinch, again without the slightest fuss or noise, without any hazard to the system and without missing a note. The player can fade and cue more consistently and more accurately than any disc jockey that ever lived!

One could continue in this vein but only to reinforce the obvious: the basic elegance of the compact disc system, as epitomized here by the SL-P7.

One query was raised in the course of our reviewing activities with the SL-P7, having to do with Handel's "Water Music", mentioned earlier. The accompanying notes refer to stanzas of interest, not by index number, which the SL-P7 could have handled, but by cumulative elapsed playing time. The SL-P7 displays total playing time at the start of the record, and times individual movements or tracks unerringly up to 99, but it does not record a progress total. In fact, we wonder how many CD players do, thereby casting some doubt on the particular method of notation.

This point aside, we formed the firm opinion that in terms of performance and its behaviour in a hifi situation, the SL-P7 would delight even a confirmed hifi enthusiast. You put it in position, plug it into the mains, connect its output lead to the "Aux" terminals of the amplifier and use it. Simple.

Why should any purchaser regret that he/she had not invested at the outset into something more elaborate? The SL-P8 for example?

In the first instance, we had to work out the answer to that question the hard way, because the player we had for review was an advance sample accompanied only by a Japanese instruction manual, with no more than the odd word in English. Fortunately, the panel was marked in English and, having already had experience with the SL-P7, we were able to find our way around it without too much trouble.

As mentioned earlier, the performance specifications of the two players are identical and the extra money does not buy wider frequency response, lower distortion, better signal/noise ratio, etc. What you get is more elaborate facilities and cosmetics which, while not improving the performance of the unit, do add considerably to its appeal.

The SL-P8 measures 430 x 325 x 88mm (W x D x H) and weighs 6.1kg. As such, it should slide straight into an existing 43cm equipment rack and become another unit in the system. Undo the three locking screws, plug it into the mains, run a stereo pair to the amplifier "Aux" input, and it is ready to go. The colour scheme, by the way, is the usual silver-grey body shell, with matte aluminium panel and black perspex disc drawer and readout window.

The Power switch, Open/Close switch, disc drawer, and the nest of control pads on the right-hand side are identical with those on the SL-P7: Pause/Stop; Play; Reverse Skip; Forward Skip; Reverse and Forward Search. At switch-on, the readout displays the number of tracks (up to 99) and the total playing time for the disc. Alternatively, it can be switched to register Index numbers, where these are encoded in the track.

From this point on, things change and we are looking at the "extras".

Headphone facilities are provided in the form of a headphone socket and volume control. With suitable stereo phones, the SL-P8 can therefore be used for serious listening without the need for an external amplifier.

Music scan: press this button after the disc has been loaded and the unit steps automatically from track to track, playing a few bars at the start of each one. When a wanted track is recognised, pressing the Play button will initiate normal play.

Delay, timer: In the Off position of this 3-position slider, the player behaves normally. In the Auto Delay position, it pauses between each number in a programmed selection of tracks and awaits a Play instruction before proceeding. The Timer position presumably provides for use with an external interval timer.

Programming facilities: The SL-P8 has 10 numeral buttons (0-9), a "Clear" button and a "Memory" button, similar to those on a calculator, with which the user can select any number of the available tracks for play in any order. The same track can be inserted more than once into a program, if desired.

Bargraph display: Over and above the numerical readout, as in the SL-P7, the SL-P8 has a bargraph which indicates the number of tracks available (up to 20), the tracks selected for programmed play, the track in play (flashing) and those remaining to be played.

Pitch control, a novel facility which enables the playback speed to be marginally increased or decreased. It is normally left in the zero position or switched out of circuit.

Time remaining: During the course of normal (not programmed) play, pressing a "Time" button changes the readout from track time to time remaining for the yet-to-be-played section of the recording.

Remote control: With the exception of Power On-Off, drawer Open/Close and headphone volume, the infrared controller provides virtually all the other functions on the manual control panel. It provides the user with complete control of the track selection and play from the listening position.

All told, those additional facilities must add up to quite a temptation to outlay the extra dollars necessary to purchase the SL-P8. In fact, if the reaction of hifi buyers is similar to that of video enthusiasts, demand for the upmarket model will probably be very strong.

At the time of writing, the recommended retail price for the SL-P7 is $799, with the SL-P8 $200 dearer at $999. Both would appear to signal some spirited competition between CD players during the coming months. (W.N.W.)

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Motorcycle Intercom

lets you talk to your passenger

Motorcycling is fun but conversation between rider and passenger is usually just not possible. Build this intercom and you can converse with your passenger at any time while you are on the move. There are no push-to-talk buttons and the circuit is easy to build.

Our motorcycle intercom in use. Note the cables from each helmet

Motorcycling is a unique form of transport and provides an experience that no other form can equal. Apart from the feeling of oneness the rider has with the machine, there comes the exhilaration of just riding. Whether it be travelling to and from work or a fast ride through a winding mountain road, the rider often shares this enjoyment with a pillion passenger. How much more enjoyable if easy communication between passenger and rider is available.

by JOHN CLARKE & LEO SIMPSON

We have had quite a few requests from readers for a motorcycle intercom and we have finally come up with a system which works well and is simple to use. The intercom employs a detachable cable to each rider's helmet which plugs into a small box which houses the electronic circuitry. Power is obtained from the motorcycle battery.

Each rider's helmet is fitted with a microphone and an earpiece and these are terminated in a short cable fitted with a 3.5mm stereo line socket.

Both rider and passenger can speak at the same time because the system is two-way (or duplex) with two separate channels. Each channel has its own volume control which can be adjusted to suit each user. Separate channels eliminate the need for press-to-talk switches or vox (voice-operated switch) circuitry.

Apart from having two separate channels, the intercom circuitry is designed for use in the very noisy environment of a motorcycle. The system has to cope with the acoustic noise from the engine and the electrical noise from the ignition system. Sorting these problems out is not easy. The power supply from the battery has to be well filtered to cope with electrical noise and the frequency response of the system is restricted to cope with extraneous acoustic noise.

The circuit

Only one channel of the intercom, plus the power supply, is shown on the circuit diagram. The system employs one quad operational amplifier IC for handling the low level signals while the two earpieces (one for each rider) are driven by discrete audio amplifier stages.

The signal chain for each channel can be described as follows: An electret microphone (in each helmet) is fed to a bandpass filter and preamplifier employing two op amps. From there the signal passes through a volume control potentiometer and thence to an audio amplifier and earpiece.

Let's look at the circuit in more detail. The electret microphone is fed with DC via a series 4.7kΩ resistor which provides the AC load for the FET stage in the microphone capsule itself. The DC is decoupled from the main 9V supply with a 1kΩ resistor and 47μF capacitor to reduce the possibility of instability.

The low level signal from the electret is fed to IC1a which is a high pass filter

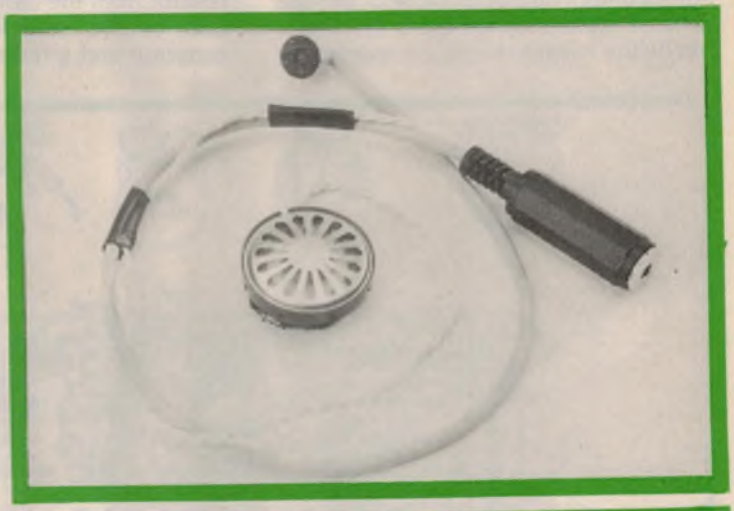
rolling off frequencies below 500Hz. The rolloff slope is 12dB/octave and the gain of the stage is set at 10.

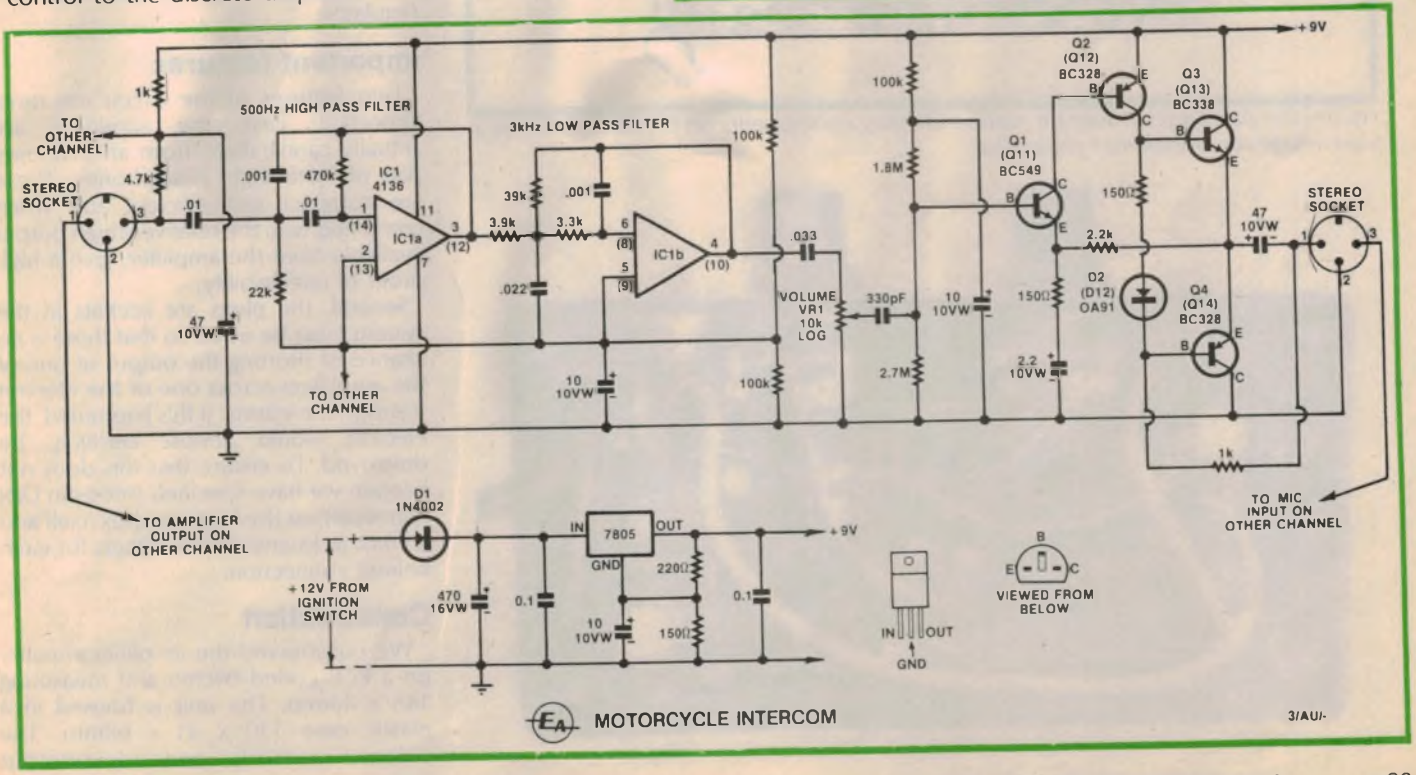
From the high pass filter the signal is fed to IC1b which is a low pass filter which rolls off signals above 3kHz at 12dB/octave. Gain is also 10 giving an overall amplification of 100. So the resultant bandwidth of the system, as far as IC1a and 1b are concerned, is from 500Hz to 3kHz.

Low frequency filtering

Further attenuation of low signal frequencies is provided by the choice of capacitors fromthe output of IC1b to the volume control and from the volume control to the discrete amplifier. These

Above is the completed unit while at right is the speaker and microphone assembly for one helmet. The speaker and microphone are attached to the helmet using Velcro strips.





Motorcycle Intercom

two capacitors have been selected to give further rolloff below 500Hz with the result that the ultimate attenuation rate for frequencies below 500Hz is 24dB/octave (or 80dB/decade).

All four op amps in the circuit are biased to mid-supply voltage (4.5V) by a common voltage divider comprising two 100kΩ resistors bypassed with a 10μF capacitor.

The audio amplifier

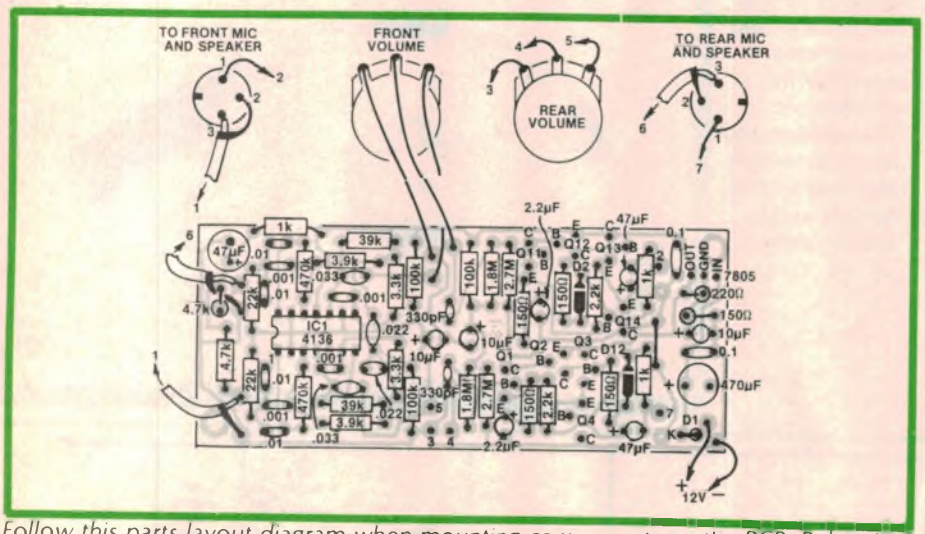
Four transistors are used in the audio amplifier which is a complementary symmetry configuration.

The amplifier is direct-coupled and its DC conditions are set by Q1. Thus the output stage is set to mid-supply voltage for maximum output by virtue of the bias voltage applied to the base of Q1. This is set by the voltage divider comprising the 1.8MΩ and 2.7MΩ resistors. Decoupling for the bias network is provided by a 100kΩ resistor and 10μF capacitor.

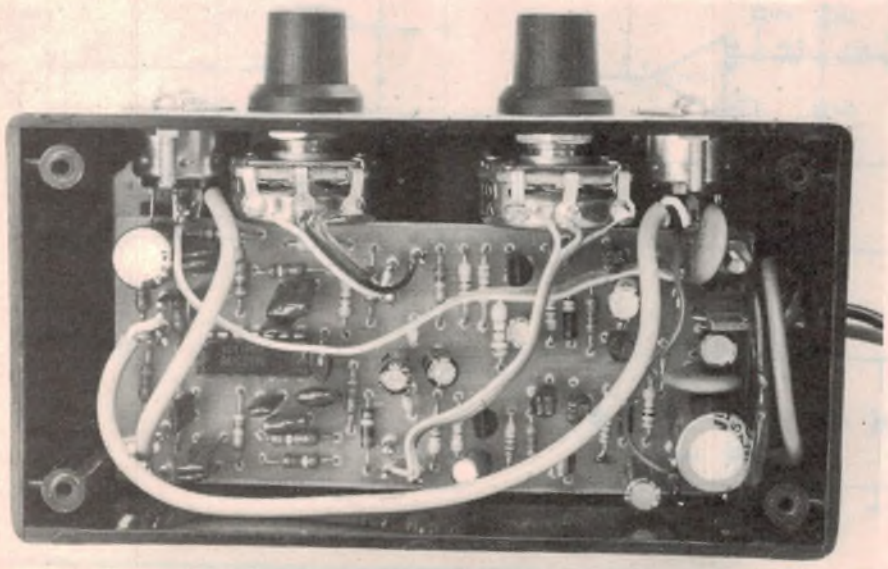
The collector of Q1 is coupled directly to the base of Q2 which drives both output transistors, Q3 and Q4. Crossover distortion in the output stage is minimised by a small forward bias applied by the diode and series 15Ω resistor.

The amplifier output is AC-coupled via a 47μF capacitor which incidentally provides another 6dB/octave rolloff for frequencies below 500Hz. No chance of a low frequency raspberry getting through this system!

Bootstrapping of the output stage drive is provided by connecting the 1kΩ bias resistor from the base of Q4 to the load side of the capacitor. This saves a capacitor and a resistor and also means that the amplifier will draw negligible current (it won't work either) unless a loudspeaker load is connected.



Follow this parts layout diagram when mounting components on the PCB. Below is a view inside the completed prototype.



We estimate the current cost of parts for this project to be

$40

This includes sales tax.

Power supply

Since the motorcycle battery voltage fluctuates widely and is very noisy it needs to be well filtered and regulated. This is achieved with a three-terminal regulator and associated components. An isolating doide, D1, prevents supply reversal and, in conjunction with a 470μF capacitor, provides initial filtering of the 12V supply.

The regulator circuit is a conventional arrangement using a 5V three-terminal regulator to provide a 9V supply. This is done by connecting the GND terminal of the regulator to a voltage multiplier network consisting of 220Ω and 150Ω resistors.

This works as follows: The normal output of the regulator is 5V and this is applied to the 220Ω resistor. Thus the current through this resistor is 23 milliamps or thereabouts. Both this current and a 6mA current from the GND terminal flow through the 150Ω resistor which "jacks up" the GND terminal by about 4V. Thus the output voltage is set to around 9V.

The 0.1μF capacitors in the power supply circuit improve filtering and improve transient response of the regulator.

Important features

Two features of the circuit are most important. First, the earpieces are actually cannibalised from an economy pair of lightweight headphones. These are compact and efficient and when combined with the relatively high output available from the amplifier, give a high order of intelligibility.

Second, the plugs are sockets in the system must be wired so that there is no chance of shorting the output of one of the amplifiers across one of the electret microphone inserts. If this happened, the electret would almost certainly be destroyed. To ensure that this does not happen we have specified three-pin DIN connectors at the intercom box itself and 3.5mm jacks and in-line sockets for each helmet connection.

Construction

We constructed the amplifier circuitry on a PCB coded 84cm5 and measuring 146 x 44mm. The unit is housed in a plastic case 130 x 41 x 68mm. The volume controls and input/output

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sockets are mounted on one side of the case together with a Scotchcal label measuring 40 x 125mm.

Start construction by fitting all the low profile components to the PCB first. This includes the resistors, diodes and IC. Next the transistors and capacitors can be inserted. note that the voltage setting resistors for the regulator stand end-on. Take care with the orientation of polarised components such as the electrolytic capacitors, diodes, transistors and IC. We used PC stakes to terminate the external wiring.

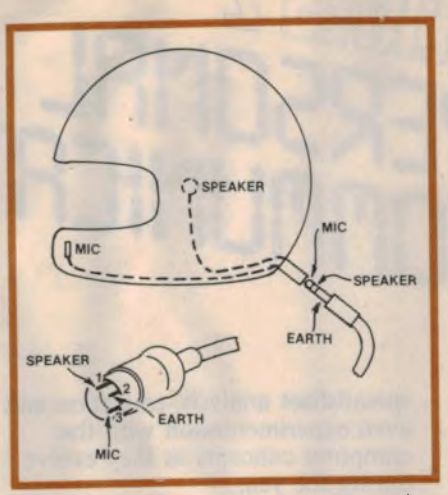
Before the PCB can be mounted inside the case, the case itself must be drilled to accept the two potentiometers and two three-pin DIN sockets. Holes for these can be drilled after the Scotchcal label has been affixed. The two holes for the PCB mounting screws should also be drilled at this time.

Mount the hardware before installing the PCB, as it cannot be done in reverse order. Don't forget to cut the potentiometer shafts to a suitable length to suit the knobs.

With the sockets installed, solder a short length of shielded cable to each one. The shield of each cable should go to pin 2 of each socket while the central conductor of each cable goes to pin 3 of each socket.

A short length of hookup wire can now be soldered to the remaining pin 1 of each socket.

With this preliminary wiring complete, the PCB can be shoehorned into the case. It is supported on two 9mm tubular spacers and secured with screws and nuts. Note that all screws should be fitted with shakeproof washers and painting the screws threads with Loctite would be a good idea too.



This diagram shows how the speaker, microphone and connector are wired.

With the PBC in place the rest of the internal wiring of the intercom can be completed.

Installation

The intercom case can be mounted at any convenient location on the bike where it will be easily accessible. It could, for example, be mounted underneath the seat or in one of the pannier bags. Two connections are made to the bike; one to the chassis and one to the 12V supply via the ignition switch. In this way, the intercom will be turned on whenever the ignition is on.

Two cables are needed to connect the DIN sockets to be stereo line sockets on each helmet. These comprise about 1.5 metres of twin shielded cable terminated at one end by a 3.2mm stereo jack and by a three-pin DIN line plug at the other end. It is important when wiring these to connect the microphone terminal of the DIN plug, pin 3, to the tip end of the stereo jack. This removes the possibility of momentarily connecting the amplifier output to the microphone when the jack is inserted into the stereo socket on the helmet.

The helmet wiring diagram shows this wiring convention.

PARTS LIST

1 PCB, code 84mc5, 146 x 44mm
1 plastic utility case, 130 x 41 x 68mm
2 electret microphone inserts
1 low cost miniature headphone set (DSE Cat. G4106)
1 Scotchcal label, 125 x 40mm
2 10kΩ (log) potentiometers
2 knobs
2 3-pin DIN sockets and plugs
2 3.2mm stereo line plugs
2 3.2mm stereo line sockets
3 metres of single or twin shielded cable
2 9mm standoffs

SEMICONDUCTORS
4 BC328 PNP transistors
2 BC338 NPN transistors
2 BC549 NPN transistors
1 1N4002 silicon diode
2 OA91 germanium diode
1 7805 5V regulator
1 4136 quad op amp

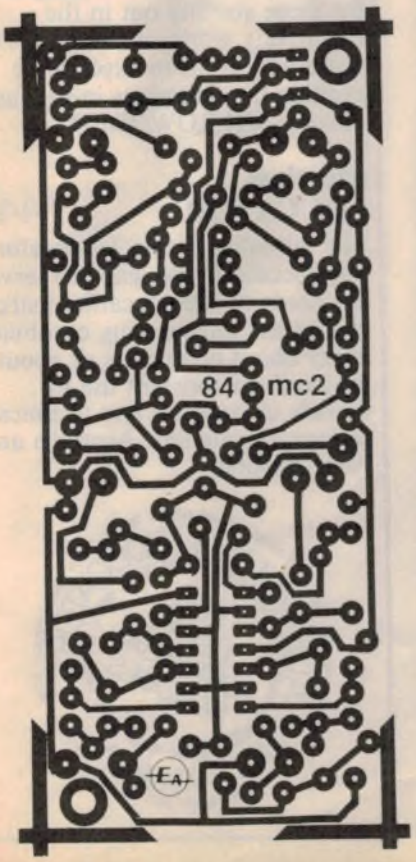
CAPACITORS
1 470µF/16VW PC electrolytic
3 47µF/10VW PC electrolytic
3 10µF/10VW PC electrolytic
2 2.2µF/10VW PC electrolytic
2 0.1µF disc ceramic
2 .033µF metallised polyester
2 .022µF metallised polyester
4 .01µF metallised polyester
4 .001µF metallised polyester
2 330pF ceramic

RESISTORS (¼W 5%)
2 x 2.7MΩ, 2 x 1.8MΩ, 2 x 470kΩ, 3 x 100kΩ, 2 x 39kΩ, 2 x 22kΩ, 2 x 4.7kΩ, 2 x 3.9kΩ, 2 x 3.3kΩ, 2 x 2.2kΩ, 3 x 1kΩ, 1 x 220Ω, 5 x 150Ω.

MISCELLANEOUS
Hookup wire, shielded hookup wire, PC stakes, machine screws and nuts, Velcro material, solder etc.

The earpieces were taken from a low cost miniature headphone set. We used the Dick Smith Cat C-4106 headphones which contain earpieces small enough to fit within the helmet where the securing straps tie to the helmet shell.

(Continued on p. 142)



At left is the full-size PCB pattern while below is the front panel artwork.

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MEMORY: 64K comprising of 8K ROM, 4k graphics and screen memory.

DISPLAY: Direct video to external monitor or modified TV. 80 by 24 and 64 by 16 character display modes, high resolution PCG graphics to 512 by 256 pixels. Upper and lower case with full programmability at any screen location.

SOFTWARE: CP/M 2.2, MICROSOFT BASIC-80, WORDSTAR 3.0, MULTIPLAN V1.05, MICROWORLD BASIC V6.0, WORDBEE, EDASM, CP/M UTILITIES, COMMUNICATIONS PACKAGE, MICROWORLD SUPPORT LIBRARY.

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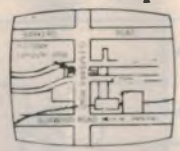

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Phone Minder
– versatile bell extender and pager

by COLIN DAWSON

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or can perform either function separately. It should be of particular value to those who suffer hearing problems.

Many people suffer from partial deafness which prevents them from hearing the telephone ringing unless they happen to be very close to it. These people are usually quite able to maintain a normal conversation once they do answer the phone – it's just that, for various reasons, they are often unable to hear the bell, especially if the telephone is in another room.

The solution to this problem is a bell repeater – an alert device that detects a ringing telephone and generates a different frequency to the bell. This frequency can then be amplified and used to drive a loudspeaker. Our Phone Minder is capable of driving a loudspeaker to quite a high volume and includes provision to adjust the new "bell" frequency to accommodate individual hearing problems.

The big advantage of this scheme is that it allows the loudspeaker to be located remotely from the phone, say in another room or in the garage. Indeed, Phone Minder is intended for just such a role. It's easy to install and, most importantly, requires no direct connections to the telephone itself.

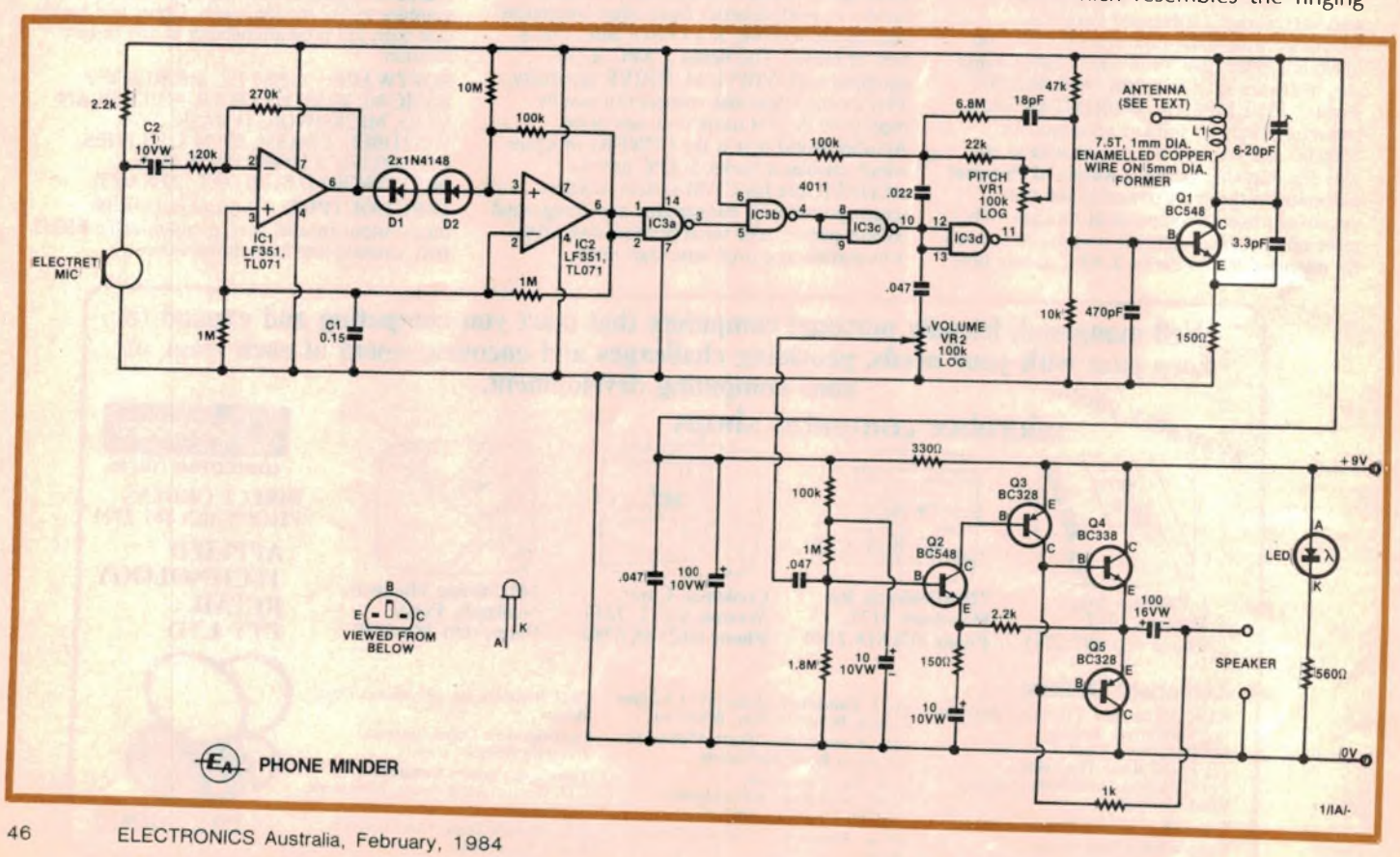
But what if you're out in the back yard? A simple bell extender is really restricted to use indoors, unless you fit very long speaker leads or add a high power amplifier. Clearly, effective coverage outside the house would be impractical in many situations, the more so when one considers the neighbours.

Perhaps the ideal solution would be for every household to be equipped with a pocket pager, but most of us can't justify the expense. Instead, we decided to add a low power FM transmitter to the circuit – one that can be used in conjunction with any domestic FM receiver. This provides sufficient range to cover most back yards and, if you already have a portable FM radio, will cost you a lot less than a commercial paging device.

So the circuit which evolved for this project is both an amplifier and a transmitter. It will prove handy for anyone with a telephone, but particularly so for those with hearing difficulties.

Design features

In use, the Phone Minder sits next to the telephone. An electret microphone is taped directly to the back of the telephone where it can pick up the sound of the bell, and this enables the circuit to detect the "ringing" tone. The circuit then responds to the sound of the bell by emitting a 400ms tone burst, the format of which resembles the ringing



Phone Minder sits next to the telephone and uses a microphone to monitor the bell.

format of the bell itself.

To explain further, the ring circuit of an ordinary telephone generates a repeating pattern of two short rings followed by a pause. The tone bursts produced by the Phone Minder duplicate this pattern. By adjusting the front-panel pitch control, the user can adjust the tone burst frequency to suit his requirements.

The amplifier incorporated into this circuit is capable of delivering about one watt into an 8Ω speaker which results in quite a high sound level, particularly where a reasonably efficient speaker is used. As most situations will not call for maximum power from the amplifier, a volume control is also included on the front panel.

The transmitter normally only transmits a carrier frequency, which means that an FM receiver tuned to the correct frequency will have no output – ie, it will be mute (apart from a small amount of hum). Whenever the phone rings, the same modulated tone that is fed to the amplifier is also fed to the transmitter. Anyone listening to the tuned receiver will thus hear the ring tone.

Even though the current drain of the circuit is quite low – around 9mA plus the LED current in the quiescent state – batteries are not really a practical power source. They would have to be replaced nearly every day, or several times a week if we dispensed with the LED. Given this limitation, a plugpack power supply is far more viable.

We found that, with the plugpack power supply, the project must be housed in a metal case, otherwise an unacceptable level of hum will modulate the transmitter. If the transmitter part of the circuit is not used, the project could probably be built into a cheaper plastic box.

Superficially, the amplifier section of this circuit would appear quite simple to implement – just an oscillator gated on by the sound of the telephone bell. However, this basic format suffers a major limitation. The loudspeaker must be located a long way from the telephone, otherwise a feedback loop will develop with the microphone picking up the sound of the loudspeaker and thereby triggering the tone generator into further operation.

There are two alternatives available to solve this problem: the microphone preamplifier circuit could be made

Phone Minder

selective so that it can detect only the telephone bell, or the tone generator can be made to operate for a predetermined period during which time the microphone preamplifier is disabled. The first of these approaches is the most difficult, as the tone generator would have to operate at a different frequency to the bell. Given that a telephone bell generates a range of frequencies, the tone generator would only be able to operate over a very restricted frequency range.

Obviously, the project loses much of its appeal if the tone generator is restricted in frequency. The whole point of its existence is to provide a tone which can be adjusted over a wide range. For this reason, we have chosen the second option of disabling the microphone for brief periods.

We have also designed the tone generator so that it is modulated at about 20Hz, which gives it that unmistakable "telephone sound", irrespective of the tone frequency.

The transmitter is very low power only, enough to give a reliable range of about 50 metres from a typical suburban dwelling. Buildings incorporating large metal structures will severely reduce the range. A trimmer capacitor is provided so that the carrier frequency can be adjusted to avoid existing broadcasting stations.

How it works

The circuit can be broken down into four distinct sections: a microphone preamplifier, detector and mute circuit; a tone generator; an FM transmitter; and a power amplifier. This simplifies the circuit description, as we can consider each section separately.

Cudlipp reborn

Actually the circuit is based on "Cudlipp", an electronic cricket which was featured in our February, 1982 issue. This just goes to show how a frivolous circuit can have a useful application.

The microphone preamplifier circuit is quite unusual, having three modes of operation which could be termed "listen", "oscillate" and "mute". Let's consider the listen mode first.

Normally, the output of IC2 (pin 6) is latched high which means that it is close to the supply voltage. This is fed back via a 1MΩ resistor to the non-inverting input (pin 3) of IC1. This pin is also connected to ground by another 1MΩ resistor so that the two resistors form a voltage divider and hold pin 3 of IC1 at half supply.

IC1 functions as an inverting amplifier with a gain of about two. Note that its inverting input is connected to its pin 6 output via a 270kΩ resistor. This feedback arrangement ensures that, in the absence of an input signal, pin 2 will be held to the same level as pin 3 – ie, pins 2, 3 and 6 will all be at half-supply.

Refer now to IC2. Its inverting input is held at half-supply by the same divider biasing pin 3 of IC1, while the non-inverting input (pin 3) is tied about 1.4V above half-supply by diodes D1 and D2 and the 10MΩ and 100kΩ resistors. Thus, IC2 is a comparator which is latched high (as already mentioned) in the listening mode.

When the microphone "hears" the telephone bell, the resulting signal is amplified by IC1 and rectified by diodes D1 and D2. This tends to pull the non-inverting input of IC2 low and, if the signal is large enough, causes IC2 to change state from high to low.

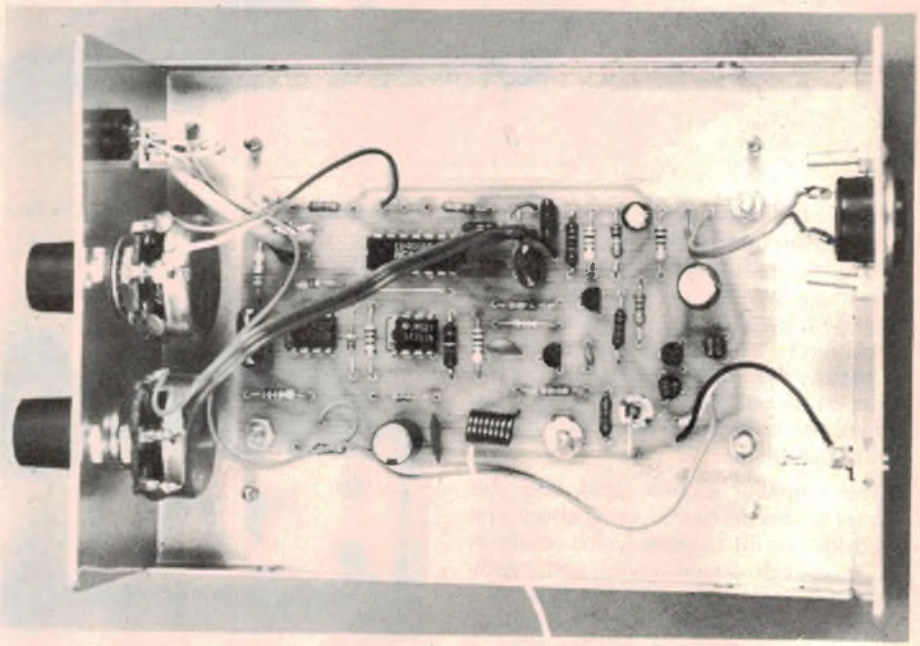
We estimate that the current cost of parts for this project is approximately

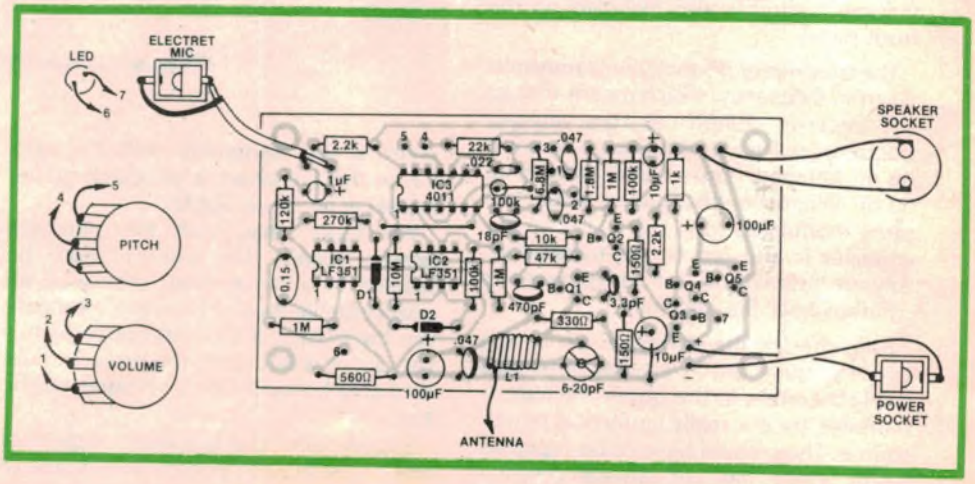
$25

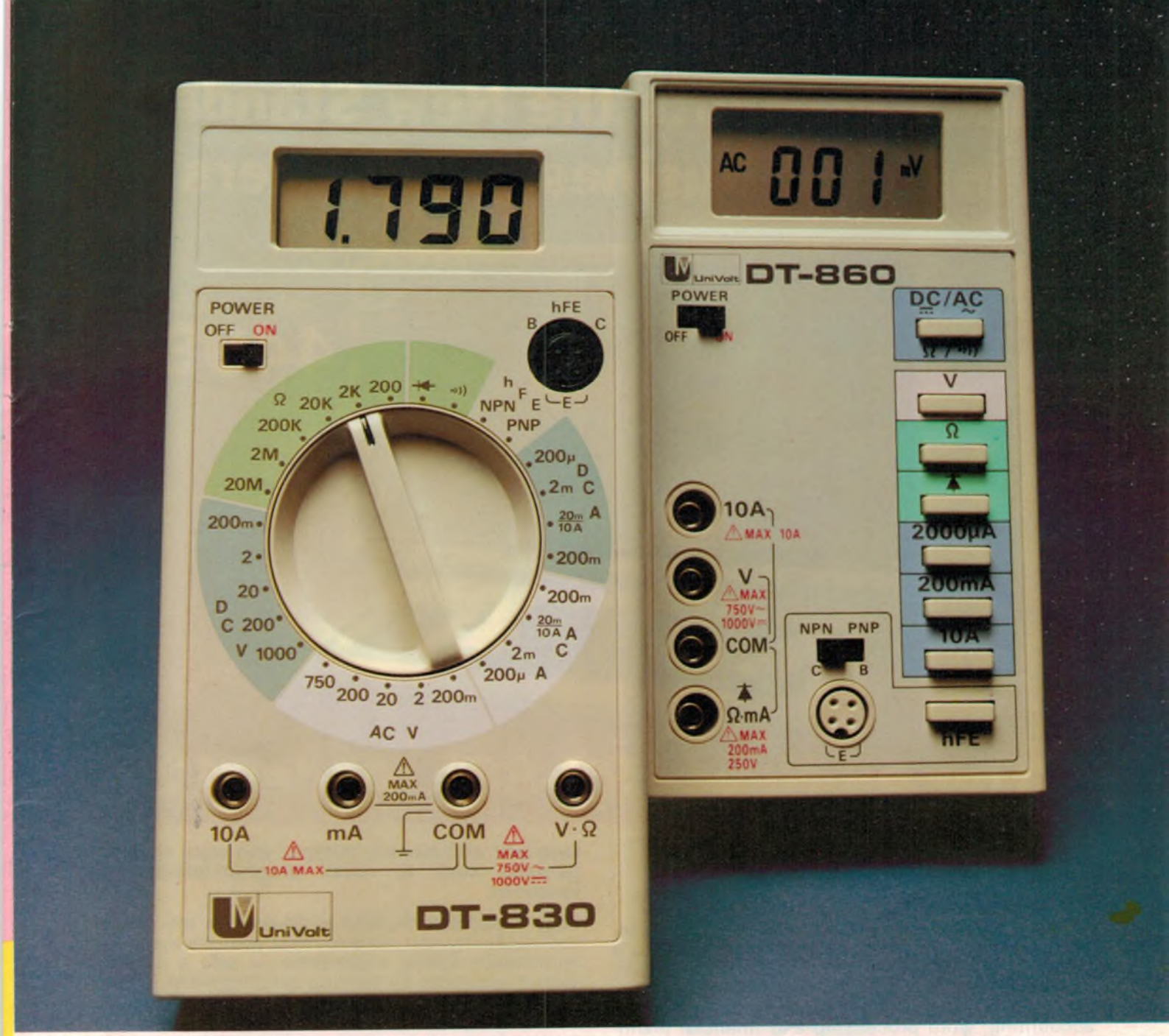
This includes sales tax but not the cost of a plugpack supply, FM tuner, or loudspeaker.

IC2 now enters the oscillate mode whereby it produces a brief series of signal pulses from its output. When the output of IC1 goes low, the output of IC2 immediately swings from close to the supply voltage to about 2V. This means that the mid-point of the 1MΩ voltage divider network will now drop from half-supply to about 1V, although this drop is momentarily delayed by C1.

The charge on C1 very quickly falls to a level where IC1 is effectively inhibited, ie the non-inverting input (pin 3) is taken lower than any of the negative signal "peaks" which appear on the inverting input. Hence its output is latched low.







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- ☐ Basic Accuracy ±0.5%

Model DT-860 Autoranging, fast sampling (0.5sec), high resolution and moderate price:

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- ☐ Built-in stand
- ☐ Basic Accuracy ±0.5%

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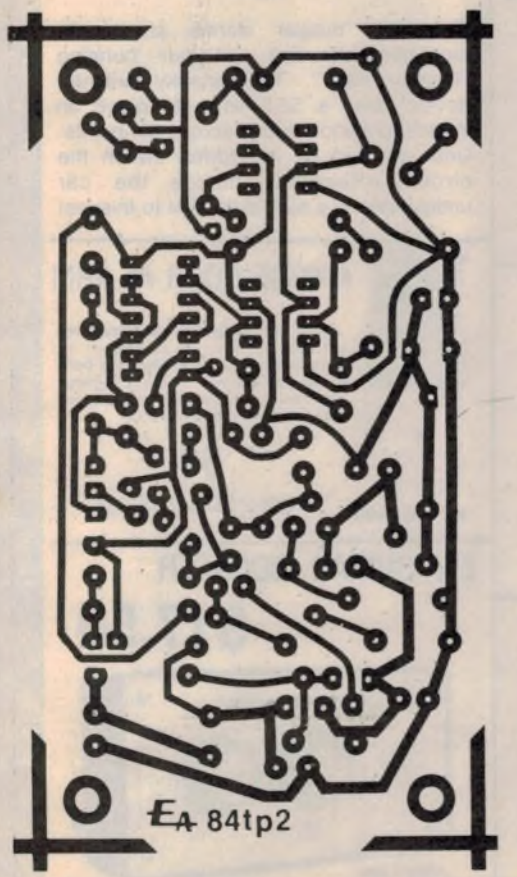
After about 20ms, the voltage on C1 also falls below the voltage on pin 3 of IC2 (about 2V). This causes the output of IC2 to change state from low to high which enables C1 to begin charging up again. But since pin 3 is tied low by the output of IC1, IC2 again changes state as soon as pin 2 goes slightly above pin 3.

Thus IC2 oscillates at about 20Hz while ever the output of IC1 is low.

The output of IC1 remains low until C2 discharges sufficiently (via the 120kΩ and 270kΩ resistors) to let pin 2 drop below pin 3. When this happens, IC1's output goes high, which effectively stops pin 3 of IC2 from being forced low. This means that, as soon as IC2 again changes state from low to high, the oscillatory mode is halted and normal bias is restored to the circuit.

The length of the oscillatory mode is set by the time constant formed by C2 and the associated feedback resistors around IC1. In practice, IC2 produces a 400ms signal burst each time the telephone rings – ie, two 400ms bursts will be produced during each cycle, corresponding to the two short rings produced by the telephone.

At the end of the oscillatory phase, the circuit enters an 800ms mute cycle while the voltages around IC1 restabilise to half supply. During this time, the circuit cannot be retriggered. This feature allows us to make the tone burst equivalent in length to the telephone ring while ensuring that we only get two tone bursts per cycle.



By comparison, the rest of the circuit is (thankfully) quite straightforward. The output of IC2 is inverted by IC3a which, in turn, enables a CMOS oscillator formed by gates IC3b, 3c and 3d. This "tone generator" operates at a frequency of between about 260Hz and 1250Hz, depending upon the setting of VR1.

When the output of IC2 is low (and thus the output of IC3a is high) the CMOS tone generator will be enabled (ie, will oscillate). As we have seen, the output signal from IC2 oscillates at 20Hz in 400ms bursts. The output from the tone generator thus consists of 400ms tone bursts modulated at 20Hz.

The output of IC3c (pin 10) is fed into the volume control (VR2) via a .047μF capacitor. From there, it passes via another .047μF capacitor to the base of transistor Q2.

Q2, Q3, Q4, and Q5 form a simple direct-coupled audio amplifier. The base of Q2 is biased to around 5V by the 1MΩ and 1.8MΩ resistors, while the 100kΩ resistor and associated 10μF capacitor decouple the bias network from the supply line. Q2's collector is direct-coupled to the base of Q3 and this in turn drives Q4 and Q5 which form a complementary output stage.

AC voltage gain of the amplifier is set to around 15 by the ratio of the 2.2kΩ and 150Ω resistors in the feedback network while the 10μF capacitor in series with the 150Ω resistor curtails the frequency response below 100Hz.

Note that, unlike the audio amplifier used in the Headphone Amplifier featured elsewhere in this issue, this circuit does not include provision to adjust the output stage quiescent current. This is because, in this application, we are not worried about crossover distortion.

The FM transmitter stage is actually very simple, consisting of a single NPN transistor (Q1) driving an LC tank circuit. It can be set to any frequency within the FM broadcast band by means of a 6-20pF trimmer capacitor, while drive for the antenna is taken from a tap on inductor

PARTS LIST

1 metal case, 100 x 150 x 60mm (W x D x H)
1 Scotchcal label, 100 x 53mm
1 PCB, code 84tp2, 105 x 56mm
1 electret microphone insert
2 3.5mm mono jack sockets and plugs
1 2-pin panel socket and plug
1 4mm banana socket and plug
1 30cm-length of 1mm enamelled copper wire
1 1-metre length of shielded audio cable

SEMICONDUCTORS
2 TL071 or LF351 FET-input op amps
1 4011 CMOS quad NAND gate
2 BC548 NPN transistors
2 BC328 PNP transistors
1 BC338 NPN transistor
2 1N4148 diodes
1 red LED and matching bezel

CAPACITORS
2 100μF/16V PC electrolytic
1 10μF/16V PC electrolytic
1 10μF/16V axial lead electrolytic
1 1μF/16V electrolytic
1 0.15μF metallised polyester
3 .047μF metallised polyester or ceramic
1 .022μF metallised polyester or ceramic
1 470pF ceramic
1 18pF ceramic
1 3.3pF ceramic
1 6-20pF trimmer

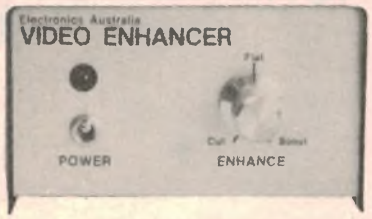
RESISTORS (¼W, 5%)
1 x 10MΩ, 1 x 6.8MΩ, 1 x 1.8MΩ, 3 x 1MΩ, 1 x 270kΩ, 1 x 120kΩ, 3 x 100kΩ, 1 x 47kΩ, 1 x 22kΩ, 1 x 10kΩ, 2 x 2.2kΩ, 1 x 1kΩ, 1 x 560Ω, 1 x 330Ω, 2 x 150Ω, 2 x 100kΩ log potentiometers.

MISCELLANEOUS
Machine screws and nuts, rainbow cable, 9V plugpack supply, 8Ω loudspeaker, speaker cable etc.

ROD IRVING ELECTRONICS

425 HIGH ST, NORTHCOTE 3070 VIC PHONE (03) 489 8866

VIDEO ENHANCER $35



Like tone controls in a hifi amplifier, touch up the signal with this Video Enhancer. EA OCTOBER 83

NAIL FINDER $10

Essential for the home handyman the Nail Finder will help locate timber studs behind Gyprock or plasterboard wall surfaces as well as locating pipes and wiring buried in walls

EA OCTOBER 83

SPEED SENTRY $11

EA OCTOBER 83

Paying speeding fines can be a painful business. Build this Speed Sentry and avoid further pains in the wallet

TRANSISTOR TESTER $15

Have you ever desoldered a suspect transistor, only to find that it checks OK? Troubleshooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester such as the EA Handy Tester.

EA SEPTEMBER 83

MOTORCYCLE INTERCOM $40

WATTMETER $65

The unit described here will measure the power consumption of any mains appliance with a rating up to three kilowatts. It makes use of a special op amp called an "output transconductance amplifier" or OTA, for short.

EA SEPTEMBER 83

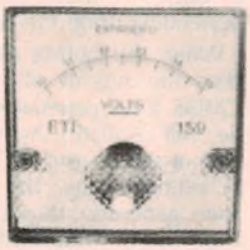
CAR ALARM $29.00

This Car Alarm uses the battery earth strap as a sensor to detect when a "courtesy" light or other electrical load occurs when a thief enters a vehicle. The circuitry is simple and immune from false triggering problems. ETI July 81

10-15V EXPANDED SCALE V-METER

ETI 159 December 81

$26.50



CAR IGNITION KILLER

$13

Most car burglar alarms are easily circumvented, but not our cunning "Ignition Killer". This sneaky antitheft device uses a 555 timer to place an intermittent short circuit across the points. Until disabled by its hidden switch the circuit effectively makes the car undriveable — a sure deterrent to thieves!

VIDEO AMPLIFIER $15

EA AUG 83

Bothered by smeary colours, signal beats and RF interference on your computer display? Throw away that cheap and nasty RF modulator and use a direct video connection instead. It's much better.

The Video Amplifier features adjustable gain and provides both normal and inverted outputs. Power is derived from a 12V DC plugpack supply.

PHONE MINDER $25

±12V RAILS FOR LAB POWER SUPPLY

EA July 1983

$13

An inexpensive addition to the 50V 5A Lab Power Supply which should prove its worth many times over. It provides additonal fixed ±12V outputs for lower power applications.

FRIDGE DOOR ALARM

When the refrigerator door has been left open for about 20 seconds — or, more correctly, when the light has been on for 20 seconds — this EA Fridge Alarm will emit a series of reminder beeps until the culprit closes the door.

$9

FOR PCB VERSION

EA July 1983

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Here is a new heart rate monitor designed specifically for use by the dedicated fitness seeker. Small enough to carry when jogging or exercising, it features an optical sensor, no electrical connections to the body, an in-built calibration circuit, and direct readout on a large liquid crystal display (LCD).

Driveway Sentry

$32

Activated by your car's headlights, the "Driveway Sentry" will turn on a driveway or garage light so that you can make a safe exit from your car on the darkest of nights. At the end of five minutes, it will automatically turn the light off again.

EA GUITAR BOOSTER $17.50

JUNE EA 1982

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Phone Minder

L1. Frequency modulation is achieved by applying an audio signal to the base of the transistor.

Only a small amount of drive is required to achieve adequate modulation depth. For this reason, the signal is coupled from the tone generator to Q1 via a series 6.8MΩ resistor and 18pF capacitor. The drive for the transmitter is taken from a point on the tone generator which has a sawtooth waveform. This provides a much cleaner and more pleasing sound from the receiver.

Construction

Most of the parts are mounted on a printed circuit board (PCB) coded 84tp2 and measuring 105 x 56mm. Mount the parts on the board according to the overlay diagram, beginning with the resistors and capacitors and then moving on to the semiconductors. Take care with component orientation and don't forget the wire link adjacent to IC3.

IC3 is a CMOS device, so be sure to observe the usual precautions. Earth the barrel of your soldering iron to the earth track on the PCB (use a small clip lead) and solder the supply pins (7 and 14) first.

Inductor L1 consists of 7½ turns of 1mm enamelled copper wire wound on a 5mm former. A drill bit makes a convenient former – wind on 7½ turns, then trim and clean the ends of enamel before mounting the coil on the PCB. The antenna is connected to the inductor one turn from the positive end (ie the end furthest from the trimmer capacitor). Scrape away the enamel from a small section so that you can solder the antenna lead to it.

A standard metal case measuring 100 x 150 x 60mm (W x D x H) is used to house the circuitry and this is fitted with a Scotchcal front-panel label to provide a neat finish. Spray the Scotchcal label with a hard-setting clear lacquer (eg, "Estapol") before fixing it in position. The label can then be used as a drilling template for the front panel.

Other holes to be drilled in the case include mounting holes for the PCB, the speaker socket and the 3.5mm power jack socket. In addition, a banana-type antenna socket is mounted on the lid of the case directly above inductor L1.

The various items of hardware may now be mounted in position and the wiring completed. Use shielded cable for connections between the microphone socket and the PCB (and for connections to the plug and the microphone itself). All other wiring can be run using rainbow cable or light-duty hookup wire.

Once the wiring has been completed, go back over your work and check carefully for errors. In particular, check the power supply polarity. If you get the supply reversed, you could damage an IC or a transistor.

Testing

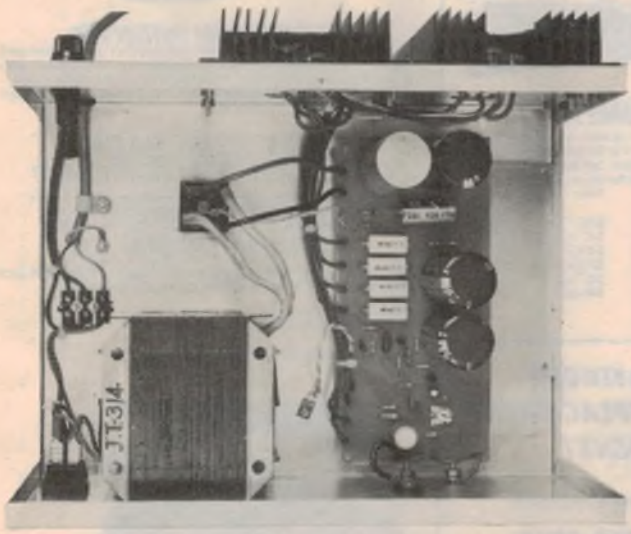
Testing the circuit involves little more than trying it out. Connect up a loudspeaker and power supply, set the volume control to half way, and whistle directly into the microphone. This should be sufficient to trigger the circuit so that it produces a modulated tone. Check that you can alter the pitch of this tone with the pitch control.

Next, the transmitter can be tested. Tune your receiver to a blank space in the FM band, switch the muting control off and adjust the trimmer capacitor on the Phone Minder PCB until a signal is detected (ie, the white noise produced by the receiver is reduced). Triggering the Phone Minder should now produce a tone from the receiver's loudspeaker (as well as from the speaker plugged into the Phone Minder itself).

Where available, a plastic alignment tool should be used to adjust the trimmer capacitor to prevent detuning effects. A frequency of around 95MHz should prove satisfactory in most cases.

Finally, an external antenna is necessary to ensure adequate transmitter range. A 30cm length of wire plugged into the antenna socket and mounted vertically will be sufficient for most applications. If a rigid antenna is used, the end of the wire should be bent in a loop as a safety precaution.

Next month in Electronics Australia**



VK Powermaster

Big brother to the VK Powermate, the VK Powermaster is a 13.8V supply that delivers a massive 14A continuously or 25A intermittently – just the thing if you run a 200W linear!

Special notice:

A last-minute technical hitch has forced us to postpone the UHF TV down-converter scheduled for this issue. We apologise to readers for this postponement and will do our best to publish a suitable design as soon as possible.

Sound level meter & wobbulator

Many people have a graphic equaliser as part of their hifi set-up. With this simple project, you can analyse your room acoustics and correctly adjust the equaliser to get rid of those nasty peaks and troughs.

Make your own log-periodic antenna

Designing your own log-periodic antenna for TV or FM is simplified in an article which includes a Basic program which will run on most computers.

** Although these articles have been prepared for publication, circumstances may change the final content. However, we will make every attempt to include the articles featured here.

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  (c) Audio input
- Full instructions supplied
- Suits any application where a stable low noise FM link is required.
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- Pre-emphasis - 50u/second standard
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The unit has a front to back ratio of 1.5:1. The power requirements are the same as for the low cost mic. insert. Each insert is supplied with a comprehensive data sheet which includes connection details, specs, and frequency response graph.
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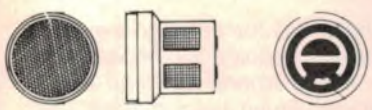

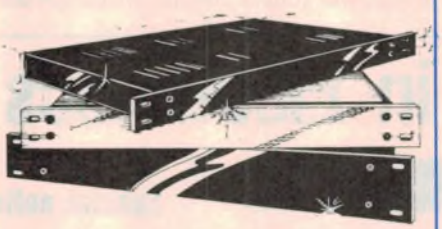

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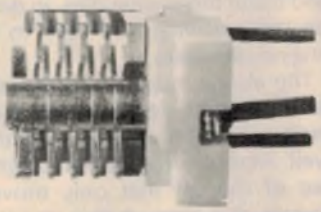

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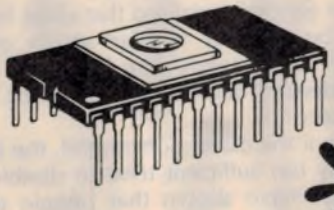

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Build this sneaky antitheft device

Ignition killer for cars

by JEFF SKEEN

Car burglar alarms are fine except that most are easily circumvented. This cunning antitheft device is cheap, easy to fit, and effective.

We may be in the midst of an economic recession, but no such recession has been reported in the car theft "industry". Last year, more than 70,000 cars were stolen in Australia, this despite the existence of car steering locks and the increasing use of car burglar alarms.

A problem concerning the car alarm concept is how to make it most effective. One philosophy – usually expounded by the commercial alarm manufacturers – is that the alarm is most effective if its presence is clearly advertised and made obvious. The thief will then, according to theory, bypass that vehicle and attack one whose owner has not been astute enough to fit the "Little Beaut Red and Green Flashing Car Alarm". (What would happen if everybody fitted the "Little Beaut . . . etc" is not clear).

But that question aside, the opposite alarm philosophy contends that a warning sticker only makes the thief aware that there is an alarm to be circumvented. And professional thieves are not above familiarising themselves with the various commercial alarms and how best to disable them.

In fact many car alarms can be effectively disabled by the simple measure of disconnecting or cutting the horn wires without lifting the bonnet. It is not generally realised that most horns can be reached without much effort from underneath the vehicle. An experienced thief can pull this trick in a few seconds.

Even if the alarm does sound, the thief usually has sufficient time to disable it. Surveys have shown that people tend initially to disregard a car burglar alarm, assuming that the owner has set it off accidentally. Provided he keeps his "cool", the thief has only to cut the wires to the horn or siren and drive away.

One of the worst thieves, as far as the car owner is concerned, is the "joyrider". This is the person who grabs your lovingly cared for Ford, Holden, Porsche, etc and takes it for a "spin around the block" to see for himself just how fast it will go. If the owner is lucky, the car will be found intact a day or so later, usually minus the radio-cassette player and any other valuable accessories that may have been fitted.

But even this can have a sting in the tail, with the real damage to the car often unseen. After all, the thief doesn't care two hoots about your property. The engine could well have been overheated or had the inside revved out of it. Or the car could have been used to show off innumerable "wheelies" to the detriment of the tyres and suspension.

Often, of course, the car will not be recovered or will be damaged beyond repair. Many cars are stolen by professional thieves to be stripped and used for spare parts. But whatever the circumstances, car theft causes the owner a great deal of expense and inconvenience.

Ignition killer

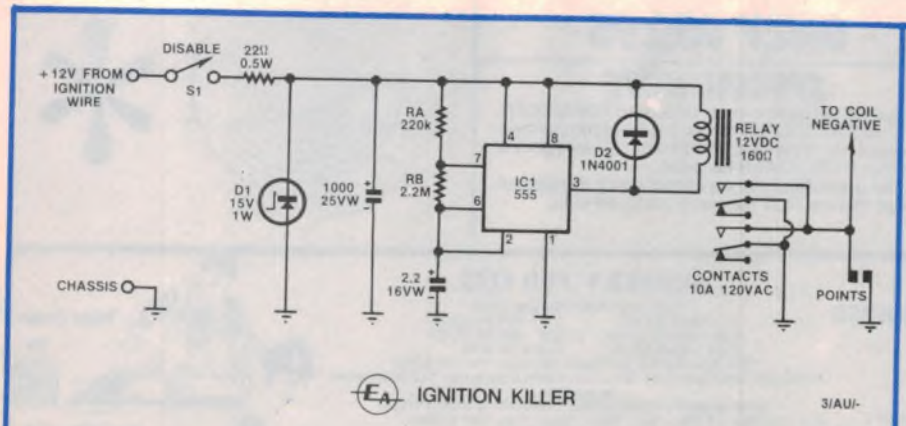
In order to protect your car against the above situations we have devised a rather cunning little circuit. We've christened it the "Ignition Killer".

It works like this: imagine a thief has just broken into your car. He starts the engine and begins to drive off. Just as he does, the engine dies. He immediately cranks the engine and a few seconds later it starts. Again he begins to drive off and again the engine dies. In desperation he tries a third time only to have the engine die again.

The above sequence of events should automatically deter any joyriders and many so-called professional thieves as well. After all, it is difficult to get any joy out of the car that only moves a few metres at a time. In this situation, most thieves will simply assume that the car has an engine problem and will abandon it for easier "game".

The simple circuit that creates this mayhem is simply an astable oscillator based on the ubiquitous 555 timer IC. The output of the 555 oscillator is connected to a relay which in turn has its normally open contacts wired in parallel with the car's points or coil switching transistor (see Fig. 1).

A few seconds after the car is started,



The circuit consists of a 555 timer IC driving a relay.

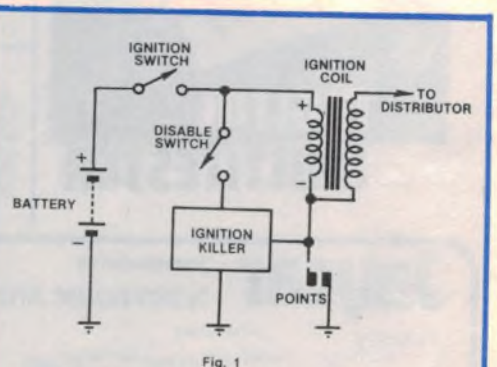
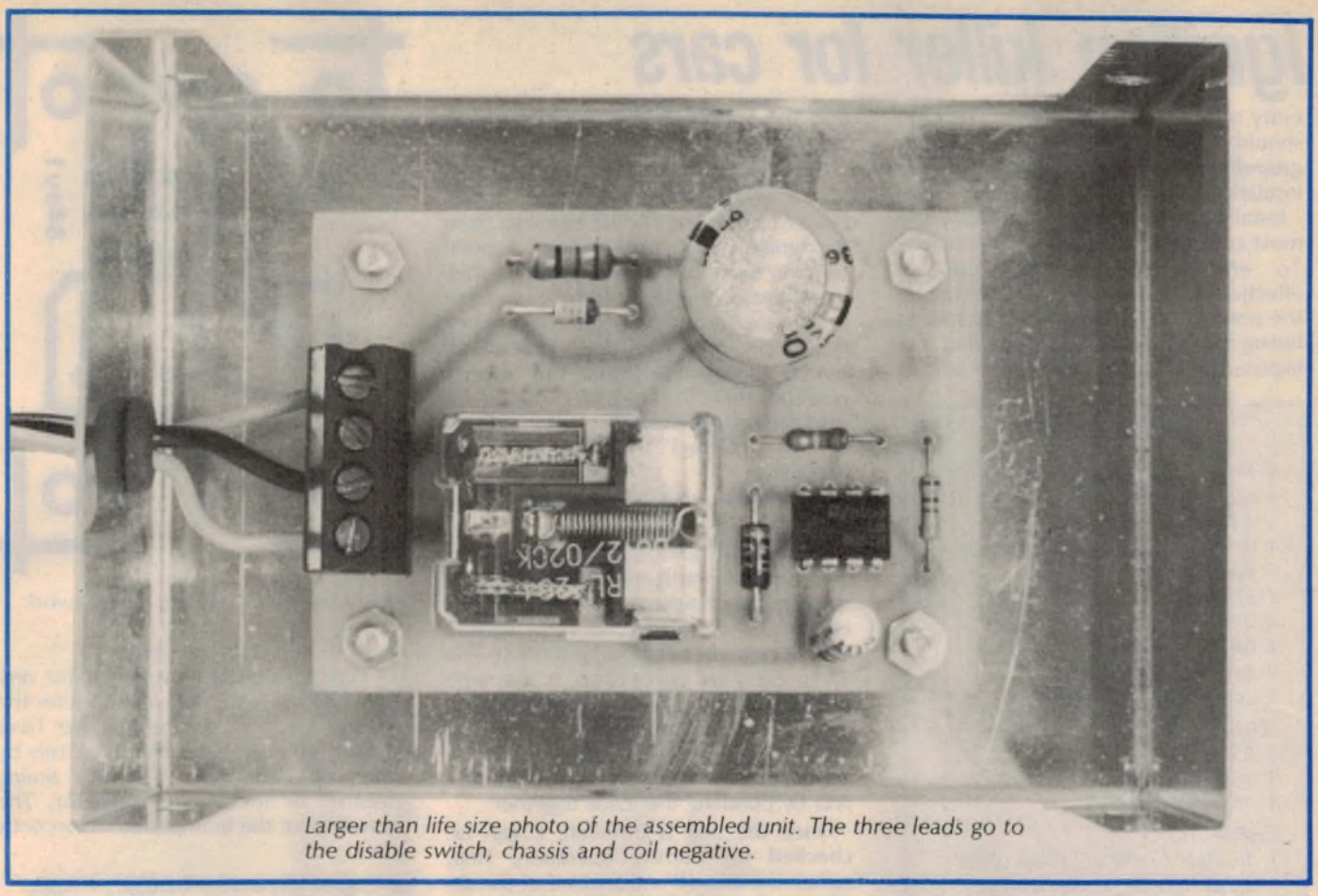


Fig. 1

The Ignition Killer is simply connected in parallel with the points (or the coil switching transistor).



Larger than life size photo of the assembled unit. The three leads go to the disable switch, chassis and coil negative.

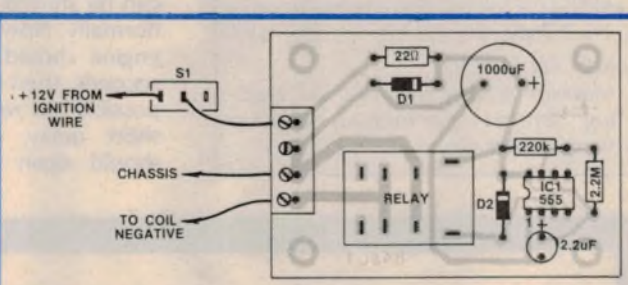
the oscillator output goes low, causing the relay to operate and short out the car's points. With no points signal the ignition system cannot produce a spark and so the engine dies. A few seconds later the oscillator output returns to the high state, the relay turns off and the contacts open. The engine can now be started and will run for a few seconds until the next low cycle of the oscillator.

The circuit is powered from the car's ignition wire and uses no power when the ignition is not switched on. Thus it will not flatten the battery when used to protect the car for extended periods.

We estimate that the current cost of parts for this project is approximately

$13.00

This includes sales tax.



Construction is easy – just follow this parts overlay diagram. Note component orientation.

How it works

The circuit consists of astable oscillator IC1 (555), a relay and a handful of minor components.

Inside the 555 timer IC is a resistor divider network which sets reference voltages of 1/3 Vcc and 2/3 Vcc on internal comparators. At switch on, the pin 2 trigger input is pulled low by an external 2.2μF capacitor, while the output is high. This means that the relay will be off and so the engine can be started.

The 2.2μF capacitor immediately begins charging via the 220kΩ and 2.2MΩ timing resistors. When the voltage across it reaches 2/3 Vcc, the 555 output (pin 3) switches low and the relay turns on to short out the points (or the coil switching transistor). At the same time, pin 7 goes low (ie, the discharge transistor turns on) and the 2.2μF capacitor begins discharging.

Pin 3 will remain low, and hence the relay remains on, until the capacitor is discharged to 1/3 Vcc. At this point, pin 3 switches high again, the pin 7 discharge transistor turns off, and the 2.2μF capacitor re-charges towards 2/3 Vcc. Thus, the cycle repeats indefinitely while ever power is applied. It follows, therefore, that the car can be started only during the charging cycle and stalls immediately the voltage across the timing capacitor reaches 2/3 Vcc.

The 1N4001 diode connected across the relay contacts shorts out the relay coil back EMF to prevent damage to the output circuit of the 555. The 22Ω resistor, 15V zener and 1000μF capacitor provide supply line filtering and decoupling. The 15V zener clamps supply line transients to 15V, thus protecting the 555 from excessive voltages.

Construction

Construction is straightforward with all parts except the switch mounted on a small printed circuit board (PCB) coded 84au1 and measuring 69 × 48mm. This is housed in a metal case measuring 102 × 70 × 51mm, although any similarly-sized plastic case would also be suitable.

We mounted the PCB assembly on the lid of the case using four 6mm brass spacers and machine screws and nuts. A small hole was drilled in the end of the lid closest to the terminal block to allow

Ignition killer for cars

entry of the connecting leads. This hole should be fitted with a small rubber grommet to prevent damage to the lead insulation.

Installation of the unit is probably the most important part of the construction. To enable the unit to function effectively, it must remain undetected by the potential thief. This not only means hiding the unit itself and disguising any exposed wiring, but locating the unit so that the sound of the relay operating cannot be heard.

The best place for the unit is probably in the engine bay against the firewall. Power for the unit should be taken from the ignition wire, preferably at a point remote from both the ignition switch and the coil. This reduces the chances of a thief spotting the extra lead when "hotwiring" the car. A single-pole on-off switch, accessable from the driver's position, should be placed in the power lead running to the unit so that the unit can be disabled and the car driven normally.

It goes without saying that this switch should also be well hidden.

The earth wire should be connected to the nearest earth point, which may actually be inside the case if this is electrically connected to the vehicle chassis (say via self-tapping screws). The most exposed connection is the wire leading to the negative or points side of the coil. This connection should be disguised by using wiring similar in appearance to the existing coil leads, and by bundling the leads together.

Once the unit is installed, it can be checked for correct operation. First, switch the unit off and check that the car can be started and that the engine runs normally. Now switch the unit on – the engine should run normally for a few seconds, then cut out. It should now be possible to restart the engine after a short delay, whereupon the engine should again run normally for a few seconds before cutting out.

If your car's engine is very easy (or very hard) to start you may wish to alter the engine run and stop times we have chosen. This can be done quite easily by changing either of the two timing resistors or the timing capacitor. The formulae for the time periods in seconds are:

- Engine run time = $0.685(R_A + R_B)C$;
- Engine stop time = $0.685(R_B)C$.

In our circuit, R_A = 220kΩ, R_B = 2.2MΩ, and C = 2.2μF. By substituting these figures into the above equations, we get an engine run time of 3.6 seconds and an engine "kill" time of 3.3 seconds.

PARTS LIST

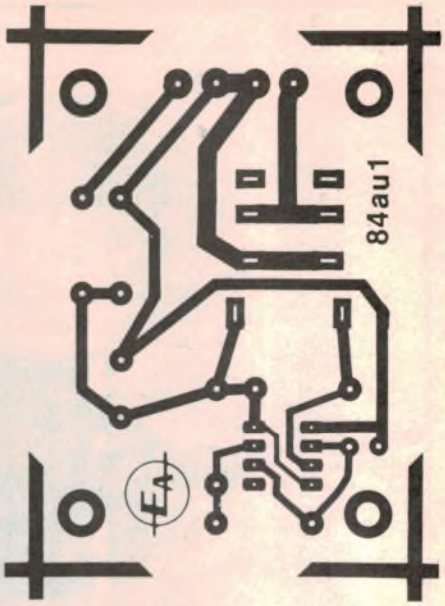
1 PCB, code 84au1, 69 × 48mm
1 aluminium case, 102 × 70 × 51mm
1 4-way PC-mounting terminal block
1 DPDT 12V relay with 10A 120VAC contacts
1 SPST toggle switch
4 6mm or 8mm spacers
1 small rubber grommet

SEMICONDUCTORS
1 555 timer IC
1 15V 1W zener diode
1 1N4001 diode

CAPACITORS
1 1000μF 25VW PC electrolytic
1 2.2μF 16VW PC electrolytic

RESISTORS (¼W, 5% unless stated)
1 x 2.2MΩ, 1 x 220kΩ, 1 x 22Ω ½W

MISCELLANEOUS
Machine screws and nuts, self tapping screws, automotive hook-up wire, solder etc.



Above is the actual size PCB artwork.

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Circuit & Design Ideas

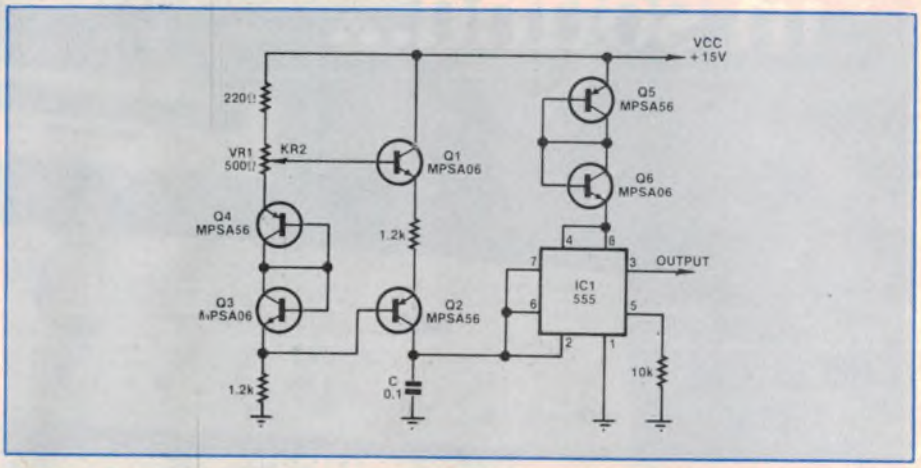
Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

Linear frequency control for the 555 timer

The 555 timer is a convenient device for use as a variable frequency oscillator, requiring a variable resistor to feed a timing capacitor in a simple configuration. The main weakness of this arrangement is that the frequency variation is not linear with respect to pot rotation, but tends to be logarithmic.

The accompanying circuit is designed to overcome this problem. It will operate linearly over the range from a few Hz to 5kHz and is also unaffected by supply voltage variations.

Heart of the circuit is a constant current network to charge the timing capacitor, C (0.1μF), so that charging is linear. This feature is augmented by arranging that the capacitor charges from only one quarter to one half of the supply voltage, rather than from one third to two thirds, as is more usual.



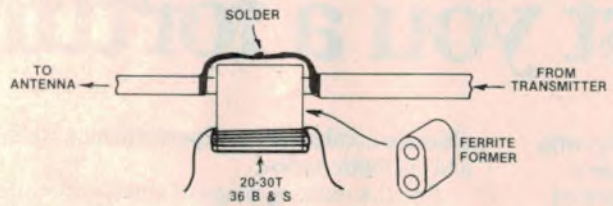
Q1, Q2, Q3 and Q4 together provide a temperature-compensated constant current source for C. Potentiometer VR1 sets the current through Q1 and Q2 and thus sets the frequency of oscillation. The 10kΩ resistor from pin 5 of IC1 to 0V restricts the charging cycle to between one quarter and one half of the supply

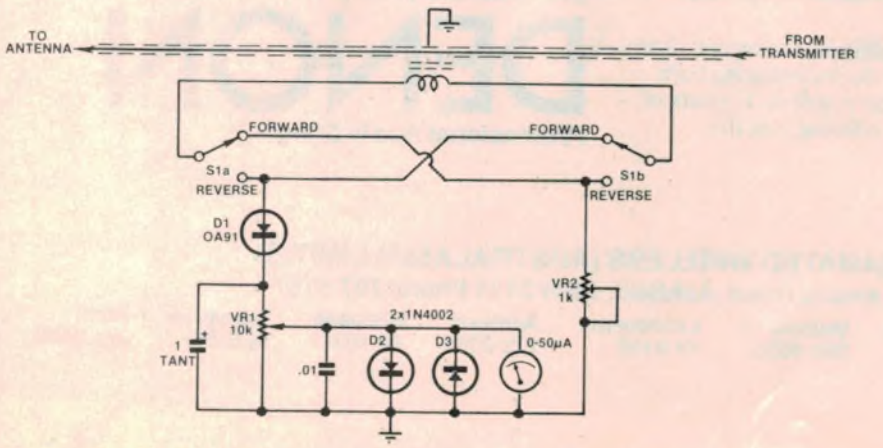
For best linearity, particularly at low frequencies, it is necessary to use matched Vbe transistors in the constant current network. Transistors Q1 and Q4 should be matched.

From "Electronics", August, 1982.

Simple SWR Meter

This simple SWR meter is suitable for both 27MHz CB and 28MHz amateur work. The pick-up loop uses a ferrite balun former, with 20-30 turns of 36 B&S enamelled copper wire for the secondary winding (see diagram).





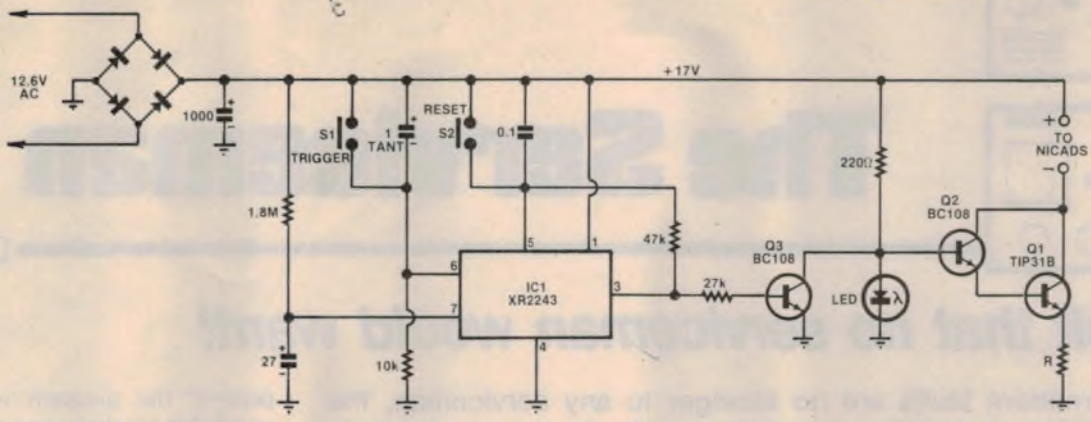
The signal from the pick-up loop is fed to switch S1 (which switches between forward and reverse readings) and then applied to the meter circuit via D1, VR1 and VR2. Diodes D2 and D3 are included to protect the meter against overload. Note that a multimeter switched to a low current range could be substituted for the meter.

Ideally, VR2 should be a multiturn pot. The procedure is to first adjust VR1 for a full-scale forward reading, then adjust VR2 for a minimum reverse reading. The SWR is then read off the accompanying table.

Construction of the pick-up loop is as follows:

- remove 45mm of outer insulation from one end of a 450mm length of RG58 coaxial cable;
- carefully cut braid 35mm from end of cable and slide off;
- slip insulated inner cable through one hole in ferrite former;
- replace braid. Solder braid over top of former where previously cut;
- wind 20-30 turns of 36 B&S enamelled copper wire on second section of ferrite former.

The circuitry should all be contained in a metal case. The antenna end of the pick-up cable is terminated in a panel-



NiCd charger with automatic shutoff

It is necessary to exercise a degree of caution when charging NiCd cells, as overcharging can lead to cell damage and reduced service life. The circuit shown here guards against this by turning off the charging current at the end of a 15 hour period.

An XR-2243 timer IC is wired as a 15 hour monostable and controls a constant current sink consisting of transistors Q1 and Q2. The LED is used as a 2V reference which means that about 800mV is maintained across resistor R. Various values for R are given in Table 1 to suit different NiCds and these could be made switch-selectable.

Switch S1 initiates the timing cycle, while switch S2 resets the XR-2243 ready for the next cycle. Both these switches should be momentary contact pushbutton types. Note that up to 10 identical cells may be charged at the same time, simply by placing them in series.

Note also that some older style LEDs only have a forward voltage of about 1.7V, leaving about 500mV across R. In this case, it will be necessary to re-calculate the values for R to get the correct charging current.

TABLE 1					
BATTERY	N	AA	SUB-C	C	D
CURRENT (mA)	15	45	120	180	400
R(Ω)	56	18	6.8	4.7	2.2/½W

R. Sawyer,
Nambour, Qld.

$15

Reverse Current (μA)	SWR	Comments
2.4	1.1:1	Excellent
5.0	1.2:1	
6.6	1.3:1	Satisfactory
10.0	1.5:1	
14.4	1.8:1	Marginal
16.8	2.0:1	
21.5	2.5:1	Unsatisfactory
25.0	3.0:1	

mounting SO-239 socket while the other end passes through a hole in the case (where it is clamped) and is fitted with a plug for connection to the transmitter.

Finally, the accompanying table assumes a 50μA meter. If other meters are used, the SWR can be found by multiplying the figures in the first column by two to obtain a percentage of full scale deflection – eg, 20% of FSD indicates an SWR of 1.5:1.

N. Jackson,
Wandin East, Vic.

$20

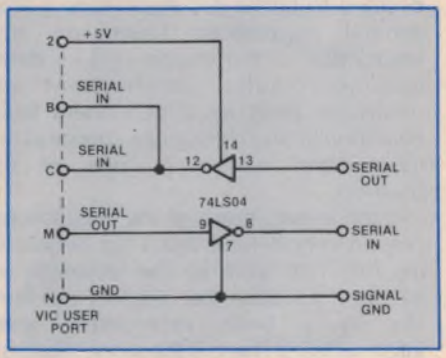
VIC-20 video terminal

A useful role for the VIC-20 is to use it as a video terminal. It can then be used as a means of communicating with other systems, through their serial input and output lines.

The program shown uses the RS-232 software already present as part of the VIC operating system. Line 10 configures the VIC to operate as a "dumb" terminal, the configuration being for 600 baud, 7-bit ASCII, no parity and full duplex. Line 20 is used to check for a VIC key depression. If a key has been depressed then line 30 sends the ASCII character to the other system, while line 40 checks for a response. If there is a response, line 50 prints the character on the screen.

The hardware consists of inverters which are used to achieve the correct signal polarity and to buffer the VIC lines.

To use the above, the program is run on the VIC followed by the application of power to the other system. This sequence is necessary as some systems only check for the presence of a video terminal during a warm start.

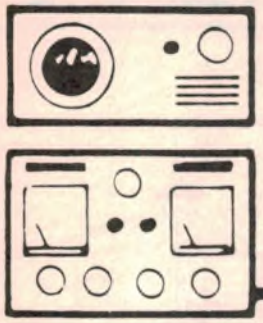


The approach shown here is extremely simple, and as such has some limitations. These are: (1) the serial lines of the other system must operate at TTL levels and not at RS-232 levels; (2) the full ASCII character set is not used; (3) the maximum communication rate is 600 baud; and (4) signal path length should be less than 500mm. However, in a lot of cases these limitations can be accommodated.

L. Murakami,
West Beach, SA.

$12

```
10 OPEN2,2,3,CHR$(167)+CHR$(0)
20 GETA$:IF A$="" THEN 40
30 A=ASC(A$):PRINT#2,CHR$(A);
40 GET#2,B$:IF B$="" THEN 20
50 B=ASC(B$):PRINT CHR$(B);:GOTO 20
```



The Serviceman

A fault that no serviceman would want!

While intermittent faults are no stranger to any serviceman, the nature, variety, and elusiveness of some faults never ceases to surprise me. In some cases, an intermittent can be so bad that there is genuine doubt as to whether it could ever be tracked down by conventional methods — at least economically.

The story I am about to tell is one such case. It was not one of my jobs, though I was vaguely aware of what was going on. It happened to an aquaintance who works in the electronics industry and has a good knowledge of the game, but is not a professional serviceman.

I first heard about the problem in its early stages, before my friend was taking it very seriously, then later when he decided to tackle it. I even made a few general suggestions based on my knowledge of the chassis and its most common faults, intermittent or otherwise. After all, a permanent fault condition in one chassis can appear as an intermittent version in one of its brothers.

In the event, none of my suggestions proved very helpful, but I did persuade my friend to write up the sequence of events. I am sure that readers will find the story both interesting and informative. So here is the story, more or less in his own words.

BRIGHTNESS CHANGE

The set is a Rank Arena 53cm colour set, model C2204, purchased in September 1975, and is thus about eight years old. The set had always performed flawlessly until one night recently when I noticed a sudden change in the picture brightness. It wasn't a gradual change but, rather, a sudden "jump". The effect lasted no more than a few seconds and I didn't think too much about it at the time, assuming that the problem was at transmission end.

That was my first mistake. That "brightness" jump was the start of one of the most elusive intermittents imaginable in a TV set. It took no less than three months to track down (off and on), and lasted some six months overall.

After its initial appearance, nothing more was seen of the fault for several weeks. Then, one night, it suddenly reappeared, again lasting no more than a few seconds. And as before, the fault took the form of a sudden jump in brightness. The effect was subtle but, nonetheless, quite noticeable.

This pattern was to be repeated over the next few months, with this puzzling brightness jump appearing at random. Sometimes it would occur only once during the evening's viewing and sometimes it would occur two or three times. It could appear several nights in a row or it could lie dormant for a week or two, reappearing when least expected. Usually, it lasted for no more than 10 or 15 seconds, but there was the odd occasion when it persisted for a couple of minutes.

By now, the extremely intermittent nature of the problem was apparent. At first, the fault was little more than a curiosity and I decided that I could live with it. After all, it only appeared for very short periods — hardly enough to interfere with one's enjoyment of the program. And even when the fault was present, the program was still quite watchable for those few seconds.

Coupled with this rationalisation was the realisation that I could probably do little about the problem. After all, how does one come to grips with an intermittent that lasts only a few seconds at a time, appears at irregular, widely-spaced intervals, and is rather subtle to boot? One can hardly call a TV serviceman — the chances of the fault appearing when he called would be extremely remote to say the least!

So while the fault remained as it was, it was no great cause for worry. On the other hand, if it got worse, I would at least have a better chance of tracking it down. At least that was the initial theory. The trouble was that, as the weeks went by, what started out as a curiosity began to irritate. It grew to be like an itch that I couldn't scratch until, finally, I decided that the fault would have to be found no matter how long it took.

The first step was to examine the picture a little more closely the next time the fault appeared, to see if I could gain some clue. And it was here that I made my first discovery. It was not really the brightness that was varying — rather, it was the contrast. In fact, one could simulate the fault — at least to some extent — by suddenly advancing the contrast control. But that was all — there were no other symptoms.

My first thought was to check the 19V rail which, among other things, supplies power to the video output board. If the 19V rail was varying, then it might alter the gain of the video amplifier stages and thus alter the contrast — or so I reasoned.

The 19V rail is derived from a winding on the line output transformer via regulator transistor TR505, the base of which is clamped to 19.7V by a series network consisting of a zener diode and two ordinary diodes. It is not unknown for this network to cause problems, so I had high hopes that this was the problem. I had no CRO, but I did have access to a digital multimeter. I connected the meter to the emitter of the regulator transistor (+19V), sat it on

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Overrange Indicator: "1" in MSD column blinks, audible tone (No audible tone for Ohms; no indicator or buzzer for DC 1000V, AC 600V).

Battery Low Indicator: BATT mark lights.

Sampling Rate: 2 per second.

Environmental Conditions (Operating): 0 ~ 40°C, < 80% RH. (No condensation)

Maximum Allowable Input: Volts; DC 1000V max. AC 750V max. Ω/A: AC 250V max.

Dielectric Strength: AC 3000V/1 min.

Power Source: Two size AA (SUM-3) batteries; Battery current, 5mW.

Dimensions: 160H x 85W x 30D (mm).

9145 carrying case supplied.

Option: 9014 HV Probe.

Measurement Range and Accuracy

(Specified for 23°C ± 5°C, < 80% RH)

	Range	Resolution	Accuracy	Notes
DCV	200mV	100μV	± 0.5%rdg ± 4dgt	Input resistance: 100MΩ
	2V	1mV	± 0.7%rdg ± 4dgt	10MΩ(approx.)
	20V	10mV	"	"
	200V	0.1V	"	"
	1000V	1V	± 1.0%rdg ± 4dgt	"
ACV	2V	1mV	± 1.0%rdg ± 8dgt	Input resistance: approx. 10MΩ (approx.) (40Hz to 500Hz)
	20V	10mV	"	"
	200V	0.1V	"	"
	600V	1V	± 1.2%rdg ± 8dgt	"
DCA	200mA	100μA	± 1.5%rdg ± 4dgt	approx. 1Ω (not including fuse resistance)
	10A	10mA	± 1.7%rdg ± 4dgt	approx. 15mΩ >
ACA	200mA	100μA	± 2.0%rdg ± 8dgt	1Ω 40Hz ~ 500Hz
	10A	10mA	± 2.2%rdg ± 8dgt	approx. 15mΩ >
OHMS	200Ω	0.1Ω	± 0.8%rdg ± 5dgt	Open-terminal voltage: 1.5V ± 0.2V, 0.65V ± 0.065V
	2kΩ	1Ω	"	"
	20kΩ	10Ω	"	"
	200kΩ	100Ω	"	"
	2000kΩ	1kΩ	± 1.8%rdg ± 10dgt	"
LPΩ	2kΩ	1Ω	± 1.0%rdg ± 10dgt	Open-terminal voltage: < 0.4V
	20kΩ	10Ω	"	"
	200kΩ	100Ω	"	"
	2000kΩ	1kΩ	± 2.0%rdg ± 10dgt	"

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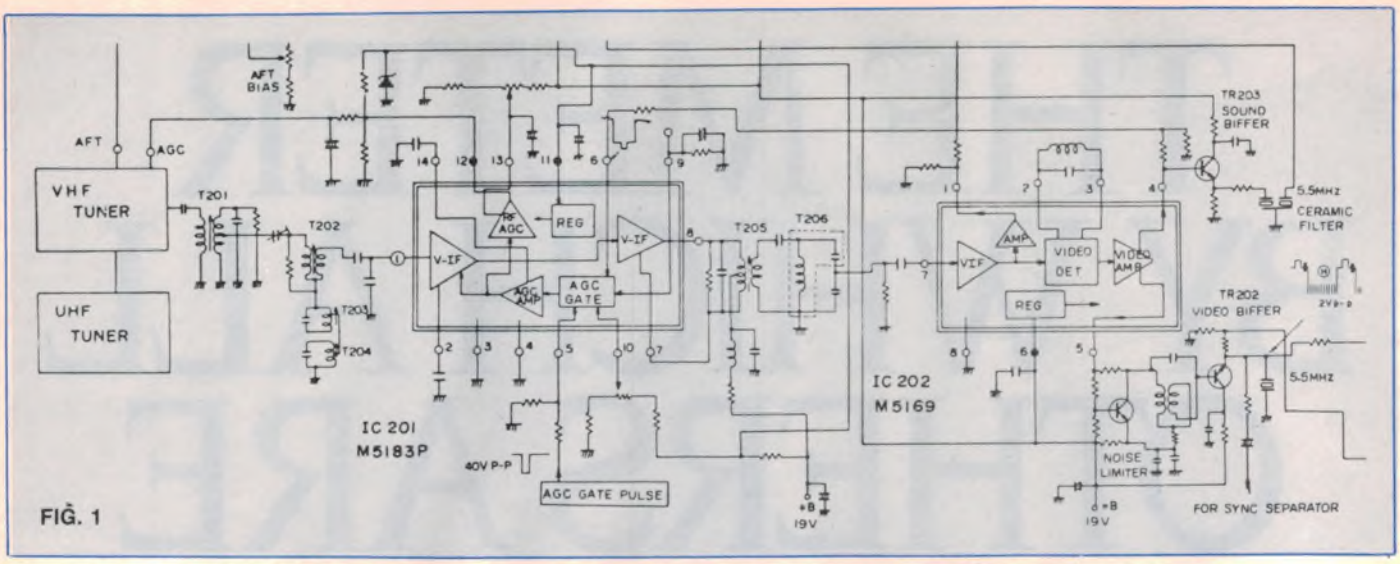

FIG. 1

top of the TV set and waited.

The fault did not appear on the first night but on the second night, just as Colombo was about to nail the guy, it was suddenly there for several seconds. The 19V rail remained rock steady.

Back to the drawing board.

Next, I took a look at the video amplifier stages and the contrast control circuit. Because the brief intermittent nature of the fault made it difficult to monitor, I decided that I would try replacing a few suspect components on a trial and error basis. As a colleague observed: "at least you will know what's not causing the problem."

TRIAL AND ERROR

First, the contrast control circuit. This circuit consists of a pot (VR1) with a 100μF capacitor (C749) connected between the wiper and chassis. It simply varies the amount of bypassing on the emitter of TR701, the first video amplifier stage. I tried replacing the 100μF capacitor, but to no avail. I checked the plug-in socket connections to the video out board (PWC-316) – no result. I removed the board from the chassis and went over it carefully for dry solder joints – again no result.

Clutching at straws, I replaced all the electrolytic capacitors on the board, followed by the brightness limiter transistor TR705 and diode D704, the latter in series between the base of TR705 and the brightness limiter trimpot.

The fault persisted.

Where to now? Frankly, I was stumped, at least temporarily. After some thought, I concluded that the only way to come to grips with the problem was to borrow a pattern generator and a CRO from my place of work in an attempt to find out just what was occurring on that video output board.

It was while musing thus that a thought suddenly struck me. What if the fault wasn't on the video output board after all? What if it was in the front end of the set or, more specifically, in the video IF stages? One thing that I hadn't checked was the AGC (automatic gain control) voltage. If it was varying for some reason, that would support such a theory.

I suddenly had a feeling that I might have been deluding myself. I had been down the "back end" of the set looking for the obvious when, all the time, the fault was probably at the start of the signal chain. It was a lead worth following up.

And so to the IF circuitry.

In the Rank Arena C2204, the signal from the tuner is coupled to a video IF/detector stage made up of two ICs and associated components. The first IC (IC201) contains two stages of IF amplification, an AGC gating circuit, and two stages of AGC amplification. Fig. 1 shows the details.

The second IC in the chain (IC202) provides additional IF amplification, video detection, and amplification of the detected video signal. As shown in Fig. 1, the postive video signal is extracted from pin 4 and fed back to the AGC gating circuit (pin 6) of IC201. At the same time a 40V p-p gating pulse, derived from the line output transformer, is fed to the AGC gate via pin 5 of IC201. This pulse opens the gate during each horizontal sync pulse period so that only the sync pulse amplitude, rather than any video, is sampled to produce the AGC voltage.

Depending on the sync pulse amplitude of the signal extracted from pin 4 of IC202, IC201 produces an AGC voltage. This is fed internally to the IF amplifier section of IC201 and also, via an AGC amplifier, to pin 12. From there it goes to the tuner, via a suitable filter network.

(Serviceman's note: While we tend to take it all for granted, TV viewing would be much less enjoyable without the benefit of today's highly effective automatic gain control – or AGC – system. Contrast would have to be adjusted each time you changed channels or to cover other signal strength variations, while aircraft reflections would frequently render the picture unwatchable.)

Just as important as the circuit is the physical set-up. A quick glance at the relevant circuit board (PWC-312 – the video IF board) revealed that both ICs were mounted in sockets. The AGC voltage is most conveniently monitored at test point TP15, in the AGC line to the tuner, so I connected the DVM to it and sat it on top of the TV set as before. The reading varied from a low of 3.66V for Channel 9 (which has the lowest signal strength) to a high of 4.23V for Channel 2. More importantly, it was rock steady for each channel, which is how it should be.

There was nothing for it now but to leave the setup connected, note the reading on the channel I was watching, and wait.

Of late, the fault had been appearing several times a night without exception. Now it simply disappeared for several days, which was all very frustrating. Then suddenly it was there. The shine on Jim Dibble's skull brightened perceptibly (it was before he retired) and the contrast of the picture shot up. It took two seconds flat to check the AGC voltage – it had fallen by nearly 400mV!

Youliddlebewdy!

THE SOLUTION

As for the solution, well that was something of an anticlimax. It just had to be an intermittent contact in one of those wretched sockets. I removed the board from the chassis, carefully prised the ICs free, and refitted them. Then, just to be sure, I went over the board and

STOP FUTURE SHOCK

The Hioki 3200 digital multimeter has a large Bussman 600V HRC fuse built into it.

This way, if you make the wrong manual range selection when measuring on high energy power systems, you won't be seriously injured.

Normal multimeters can't offer this full over voltage protection up to AC 600V (Ω, μA, mA ranges).

And the HRC fuse is only one of a whole range of safety features offered by the Hioki 3200.

It's been shock-tested to withstand drops onto concrete of up to one metre.

The internal circuitry has been sealed against dust entry. A neon lamp indicator warns over voltage in ohms and →|← ranges.

The safety collar terminals and safety test leads provide maximum protection against electrical shock.

All the controls and terminals have been positioned according to research in human engineering, therefore minimizing any chance for operator error.

So while all these features may come as a surprise, they certainly won't shock you, now or in the future.

Special introductory price **$119.** Normally $141. *Plus Sales Tax

Measurement Range and Accuracy (specified for 23°C ± 5°C, <80% R.H. after zero adjustment)

	Range	Resolution	Accuracy	Notes
DCV	200 mV	100μV	±0.35% rdg ± 1 dgt	Input resistance > 1000MΩ
	2 V	1mV	±0.5% rdg + 1 dgt	approx 12MΩ
	20 V	10mV		approx 11MΩ
	200 V	0.1 V		
	1000 V	1 V	±1.0% rdg ± 1 dgt	
ACV	2 V	1mV	±1.0% rdg ± 4 dgt	approx 040Hz ~ 500Hz
			±2.0% rdg ± 4 dgt	500Hz ~ 1kHz
	20 V	10mV	±1.0% rdg ± 4 dgt	approx 11MΩ 40Hz ~ 1kHz
			±2.0% rdg ± 4 dgt	1kHz ~ 5kHz
	200 V	0.1 V	±1.0% rdg ± 4 dgt	40Hz ~ 1kHz
			±2.0% rdg ± 4 dgt	1kHz ~ 5kHz
	750 V	1 V	±1.0% rdg ± 4 dgt	40Hz ~ 500Hz
			±2.0% rdg ± 4 dgt	500Hz ~ 1kHz
DIODES	2	0.1Ω	±0.7% rdg ±2 dgt	Open terminal voltage 0.45V >
	2 kΩ	1Ω		
	20 kΩ	10Ω		

	Range	Resolution	Accuracy	Notes
OHMS	200 kΩ	100Ω	±0.7%rdg ± 2dgt	Open terminal voltage 0.45V >
	2000 kΩ	1kΩ	±1.0% rdg ± 2 dgt	
	20 MΩ	10kΩ	±2.0% rdg ± dgt	
DCA	20 μA	10nA	±1.0%rdg ± 1dgt	Int. resistance approx 10kΩ
	200 μA	100nA		1kΩ
	20 mA	10μA		100
	200 mA	100μA		10
	10 A	10mA	±1.2%rdg ± 1dgt	< 15mΩ
ACA	20 μA	10nA	±1.5%rdg ± 4dgt	approx 10kΩ 40 ~ 500Hz
	200 μA	100nA	±1.2%rdg ± 4 dgt	± 1kΩ 40 ~ 1kHz
	20 mA	10μA		100
	200 mA	100μA		10
	10 A	10mA	±1.5%rdg ± 4 dgt	< 15mΩ 40 ~ 500Hz

Models
Protected up to AC 250V : 3200, 3200-01 (With carrying case)
Protected up to AC 600V : 3200-50, 3200-51 (With carrying case)

General Specifications
Display: 3½ digit LCD, maximum reading of 1999, autopolarity, unit and other annunciators.
Ranging: Auto and manual.
Overrange Indicator: "1" in MSD column blinks, audible tone. (No tone for Ohms, no indicator or audible tone for DC 1000V, AC 750V, 10A.)
Battery Low Indicator: BATT mark lights.
Sampling Rate: 2 per second.
Continuity Test & Diode Test
Environmental Conditions: (Operating) 0-40°C (<80% RH (No condensation)

Maximum Allowable Input: Volts DC 1100V or DC + AC peak. Ω, μA, mA, Cnty, →|←: AC 600V max. (10A fuse) 10A range: No protection.
Power Source: Two size AA (SUM-3) batteries. Life: 500 hours (continuous use)
Dimensions: 160H × 85W × 32.5D (mm), 310g
Accessories: Test Leads, Fuse 3200-50 0.5A 1A, 9145 Carrying case supplied.
Option: 9038 HV probe.

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resoldered every connection before replacing it.

That was six months ago and the set has performed perfectly ever since. I'll never really know whether it was a socket or a bad solder joint, but my money would have to be on the socket. These devices may make servicing easier but, at the same time, they seem to introduce more than their fair share of faults.

A FEW COMMENTS

And that is my friend's story. I feel that it is not only interesting and informative, but thought provoking as well. I will comment more on that last point in a moment. In the meantime I should like to comment on the technical aspects, and the manner in which he tackled the problem.

First, I think that full marks are due for appreciating the need to differentiate between brightness and contrast, and the ability to tell the difference. This difference is far too subtle for most non-technical customers, and their descriptions of intermittent faults are rendered so much less valuable as a result.

The idea of connecting a meter to the set, while continuing to use it, is also worthy of comment. While it may not be anything new at the professional level, it was an original thought as far as my friend was concerned.

And monitoring the AGC voltage – also an original thought as far as he was concerned – deserves full marks. Again, it is not a new trick, but any up and coming young serviceman should take careful note, because it is a very handy one.

In fact, its use goes way back before the days of TV, to the time when intermittents in radio receivers was our biggest bugbear. These, in their way, could be just as time consuming as the ones we get today and the AGC measurement was a valuable technique. The advantage was – and still is – that it indicated immediately if the change in gain was occurring before or after the point at which the AGC voltage was derived. In the case of a radio set it just about halved the number of suspect components.

In fact, I first mentioned this trick in these notes way back in 1951, in the March issue to be exact. It concerned a set with markedly varying volume and which had come to me after several other professional servicemen had tried and failed.

The AGC check indicated that it was in the front end and this was ultimately confirmed when I uncovered – literally – two internal connections of the second IF transformer, encased in protective wax, which had never had a soldering iron near them. It took about a week to find and two minutes to fix.

But to return to my friend's story. I feel that it is thought provoking in that it poses the question as to just how a fault of this nature should be tackled at professional servicing level.

How would you tackle it?

Come to that, how would I tackle it?

The point is, of course, that it is the kind of fault that can only be tackled by "living with it". But how many servicemen, or service organisations, are geared to tackle such a fault on this basis? It is not sufficient to sit it in a corner of the workshop and let it run till it fails because, as we have seen, it seldom lasted for more than a few seconds. An occasional glance is not good enough, and who can afford to sit and watch it for hours at a time.

Take it home and put it in the lounge room in place of the regular set? Well, that has been done, but it is not always as convenient as might be imagined and the Mrs Serviceman involved may not be too happy. And, in any case, it would be useful only while the serviceman himself was watching it – and how many of us have time to watch TV!

And even if such an approach is practical, what about the customer? Is he going to be happy without his set for a couple of months while all this sleuthing is going on? Loan him a set? Well, yes, but this is not always convenient either, and may actually cost money.

Granted, some of the more experienced among us may have suspected the IC sockets from the start and cured it on a routine basis. But supposing it wasn't the IC sockets. Supposing it had been a dry joint, what then?

The point is that there are faults which are so elusive that our regular approach to servicing is not really equal to them. And I'm not being critical when I say this, merely factual.

I don't have the answer either.

CURRENT TECHNOLOGY

This is the sensational new Hioki 3211 Pen – DMM, a technological breakthrough in digital multimeters.

Designed to be held in one hand like a large pen, it is extremely useful for trouble shooting and maintenance work on computer systems and other microcircuits.

The controls and display panel have been positioned according to results from research into human engineering.

The Hioki 3211 Pen – DMM even has a display hold function. This way, you can take readings after the meter has been removed from a point that's difficult to reach.

But you won't really know how good it is until you give it a try.

Special introductory price **$78.** Normally $92. *Plus Sales Tax.

Specifications

Display: 3 ½-digit, maximum reading of "1999", autopolarity, unit and other annunciators.
Ranging: Auto.
Overrange Indicator: "1" in MSD column blinks.
Battery Low Indicator: BATT mark lights.
Sampling Rate: 2 per second.
Environmental Conditions (Operating): 0 – 40°C, < 80% RH.
Maximum Allowable Input: Volts; 700 VDC or DC + AC peak. Ω/Cnty.; 250 VAC max.
Dielectric Strength: AC 2000 V/1 min (between input terminals and case).
Power Source: Two SR-44 or LR-44 batteries. Battery current approx. 3mW.
Dimensions: 163L x 19W x 28H (mm).

Measurement Range and Accuracy

(Specified for 23°C ± 5°C < 80% RH, no condensation)

	Range	Resolution	Accuracy	Notes
DC V	2V	1mV	± 0.5%rdg ± 4dgt	Input resistance approx. 12MΩ
	20V	10mV	± 0.7%rdg ± 4dgt	approx. 11MΩ
	200V	0.1V		
	500V	1V	± 1.0%rdg ± 4dgt	
AC V	2V	1mV	± 1.0%rdg ± 8dgt	Input resistance approx. 12MΩ (40Hz to 500Hz)
	20V	10mV		approx. 11MΩ
	200V	0.1V		
	500V	1V		
OHMS	2kΩ	1Ω	± 0.7%rdg ± 4dgt	Open-terminal voltage < 0.45V
	20kΩ	10Ω		
	200kΩ	100Ω		
	2000kΩ	1kΩ	± 1.2%rdg ± 4dgt	
Continuity Test				Open-terminal voltage 1.5V (approx.)

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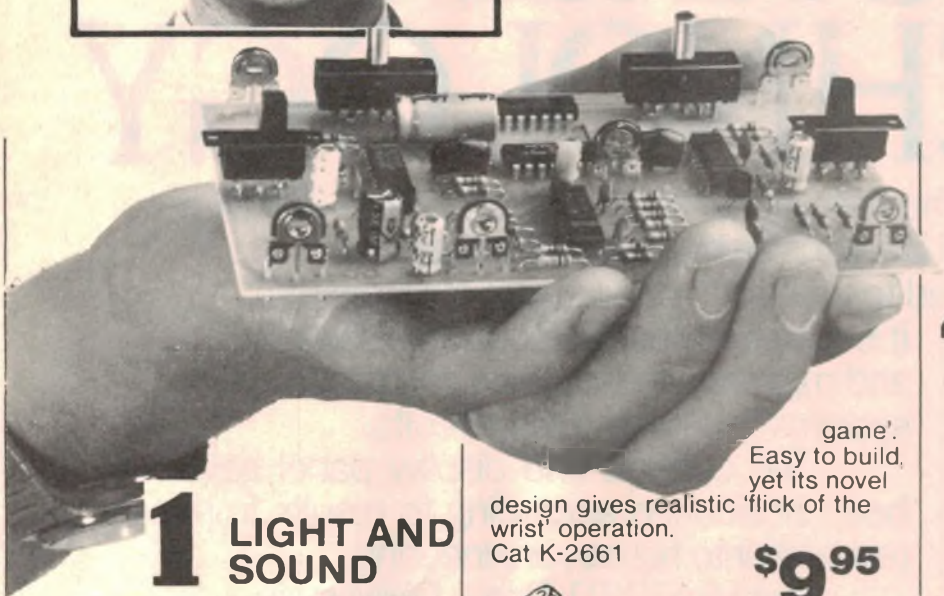

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Not just one project, but many! You can use it to produce all sorts of sound effects, to flash lights, as a strobe, as a continuity tester, even a Morse Code practice set. Simple and easy to build, too.
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Put yourself in the winner's circle with this space-age electronic version of Australia's 'national game'. Easy to build, yet its novel design gives realistic 'flick of the wrist' operation.
Cat K-2661

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3 CRICKET

Put this project in a quiet, dark place, and it starts chirping; turn on the light or make a noise, and it stops! Infuriating - just like a real Nocturnalis Stridulus Gryllidae (Cricket to you). Cat K-2663

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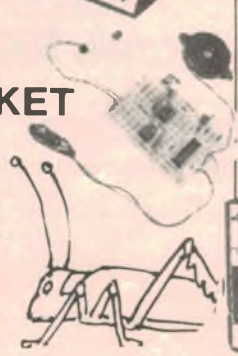

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Just the shot for turning your headphones-type 'Walkie' stereo or FM radio into a full speaker system for your bedroom! Or you can use it as an amplifier for a loudhailer or mini PA system.
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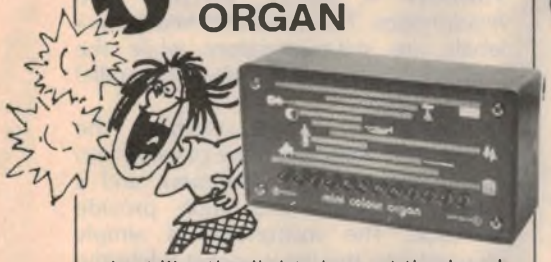

Just like the light show at the local disco. Connects to your radio or cassette recorder, adds an extra dimension to your musical entertainment. Easy to build and can be battery operated, so it's safe.
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$12.95

7 COMBINATION TIME LOCK SWITCH

Use it as a combination lock for a burglar alarm, or as a challenging 'brain teaser' party game. Just try cracking the combination without setting off the alarm! It's really good.
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8 LI'L POKEY

Just like the one-arm bandits at the club! A barrel of fun to play, but you won't risk losing your shirt or your pocket money. A satisfying project – your friends will be most impressed!
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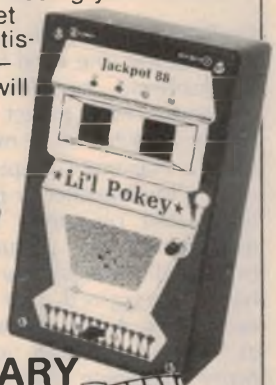

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A lot harder to play than it looks – just try it and see! Tests your reaction time, also helps you learn binary numbers. Four levels of skill. Easy to build, battery operated for safety.
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Incredible – a real music synthesiser, with decay, frequency doubling and halving, tremolo Its really unique feature is that YOU become the note generator! Whistle, hum or sing and see what interesting effects you produce!
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* Please note: all projects shown with optional cases. The labels shown are all printed in the Fun Way 3 book.

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A682/LL

Headphone amplifier

Practise without annoying the family

If you play any type of electronic musical instrument, this headphone amplifier will surely interest you. It will let you practise for hours without upsetting the household, or you can use it to monitor your own instrument in the midst of a rowdy jam session.

Whenever a number of musicians are playing together, a problem arises with their relative volumes. Each musician wants to hear his own instrument or voice above the others. The problem is more severe with instruments which are intended only as background – the musician simply can not hear himself. "Live" bands usually overcome this problem by using "foldback", with a small speaker aimed at each performer in addition to the larger units aimed at the audience. This allows each performer to monitor his own sound without the need for excessive volume.

A different approach is used in recording studios where each performer wears a pair of headphones. This virtually eliminates direct ambient sounds. The console operator can then control exactly how much ambient and how much foldback each performer gets. We are not suggesting that this headphone amplifier has a place in recording studios, but it is an economical way for low budget bands to derive more pleasure from their activities.

If the circuit for this project looks familiar, you're right – it's virtually the same as the one used for the parabolic microphone project described in November 1983. In fact, this type of low power amplifier has a multitude of uses. With a maximum output of 1W, it can drive a loudspeaker or headphones. For the stated objectives of this project, though, 1W into a loudspeaker would be virtually useless. For this reason we have designed for headphones exclusively. A pair of headphones driven at only a hundred milliwatts would prove deafening for most people so a 1W capability is ample.

Construction is simple, with most of the parts mounted on a small printed circuit board. This is mounted together with the various input/output jacks and front panel controls in a small plastic "Bimbox" case measuring 105 × 135 × 55mm (W × D × H). With its sloping front panel, the case looks just right for this project – certainly better than a zippy box.

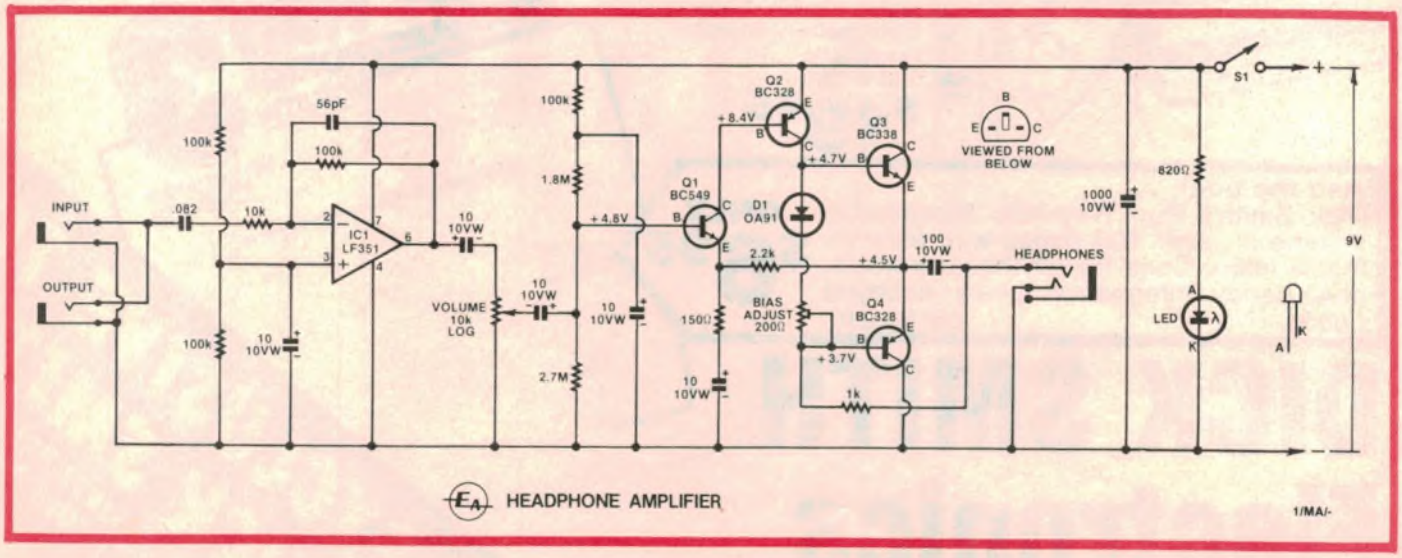
Front panel controls and facilities have been kept to a minimum. On the sloping panel of the case, we have an on/off switch, a LED indicator and, to the right, a volume control. Above these, on the top of the case, are three RCA jack sockets – input, output and headphones. The input and headphone labels are self-explanatory while the output socket is simply wired in parallel with the input.

This latter feature enables the Headphone Amplifier to be patched into circuit between the instrument and a power amplifier and thus provide foldback. The instrument is simply plugged into the input socket while the signal for the power amplifier is taken from the output socket. Operation of the instrument/amplifier combination is unaffected by the Headphone Amplifier.

Modern lightweight headphones are the most suitable when using the amplifier in the foldback or monitor role. Those of "open-air" construction only partially exclude ambient sounds and thus offer the musician the best effect. Watch the power rating though, as many have a very low rating and are easily driven into overload by the high signal transients generated by the plucked strings of a guitar.

How it works

As stated, the circuit is essentially the same as that used for the parabolic microphone project – an op amp input stage followed by a direct coupled transistor power amplifier. There are, however, a few minor changes to adapt



HEADPHONE AMPLIFIER

1/MA/-

for musicians

by COLIN DAWSON

PARTS LIST

1 PCB, code 83 ma11, 68 × 51mm
1 plastic project box ("Bimbox" No. 6005 or similar)
1 Scotchcal front panel label, 102 × 140mm
1 SPST toggle switch
6 1.5V batteries (Eveready AA or equivalent)
1 battery holder to suit
1 battery snap connector
1 stereo audio socket to suit (3.5 or 6.5mm)
2 mono audio sockets (6.5mm)
1 3.5mm socket for plugpack transformer (see text)
1 knob to suit volume control
1 rubber grommet

SEMICONDUCTORS
1 LF351, TL071 FET input op amp
2 BC328 PNP transistors
1 BC338 NPN transistor
1 BC549 transistor
1 OA91 germanium diode
1 red LED

CAPACITORS
1 1000μF/10V electrolytic
1 100μF/10V electrolytic
4 10μF/10V electrolytic
1 10μF/10V axial electrolytic
1 .082μF metallised ployester (greencap)
1 56pF ceramic

RESISTORS (¼W, 5% unless noted)
1 x 2.7MΩ, 1 x 1.8MΩ, 4 x 100kΩ, 1 x 10kΩ, 1 x 2.2kΩ, 1 x 1kΩ, 1 x 820Ω, 1 x 150Ω, 1 x 10kΩ log potentiometer, 1 x 200Ω small horizontal trimpot

MISCELLANEOUS
Hook-up wire, shielded hook-up wire, screws, nuts, scrap aluminium, solder etc.

the circuit to its new role. In particular, the electret microphone and its associated 4.7kΩ bias resistor have been deleted.

Signals from the instrument are AC coupled to the inverting input of IC1 via a .082μF capacitor. The non-inverting input (pin 3) is connected to the mid-point of a voltage divider consisting of two 100kΩ resistors connected across the supply. This biases pin 3 at half the supply voltage.

IC1, an LF351 FET-input type, operates as an inverting amplifier with a gain of 10. A 56pF capacitor connected in parallel with the 100kΩ feedback resistor restricts the bandwidth of the op amp so that it will not respond to RF signals picked up by the input leads. The output from pin 6 is AC-coupled to a 10kΩ volume potentiometer and applied to the base of transistor Q1.

The base of Q1 is biased to around 4.8V by a divider network consisting of 1.8MΩ and 2.7MΩ resistors. There is also a 100kΩ resistor connected in series with these bias resistors and this, in conjunction with the 10μF capacitor, decouples the bias network from any signal present on the supply line.

The series resistor and capacitor in the emitter circuit of Q1 provide AC negative feedback, limiting the response below 100Hz. DC negative feedback is provided by the 2.2kΩ resistor between Q1's emitter and the output.

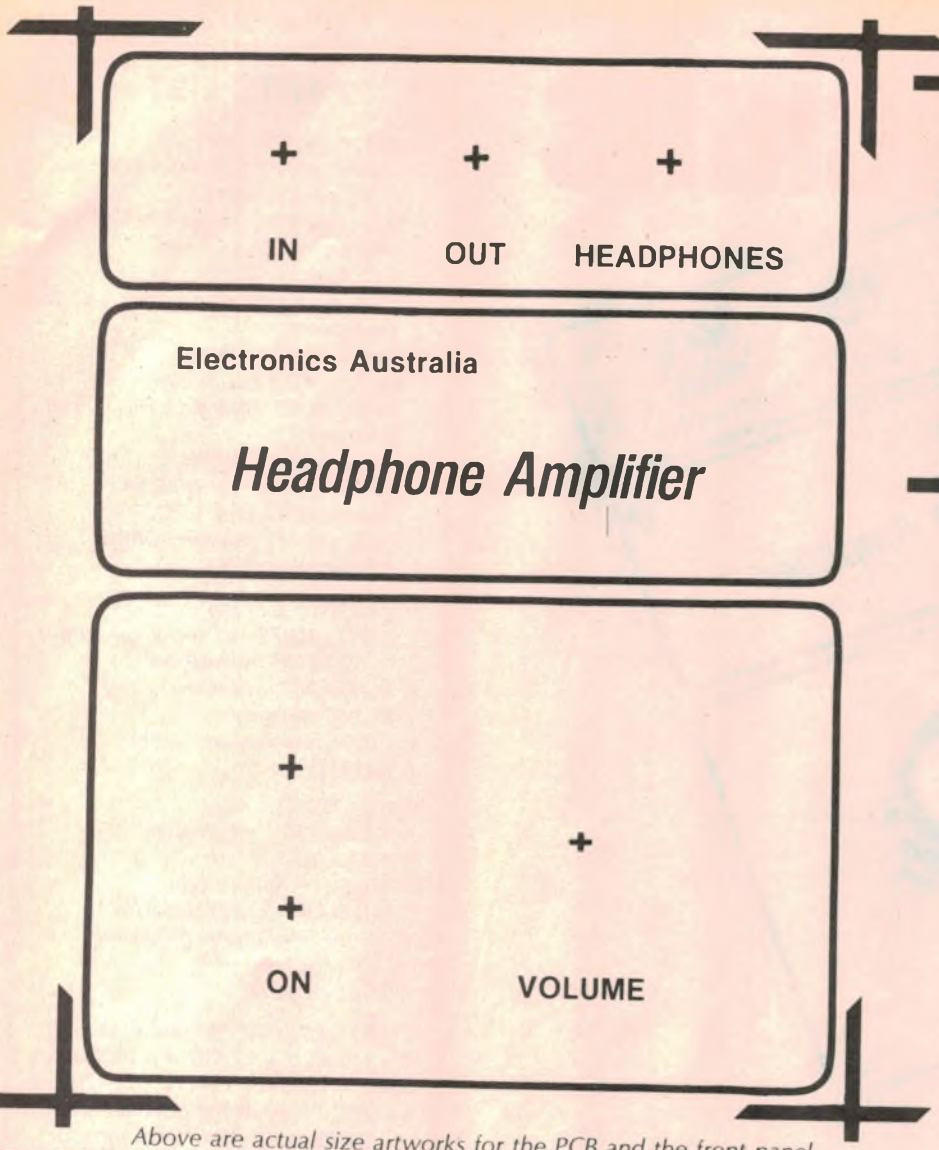
Q1's collector is direct coupled to the base of Q2, a BC328 NPN transistor. This in turn drives a complementary output stage consisting of transistors Q3 and Q4. An adjustable bias control consisting of a 200Ω trimpot and a series germanium diode (D1) is connected between the bases of Q3 and Q4 and allows the quiescent current in the output stage to be adjusted for minimum crossover distortion.

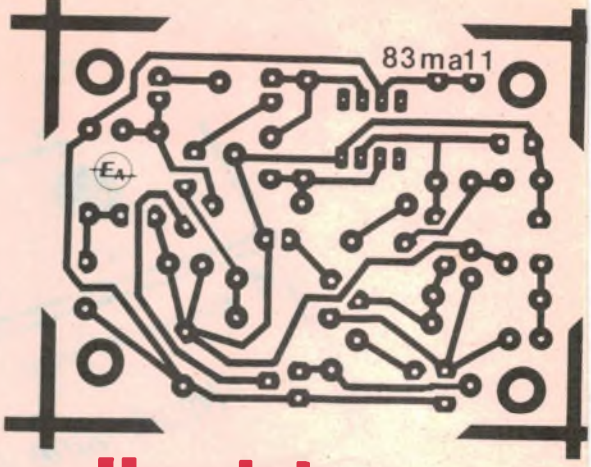
With the trimpot set to least resistance, the quiescent current will be at a minimum and the overall current consumption will be around 15mA. At this setting however, crossover distortion will be quite apparent. This problem can be overcome by adjusting the trimpot to give an overall consumption of about 20mA.

The output signal is taken from the junction of the emitters of Q3 and Q4 and AC-coupled via a 100μF capacitor to the headphone socket. This arrangement prevents any current from flowing in the load unless there is an input signal.

Power for the circuit is derived from a 9V plugpack supply or from a 9V battery pack consisting of six 1.5V penlight cells. The supply is filtered by a 1000μF capacitor while power on/off indication is provided by a LED wired in series with an 820Ω resistor across the supply. Do not use a single 9V "transistor" battery – it service life will be much too short.

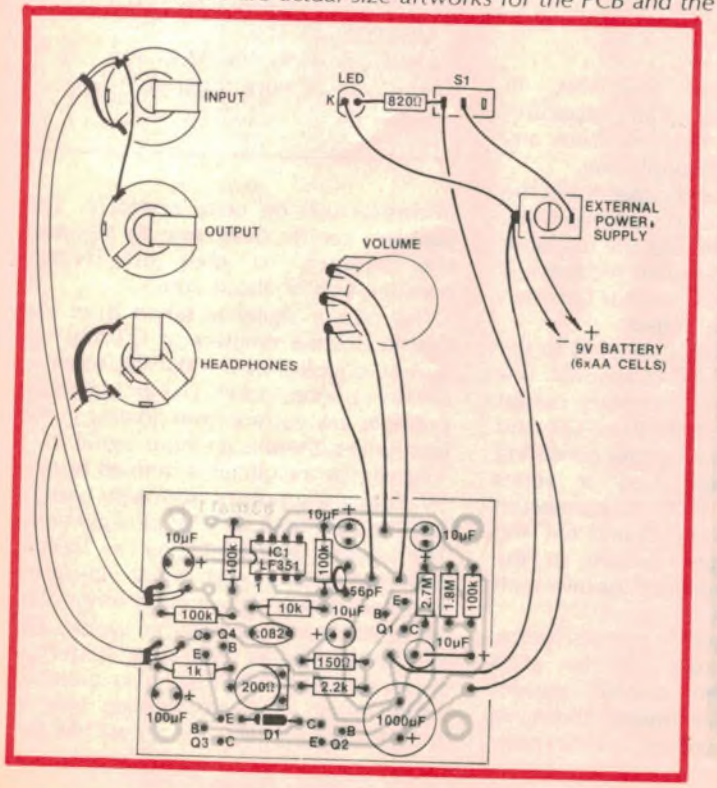
One point worth considering here is that the LED accounts for almost half the





Headphone Amplifier

Above are actual size artworks for the PCB and the front panel.



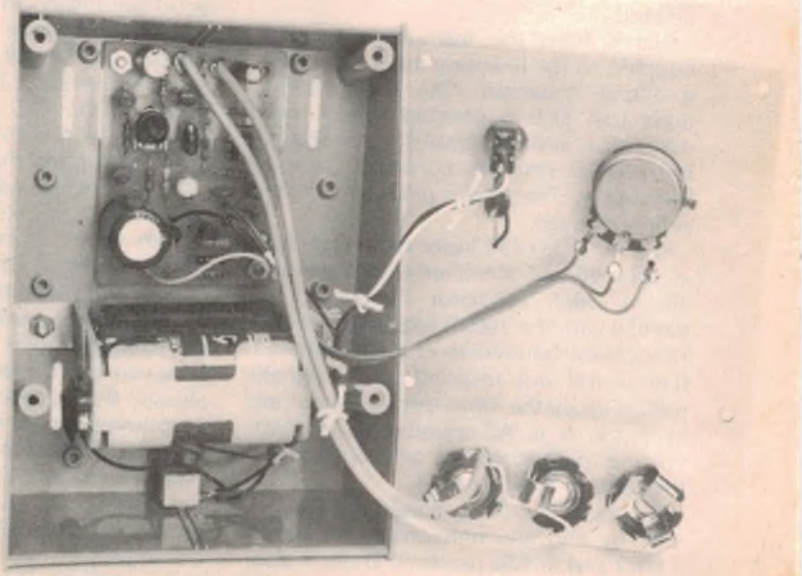
total current drain of the circuit. Some readers may therefore prefer to delete the LED, particularly if the unit is to be operated for long periods on battery power alone.

Construction

Most of the parts are mounted on a small printed circuit board (PCB) coded 83ma11 and measuring 68 × 51mm. Begin construction by mounting the parts on the PCB according to the overlay diagram, with particular attention to polarised components.

This done, spray the Scotchcal label with a hard setting lacquer, then carefully attach it to the front panel of the box. The front panel holes can now be drilled and the various hardware items mounted in position.

Note the use of shielded cable for connections to the input and headphone sockets. Take care with component orientation.



We estimate that the current cost of parts for this project is approximately

$28

This includes sales tax.

The input and output sockets should both be 6.5mm mono types, but the headphone socket should be selected to suit your headphones. In most cases this will be 6.5mm stereo, although some lightweight headphones use a 3.5mm stereo plug. Note that the load impedance should not be less than 8Ω. This means that the headphone socket must be wired so that, when the headphones are plugged in, the transducers will be in series.

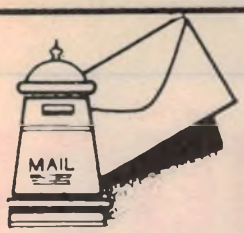
Make sure that none of the terminals on the headphone socket contact the front panel, otherwise an earth loop will develop, possibly resulting in instability. Usually, the fascia of the socket is connected to its earth terminal – unless it is a plastic body type socket. We used a conventional metal socket but isolated it from the front panel with a large rubber grommet.

We used a 3.5mm jack socket to suit our plugpack supply, but this may not necessarily suit other plugpacks. Note that the plugpack socket must be a changeover type which disconnects the batteries when the plug is inserted. Mount it low on the rear panel to ensure sufficient clearance for the front panel jack sockets.

The wiring can now be completed according to the wiring diagram. Shielded cable must be used for connections between the PCB and the front panel jack sockets while light duty hookup wire or rainbow cable can be used for the remaining connections. Once the wiring is completed, the PCB can be mounted on the floor of the case using machine screws and nuts. The battery pack sits between the PCB and the rear of the case and is secured by a bracket made from scrap aluminium.

Before switch on, set the 200Ω bias trimpot fully anti-clockwise and set the volume to minimum. Now check that the LED illuminates when the unit is switched on. If not, trace the problem before proceeding. Plug in a guitar and advance the amplifier volume control until the volume is at a comfortable level.

Finally, the bias control should be used to reduce the crossover distortion by adjusting the trimpot in a clockwise direction. In practice, it is sufficient to simply advance the trimpot until the ear can no longer detect distortion. Advancing the control further will only serve to shorten the battery life.



Letters to the editor

Thomas Edison — another version

In reply to G. Nichols comments "The Myth of Edison" in Letters to the Editor in EA December 1983, I am afraid Mr Nichols is unaware of quite a few things. Undoubtedly the comments by J. L. Elkhorne concerning Edison, in his article on Nikola Tesla, in the September issue, are correct. Attached are copies of a few pages from Francis Jehl's "Menlo Park Reminiscences" dealing with the successful fabrication of a carbon filament which finally expired on October 21, 1879 (Edison Lamp Day) after burning continuously for about 44 hours.

Jehl was one of Edison's young assistants at the time (he was then 19 years of age) and his account of the experiment is written in the first person, since he took some part in the experiments.

Turning to the comments on Swan, it is also true that in the period between 1878 and 1880 Swan's experiments in England ran closely parallel to those of Edison and his team at Menlo Park. Some claim indeed that Swan anticipated Edison in the use of "parchmentised cotton thread". (Glazebrook, Dictionary of Applied Physics.) It was an issue never fully resolved and still remains very much which side of the Atlantic you support.

However, there were patent claims on both sides and it was apparently the clash of these claims, very bitter for a time, that was finally settled, very sensibly it would seem, by the formation of the Edison-Swan Electric Light Co. This association continued quite successfully for over 20 years, or until the metallised carbon filament was patented by GE USA in 1904, followed in 1906 by GE's invention of ductile tungsten which finally lead to the tungsten filament lamps which we use today.

I trust these details will prove of interest.

R. L. Burns,
Turramurra, NSW.

Nikola Tesla

Apropos of Nikola Tesla, the following which appeared as editorial comment in one of the issues of "The Electrician" for 1904, may be of interest.

"No one will deny that Mr Tesla possesses genius – his valuable work in connection with polyphase methods alone demonstrate this. But from the soil of his genius have sprung up two varieties of dangerous weeds – a craving for notoriety and dreams of ultimate possibilities – and these have grown so thickly that it requires a skilful gardener indeed to discover the fruit."

D. C. Sutherland,
Wanganui, NZ.

More on the origin of Murphy's law

I have just read Ronald W. Fiegert's letter in the December EA concerning the origin of Murphy's Law, a subject on which there has been a lot of recent press comment, most of it badly misinformed.

Mr Fiergert, at least, has got part of it right: the purpose of Murphy's Law was to encourage the design of equipment that could not be wrongly assembled. In its original form, Murphy's Law said simply, "If an aircraft part can be installed incorrectly, someone will install it that way". It was invented (c 1950) by a US Navy Chief Aviation Machinist's Mate named Murphy, but the whole idea behind it was to insist on foolproof design practice and ferret out any examples that didn't meet these standards.

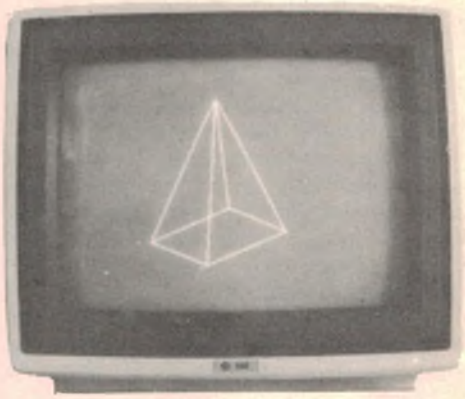
The Navy's safety office was so serious about it, in fact, that for a number of years they resisted all attempts to broaden the definition of the law and, at every chance they got, insisted the law meant only what it said. Anyone who is seriously interested in tracing Murphy's law to its source could start with such semi-official publications as Naval Aviation News, in which there were numerous references to it in the early 1950's.

D. Call,
Ipswich, Q.

Low cost TTL circuit for any computer

High resolution

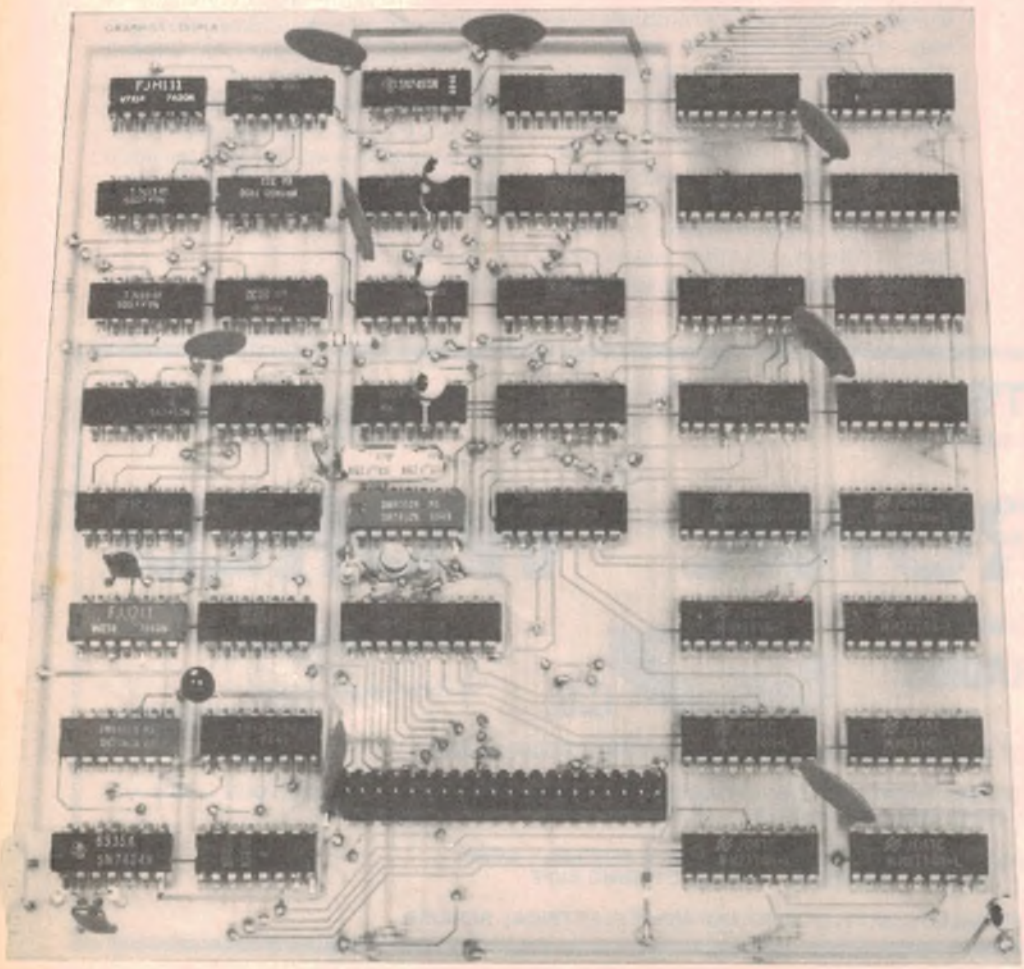
This article describes the design and construction of a high resolution graphics interface. The circuit provides a resolution of 256 x 256 pixels in black and white and can be added easily to any computer, although the software provided here is for Z80-based machines.



This on-screen display was drawn using the pyramid program on page 81.

Many computers sold today have some sort of graphics display available either built in or as an optional extra. These displays vary in resolution and format, from "chunky" graphics to character-generated graphics and are an integral part of the video display section of the computer, often using the same memory that it used to store the character information. However, there are many computers that don't provide graphics at all or if available as an accessory the graphics are fairly expensive. The graphics display described here will provide a computer owner with high resolution graphics at a reasonably low cost.

This unit generates its own composite video and only requires connection to the address bus and data bus of the host computer. The connection to the computer is identical to adding an 8K memory expansion board and the board can be used as extra memory when the display is not required. The fact that it generates its own composite video (ie display information and sync pulses) means that a video monitor is needed but this can be the one used by the computer. Sharing this monitor with the graphics display can be achieved by switching the composite video either by a manual switch or by a relay controlled by software.



Resolution of the display is 256 x 256 pixels, that is, 65536 individual points, representing 8K bytes of RAM. From the circuit diagram it can be seen that this pixel information is presented as an 8 bit word to the 74165 shift register (IC9) and is then clocked out serially at a 6MHz rate. The shift register inputs are connected directly to the RAM data bus with the data direction being controlled by a bidirectional bus driver, IC17, a 74LS245.

Normally, the RAM is held in the read mode and is continually addressed by the four 7493 counters, ICs 19, 20, 21 and 22, which have priority over the computer address bus. The counters are incremented after the data is loaded into the shift register so data is continually clocked out to the video monitor. Whenever it is required to write data into RAM, the four 74157 multiplexer ICs 24, 25, 26 and 27 are switched to the computer address bus and data is directed into RAM via the data bus driver. The multiplexers and data bus driver are controlled from the enable line which should be a decoded input from the computer to select a block of 8K of RAM. The only other control line required is the R/W line which should be

The circuitry is all contained on a double-sided PCB. PCBs will be available from the usual suppliers, although not necessarily plated-through.

by MICHAEL O'NEILL* *Department of Physics, University of Newcastle

graphics display

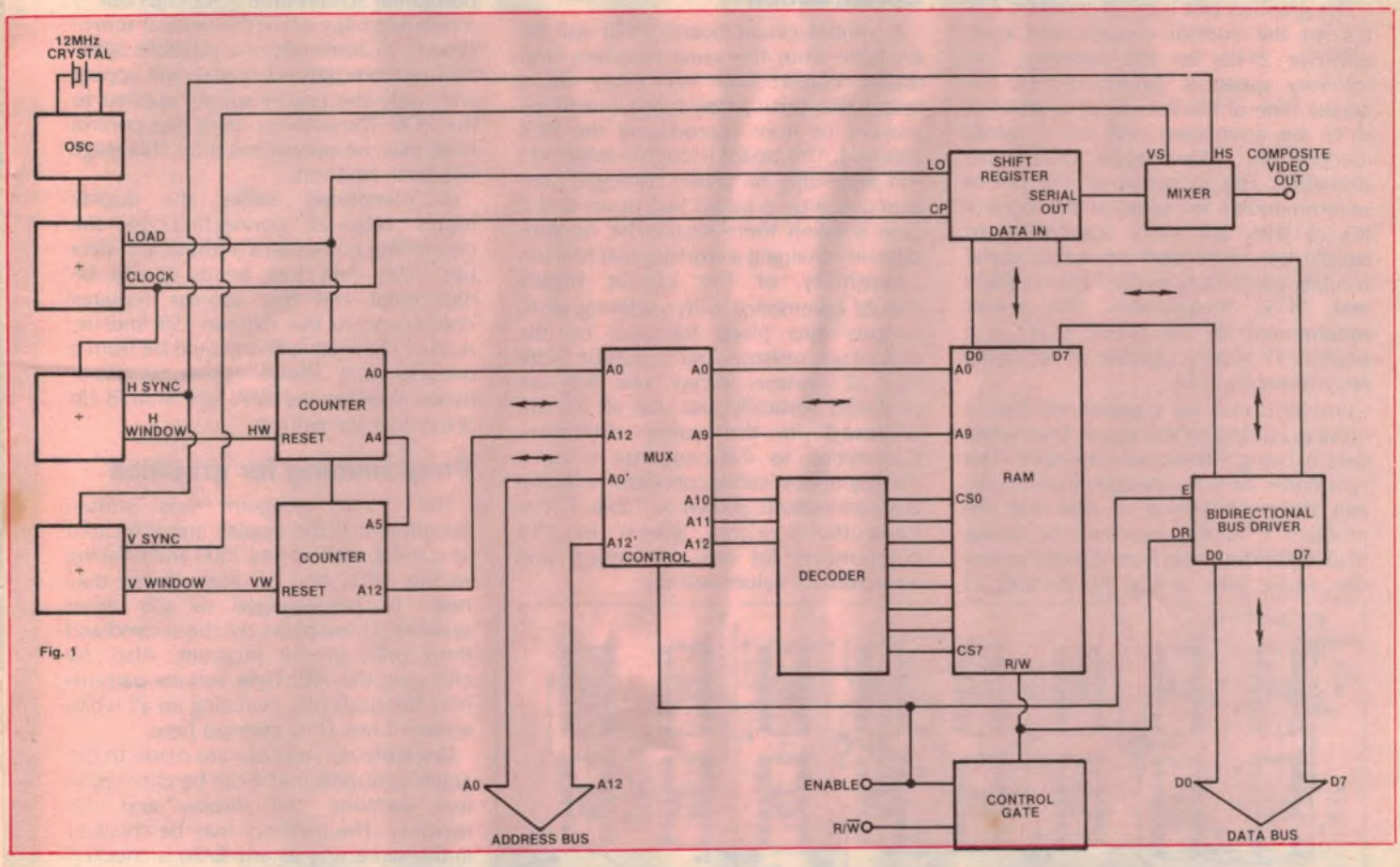


Fig. 1

Fig. 1: basic scheme for the new graphics display unit. Resolution is 256 × 256 pixels.

active low for writing data into memory.

Since the data in RAM is fed out as an 8-bit word and clocked out serially as video information, the resulting picture on the monitor screen is built up depending on which bits of each byte are set to a logic "one" level. Each byte controls eight pixels and a total of 32 bytes is clocked out to form a horizontal video line of 256 bits, with 256 of these lines to provide a full screen. Therefore if memory was loaded at address hex X000 with hex FF, a short horizontal line (eight pixels long) would appear in the top lefthand corner of the screen while if hex FF were loaded into address hex XFFF the same line would appear at the bottom righthand corner of the screen. A dot at the lefthand side of the screen would appear if hex 01 was the data byte while a dot eight pixels to the right would require the data byte hex 80 to be written in. The "X" in the address indicates that the most significant hex digit of the address depends on where the 8K video memory is located in the computer's address space. The last byte of the screen memory will be the starting address plus 2000 (in hex).

Timing for the graphics display is derived from a 12MHz TTL oscillator which is divided down by the counter ICs 2, 3 and 5 to produce a frequency of 15,625Hz. From these counters a horizontal window pulse (HW) and a horizontal sync pulse (HS) are produced. The horizontal sync pulses are then counted by counter ICs 6, 7 and 16. When a count of 312 is reached these counters are reset, thus producing a frequency of 50Hz to provide a vertical window pulse (VW) and a vertical sync pulse (VS).

The sync pulses are gated by IC14 to produce composite sync, while the window pulses are gated with the serial data from the shift register for blanking. These signals are then mixed by transistor Q1 to produce the composite video signal. A delay was required in the serial data line from the shift register to compensate for the delay of the clock pulses through counter ICs 2, 3, and 5, which generate the horizontal window pulses. Both window pulses are also used to reset the memory refresh counters, ICs 19, 20, 21 and 22, to synchronise the whole system.

With the values of resistors R3-R6 given in the circuit diagram the composite video signal level is much higher than the CCIR standard. This level has been chosen as it is sometimes required when an RF modulator is used to feed the signal to a television receiver. This higher signal level is also an advantage if the video is fed directly into the video amplifier of a TV set as no alterations then have to be made to the TV circuit. In fact the TV circuitry often attenuates this video signal to its normal level. If the signal level is too high it can be modified

High resolution graphics display *continued*

by reducing the value of resistor R4 which will reduce the overall level with a slight variation in the sync-to-video ratio. R5 may also be varied which will affect the amplitude of the video signal and thus the brightness of the TV picture.

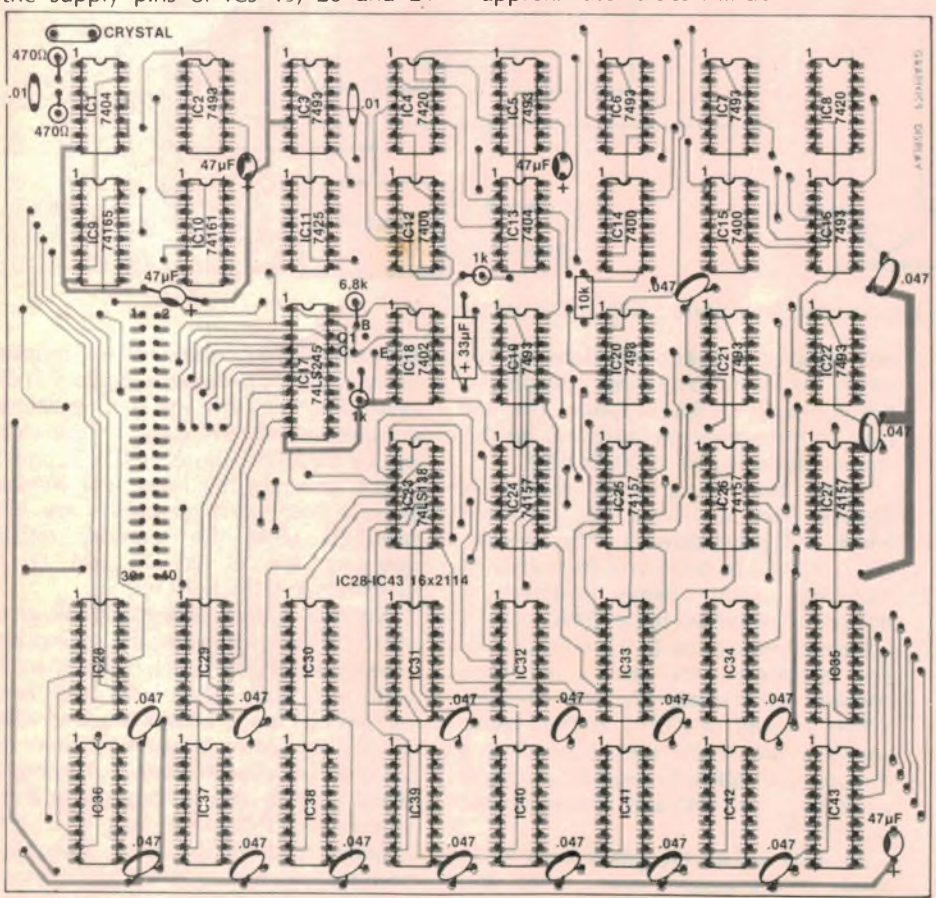
The graphics unit uses all standard TTL ICs for the control circuitry and cost-effective 2114s for the memory. The memory speed is determined by the access time of the computer to which it is to be connected and for a safety margin the 250ns type would be desirable. The LS series of TTL is not recommended for most of the control ICs as they are more susceptible to supply line noise and can cause some trouble, particularly in the 7493 counters and 74157 multiplexers. The power requirement for the circuit board is a single +5V supply capable of supplying approximately 1.2A.

Problems may be experienced due to noise occurring on the supply lines while data is being written into memory. The symptoms are a momentary loss of sync and incorrect writing of data but the problem is easily overcome by wiring 47μF tantalum capacitors directly across the supply pins of ICs 19, 20 and 21 (between pins 5 and 10). These capacitors may not be required if low power memory chips (2114N-L) are used because these chips produce a lower voltage drop.

Construction

A printed circuit board (PCB) will be available from the usual suppliers, and makes construction very easy at a reasonable price (note: space limitations prevent us from reproducing the PCB artwork). This board is double-sided and will preferably be plated through. Construction time is about two hours and if care is taken there should be no problem in obtaining a working unit first off.

Assembly of the circuit board should commence with soldering all IC sockets into place followed by the capacitors, resistors and transistor. Note that all resistors except one (R6) are mounted vertically and that all ICs are oriented in the same direction. Connection to the computer is via a 40-way ribbon cable connector with the pin connections shown in Table 1. The capacitor values given in the components list are not critical and approximate values will do.



This parts location diagram shows the copper pattern on the component side of the board. Note that all the ICs face in the same direction. Don't forget to solder on both sides if the PCB does not have plated-through holes.

On applying power to the display board the monitor should display a screen of random dots and lines within the window area of the screen. The window area should be well within the viewing area of all TV sets as the horizontal screen time is 42.66μs out of a possible 64μs while the vertical screen time is 16.38ms out of a possible 20ms. This random pattern display will appear with only the power supply applied to the PCB. The address, data and control lines may be connected after this stage has been reached.

As mentioned earlier, the display board requires connection to the controlling computer's address and data bus. The data bus needs to be bi-directional and the address requires connection to the thirteen LSB lines ie, A_0-A_{12}. The enable line should be from a decoder that allows access to 8K of memory while the R/W line should be active low for writing.

Programming for graphics

The "clear" program was written assuming that the display unit is located at starting address hex 1000 and finishing at hex 2FFF, and so these bytes may need to be changed to suit other systems. These bytes are the second and third ones in the program. Also, by changing the fifth byte various patterns may be displayed, including an all white screen if hex FF is inserted here.

Once the connections are made to the graphics display unit it can be checked in two sections; the display and the memory. The memory may be checked in the same way as any RAM is checked in a computer, and if this works the data written into RAM should appear on the screen. With the random display pattern appearing on the monitor it may be difficult to see new data being written to it and so this points to the next step in using this graphics display unit; writing the software for it. There is no better starting place than to write a program that clears the screen. This is best done in machine language as it will clear the screen almost instantly and a copy of such a program is provided here written in Z80 machine language.

Once this program is running successfully the second program may be tried. This program was written in Basic to demonstrate how a dot position can be calculated from two X, Y coordinates. A short machine language routine is used with this program to actually place the data into the correct location in the graphics memory. When running this program (called "DOT") the user inputs the X and Y values ranging from 0 to 255 and a dot will appear at that point on the

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

— MICROPROCESSOR —	
420306565-00	28.18
420306573-00	25.22
420306617-00	54.83
420306618-00	19.38
420306619-00	19.38
420306675-00	13.87
420306676-00	16.32
420308038-00	8.83
424009011-00	15.87
DP8212N	4.00
DP8216N	3.74
DP8224N	4.80
DP8226N	3.74
DP8228N	8.67
DP8238N	8.67
DP8303N	5.34
DP8304BN	5.34
DP8342N	40.02
DP8343N	40.02
DP8350N	85.38
ICL7209IPA	2.47
ICL8052ACP	2.47
ICL8053ACP	2.47
ICL8212CPA	2.47
ICL8250CPE	2.47
IMP-00M/881	182.12
INS1771N-1	40.02
INS2651N	11.47
INS8060N	20.01
INS8070N	61.48
INS8072N	61.48
INS8040UAN	7.47
INS8250AN	18.97
INS8250N	19.03
INS8250N-B	24.44
INS8251N	7.22
INS8253N	13.40
INS8255D	13.08
INS8255N	6.43
INTEL P8085A	12.65
INTEL P8155	13.83
MM52116FDW/N	18.87
MM5303N	7.45
MM5307AA/N	12.85
MM5307FAG/N	12.87
MM57409N	21.47
MM57499N	10.41
NSC800N-1	12.62
NSC810N-1	15.15
NSC831N-1	11.38
NS16OKIT-96	151.73
NS16032D-6	125.18
NS16081D-6	246.56
NS16082D-6	238.97
NS16202D-6	140.63
SMC COM5016P	23.74
SMC COM8116P	18.54
SMC FDC1793P	18.54
— CMOS —	
CD4000BCN	0.48
CD4001BCN	0.48
CD4001CN	0.53
CD4002BCN	0.48
CD4006CN	1.45
CD4007CN	0.48
CD4008BCN	1.52
CD4009CN	0.80
CD4010CN	0.80
CD4011BCN	0.48
CD4012BCN	0.48
CD4013BCN	0.72
CD4013CN	0.80
CD4014BCN	1.59
CD4015BCN	1.35
CD4015CN	1.19
CD4016BCN	0.87
CD4017BCN	1.45
CD4018BCN	1.33
CD4019BCN	0.80
CD4020BCN	1.64
CD4021BCN	1.52
CD4022BCN	1.52
CD4023BCN	0.48
CD4024BCN	1.04
CD4025BCN	0.48
CD4027BCN	0.68
CD4028BCN	0.95
CD4029BCN	1.65
CD4031BCN	4.05
CD4034BCN	2.75
CD4035BCN	2.17
CD4040BCN	1.64
CD4041BCN	1.69
CD4042BCN	1.16
CD4043BCN	1.21
CD4043CN	1.15
CD4044BCN	1.38
CD4044CN	0.83
CD4046BCN	1.91
CD4047BCN	1.95
CD4048BCN	0.80
CD4049CN	0.79
CD4050BCN	0.63
CD4051BCN	1.28
CD4052BCN	1.28
CD4053BCN	1.28
CD4060BCN	2.41
CD4066BCN	0.72
CD4068BCN	0.29
CD4071BCN	0.48
CD4072BCN	0.48
CD4073BCN	0.48
CD4075BCN	0.48
CD4076BCN	2.11
CD4081BCN	0.48
CD4082BCN	0.48
CD4085BCN	0.36
CD4089BCN	3.02
CD4093BCN	0.73
CD4094BCN	3.09
CD4099BCN	2.65
CD4502BCN	0.88
CD4503BCN	1.01
CD4507BCN	0.88
CD4510BCN	1.61
CD4511BCN	1.52
CD4512BCN	1.28
CD4514BCN	4.54
CD4515BCN	3.52
CD4516BCN	1.64
CD4518BCN	1.64
CD4519BCN	0.80
CD4520BCN	1.64
CD4521BCN	0.94
CD4522BCN	2.40
CD4526BCN	2.17
CD4527BCN	1.93
CD4528BCN	2.17
CD4528BMJ	3.35
CD4529BCN	2.41
CD4538BCN	2.07
CD4541BCN	1.81
CD4543BCN	3.38
CD4553BCN	2.50
CD4555BCN	2.50
CD4556BCN	2.50
CD4583BCN	0.48
CD4584BCN	0.65
CD4723BCN	2.00
CD4724BCN	2.00
MM74C00N	0.48
MM74C02N	0.48
MM74C04N	0.51

MM74C08N	0.48
MM74C10N	0.48
MM74C14N	0.89
MM74C20N	0.48
MM74C30N	0.48
MM74C32N	0.48
MM74C42N	1.72
MM74C48N	2.53
MM74C73N	1.14
MM74C74N	0.93
MM74C76N	1.14
MM74C83N	2.40
MM74C85N	2.40
MM74C86N	0.51
MM74C89N	10.11
MM74C90N	1.68
MM74C93N	1.68
MM74C95N	1.87
MM74C107N	1.20
MM74C150N	4.81
MM74C151N	3.34
MM74C154N	5.12
MM74C157N	3.15
MM74C160N	1.71
MM74C161N	1.60
MM74C162N	1.60
MM74C163N	1.60
MM74C164N	2.00
MM74C165N	2.00
MM74C173N	2.11
MM74C174N	1.62
MM74C175N	1.52
MM74C192N	2.13
MM74C193N	2.13
MM74C195N	1.87
MM74C200N	14.81
MM74C221N	2.67
MM74C240N	2.67
MM74C244N	2.67
MM74C373N	1.44
MM74C374N	3.34
MM74C901N	0.93
MM74C902N	0.93
MM74C903N	0.93
MM74C904N	0.93
MM74C905N	13.75
MM74C906N	0.93
MM74C907N	0.93
MM74C908N	2.00
MM74C909N	3.39
MM74C910N	14.91
MM74C911N	13.87
MM74C912N	13.87
MM74C914N	2.67
MM74C915N	2.32
MM74C917N	13.87
MM74C918N	2.19
MM74C920N	8.92
MM74C921N	6.67
MM74C9212-3	5.20
MM74C922N	6.32
MM74C923N	6.67
MM74C925N	9.34
MM74C926N	9.34
MM74C927N	9.34
MM74C928N	9.34
MM74C932N	1.86
MM74C941N	2.87
MM74C945N	14.58
MM74C946N	14.58
MM74C947N	14.58
MM74C956N	14.58
MM74HC00N	0.72
MM74HC02N	0.72
MM74HC04N	0.72
MM74HC08N	0.67
MM74HC10N	0.72
MM74HC11N	0.83
MM74HC14N	1.15
MM74HC20N	0.72
MM74HC27N	0.72
MM74HC30N	0.83
MM74HC32N	0.99
MM74HC42N	1.33
MM74HC73N	1.01
MM74HC74N	1.01
MM74HC75N	1.20
MM74HC76N	1.01
MM74HC85N	2.05
MM74HC86N	0.93
MM74HCU04N	0.85
MM74HC107N	1.01
MM74HC109N	1.01
MM74HC112N	1.01
MM74HC113N	1.01
MM74HC123N	2.77
MM74HC125N	2.16
MM74HC126N	2.16
MM74HC131N	0.83
MM74HC138N	1.44
MM74HC139N	1.31
MM74HC147N	1.63
MM74HC151N	1.20
MM74HC153N	1.33
MM74HC154N	3.25
MM74HC157N	1.28
MM74HC158N	1.20
MM74HC160N	1.73
MM74HC161N	1.73
MM74HC162N	1.73
MM74HC163N	1.73
MM74HC164N	1.68
MM74HC165N	2.45
MM74HC174N	1.33
MM74HC175N	1.33
MM74HC192N	1.87
MM74HC193N	1.87
MM74HC194N	1.44
MM74HC195N	1.44
MM74HC240N	2.75
MM74HC241N	2.75
MM74HC242N	3.01
MM74HC243N	2.45
MM74HC244N	2.75
MM74HC245N	3.07
MM74HC251N	1.20
MM74HC253N	1.33
MM74HC257N	1.20
MM74HC259N	2.00
MM74HC266N	0.93
MM74HC280N	5.60
MM74HC299N	6.62
MM74HC354N	6.62
MM74HC356N	6.62
MM74HC365N	3.25
MM74HC366N	3.25
MM74HC367N	3.25
MM74HC368N	3.25
MM74HC373N	3.20
MM74HC374N	3.20
MM74HC390N	2.00
MM74HC393N	2.00
MM74HC423N	2.77
MM74HC533N	3.20
MM74HC534N	3.20
MM74HC563N	4.30
MM74HC564N	4.30
MM74HC573N	4.30
MM74HC574N	4.30
MM74HC640N	2.80
MM74HC643N	2.80
MM74HC688N	4.27
MM74HCT240N	3.01
MM74HCT241N	3.01
MM74HCT244N	3.01

MM74HCT245N	3.07
MM74HCT640N	3.07
MM74HCT643N	3.07
MM74HC4002N	0.72
MM74HC4020N	1.87
MM74HC4040N	1.87
MM74HC4049N	1.25
MM74HC4050N	1.25
MM74HC4060N	1.87
MM74HC4075N	0.72
MM74HC4078N	0.83
MM74HC4538N	3.12
MM80C95N	1.01
MM80C96N	1.01
MM80C97N	1.01
MM80C98N	1.01
MM88C29N	3.74
MM88C30N	3.74
— TTL LOGIC —	
DM2502CN	9.46
DM5401	[illegible]
DM7400N	0.51
DM7401N	0.48
DM7402N	0.48
DM7403N	0.48
DM7404N	0.51
DM7405N	0.53
DM7406N	0.80
DM7407N	1.02
DM7408N	0.51
DM7409N	0.51
DM7410N	0.51
DM7411N	0.51
DM7413N	0.64
DM7414N	0.77
DM7420N	0.48
DM7422N	0.48
DM7425N	0.51
DM7426N	0.51
DM7427N	0.51
DM7430N	0.51
DM7432N	0.51
DM7437N	0.75
DM7438N	0.75
DM7440N	0.51
DM7441AN	1.60
DM7442N	0.68
DM7445N	1.25
DM7446AN	1.33
DM7448N	1.33
DM7450N	0.51
DM7451N	0.51
DM7453N	0.51
DM7454N	0.51
DM7470N	0.53
DM7472N	0.53
DM7473N	0.53
DM7474N	0.64
DM7475N	0.77
DM7476N	0.61
DM7483N	2.87
DM7483N	0.91
DM7485N	1.04
DM7486N	0.59
DM7489N	4.09
DM7490AN	0.64
DM7491AN	0.55
DM7492AN	0.80
DM7493AN	0.64
DM7494J	0.75
DM7495N	0.75
DM7496N	0.88
DM74100N	2.28
DM74107N	0.67
DM74109N	0.67
DM74121N	0.64
DM74123N	0.85
DM74125N	0.83
DM74126N	0.83
DM74132N	0.93
DM74141N	1.73
DM74145N	3.17
DM74147N	2.27
DM74148N	1.47
DM74150N	2.16
DM74151AN	0.77
DM74153N	0.77
DM74154N	1.60
DM74155J	3.20
DM74155N	0.77
DM74156N	0.93
DM74157N	0.91
DM74160AN	1.04
DM74161AN	1.04
DM74162AN	1.04
DM74163AN	1.04
DM74164N	1.04
DM74165N	1.09
DM74166N	1.20
DM74170N	2.80
DM74173N	1.47
DM74174N	0.93
DM74175N	0.93
DM74176N	1.38
DM74177N	1.38
DM74180N	1.20
DM74181N	3.20
DM74182N	2.76
DM74184AN	3.87
DM74185AN	3.87
DM74189N	1.74
DM74190N	1.15
DM74191N	1.15
DM74192N	1.15
DM74193N	1.15
DM74194N	1.15
DM74195N	0.80
DM74196N	1.38
DM74197N	1.38
DM74198N	2.15
DM74199N	2.15
DM74221N	2.15
DM74251N	1.47
DM74279N	2.15
DM74284N	4.00
DM74285N	4.00
DM74293N	2.15
DM74365N	0.93
DM74366N	0.93
DM74367N	0.93
DM74368N	0.93
DM74390N	2.15
DM74ALS00N	0.86
DM74ALS01N	0.86
DM74ALS02N	0.86
DM74ALS03N	0.86
DM74ALS04N	0.94
DM74ALS05N	0.94
DM74ALS08N	0.94
DM74ALS09N	0.94
DM74ALS10N	0.86
DM74ALS11N	0.86
DM74ALS12N	0.86
DM74ALS15N	0.86
DM74ALS20N	0.86
DM74ALS21N	0.88
DM74ALS22N	0.88
DM74ALS26N	0.86
DM74ALS27N	0.86
DM74ALS28N	1.03
DM74ALS30N	0.86
DM74ALS32N	0.86
DM74ALS33N	1.03

DM74ALS37N	1.03
DM74ALS38N	1.03
DM74ALS40N	1.03
DM74ALS74N	1.28
DM74ALS109N	1.28
DM74ALS131N	1.74
DM74ALS133N	1.08
DM74ALS137N	1.74
DM74ALS138N	1.74
DM74ALS160N	2.00
DM74ALS162N	2.00
DM74ALS163N	2.00
DM74ALS373N	4.28
DM74ALS374N	4.28
DM74ALS245N	2.85
DM74ALS533N	4.28
DM74ALS534N	4.28
DM74ALS573N	4.28
DM74ALS574N	4.28
DM74ALS576N	4.28
DM74ALS580N	4.28
DM74ALS1000N	1.03
DM74ALS1001N	1.03
DM74ALS1002N	1.03
DM74ALS1003N	1.03
DM74ALS1008N	1.03
DM74ALS1010N	1.03
DM74ALS1011N	1.03
DM74ALS1020N	1.03
DM74ALS1032N	1.03
DM74S00N	0.63
DM74S02N	0.63
DM74S03N	0.63
DM74S04N	0.69
DM74S05N	0.69
DM74S08N	0.63
DM74S09N	0.65
DM74S10N	0.63
DM74S11N	0.63
DM74S15N	0.66
DM74S20N	0.63
DM74S22N	0.63
DM74S30N	0.63
DM74S32N	0.69
DM74S40N	0.69
DM74S51N	0.63
DM74S64N	0.63
DM74S65N	0.69
DM74S74N	0.92
DM74S86N	0.97
DM74S112N	0.95
DM74S113N	0.95
DM74S114N	0.95
DM74S133N	0.66
DM74S134N	0.83
DM74S135N	1.43
DM74S136N	2.18
DM74S138N	1.72
DM74S139N	1.72
DM74S140N	0.92
DM74S151N	1.72
DM74S153N	1.72
DM74S157N	1.72
DM74S158N	1.72
DM74S160N	4.30
DM74S161N	4.30
DM74S162N	4.30
DM74S163N	4.30
DM74S174N	2.01
DM74S175N	2.01
DM74S181N	6.30
DM74S182N	2.58
DM74S188N	2.84
DM74S189AN	6.45
DM74S189N	4.30
DM74S194N	2.58
DM74S195N	2.72
DM74S196N	2.87
DM74S197N	4.15
DM74S200N	7.88
DM74S240N	3.29
DM74S241N	3.29
DM74S242N	4.01
DM74S243N	4.01
DM74S244N	3.72
DM74S251N	1.86
DM74S253N	1.86
DM74S257N	1.72
DM74S258N	1.72
DM74S262N	1.72
DM74S280N	2.72
DM74S283N	4.73
DM74S287N	3.01
DM74S288N	2.64
DM74S299N	9.34
DM74S373N	4.00
DM74S374N	4.00
DM74S387J	4.01
DM74S387N	2.80
DM74S472N	8.00
DM74S474N	8.80
DM8091N	3.66
DM8099N	3.66
DM8121N	1.43
DM8123N	2.12
DM8130N	5.93
DM8131N	4.73
DM8136N	4.73
DM8160N	4.73
DM8211N	5.93
DM8219N	2.43
DM8220N	4.73
DM8223N	2.36
DM8288N	2.66
DM8312N	2.60
DM8334N	5.16
DM8520N	14.68
DM8542N	8.32
DM8544N	1.50
DM8552N	9.42
DM8553N	9.42
DM85568N	8.46
DM8601N	1.07
DM8602N	1.91
DM8678CAB/N	10.99
DM86S64BTK/N	19.98
DM86S64CAB/N	19.98
DM86S64CAH/N	19.98
FSC 40965DC	2.87
FSC 9301PC	2.87
— CONVERTERS —	
ADB1200PCN	10.91
ADB4500PCN	7.99
ADC0800PCD	18.21
ADC0801LCN	21.21
ADC0803LCN	8.27
ADC0804LCN	5.20
ADC0808CCN	14.50
ADC0809CCN	6.73
ADC0816CCN	19.90
ADC0817CCN	12.89
ADC0820CCN	16.68
ADC0831CCN	5.04
ADC0833BCN	15.82
ADC0833CCN	6.02
ADC1001CCD-1	27.94
ADC1021CCD-1	29.65
ADC1210HCD	68.03
ADC3511CCN	14.67
ADC3711CCN	16.68
ADD3501CCN	14.67
ADD3701CCN	16.68
AH0014CD	22.70
AM3705CN	8.31

DAC0800LCN	3.60
DAC0808LCN	2.13
DAC0831LCN	6.06
DAC1000LCN	11.27
DAC1006LCN	12.06
DAC1020LCN	11.21
DAC1021LCN	9.34
DAC1022LCN	7.47
DAC1203HCD	148.39
DAC1220LCN	12.99
DAC1221LCN	10.99
DAC1222LCN	8.99
DAC1230LCD	19.85
DAC1231LCD	16.93
DAC1280HCD	36.02
HA 2-2502	2.87
LF398H	4.98
LF398N	3.47
LF13006N	6.06
LF13201N	5.71
LF13202N	5.71
LF13331N	5.71
LF13332N	5.71
LF13333N	5.71
LF13508D	12.81
LH0023CG	54.74
[illegible]	3.34
LM2907N-8	1.20
LM2917N	3.34
LM2917N-8	3.20
LM331AN	7.20
LM331H	9.78
LM331N	5.60
— LINEAR —	
DT1050	66.70
DT1057	45.16
LF311H	6.15
LF347N	3.27
LF351H	1.47
LF351N	0.85
LF353H	1.89
LF353N	1.04
LF355H	2.37
LF355N	1.60
LF356H	2.13
LF356N	1.52
LF357H	2.13
LF357N	1.52
LF411CH	1.96
LF411CN	0.99
LF412CH	3.07
LF412CN	2.13
LF441CH	1.86
LF441CN	0.93
LF442CN	1.60
LF444CN	2.67
LF13741H	0.75
LF13741N	0.75
LH0002CH	15.57
LH0002CN	11.90
LH0022CN	21.74
LH0024CH	11.81
LH0032CG	38.48
LH0033CG	41.06
LH0036CG	50.23
LH0038CD	88.87
LH0042CH	10.07
LH0044CH	23.18
LH0086CD	63.43
LH0101CK	47.82
LH740ACH	31.78
LM10CH	8.00
LM10CLH	6.00
LM10CLN	4.00
LM111H	4.67
LM11CH	7.45
LM11CLH	5.16
LM11CLN	2.55
LM11CN	2.72
LM1304N	4.36
LM13080N	1.60
LM13600N	1.55
LM13700N	1.55
LM1414N	1.97
LM1458H	2.15
LM1458N	0.56
LM1496H	3.60
LM1496N	1.60
LM1818N	3.72
LM1886N	5.73
LM1889N	4.30
LM201AH	3.07
LM211H	4.01
LM2877P	2.87
LM301AD	5.74
LM301AH	1.60
LM301AN	0.67
LM306H	6.67
LM307H	1.60
LM307N	0.75
LM308AH	5.34
LM308AN	4.00
LM308H	1.73
LM308N	0.94
LM3080N	1.31
LM3089N	2.80
LM310H	3.07
LM310N	3.36
LM311H	1.73
LM311N	0.80
LM312H	4.67
LM316AH	14.44
LM316H	8.00
LM318H	3.41
LM318J-8	3.79
LM318N	3.58
LM319H	4.00
LM319N	3.07
LM321AH	22.14
LM321H	8.00
LM324AN	3.34
LM324J	1.86
LM324N	0.93
LM339AN	1.87
LM339N	0.93
LM3302J	3.07
LM344H	8.09
LM346N	3.52
LM348N	1.33
LM349N	1.73
LM358AN	2.19
LM358H	1.39
LM358N	0.80
LM359N	2.29
LM360H	7.16
LM360N	6.73
LM360N-14	6.73
LM361N	3.60
LM363D	26.28
LM363H-10	16.68
LM363H-100	16.68
LM363H-500	16.68
LM368H-10	8.00
LM368H-5.0	8.00
LM368H-6.2	8.00
LM372H	5.74
LM377N	3.20
LM378N	4.14
LM379S	13.34
LM380N	1.33
LM380N-8	1.33
LM381AN	4.27
LM381N	2.80
LM382N	2.27

LM383AT	3.60
LM384N	2.67
LM386N-1	1.07
LM387N	2.15
LM388N-1	1.72
LM389N	1.92
LM390N	2.87
LM391N-100	2.87
LM391N-80	1.58
LM392N	0.96
LM393AN	5.07
LM393N	0.72
LM3900N	1.07
LM4250CH	3.15
LM4250CN	2.40
LM565CH	4.30
LM565CN	2.40
LM566CN	2.40
LM567CN	1.67
LM703LN	0.93
LM709CH	1.73
LM709CN	0.93
LM710CH	1.33
LM710CN	0.93
LM711CN	1.20
LM725CH	8.00
LM725CN	3.16
LM733CH	1.87
LM733CN	0.99
LM741CH	1.20
LM741CJ-14	1.47
LM741CN-14	1.06
LM741CN	0.51
LM741CS	0.93
LM747CH	1.47
LM747CN	1.07
LM748CH	1.87
LM748CN	0.86
MM5824N	3.47
NE521-SIG	2.87
NE510-SIG	2.87
NE515-SIG	2.87
NE526-SIG	2.87
NE543-SIG	2.87
NE553-SIG	2.87
RC3403N	2.87
RC4739N	2.87
TBA120S	1.86
XR1310	2.87
XR2216	2.67
XR2240CP	3.38
XR2567	3.68
— XTALS —	
CRYS-32KHZ	3.10
CRYS-3.58MHZ	3.00
CRYS-4MHZ	3.10
CRYS-5.068MH	3.10
CRYS-8MHZ	3.10
CRYS-16MHZ	3.10
— CLOCKS —	
MA1003	36.62
MA1010E	23.22
MA1026ALP	33.53
MM5309N	9.31
MM5314N	9.31
MM5318N	11.17
MM5369AA/N	2.87
MM5387AA/N	8.60
MM53107N	2.87
MM5865N	15.57
MM5871AA/N	15.57
MM58167AN	16.01
MM58174AN	14.67
— DATA —	
DATA ADV. LO	6.25
DATA AUDIO/R	6.25
DATA CMOS/81	9.00
DATA HYBRID/	8.85
DATA INTERFA	15.00
DATA LINEAR/	20.00
DATA LIN APP	17.00
DATA LOGIC/8	11.25
DATA MEMORY	7.00
DATA TRANSIS	7.50
DATA V.REG/8	6.25
— DIODES —	
1N60	0.00
1N914	0.01
1N3070	0.00
1N5626	0.00
701PBS	0.00
701PES	0.00
A14P	0.24
PK40F	2.51
SB2	0.74
— OPTO —	
FOR261P-2	21.72
LH0082CD	51.68
LM3914N	3.34
LM3915N	3.34
LM3916N	3.34
MM5451N	5.60
MM5453N	5.60
NSB3881	10.12
NSB5382	11.13
NSB5388	10.87
NSB5881	10.87
NSB5882	10.87
NSB5917	14.94
NSB7382	12.14
NSB7881	12.14
NSB7882	12.14
NSC003	0.06
NSL4550	0.35
NSL4550•CLIP	0.48
NSL4555•CLIP	0.56
NSL4855	0.15
NSL4944	0.83
NSL4944•CLIP	1.04
NSL4955	0.15
NSL4955•CLIP	0.56
NSL5053	0.35
NSL5053•CLIP	0.43
NSL5056	0.23
NSL5056•CLIP	0.43
NSL5086	0.16
NSL5253A•CLI	0.83
NSL5353A•CLI	0.83
NSL6754	0.20
NSL52124	0.64
NSL53124	0.69
NSL57124	0.67
NSM1416	24.01
NSM3914	8.00
NSM39142	10.31
NSM39146	10.31
NSM39152	10.31
NSM39158	8.40
NSM3916	8.00
NSM39168	9.74
NSM4000A	12.01
NSM4005	12.94
NSN334	5.06
NSN373	5.73
NSN374	5.73
NSN381	5.73
NSN382	5.73
NSN534	5.73
NSN581	5.73
NSN583	5.73

NSN584	6.30
NSN782	6.40
NSN783	6.40
NSN784	6.40
XC209-G	0.33
XC209-Y	0.33
XC-500B	0.71
XC5491	1.14
— HARDWARE —	
BEZEL 23441N	2.65
BEZEL 23441N	2.65
BEZEL 23441N	2.65
BEZEL 23441R	2.65
BEZEL 23441R	2.65
BEZEL 23441R	2.65
BEZEL 23441R	2.65
BEZEL 23441R	2.65
BEZEL 22463R	2.65
BEZEL 22463R	2.65
BEZEL 22463R	2.65
BEZEL 22463N	2.65
BOWN KBA3149	24.40
BOWN KBA3150	24.40
BOWN KBA3200	18.01
BOWN KBA3201	18.01
BOWN KBA3203	15.36
BOWN KBA3204	15.36
BOWN TP3150	384.70
DUNC 3253R1K	12.40
DUNC 3253R2K	12.40
DUNC 3253R5K	12.40
DUNC 3253R10	12.40
DUNC 4215A10	26.45
DUNC 4215L10	26.45
DUNC 4415A10	27.80
DUNC 4415L10	27.80
DUNC 62 DIAL	58.19
DUNC 82 DIAL	26.44
DUNC KNOB LO	2.23
DUNC KNOB RO	2.23
DUNC KNOB SO	2.23
DUNC OTHER	0.00
[illegible]	2.46
ROT 428056	7.92
ROT 476042	4.36
ROT 476143	4.95
ROT MU2A1 11	30.63
ROT MU3A1 23	27.80
ROT SU2A1 11	32.37
ROT SU3A1 23	34.13
ROT WR3A1 23	36.76
SOCKET 8 PIN	0.32
SOCKET 8 PIN	0.32
SOCKET 14 PI	0.28
SOCKET 16 PI	0.28
SOCKET 18 PI	0.30
SOCKET 20 PI	0.35
SOCKET 22 PI	0.35
SOCKET 24 PI	0.63
SOCKET 28 PI	0.60
SOCKET 40 PI	0.82
SPEC 008T00	2.55
SPEC 43P-101	1.79
SPEC 43P-102	1.79
SPEC 43P-103	1.79
SPEC 43P-104	1.79
SPEC 43P-105	1.79
SPEC 43P-201	1.79
SPEC 43P-202	1.79
SPEC 43P-203	1.79
SPEC 43P-204	1.79
SPEC 43P-205	1.79
SPEC 43P-501	1.79
SPEC 43P-502	1.79
SPEC 43P-503	1.79
SPEC 43P-504	1.79
SPEC 43P-505	1.79
SPEC 63P-101	1.42
SPEC 63P-102	1.42
SPEC 63P-103	1.42
SPEC 63P-104	1.42
SPEC 63P-105	1.42
SPEC 63P-201	1.42
SPEC 63P-202	1.42
SPEC 63P-203	1.42
SPEC 63P-204	1.42
SPEC 63P-205	1.42
SPEC 63P-501	1.42
SPEC 63P-502	1.42
SPEC 63P-503	1.42
SPEC 63P-504	1.42
SPEC 63P-505	1.42
SPEC 64Y-101	3.40
SPEC 64Y-102	3.40
SPEC 64Y-103	3.40
SPEC 64Y-104	3.40
SPEC 64Y-105	3.40
SPEC 64Y-201	3.40
SPEC 64Y-202	3.40
SPEC 64Y-203	3.40
SPEC 64Y-204	3.40
SPEC 64Y-205	3.40
SPEC 64Y-501	3.40
SPEC 64Y-502	3.40
SPEC 64Y-503	3.40
SPEC 64Y-504	3.40
SPEC 64Y-505	3.40
— INTERFACE —	
DP8310N	6.73
DP8311N	6.73
DS0026CN	2.44
DS1488N	1.26
DS1489AJ	1.72
DS1489AN	1.26
DS1489N	1.26
DS1691J	8.82
DS26LS31CN	3.79
DS26LS32CN	3.79
DS26LS33CN	3.79
DS26S11N	4.35
DS3245N	7.07
DS3486N	4.00
DS3487N	4.00
DS3605N	5.02
DS3611N	1.66
DS3612N	1.66
DS3613N	1.66
DS3614N	1.66
DS3625N	4.30
DS3630N	2.58
DS3631N	2.72
DS3632N	2.72
DS3633N	2.72
DS3634N	2.72
DS3640N	2.35
DS3642N	2.73
DS3644N	6.88
DS3648N	3.58
DS3649N	2.29
DS3662N	5.47
DS3675N	4.01
DS3686N	5.73
DS3687N	5.73
DS3692N	4.94
DS36149N	2.46
DS7524N	2.87
DS75107N	2.05
DS75108J	5.73
DS75108N	2.05
DS75113N	2.93
DS75121N	2.13
DS75124N	2.13
DS75125N	4.00
DS75150N	2.93

DS75154N	2.45
DS75160AN	7.27
DS75161AN	7.93
DS75324N	2.19
DS75361N	3.34
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DS75451N	0.93
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DS75453N	0.93
DS75454N	0.93
DS75461N	1.01
DS75491N	1.12
DS75492N	1.12
DS75494N	1.68
DS8T26AN	3.34
DS8T28N	2.53
DS8629N	7.16
DS8640N	1.55
DS8641N	3.58
DS8644N	5.01
DS8664N	8.31
DS8692N	6.45
DS8800H	8.60
DS8812N	1.76
DS8820AN	2.15
DS8820N	1.90
DS8822N	6.66
DS8830N	1.90
DS8831N	4.30
DS8832N	4.30
DS8833N	3.58
DS8834N	2.15
DS8835N	3.58
DS8836N	1.41
DS8837N	2.87
DS8838N	2.44
DS8839N	3.58
DS8853N	3.58
DS8859N	2.58
DS8861N	2.58
DS8864N	4.45
DS8867N	2.87
DS8868N	2.47
DS8869AN	2.76
DS8870N	2.29
DS8871N	2.72
DS8872N	2.87
DS8875N	3.33
DS8877N	1.86
DS8880J	4.73
DS8880N	2.15
DS8881N	8.60
DS8885N	3.72
DS8887J	4.13
DS8889N	3.87
DS88C20N	5.73
DS88C120N	5.73
DS88LS120N	4.15
DS8963N	5.87
— MEMORY —	
MM1101AN	3.34
MM1402A	3.34
MM1403A	3.34
MM2102AN	2.40
MM2102AN-2	2.80
MM2114N	1.60
MM2114N-055	0.76
MM2114N-2	3.60
MM2114N-3	3.34
MM27080	10.12
MM27160	7.59
MM27160-1	10.12
MM27160-T1	13.23
MM25320	10.70
MM27320	10.70
MM27580-A	7.20
MM5001	12.89
MM5050	12.89
MM5034N	12.89
MM52040	28.60
MM5280N	6.94
MM5290J-2	5.20
MM5290J-4	4.94
MM5290N-4	3.20
MM5298N-4	3.20
NMC27C16Q-35	18.68
NMC27C16Q-45	17.34
NMC27C16Q-55	15.61
NMC27C32Q-35	24.01
NMC27C32Q-55	18.68
NMC6116LP-3	10.46
NMC6514J-9	8.00
TMS40L45NL	0.43
TMS4045NL	0.43
TMS4050NL	0.43
— REGULATORS —	
LH0070-0H	10.63
LH0070-1H	15.42
LH0071-0H	10.63
LH0071-2H	25.79
LH1605CK	20.75
LM113H	14.24
LM125H	10.14
LM217H	14.41
LM2930T-5.0	1.73
LM2930T-8.0	1.61
LM2931CT	2.42
LM304H	4.00
LM305AH	3.60
LM305H	1.33
LM309H	3.92
LM309K	2.78
LM309K-STEEL	4.94
LM313H	8.94
LM317H	5.20
LM317HVH	8.00
LM317HVK-STE	8.00
LM317K-STEEL	4.94
LM317KC	3.34
LM317LZ	0.93
LM317MP	1.47
LM317T	1.87
LM320H-15	7.47
LM320H-5.0	7.47
LM320K-12	7.34
LM320K-15	7.34
LM320K-6.0	7.34
LM320K-5.0	7.34
LM320KC-12	4.68
LM320KC-15	4.68
LM320KC-5.0	4.68
LM320LZ-12	1.26
LM320LZ-15	1.26
LM320LZ-5.0	1.26
LM320MP-12	2.40
LM320MP-15	2.40
LM320MP-5.0	2.40
LM320T-12	3.29
LM320T-15	3.29
LM320T-5.0	3.29
LM323K-STEEL	8.67
LM325AN	6.94
LM325N	4.67
LM325N	4.40
LM326H	4.67
LM326N	4.40
LM329BZ	2.67
LM329CH	4.27
LM329DZ	0.80
LM3342	1.93
LM3362-2.5	1.43
LM3362-5.0	1.43
LM337H	6.27

LM337HVH	10.27
LM337HVK-STE	12.94
LM337K-STEEL	6.83
LM337LZ	1.20
LM337MP	1.60
LM337T	2.53
LM338K-STEEL	9.23
LM340K-12	4.80
LM340K-15	4.80
LM340K-5.0	4.80
LM340K-6.0	4.45
LM340K-8.0	4.45
LM340KC-12	1.97
LM340KC-15	1.97
LM340KC-5.0	1.97
LM340KC-8.0	2.09
LM340T-12	0.93
LM340T-15	0.93
LM340T-5	0.93
LM341P-12	0.83
LM341P-15	0.83
LM341P-5.0	0.83
LM342P-12	0.86
LM342P-15	0.86
LM342P-5.0	0.86
LM350K-STEEL	7.08
LM350T	5.39
LM3524N	3.95
LM376N	0.75
LM385Z	2.48
LM385Z-1.2	2.29
LM396K-STEEL	20.23
LM399H	6.67
LM3999Z	1.44
LM723CH	1.04
LM723CN	0.59
LM7805CK	0.00
LM78L05ACZ	0.53
LM78L06ACZ	0.53
LM78L12ACH	1.60
LM78L12ACZ	0.53
LM78L15ACH	1.62
LM78L15ACZ	0.53
LM78L18ACZ	0.46
LM78L24ACZ	0.46
LM7905CK	2.34
LM7905CT	0.99
LM7912CK	2.24
LM7912CT	0.99
LM7915CK	2.24
LM7915CT	0.99
LM79L05ACZ	1.26
LM79L12ACZ	1.26
LM79L15ACZ	1.26
RC4195N	2.87
SR1605	64.64
— RELAYS —	
ELECT HSK201	38.15
ELECT HSK202	49.86
ELECT PA3038	8.28
ELECT PA3038	6.92
ELECT PA3044	10.40
ELECT PA3044	10.40
ELECT PA3045	3.98
— SUNDRY —	
DM9097	0.55
LH0091CD	60.12
LH0094CD	88.87
LM1014N	1.60
LM1801N	4.30
LM1812N	10.94
LM1830N	2.38
LM1871N	5.73
LM1872N	5.73
LM322H	2.47
LM322N	2.13
LM375N	5.74
LM3905N	1.72
LM3909N	1.33
LM555CN	0.93
LM556CN	1.21
LU316-SIG	2.65
MM53200N	6.02
MM54240N	10.41
MM58037N	3.58
N1013AN-SIG	2.65
N2501N-SIG	2.65
N2509N-SIG	2.65
N2521N-SIG	2.65
N2527N-SIG	2.65
N5880BN-SIG	2.65
N8244N-SIG	2.65
N8252N-SIG	2.65
N8269N-SIG	2.65
N8273N-SIG	2.65
N8274N-SIG	2.65
N8284N-SIG	2.65
N8285N-SIG	2.65
N82S10N-SIG	2.65
N82S21N-SIG	2.65
N8815N-SIG	2.65
N8824N-SIG	2.65
N8825N-SIG	2.65
N8226N-SIG	2.65
N8840N-SIG	2.65
N8875N-SIG	2.65
N8T04BN-SIG	2.65
N8T09BN-SIG	2.65
N8T35BN-SIG	2.65
N8T36BN-SIG	2.65
N8T363N-SIG	2.65
N9314N-SIG	2.65
N10101BN-SIG	2.65
N10106BN-SIG	2.65
N10112BN-SIG	2.65
N10114BN-SIG	2.65
N10115BN-SIG	2.65
N10125BN-SIG	2.65
N10131BN-SIG	2.65
N10231BN-SIG	2.65
NE592-SIG	2.47
ULN2208N	1.15
ULN2209N	2.15
VELOSTAT	11.73
XR2206CP	6.60
XR2211CP	6.77
— TEMPERATURE —	
LM135H	10.14
LM335H	2.46
LM3352	2.25
LM3911H-46	4.50
LM3911N	2.42
— TRANSISTORS —	
2N706	1.31
2N1302	1.31
2N1308	1.31
2N1711	1.15
2N2017	1.15
2N2160	1.31
2N2222	0.75
2N2222A	0.79
2N2270	1.55
2N2367	1.31
2N2644	3.51
2N2647	1.31
2N2904	1.31
2N2904A	1.31
2N2906	0.85
2N2906A	0.85
2N2920	5.67

2N3019	1.08
2N3020	1.15
2N3053	1.08
2N3058	1.52
2N3069	1.75
2N3249	1.52
2N3460	1.52
2N3546	1.52
2N3640	0.98
2N3704	0.28
2N3819	1.53
2N3822	1.53
2N3829	1.63
2N3860	1.63
2N3904	0.17
2N3905	0.19
2N3906	0.17
2N3971	1.53
2N3993	1.53
2N4032	1.15
2N4036	1.08
2N4037	1.53
2N4123	1.63
2N4288	1.63
2N4360	1.63
2N4401	0.19
2N4403	0.19
2N4918	1.53
2N4921	1.53
2N5087	0.26
2N5089	0.23
2N5305	1.63
2N5457	1.53
2N5459	0.57
2N5460	1.06
2N5484	1.53
2N5485	0.45
2N5656	1.53
2N5770	1.53
2N5771	0.45
2N5871	1.53
2N5953	1.63
2N6027	1.53
2N6107	1.03
2N6121	1.53
2N6123	1.53
2N6459	1.53
2N6706	1.53
2N6707	0.55
2N6710	0.54
2N6724	0.42
2N6725	0.42
3N204	1.22
BC107	0.79
BC108	0.79
BC178	0.79
BC183L	0.18
BC184L	0.13
BC213L	0.18
BC308-92	0.18
BC309-92	0.17
BC317	0.17
BC318	0.17
BC327-16	0.14
BC338	0.17
BC547B	0.17
BC548C	0.17
BC549	0.17
BC557B	0.17
BC558	0.17
BC559	0.17
BD137	0.48
BD138	0.44
BD139	0.60
BD140	0.60
BD235	0.64
BD236	0.64
BD439	0.64
BD440	0.64
BD678	0.44
BFY51	1.15
BF258	0.99
BF458	0.99
PN1109A	2.87
LM3045J	2.00
LM3046N	1.39
LM3086N	0.80
LM394CH	4.00
LM394CN	3.60
LM394H	6.40
LM395K	9.34
LM395T	2.67
MJE2955	0.78
MJE3055	0.76
MJE700	1.06
MJE800	0.91
MOUNT KIT TO	0.02
MOUNT KIT TO	0.01
MPF102	0.56
MPF1[illegible]	0.55
MPSA1[illegible]	0.39
MPD830[illegible]	1.48
MSD10[illegible]	1.06
MSD1[illegible]	1.31
MSD2[illegible]	0.89
MSD206	1.31
P1086	1.36
PN918	0.26
PN2222	0.17
PN3[illegible]	0.17
PN3563	0.20
PN3564	0.20
PN3567	0.20
PN3568	0.20
PN3569	0.26
PN3638	0.20
PN3638A	0.20
PN3641	0.22
PN3642	0.22
PN3643	0.22
PN3644	0.22
PN3645	0.22
PN3646	0.26
PN4121	0.17
PN4355	0.26
PN4356	0.26
PT3164C	2.61
PT3164D	2.61
PT4207B	2.61
TIC206A	2.67
TIC226A	2.67
TIP29B	0.77
TIP30C	0.91
TIP31C	0.85
TIP32C	0.98
TN1711	0.43
TN2017	0.51
TN2102	0.54
TN2218A	0.65
TN2270	0.55
TN2904A	0.45
TN2905A	0.45
TN3019	0.48
TN3020	0.55
TN3053	0.54
TN3244	0.42
TN3245	0.46
TN3252	0.45
TN3440	0.45
TN3444	0.45
TN3467	0.56
TN3724	0.40
U310	1.44

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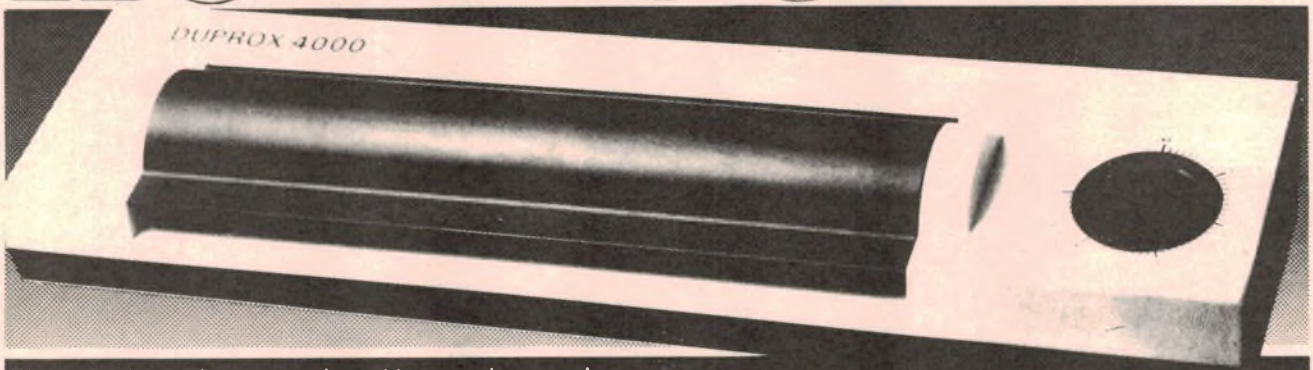

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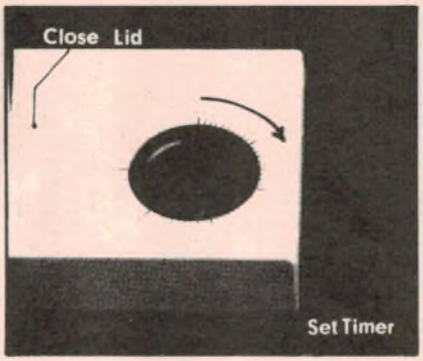

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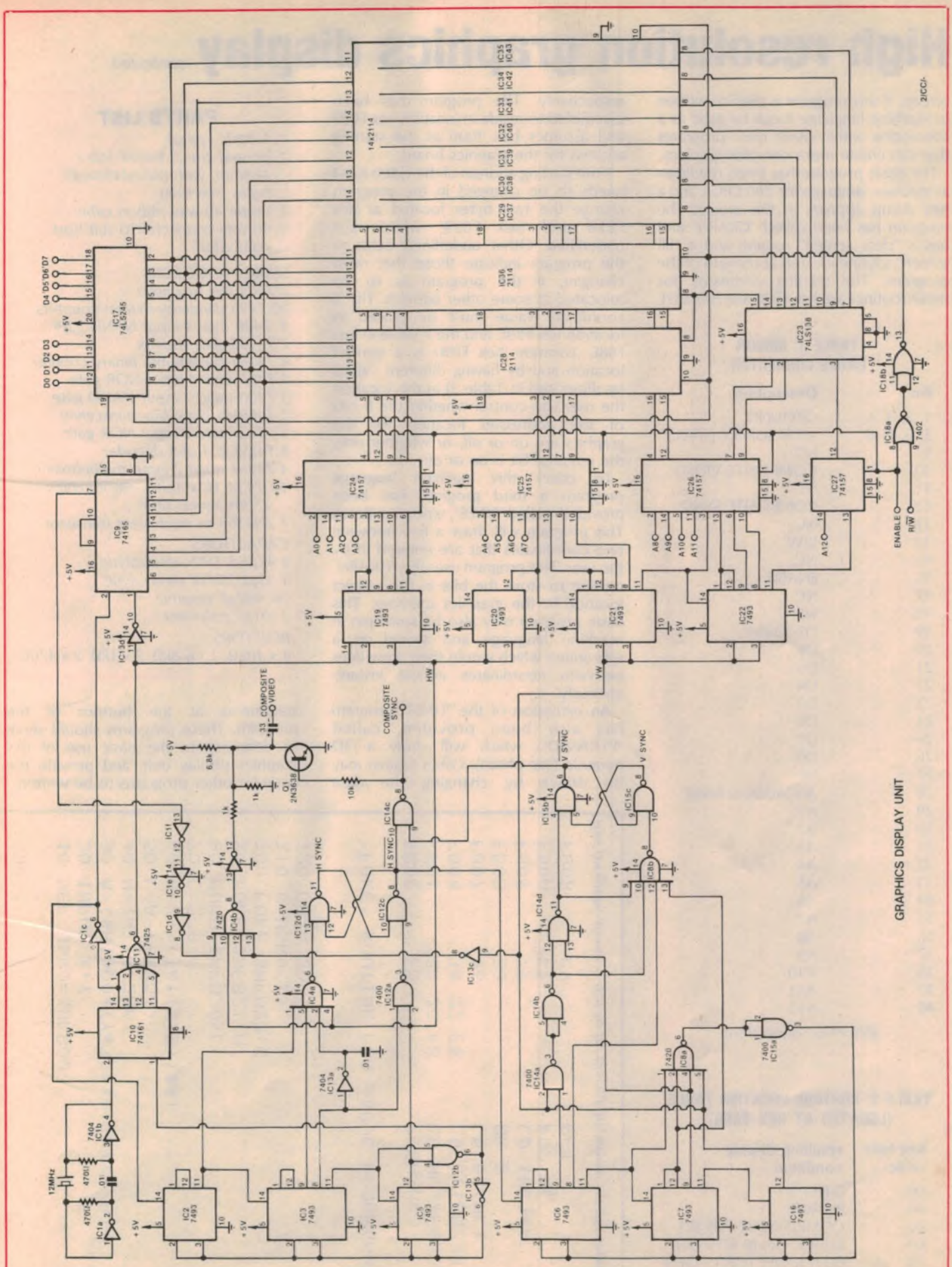
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IC9 74165
IC24 74157
IC25 74157
IC26 74157
IC27 74157
IC23 74LS138
IC36 2114
IC28 2114
IC19 7493
IC20 7493
IC21 7493
IC22 7493
IC2 7493
IC3 7493
IC5 7493
IC6 7493
IC7 7493
IC16 7493
IC10 74161
IC11 7425
IC4 7420
IC8 7420
IC12 7400
IC13 7404
IC14 7400
IC15 7400
IC18 7402
Q1 2N3638
12MHz
COMPOSITE VIDEO
COMPOSITE SYNC
H SYNC
V SYNC
ENABLE
R/W
D0 D1 D2 D3
D4 D5 D6 D7

High resolution graphics display *continued*

screen. If this program is then re-written in machine language it can be used as a subroutine within other main programs that can create more complex graphics.

The Basic program has been rewritten in machine language for Z80 CPUs, and a hex dump appears in this article. The program has been called "GRAPH" and has a "clear screen" routine and a "fill screen" routine located at the end of the program. The starting addresses for these routines are hex F870 and hex F87E respectively. The program has been assembled to reside in location hex F800 and assumes hex 1000 as the starting address for the graphics board.

If the starting address of the video RAM needs to be changed in the program change the two bytes located at hex F828 and hex F829, which are underlined. Other underlined bytes in the program indicate those that need changing if the program is to be relocated at some other address. The X coordinate value must be placed in location hex F88C and the Y value in hex F88E. Location hex F890 is a control location and by having different values (as illustrated in Table 2) in this location the user can control whether the 8 bits of the addressed location for the graphics are on or off, or whether only the required bit is on or off.

To check this machine language program a third program has been provided, called "LINES", written in Basic. This program will draw a line between two coordinates that are entered in by the user. This program uses the "GRAPH" routine to store the bits in the correct location in the graphics memory. This Basic program may also be rewritten in machine language and stored as a subroutine which would then draw lines between coordinates almost instantaneously.

An extension of the "LINES" program has also been provided, called "PYRAMID", which will draw a 3D pyramid (see photo). Other figures may be drawn by changing the data statements at the bottom of the program. These programs should serve to demonstrate the basic use of this graphics display unit, and provide the basis for other programs to be written.

TABLE 1: RIBBON CABLE CONNECTOR

Pin	Description
1, 2, 3, 4	GROUND
5, 6, 7, 8	+5 V SUPPLY (+Vcc)
9	NC
10	COMPOSITE VIDEO
11	NC
12	COMPOSITE SYNC
13	NC
14	R/W
15	NC
16	ENABLE
17	NC
18	NC
19	D7 (Data)
20	D6
21	D5
22	D4
23	D3
24	D2
25	D1
26	D0
27	NC
28	A0 (Address lines)
29	A1
30	A2
31	A3
32	A4
33	A5
34	A6
35	A7
36	A8
37	A9
38	A10
39	A11
40	A12

(NC=No connection)

TABLE 2: CONTROL LOCATION TABLE (LOCATED AT HEX F890)

hex byte value	resulting display condition
00	BIT ON
01	BIT OFF
02	COMPLEMENT THE BIT
03	BLOCK ON (8 BITS ON)
04	BLOCK OFF (8 BITS OFF)

PARTS LIST

1 12MHz crystal
1 printed circuit board 160 x 169mm, with plated-through holes (see text)
1 metre 40-way ribbon cable
1 40-way connector to suit host computer

SEMICONDUCTORS
2 7404 hex inventers
10 7493 divide-by-sixteen counters
1 7420 dual 4-input NAND gate
1 74165 shift register
1 74161 presettable binary counter
1 7425 dual 4-input NOR gate
3 7400 quad 2-input NAND gate
1 74LS245 octal bus transceiver
1 7402 quad 2-input NOR gate
1 74LS138 1-of-8 decoder
4 74157 quad 2-input multiplexer
16 2114 1K x 4bit memory chips, 250ns access time
1 2N2369 or equivalent transistor

CAPACITORS
4 47µF/6.3VW electrolytic
1 33µF/25VW electrolytic
16 .047µF ceramic
2 .01µF polyester

RESISTORS
1 x 10kΩ, 1 x 6.8kΩ, 2 x 1kΩ, 2 x 470Ω

```
"DOT"
10 DEF USR0=&HF800
20 INPUT X,Y
30 A=(&H1000+(Y*32))+(INT(X/8))
40 H=INT(A/256)
50 L=A-(H*256)
60 B=X-((INT(X/8))*8)
70 C=2^B
80 POKE &HF820,L
90 POKE &HF821,H
100 POKE &HF822,C
110 G=USR0(Z)
120 GOTO 20
```

```
"POKE" ROUTINE FOR ABOVE PROGRAMME

F800   E5       PUSH HL
F801   2A 20 F8  LD HL,(F820H)
F804   3A 22 F8  LD A,(F822H)
F807   46        LD B,(HL)
F808   B0        OR B
F809   77        LD (HL),A
F80A   E1        POP HL
F80B   C9        RET
```

This program allows a dot to be placed anywhere on the screen.

"LINES"

```
5 DEF USR0=&HF870
6 X=USR0(Y)
7 DEF USR1=&HF800
10 INPUT X1,Y1,X2,Y2
20 FGX=0:FGY=0
30 IF X1>X2 THEN XD=X1-X2 ELSE XD=X2-X1:FGX=1
40 IF Y1>Y2 THEN YD=Y1-Y2 ELSE YD=Y2-Y1:FGY=1
45 IF YD=0 THEN YD=1
46 IF XD=0 THEN XD=1
50 IF YD>XD THEN XINT=XD/YD ELSE YINT=YD/XD
60 IF YD>XD THEN YINT=1 ELSE XINT=1
65 IF XD=YD THEN XINT=1:YINT=1
70 X=X1:Y=Y1
75 PRINT CHR$(26)
76 POKE &HF890,0
80 IF XD>YD THEN I=XD ELSE I=YD
90 FOR J=0 TO I
100 POKE &HF88C,INT(X):POKE &HF88E,INT(Y)
110 G=USR1(K)
120 IF FGX=1 THEN X=X+XINT ELSE X=X-XINT
130 IF FGY=1 THEN Y=Y+YINT ELSE Y=Y-YINT
140 NEXT J
150 GOTO 10
```

Use this program to draw a line between two co-ordinates.

"GRAPH"

```
F800 E5 C5 D5 F5 3A 8C F8 4F 3E 07 A1 20 04 3E 01 18
F810 09 5F 3E 00 37 17 17 1D 20 FC 5F 3E F8 A1 CB 3F
F820 CB 3F CB 3F 4F 06 00 21 00 10 09 3A 8E F8 4F 16
F830 05 37 3F CB 11 CB 10 15 20 F7 09 3A 90 F8 FE 00
F840 28 12 FE 01 28 13 FE 02 28 16 FE 03 28 17 FE 04
F850 28 17 18 17 7E B3 77 18 12 7B 2F 5E A3 77 18 0B
F860 7E AB 77 18 06 36 FF 18 02 36 00 F1 D1 C1 E1 C9
F870 E5 21 00 10 36 00 23 7C FE 30 20 F8 E1 C9 E5 21
F880 00 10 36 FF 23 7C FE 30 20 F8 E1 C9 00 00 00 00
F890 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
F8A0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
F8B0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

Graph is used as a subroutine in other programs to create complex graphics.

"PYRAMID"

```
5 DEF USR0=&HF870
6 X=USR0(Y)
7 DEF USR1=&HF800
8 FOR U=1 TO 8
10 FOR I=1 TO 4
12 READ M(I)
14 NEXT I
16 X1=M(1):Y1=M(2):X2=M(3):Y2=M(4)
20 FGX=0:FGY=0
30 IF X1>X2 THEN XD=X1-X2 ELSE XD=X2-X1:FGX=1
40 IF Y1>Y2 THEN YD=Y1-Y2 ELSE YD=Y2-Y1:FGY=1
45 IF YD=0 THEN YD=1
46 IF XD=0 THEN XD=1
50 IF YD>XD THEN XINT=XD/YD ELSE YINT=YD/XD
60 IF YD>XD THEN YINT=1 ELSE XINT=1
65 IF XD=YD THEN XINT=1:YINT=1
70 X=X1:Y=Y1
75 PRINT CHR$(26)
76 POKE &HF890,0
80 IF XD>YD THEN I=XD ELSE I=YD
90 FOR J=0 TO I
100 POKE &HF88C,INT(X):POKE &HF88E,INT(Y)
110 G=USR1(K)
120 IF FGX=1 THEN X=X+XINT ELSE X=X-XINT
130 IF FGY=1 THEN Y=Y+YINT ELSE Y=Y-YINT
140 NEXT J
150 NEXT U
200 DATA 50,200,100,230,100,230,170,190
210 DATA 170,190,120,160,120,160,50,200
220 DATA 50,200,110,20,100,230,110,20
230 DATA 170,190,110,20,120,160,110,20
```

This program will draw a 3D pyramid or you can draw other figures by changing the data statements at the bottom of the program.

"CLEAR"

```
F800            21 00 10    LD HL,1000H
F803   CLOOP:    36 00       LD (HL),00
F805            23          INC HL
F806            7C          LD A,H
F807            FE 30       CP 30H
F809            20 F8       JR NZ,CLOOP
```

This machine language program will clear the screen almost instantly.

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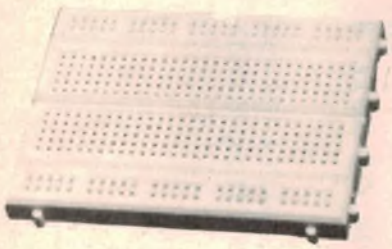

MICROBEE KITS

ETI 733 RTTY CONVERTOR. Ref: ETI April 1983

This simple project allows you to hook-up your MicroBee to a HF receiver and print radio teletype messages on a monitor screen. Listen to the world news FREE!!

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ETI 668 MICROBEE EPROM PROGRAMMER Ref: ETI February 1983

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Cat. KE-4650 ..... $39.95

ETI 649 MICROBEE LIGHT PEN Ref: ETI Aug '83

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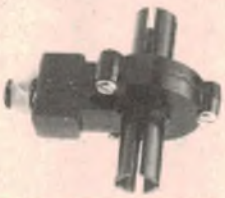

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SR-1214	3 pole x 4 way
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Ref: ETI October 1982

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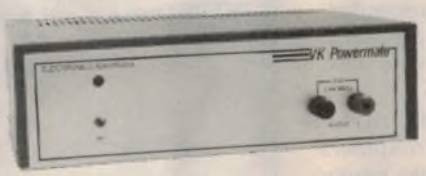

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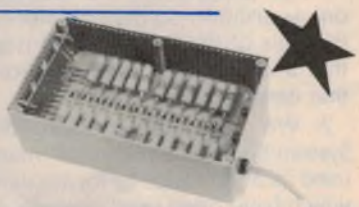

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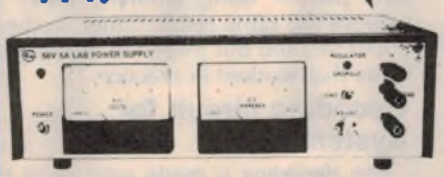

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Low-cost method gives 48K RAM

Extra RAM for the System-80 computer

This article describes a method of increasing the memory of a System-80 or TRS-80 computer from 16K to its maximum of 48K of RAM. The cost is limited to the price of the 4116 dynamic RAM chips and other components available for less than a dollar, and the increased memory is fitted inside the keyboard console.

by G. W. BLACK & J. PITTAR

This modification has been running in several System-80s for two years, and more recently in a TRS-80. In this period no problems have been experienced. But before we proceed there are just a few points of advice to those who wish to make this modification:

1. Since this project is intended for persons with experience with computers and the construction of intricate equipment, no details have been given as to how to disassemble the cabinet and so on. As accurate soldering is necessary on the pins of the RAM chips it is essential that a low voltage soldering iron with a fine earthed tip is used.

2. We also recommend that the System-80/TRS80 technical manual be used as a reference to locate various ICs which have been used as signal sources.

3. To enable the new RAM to be tested we have included a program to test all memory locations, which should be used at various times during the construction. We also used the program to test the new RAM chips before they were soldered in place.

4. If your computer is new, then be warned that these modifications will void any warranty.

5. The System-80 uses a three terminal regulator for the +12V supply. It will be necessary to fit a heatsink to this device to prevent overheating.

The circuit

If you look closely at any large 4116 RAM system it is obvious that all the RAM pins are connected in parallel, except for the CAS (column address strobe) which is used to decode different 16K banks of RAM. Basically all that is involved in the modification is to solder the sixteen extra RAM chips in place and to decode two signals to enable the extra 16K banks when necessary. This decoding is achieved in the System-80 by using several spare gates and inverters from the original computer plus an extra 7400 NAND gate and one 4.7kΩ resistor, while in the TRS-80 an extra 7410 is used along with several existing gates to decode the extra signals.

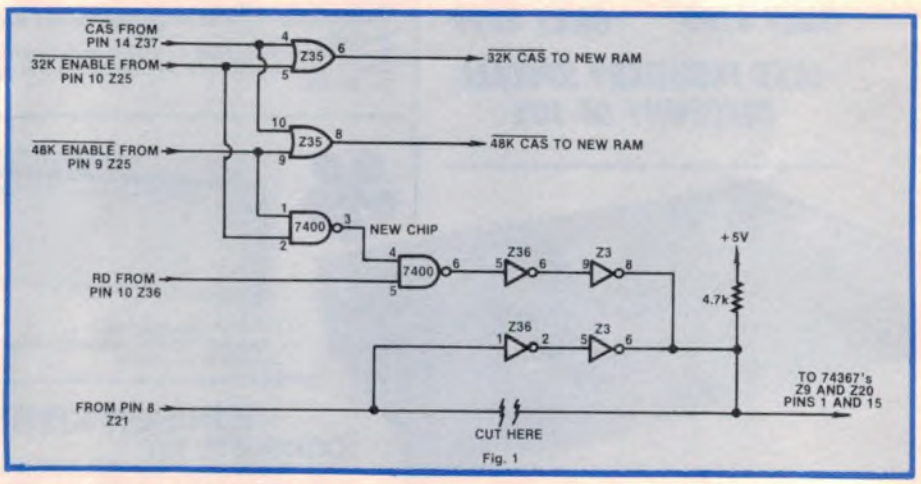

Fig. 1

The method of decoding is a result of two people using different ideas to achieve the same result. Other methods could be used but these are our original ideas that worked in practice.

Decoding circuit for System-80

The decoding is made easy since the enable signals are already decoded in the System-80 by IC Z25. (All references are to the circuit diagrams contained in the System-80 technical manual.)

On the CPU board first cut the track from pin 8 Z21 right at pin 8. Next bend all the pins except 7 and 14 on the new 7400 at right angles to their original position and solder pins 7 and 14 to pins 7 and 14 of Z36 to connect the supply pins. Using wire-wrap wire make all of the connections shown in Fig 1, bringing the wire from pin 8 Z21 to pin 1 Z36, and the wire from pins 6 and 8 of Z3 and the resistor to the track that was connected to pin 8 of Z21. At this time do not connect the wires to 32K CAS or 48K CAS.

Decoding circuit for TRS-80

There are several different TRS-80 circuit boards in existence so there may be slight differences between your circuit and the circuit given in the TRS-80 technical manual.

First cut the track between pin 8 Z74 and pin 9 Z73. Next bend all the pins except 7 and 14 on the 7410 at right angles to their original position and solder pins 7 and 14 to pins 7 and 14 of Z36 to connect the supply pins. Using wire-wrap wire make the connections as shown in Fig. 2. Do not connect the wires to 32K CAS or 48K CAS at this time.

This completes the decoding circuit. The CPU board can now be refitted to the computer case. It is probably a good idea at this point to reconnect the CPU

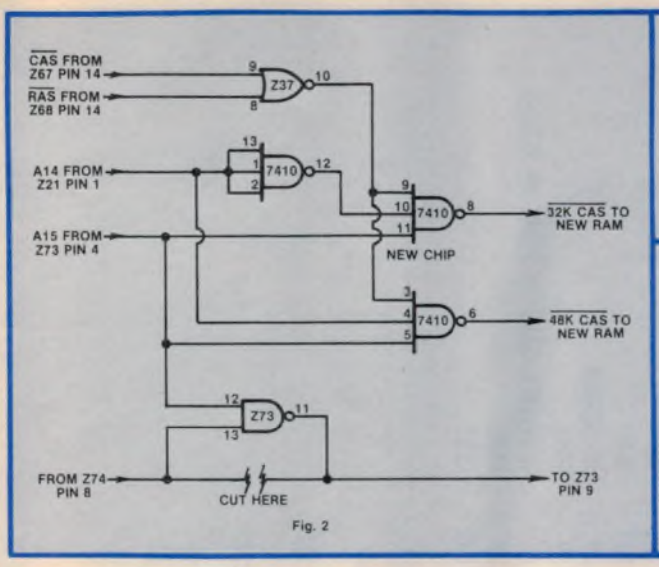

Fig. 2

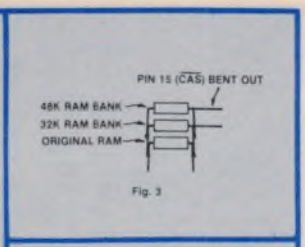

Fig. 3

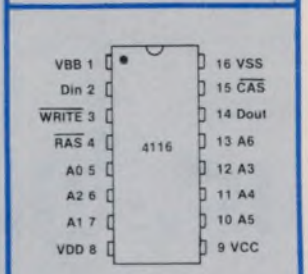

Fig. 4

board and the keyboard and try the computer. It should work just as before any modifications were made; if not check your work for any mistakes, especially for solder bridges between adjacent IC pins.

Installing the RAM chips

First bend pin 15 of all the new RAM chips at right angles to their original positions then solder the new chips on top of the original RAM chips in two layers as shown in Fig 3. All the pin 15's on the bottom layer are connected together and connected to 32K CAS, similarly pin 15's on the top layer are connected to the 48K CAS signal line.

This completes the installation and the computer can now be reassembled and tested. Upon power up you should be rewarded with the normal READY/MEM SIZE message. Press ENTER/NEW LINE and wait; the extra time taken for the ready message to return is due to the computer checking the extra RAM.

If you are stuck with a screen full of garbage then turn the computer off immediately and check your work, particularly for shorts between RAM pins.

If the ready prompt comes up as normal, type PRINT MEM. You should be rewarded with a number greater than 48000 if everything is working as it should.

If the number returned is the same as before the extra RAM was added, or is less than 48,000, then you could have a decoding problem or a defective RAM chip. If a memory error is your problem then the memory testing program will be your best friend in finding the fault.

RAM testing program

The program included here has been written so that it can be run from ROM if desired as it uses only CPU registers and does not make use of a stack or any RAM. This makes it possible to use this program to test RAM which is unreliable.

The program can be loaded using an editor/assembler from the listing from Fig 5 or by typing in the hex code from Fig 6 using a monitor program.

No provision has been included in the program to change the area of the memory to be checked from the keyboard, although this can be achieved by changing the relevant start and finish addresses in the equate table, or directly at addresses 42F8-9 and 42FD-E if you are using a monitor.

If the RAM checks OK then you will get a pass number message on top of the screen, if not then the program will print out all the addresses of faulty RAM in rapid succession on the screen.

Hopefully all will be well and you can begin writing programs to use the new expanded memory of your system.

FIGURE 5

```
                ;
                ; MEMORY TEST ROUTINE FOR TRS-80 OR SYSTEM-80
                ; BY G.W.BLACK
                ; A.C.T.
                ;
                ; PROGRAM RESIDES AT BEGINNING OF MEMORY
                ; THIS ROUTINE CAN BE RUN FROM ROM WITHOUT
                ; ANY NEED FOR RAM
                ; I.E. THIS CAN BE RUN IN A COMPUTER IN WHICH
                ; ALL THE RAM MAY BE FAULTY
                ;
                ; TO CHANGE TO AREA OF MEMORY TO BE TESTED
                ; CHANGE THE VALUES IN THE EQUATE TABLE
                ;
4400            START   EQU     4400H   ;START OF TEST RAM
FFFF            ENDM    EQU     0FFFFH  ;END OF TEST RAM
3C00            VIDEO   EQU     3C00H   ;DISPLAY AREA
                ;
                ;
42E9                    ORG     42E9H   ;CAN BE CHANGED TO
                                        ;SUIT YOU NEEDS
                                        ;DISABLE INTERRUPTS
42E9 F3         TEST    DI
42EA 013C03             LD      BC,VIDEO;DISPLAY AREA
42ED 3E20               LD      A,20H   ;SPACE CHAR
42EF CB70       CLEAR   BIT     6,B     ;TEST FOR END OF VIDEO
42F1 2004               JR      NZ,BEGIN;YES START TEST
42F3 02                 LD      (BC),A  ;CLEAR SCREEN
42F4 03                 INC     BC
42F5 18F8               JR      CLEAR
42F7 31FFFF     BEGIN   LD      SP,ENDM ;END POINTER
42FA 1600               LD      D,00H   ;PASS COUNTER
42FC 210044     MEMTST  LD      HL,START;TEST POINTER
42FF 013C03             LD      BC,VIDEO;SCREEN
4302 23         NEXT    INC     HL      ;NEXT BYTE
4303 3E55               LD      A,55H   ;TEST BYTE
4305 77                 LD      (HL),A  ;SET MEMORY
4306 BE                 CP      (HL)    ;CHECK MEMORY
4307 204E               JR      NZ,ERROR;GO IF ERROR
4309 3EBB               LD      A,0BBH  ;INVERT BITS
430B 77                 LD      (HL),A  ;SET MEMORY
430C BE                 CP      (HL)    ;CHECK MEMORY
430D 2048               JR      NZ,ERROR;GO IF WRONG
```

Continued next page

Extra RAM for the System-80 computer . . . Figure 5 ctd

```
430F 7C       00520 ENDC   LD      A,H     ;SAVE BYTE POINTER
4310 5D       00530        LD      E,L
4311 ED72     00540        SBC     HL,SP   ;SEE IF AT END YET
4313 67       00550        LD      H,A     ;RESTORE
4314 6B       00560        LD      L,E
4315 20EB     00580        JR      NZ,NEXT ;NO CHECK NEXT BYTE
4317 14       00590        INC     D       ;INC PASS COUNTER
              00600 ;
              00610 ;      ROUTINE TO PRINT PASS NUMBER ON SCREEN
              00620 ;
4318 214843   00630        LD      HL,TEXT ;POINT TO TEXT
431B 7E       00640 NXTMSG LD      A,(HL)  ;GET BYTE
431C FE00     00650        CP      00H     ;CHECK FOR END OF TEXT
431E 2805     00660        JR      Z,PASS  ;YES GO TO PASS NO.
4320 02       00670        LD      (BC),A  ;PUT BYTE ON SCREEN
4321 03       00680        INC     BC      ;NEXT SCREEN LOCATION
4322 23       00690        INC     HL      ;NEXT TEXT BYTE
4323 18F6     00700        JR      NXTMSG
4325 7A       00710 PASS   LD      A,D     ;GET PASS NO.
4326 CB3F     00720        SRL     A
4328 CB3F     00730        SRL     A
432A CB3F     00740        SRL     A
432C CB3F     00750        SRL     A       ;GET MSD
432E C630     00760        ADD     A,30H   ;CONVERT TO ASCII
4330 FE3A     00770        CP      3AH     ;CHECK FOR 0-9
4332 FA3743   00780        JP      M,OUT1  ;YES 0-9
4335 C607     00790        ADD     A,07H   ;ADJUST FOR A-F
4337 02       00800 OUT1   LD      (BC),A  ;WRITE TO SCREEN
4338 03       00810        INC     BC      ;NEXT LOCATION
4339 7A       00820        LD      A,D     ;GET PASS NO. AGAIN
433A E60F     00830        AND     0FH     ;MASK FOR LSD
433C C630     00840        ADD     A,30H
433E FE3A     00850        CP      3AH
4340 FA4543   00860        JP      M,OUT2
4343 C607     00870        ADD     A,07H
4345 02       00880 OUT2   LD      (BC),A
4346 18B4     00890        JR      MEMTST  ;NEXT PASS
4348 50       00900 TEXT   DEFM    'PASS NUMBER = '
4356 00       00910        DEFB    00H
4357 7C       00920 ERROR  LD      A,H     ;GET NUMBER FROM HL
438C C630     01160        ADD     A,30H
438E FE3A     01170        CP      3AH
4390 FA9543   01180        JP      M,OUT5
4393 C607     01190        ADD     A,07H
4395 02       01200 OUT5   LD      (BC),A
4396 03       01210        INC     BC
4397 CB70     01211        BIT     6,B
4399 C2BB43   01212        JP      NZ,SCREEN
439C 7D       01220        LD      A,L
439D E60F     01230        AND     0FH
439F C630     01240        ADD     A,30H
43A1 FE3A     01250        CP      3AH
43A3 FAA843   01260        JP      M,OUT6
43A6 C607     01270        ADD     A,07H
43A8 02       01280 OUT6   LD      (BC),A
43A9 03       01290        INC     BC
43AA CB70     01291        BIT     6,B
43AC C2BB43   01292        JP      NZ,SCREEN
43AF 3E20     01300        LD      A,20H
43B1 02       01310        LD      (BC),A
43B2 03       01320        INC     BC
43B3 CB70     01321        BIT     6,B
43B5 C2BB43   01322        JP      NZ,SCREEN
43B8 C30F43   01330        JP      ENDC
43BB 01003C   01340 SCREEN  LD      BC,VIDEO;POINT TO START OF SCREEN
43BE C30F43   01350        JP      ENDC
42E9          01360        END     TEST
00000 TOTAL ERRORS
32221  TEXT AREA BYTES LEFT
BEGIN  42F7 00380   00340
CLEAR  42EF 00330   00370
ENDC   430F 00520   01330 01350
ENDM   FFFF 00240   00380
ERROR  4357 00920   00460 00500
MEMTST 42FC 00400   00890
NEXT   4302 00420   00580
NXTMSG 431B 00640   00700
OUT1   4337 00800   00780
OUT2   4345 00880   00860
OUT3   4369 01010   00990
```

```
4358 CB3F 00930          SRL   A       :AND PRINT VALUE
435A CB3F 00940          SRL   A       :ON SCREEN
435C CB3F 00950          SRL   A
435E CB3F 00960          SRL   A
4360 C630 00970          ADD   A,30H
4362 FE3A 00980          CP    3AH
4364 FA6943 00990        JP    M,OUT3
4367 C607 01000          ADD   A,07H
4369 02   01010 OUT3     LD    (BC),A
436A 03   01020          INC   BC
436B CB78 01021          BIT   6,B
436D C2BB43 01022        JP    NZ,SCREEN
4370 7C   01030          LD    A,H
4371 E60F 01040          AND   0FH
4373 C630 01050          ADD   A,30H
4375 FE3A 01060          CP    3AH
4377 FA7C43 01070        JP    M,OUT4
437A C607 01080          ADD   A,07H
437C 02   01090 OUT4     LD    (BC),A
437D 03   01100          INC   BC
437E CB78 01101          BIT   6,B     :CHECK FOR )3FH
4380 C2BB43 01102        JP    NZ,SCREEN
4383 7D   01110          LD    A,L
4384 CB3F 01120          SRL   A
4386 CB3F 01130          SRL   A
4388 CB3F 01140          SRL   A
438A CB3F 01150          SRL   A

OUT4   437C 01090   01070
OUT5   4395 01200   01180
OUT6   43A8 01280   01250
PASS   4325 00710   00660
SCREEN 43BB 01340   01022 01102 01212 01292 01322
START  4400 00230   00400
TEST   42E9 00300   01350
TEXT   4348 00900   00630
VIDEO  3C00 00250   00310 00410 01340
```

FIGURE 6

```
42E9 F3 01 00 3C 3E 20 CB 70 20 04 02 03 18 F8 31 FF
42F9 FF 16 00 21 00 44 01 00 3C 23 3E 55 77 BE 20 4E
4309 3E BB 77 BE 20 48 7C 5D ED 72 67 6B 20 EB 14 21
4319 40 43 7E FE 00 28 05 02 03 23 18 F6 7A CB 3F CB
4329 3F CB 3F CB 3F C6 30 FE 3A FA 37 43 C6 07 02 03
4339 7A E6 0F C6 30 FE 3A FA 45 43 C6 07 02 18 B4 50
4349 41 53 53 20 4E 55 4D 42 45 52 20 3D 20 00 7C CB
4359 3F CB 3F CB 3F CB 3F C6 30 FE 3A FA 69 43 C6 07
4369 02 03 CB 78 C2 BB 43 7C E6 0F C6 30 FE 3A FA 7C
4379 43 C6 07 02 03 CB 78 C2 BB 43 7D CB 3F CB 3F CB
4389 3F CB 3F CB 3F C6 30 FE 3A FA 95 43 C6 07 02 03
4399 C2 BB 43 7D E6 0F C6 30 FE 3A FA A8 43 C6 07 02
43A9 03 CB 78 C2 BB 43 3E 20 02 03 CB 78 C2 BB 43 C3
43B9 0F 43 01 00 3C C3 0F 43
```

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Regulation	see table
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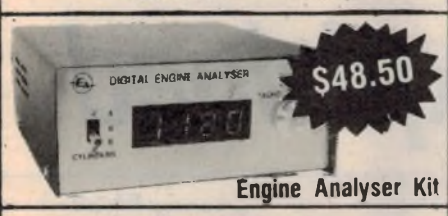
Efficiency	see table

Resistive load W	Output voltage (RMS)	Input current (A)	Efficiency (%)	Battery life 40AH/20h rate (minutes)
no load	210	1.2	0	–
40	235	4.5	60	240
100	240	11.3	62	80
140	240	15.0	69	60
200	240	20.1	78	50
240	240	24.0	79	32
300	235	29.6	82	28



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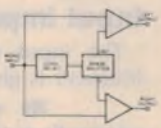

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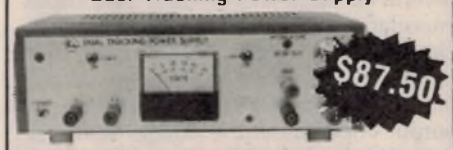

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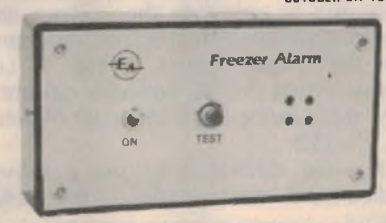

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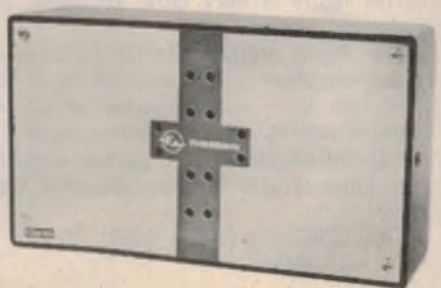

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A look at emitter followers —bootstrapping explained

by ELMO JANSZ, VK7CJ

One of the most useful electronic circuits ever devised is the emitter follower. This article shows how to analyse the emitter follower in both its normal and bootstrapped forms.

Emitter followers, or common collector amplifiers, are normally used as an interface between a high impedance signal source and a low impedance load. Such an amplifier should have a high input impedance and a low output impedance. The emitter follower fulfils both these requirements and has a voltage gain only slightly less than unity.

With correct design, the input impedance can be made as high as several hundred kilohms and the output impedance as low as a few tens of ohms. On this basis, with approximately the same voltage being developed across the high input impedance and the low output impedance, the emitter follower provides a substantial power gain.

The fact that the voltage output is approximately equal to the voltage input – that is, the output follows the input – is the basis for the name, emitter follower. Also, there is no phase change between input and output.

Fig. 1 shows an emitter follower circuit. Notice that the output is taken from the top of the emitter resistor, R_e. Let's examine this circuit more closely by working out its voltage gain, input impedance and output impedance.

Voltage gain

The voltage gain of an emitter follower is given by:

$$AV = \frac{Re}{re + Re}$$

where R_e is the value of the emitter resistor and r_e is the intrinsic base-emitter resistance of the transistor.

The value of r_e can be calculated using the formula:

$$re\ (ohms) = \frac{25}{Ic\ (mA)}$$

where I_c is the transistor collector current. Since r_e is small compared to R_e, the voltage gain is close to unity.

Note that there is no phase change between input and output as indicated by the positive value of AV.

Input impedance

The input impedance of the emitter follower is given by:

$$Zin = Rb \parallel hfe\ (re + Re)$$

where R_b is the parallel combination of R1 and R2 in Fig. 1. (The symbol // stands for "in parallel with").

Output impedance

The output impedance of the emitter follower is given by:

$$Zo = Re \parallel \frac{(Rb \parallel Rs + re)}{hfe}$$

where R_s is the impedance of the signal source and hfe is the gain of the transistor.

By using these four equations, it is possible to calculate the voltage gain, input impedance and output impedance of the circuit shown in Fig. 1. Let's assume that the DC collector current of the transistor is 1mA. Then, by equation 2, $r_e = 25\Omega$.

Having calculted r_e, we can now calculate the voltage gain using equation 1:

$$AV = R_e/(R_e + r_e) = 1k\Omega/(1k\Omega + 25\Omega) = 0.976.$$

This figure is very close to unity, as indicated above.

The input impedance is calculated using equation 3 but first we have to calculate R_b – ie, the value of R1 in parallel with R2. This, in fact, is equal to 27kΩ. Substituting this, together with an hfe value of 200 for the transistor, we have:

$$Zin = 27k\Omega//200\ (1k\Omega + 25\Omega) = 23.9k\Omega.$$

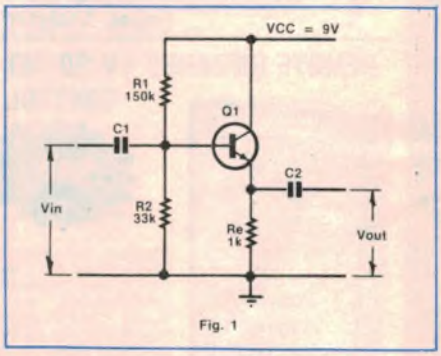

Fig. 1

Notice that if not for the effect of R1//R2, which is equal to 27kΩ, the input impedance would be much bigger than 23.9kΩ. In fact, it would be 205kΩ.

Finally, we can calculate the output impedance using equation 4. If we assume that the source impedance R_s is 1kΩ, then $R_b//R_s = 27k\Omega//1k\Omega = 964\Omega$.

Substituting the known values in equation 4 gives:

$$Z_o = 1k\Omega//(964\Omega/200 + 25\Omega) = 29\Omega.$$

These figures verify the main properties of the emitter follower.

Bootstrapping

At noted before, the input impedance of the circuit is reduced by the transistor's base bias network, made up of R1 and R2. These two resistors effectively shunt the input signal. This effect can be largely overcome by using a circuit technique known as "bootstrapping". Fig. 2 shows a modified version of the circuit of Fig. 1 incorporating boostrapping.

In this circuit R1 and R2 do not connect directly to the base of the transistor. Instead, they are isolated from the base by means of R3. The junction of R1, R2 and R3 is connected to the transistor emitter via capacitor C3 (the so-called bootstrap capacitor).

At signal frequencies, we can assume that all three capacitors, C1, C2 and C3, have negligible impedance. Therefore,

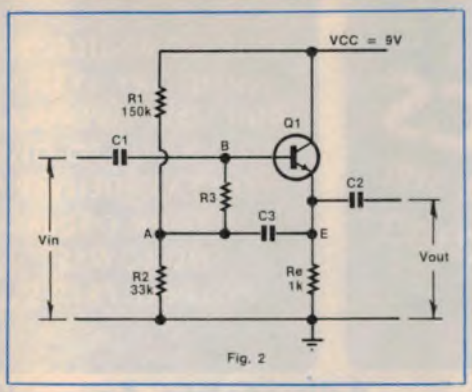

Fig. 2

as far as AC voltages are concerned, point A on the circuit is connected directly to point E.

Despite the modifications, the circuit is still an emitter follower and consequently has almost unity gain. Because of C3, the signal at A will be the same as at point E and thus the voltages at points A and B at either end of R3 will be almost identical. As a result, very little signal current can flow in R3 or in bias resistors R1 and R2.

Bootstrapping thus effectively isolates the bias network and removes its shunting effect on the input signal. In other words, it increases the circuit input impedance.

The voltage gain of the circuit shown in Fig. 2 is the same as for the normal emitter follower and is given by equation 1. The input impedance Zin is given by:

$$Zin = \frac{R3}{1-AV} \parallel hfe\ (re + Rb \parallel Re)$$

where R_b =R1//R2 as before.

In practice, R3/(1-AV) is very much greater than $hfe(r_e + R_b//R_e)$ and can be neglected. Also, R_b is very much greater than R_e. Equation 5 can now be re-written as:

$$Zin = hfe\ (re + Re)$$

which shows that Zin is not affected by R1 and R2.

The input impedance of the circuit shown in Fig. 2 is thus:

$Zin = hfe(r_e + R_e)$

$= 200(25\Omega + 1k\Omega) = 205k\Omega.$

So the emitter follower and its modified form — ie, the bootstrapped circuit — are quite easy to analyse. It is simply necessary to be familiar with the above equations and to be able to substitute the numerical values.

Editor's note: It is more usual for an emitter-follower to be biased so that the emitter is at half-supply voltage, so that the stage can deliver maximum output voltage swing. In the above example this could be achieved by increasing R2 to 180kΩ which would also have the effect of raising the input impedance considerably. However the author has used the above example to demonstrate the effect of bootstrapping.

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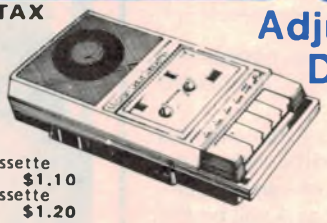

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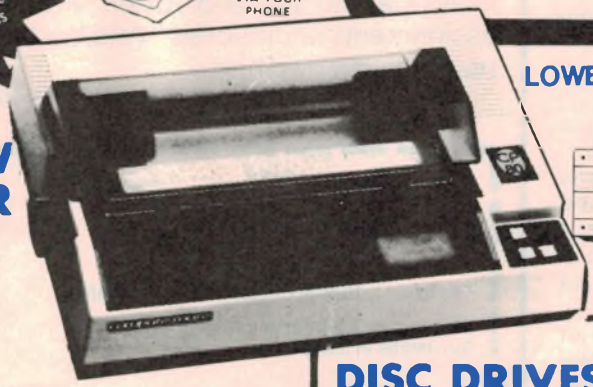

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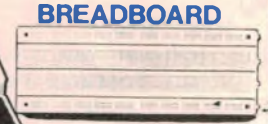

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74LS95	59
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74LS112	43
74LS123	58
74LS125	46
74LS126	59
74LS132	46
74LS136	45
74LS138	65
74LS139	65
74LS151	47
74LS153	60
74LS154	1 30
74LS155	52
74LS156	54
74LS157	46
74LS158	43
74LS160	68
74LS161	58
74LS163	57
74LS164	70
74LS165	63
74LS170	79
74LS173	61
74LS174	75
74LS175	75
74LS190	82
74LS191	79
74LS192	60
74LS193	79
74LS194	80
74LS195	75
74LS197	79
74LS221	80
74LS240	1 20
74LS241	1 80
74LS242	1 90
74LS243	1 80
74LS244	1 50
74LS245	1 90
74LS251	54
74LS253	52
74LS257	80
74LS258	47
74LS259	76
74LS266	43
74LS273	88
74LS279	49
74LS283	56
72LS290	62
74LS293	75
74LS298	62
74LS365	75
74LS366	90
74LS367	58
74LS368	58
74LS373	1 50
74LS374	1 50
74LS375	57
74LS377	1 10
74LS378	89
74LS390	69
74LS393	75
74LS629	4 50
74LS640	1 70
74LS670	1 40
81LS95	1 85
81LS96	1 85
81LS97	1 85
81LS98	1 85

74F00

74F00	68
74F02	68
74F04	68
74F08	68
74F10	72
74F11	72
74F20	72
74F32	72
74F64	72
74F74	83
74F86	1 05
74F109	94
74F138	1 50
74F139	1 50
74F151	1 50
74F153	1 50
74F157	1 50
74F158	1 50
74F175	2 45
74F181	4 20
74F182	2 20
74F189	6 50
74F190	3 90
74F191	3 90
74F194	2 10
74F241	3 10
74F243	3 90
74F244	3 10
74F251	1 70
74F253	1 70
74F257	1 70
74F258	1 70
74F350	3 10
74F352	1 70
74F353	1 70
74F373	3 50
74F374	3 50
74F399	2 40
74F521	3 70
74F533	3 50
74F534	3 50

74S00

74S00	39
74S02	47
74S03	44
74S04	38
74S05	42
74S08	42
74S10	42
74S11	40
74S15	58
74S20	40
74S30	45
74S32	49
74S40	49
74S51	40
74S64	43
74S74	48
74S86	58
74S112	66
74S113	76
74S132	56
74S133	43
74S135	1 10
74S136	2 10
74S138	76
74S139	86
74S140	78
74S151	63
74S153	63
74S157	78
74S158	76
74S161	4 20
74S174	76
74S175	83
74S188	2 80
74S189	2 80
74S194	1 45
74S247	3 95
74S251	83
74S257	90
74S258	97
74S283	1 50
74S287	2 40
74S288	2 30
74S289	2 95

74C00

74C00	58
74C02	58
74C04	50
74C08	58
74C10	58
74C14	78
74C20	58
74C30	58
74C32	58
74C42	1 20
74C48	1 65
74C73	83
74C74	95
74C83	2 05
74C85	1 35
74C86	55
74C89	3 60
74C90	1 40
74C93	1 40
74C95	1 45
74C107	1 00
74C150	3 30
74C151	2 90
74C154	4 60
74C157	2 60
74C160	1 30
74C161	1 05
74C162	1 20
74C163	1 20
74C164	1 45
74C165	1 65
74C173	98
74C174	98
74C175	89
74C192	1 50
74C193	90
74C195	1 65
74C200	12 95
74C221	2 55
74C240	3 10
74C244	2 55
74C373	2 60
74C374	2 50
74C901	85
74C902	78
74C904	75
74C906	75
74C907	75
74C908	1 45
74C910	12 10
74C911	11 85
74C912	11 95
74C914	2 20
74C915	1 95
74C917	12 00
74C918	1 75
74C920	5 30
74C922	5 40
74C923	5 40
74C925	7 40
74C926	7 90
74C927	6 80
74C928	8 50
74C929	4 10
74C930	4 10
74C941	2 20
74C989	8 60

4000

4000	40
4001	45
4002	45
4006	78
4007	45
4008	68
4009	64
4010	60
4011	45
4012	45
4013	30
4014	78
4015	60
4016	58
4017	96
4018	76
4019	58
4020	58
4021	72
4022	64
4023	35
4024	54
4025	38
4026	96
4027	58
4028	67
4029	82
4030	58
4031	3 20
4033	1 70
4034	1 70
4035	85
4040	98
4041	1 00
4042	58
4043	78
4044	95
4046	1 20
4047	1 00
4048	48
4049	48
4050	48
4051	70
4052	1 15
4053	78
4055	2 10
4060	98
4063	1 05
4066	70
4068	55
4069	35
4070	35
4071	55
4072	55
4073	55
4075	55
4076	95
4077	58
4081	55
4082	55
4085	55
4086	55
4089	2 00
4093	38
4094	88
4099	1 10
4104	2 30
4160	78
4161	1 10
4163	1 10
4174	80
4175	80
4194	80
4409	5 60
4411	10 00
4419	3 30
4469	13 00
4495	2 70
4500	5 80
4507	88
4503	66
4507	58
4508	1 20
4510	78
4511	78
4512	68
4514	1 50
4515	1 95
4516	98
4518	96
4519	90
4520	96
4521	2 00
4522	1 10
4526	1 50
4527	1 00
4528	80
4529	1 20
4531	1 00
4532	90
4534	6 00
4538	1 05
4539	58
4541	1 10
4543	90
4553	2 90
4555	58
4556	60
4558	1 30
4560	2 40
4569	2 00
4572	58
4583	98
4584	68
4585	80
4599	4 20

9000

9300	58
9302	1 05
9304	60
9307	1 40
9308	1 80
9309	60
9310	85
9311	1 60
9312	50
9314	58
9316	78
9318	1 40
9320	4 80
9321	87
9322	54
9324	76
9328	98
9334	1 10
9338	1 20
9340	2 80
9368	1 15
9370	92

LINEAR ETC

AD570	54 00
AD7524	12 00
ADC0800	14 90
ADC0804	5 50
ADC0808	12 60
ADC0809	8 00
ADC0817	13 60
ADC1210	58 00
AY 3 1015	6 50
AY 3 8910	10 00
BR1941	11 50
BR1943	12 00
CA3028	1 90
CA3036	4 40
CA3039	1 50
CA3059	5 80
CA3081	98
CA3130	1 30
CA3130T	1 70
CA3140	78
CA3140T	1 92
CA3146	2 20
CA3401	99
DAC0800	3 20
DAC0808	2 50
DAC1220	12 50
DM8121	2 50
DM8130	5 70
DM8131	2 95
DM8309	64
DM8310	87
DM8313	52
DM8316	76
DS8820	2 40
DS8830	2 40
DS8833	2 80
DS8836	2 40
DS8859	2 05
DS8869	1 80
DS75107	78
DS75108	1 10
DS75110	1 20
DS75150	1 20
DS75154	90
DS75451	90
DS75452	45
DS75453	78
DS75454	66
FD1771	19 00
FD1791	36 00
FD1793	30 00
FD1795	35 00
ICL7106	13 50
ICL7107	17 00
ICL7660	4 80
ICM7217A	17 50
ICM7218A	18 00
ICM7555	1 85
ICM7556	2 70
L120	2 87
L321	2 76
LF347	1 90
LF351	58
LF353	88
LF356	1 20
LF357	1 20
LF398	3 90
LF398H	6 50
LF13741	70
LH0002	10 90
LH0042CH	9 40
LH0070 1H	15 90
LH0071 1H	17 10
LM10CH	6 50
LM304H	2 90
LM307	48
LM310	1 90
LM311 14	1 10
LM318	1 70
LM319	1 90
LM322	1 90
LM325	4 50
LM329	78
LM334	1 60
LM3352	1 45
LM3362	1 45
LM349	1 60
LM358	78
LM358AN	1 38
LM374	4 80
LM377	2 10
LM380 8	1 20
LM380 14	1 30
LM381	1 75
LM382	1 45
LM383	1 90
LM386	70
LM387	78
LM394CH	5 60
LM565	88
LM566	1 90
LM567	89
LM1830	3 20
LM1886	6 00
LM1889	2 30
LM2917 14	2 05
LM3080	1 15
LM3089	2 90
LM3524	2 95
LM3900	95
LM3905	1 40
LM3909	1 40
LM3911	2 00
LM3914	4 50
LM3915	4 50
LM3916	4 50
LM4250	2 90
MC1350	1 30
MC1406	8 90
MC1445	3 80
MC1456	1 50
MC1466	13 00
MC1494	7 10
MC1495	7 10
MC1496	3 60
MC3340	1 30
MC3370	3 70
MC3470	8 90
MC3486	3 20
MC10116	1 40
MCM66740	16 00
MM5303	6 50
MM5837	2 40
MM58167	11 50
MN3001	13 90
MSM58372	11 00
NE530	2 30
NE558	1 85
NE571	2 80
NE5534	1 70
NE5534AN	2 40
OM321	9 80
OM335	16 80
OM350	9 30
SAB0600	6 40
SAK140	1 50
SN76477	5 60
SN76488	7 20
TA7205	2 60
TCA220	8 10
TL061	1 05
TL062	1 50
TL071	78
TL072	1 45
TL074	2 80
TL075	3 10
TL081	58
TL082	1 10
TL084	2 30
TR1602	7 10
TR1863	6 70
TR1983	8 90
UA301	45
UA301H	1 30
UA305H	1 20
UA308	56
UA311	62
UA311H	1 25
UA324	84
UA339	44
UA348	1 40
UA393	51
UA555	55
UA556	88
UA709	56
UA710	75
UA711	58
UA723	48
UA723H	3 20
UA725	2 40
UA739	98
UA741	55
UA741H	1 15
UA747	98
UA1458	48
UA1488	70
UA1489	70
UA2901	58
UA3086	48
UA4136	1 15
UAA170	4 60
UAA180	4 20
ULN2003	1 20
WD1393	64 00
WD1691	32 50
XR2206	5 95
XR2207	4 90
XR2208	3 10
XR2211	6 80
XR2216	2 80
XR2740	3 00
XR2243	2 90
8126	1 70
8128	2 30
8195	1 60
8196	1 80
8197	1 90
11C90	12 00
95H90	7 00

MICRO

2102	1 40
2112	7 20
2114	2 80
2532	10 20
2564	16 50
2708	5 90
2716	4 20
27128	38 00
2732	5 20
2764	9 50
2816	12 00
2911	32 00
2912	22 00
2920	108 00
4116 150NS	2 90
4164 150NS	7 20
6116P3	6 80
6502	9 20
6502A	9 50
6505	11 90
6507	8 50
6520	2 90
6522	7 20
6522A	10 50
6532	10 50
6545	19 80
6551	12 50
6800	4 80
6802	6 40
6808	4 20
6809	13 90
6810	3 10
6820	2 85
6821	2 60
6840	5 60
6844	11 00
6845	11 00
6847	7 20
6850	2 40
6852	2 60
6854	8 60
6875	12 00
68B00	6 50
68B21	3 80
68B40	17 00
68B45	16 00
68B50	3 20
68B54	11 90
8080	6 90
8085A	5 80
8086	52 00
8088	41 00
8155	5 10
8156	5 40
8185	34 00
8202A	56 00
8203	56 00
8206	115 00
8212	1 55
8214	1 80
8216	1 60
8224	4 40
8226	1 75
8228	3 40
8231	285 00
8237	41 00
8238	10 50
8243	2 90
8251A	4 80
8253	5 50
8255A	3 40
8257	6 40
8259	4 60
8271	95 00
8272	29 00
8273	58 00
8274	43 00
8275	44 00
8276	23 00
8282	8 20
8283	8 20
8284	10 00
8286	8 20
8287	8 20
8288	24 00
8289	31 00
8291A	42 00
8292	14 00
8293	25 00
Z80CPU	4 80
Z80ACPU	5 80
Z80BCPU	10 50
Z80PIO	4 20
Z80APIO	5 60
Z80SIO	12 10
Z80ASIO	15 00
Z80CTC	4 90
Z80ACTC	6 40
Z80DMA	14 00
Z80ADMA	16 00
8741A	35 00
8748 8	25 00
8749	54 00
8755A	34 00

VOLT REGS

LM309H	3 90
LM317HVK	7 50
LM337T	1 40
LM337HVK	12 00
LM337K	6 40
LM338K	7 90
LM350K	6 30
LM350T	4 50
LM396K	18 90
LM79L05	70
LM79L12	58
LM79L15	58
SH1605	14 00
UA317T	1 40
UA317K	2 50
UA309K	1 60
UA494	3 10
UA7805	68
UA7805K	1 60
UA7806	70
UA7808	60
UA7808K	1 60
UA7812	64
UA7812K	1 60
UA7815	64
UA7815K	1 60
UA7818	64
UA7818K	1 60
UA7824	64
UA7824K	1 70
UA78H05K	7 40
UA78H12K	9 10
UA78HGKC	9 70
UA78L05	39
UA78L12	39
UA78L15	39
UA78M05	58
UA78M12	58
UA78P05K	15 70
UA78S40	2 70
UA7905	70
UA7905K	1 80
UA7908	70
UA7908K	1 80
UA7912	70
UA7912K	1 80
UA7915	90
UA7915K	1 80
UA79HGKC	15 00
UA79M05	60
UA79M12	60

OPTO

4N25	97
4N26	97
4N28	97
4N32	97
4N33	1 20
4N35	97
MC16	1 30
MC12	90
FND357	1 30
FND500	1 30
FND507	1 58
FND800	3 40
TIL31A	2 50
TIL81	2 00
BPW50	2 00
CQY89	85
MOC3020	2 10
MOC3021	2 40
MAN72A	1 20
MAN74A	1 20
FCD820C	90
FCD825C	90
FCD850C	1 10
FPT100B	1 20
MSM3914	8 50
MSM3916	8 50

LEDS

TLG123 SGS 3mm GREEN	15
TLR123 SGS 3mm RED	09
TLO123 SGS 3mm YELLOW	15
TLG113 SGS 5mm GREEN	15
TLR113 SGS 5mm RED	09
TLO113 SGS 5mm YELLOW	15
20160 RECT RED	25
20162 RECT GREEN	25
20164 RECT YELLOW	25
FLS010	
5mm LED CLIP	06

DIODES

IN4148	03
IN914	03
IN4001	05
IN4002	05
IN4004	05
IN4007	05
IN5404	15
IN5408	17
OA47	43
OA90	17
OA202	87
OA636	89
P600G	35
6A400V	59
BAW62	30
BA102	70
OA91	27
OA95	26
IN3492 25A100V	1 50
IN3492R 25A100V	1 50
IN5060	30

BRIDGES

VJ448 10A400V	1 70
BR154 15A400V	3 00
BR254 25A400V	3 05
BR354 35A400V	3 90
P04 6A400V	1 50
RS204 2A400V INLINE	96
SB204 2A400V	79
W04 1 5A400V	39

ZENERS

IN4733A 5 1V 1 WATT	17
IN4734A 5 6V 1 WATT	17
IN4736A 6 8V 1 WATT	17
IN4740A 10V 1 WATT	17
IN4742A 12V 1 WATT	17
IN5349B 12V 5 WATT	84
BZX61 C75 75V 1 3 WATT	79

TRANSISTORS

AC126	70
AC127	60
AC128	85
AC187	56
AC188	1 10
AD149	1 85
AD161	1 70
AD162	1 70
AF127	45
BC107	29
BC107B	14
BC108	29
BC108C	34
BC109	29
BC109C	34
BC177	34
BC178	34
BC179	34
BC212	19
BC318	14
BC327	18
BC328	18
BC546	14
BC547	14
BC547C	15
BC548	12
BC548C	18
BC549	12
BC549C	16
BC550	14
BC556	14
BC557	12
BC557B	16
BC558	12
BC558B	18
BC559	12
BC559B	18
BC637	34
BC639	29
BC640	29
BCY70	55
BCY71	59
BD135	55
BD136	55
BD137	39
BD138	39
BD139	39
BD140	39
BD233	39
BD235	40
BD236	40
BD237	42
BD238	42
BD262	70
BD263	70
BD437	45
BD647	1 90
BD677	60
BD681	71
BD682	71
BDV64B	2 80
BDV65B	2 80
BDY96	3 50
BDY97	3 50
BF115	55
BF167	58
BF173	58
BF180	78
BF184	68
BF198	22
BF199	22
BF337	48
BF458	50
BF459	50
BF469	78
BF470	78
BF494	26
BFY50	52
BFY90	71
BU126	1 85
BU208	1 45
BU326A	1 90
JUX80	2 40
MFE121	1 40
MFE131	1 40
MJ413	3 20
MJ802	3 90
MJ1001	2 40
MJ15003	3 90
MJ15004	3 90
MJ2955	1 65
MJ4032	7 90
MJ4035	7 40
MJ4502	4 00
MJE340	70
MJE350	80
MJE521	1 20
MJE700	50
MJE800	50
MJE2955	1 90
MJE3055	1 70
MPSA05	19
MPSA06	19
MPSA12	19
MPSA14	19
MPSA42	19
MPSA56	19
MPSA92	19
MPF102	36
MPF103	79
MPF105	79
MRF237	3 80
MRF454	28 00
MRF475	4 40
MRF901	2 70
TIP31	38
TIP31A	39
TIP31B	50
TIP31C	55
TIP32	38
TIP32A	54
TIP32B	52
TIP32C	61
TIP41	65
TIP41A	68
TIP41B	70
TIP41C	75
TIP42	58
TIP42A	74
TIP42B	78
TIP42C	80
TIP111	66
TIP112	70
TIP116	70
TIP117	80
TIP120	85
TIP122	70
TIP125	75
TIP127	95
TIP2955	1 40
TIP3055	1 40
2N301	3 80
2N697	40
2N918	40
2N2219	42
2N2219A	45
2N2222	40
2N2222A	45
2N2369	40
2N2484	41
2N2646	96
2N2647	1 60
2N2894	35
2N2904	40
2N2905	40
2N2905A	45
2N2906	39
2N2907	40
2N2907A	45
2N3019	45
2N3053	45
2N3054	1 70
2N3055	75
2N3302	35
2N3440	75
2N3441	2 40
2N3442	2 30
2N3563	18
2N3564	18
2N3565	18
2N3566	18
2N3567	18
2N3568	18
2N3569	18
2N3638	18
2N3640	18
2N3641	18
2N3642	18
2N3643	18
2N3644	18
2N3646	18
2N3702	27
2N3704	25
2N3771	3 10
2N3772	3 50
2N3773	4 20
2N3819	60
2N3866	85
2N3904	20
2N3906	20
2N4032	45
2N4033	69
2N4036	45
2N4121	20
2N4236	1 20
2N4237	1 10
2N4250	19
2N4258	21
2N4355	19
2N4356	19
2N4360	48
2N4401	18
2N4402	18
2N4403	18
2N4416	1 40
2N4427	79
2N5088	18
2N5089	20
2N5179	1 15
2N5190	70
2N5191	70
2N5192	60
2N5193	60
2N5195	64
2N5210	19
2N5245	70
2N5303	3 60
2N5401	20
2N5457	54
2N5458	54
2N5459	59
2N5461	65
2N5485	54
2N5486	54
2N5590	14 00
2N5591	15 00
2N5770	19
2N5777	95
2N5873	1 30
2N5944	13 00
2N5946	18 00
2N5961	19
2N6027	54
2N6084	22 00
2N6121	55
2N6122	55
2N6123	50
2N6124	55
2N6125	60
2N6126	55
2N6129	1 10
2N6130	1 30
2N6131	1 40
2N6133	1 50
2N696	85
2N918	40
2SA683	78
2SC1017	2 50
2SC1061	69
2SC1096	70
2SC1106	4 80
2SC1226	95
2SC1306	1 50
2SC945A	24
2SD350A	2 20
2SJ49	5 90
2SK134	5 90
3N201	1 70

SCR & TRIACS

C103D	64
C106D	79
C1220	1 55
C122E	1 90
C230D	5 80
Q4010L4	1 90
Q4015L5	2 70
Q6010L5	3 20
Q6015L5	3 50
Q6025H	9 80
S4015L5	2 20
S4025H	8 20
SC141D	1 25
SC146D	1 60
SC151D	2 10
ST2	50
S14	60

TANTALUM

1UF 35V	18
22UF 35V	19
33UF 35V	19
47UF 35V	19
1UF 35V	19
1 5UF 35V	20
2 2UF 35V	21
3 3UF 35V	24
4 7UF 35V	40
10UF 35V	50

ELECTRO PCB

1UF 50V	15
2 2UF 25V	15
4 7UF 25V	15
10UF 25V	15
33UF 25V	15
47UF 25V	15
100UF 25V	16
220UF 25V	20
330UF 25V	25
470UF 25V	34
1000UF 16V	39
1000UF 25V	49
2200UF 25V	80

ELECTRO AXIAL

47UF 63V	18
1UF 63V	18
2 2UF 63V	18
3 3UF 25V	18
4 7UF 25V	18
10UF 160V	24
10UF 16V	18
10UF 25V	18
10UF 63V	19
22UF 25V	19
22UF 63V	19
47UF 16V	18
47UF 25V	18
47UF 63V	19
100UF 25V	19
100UF 63V	34
220UF 16V	19
220UF 25V	24
220UF 63V	49
470UF 16V	37
470UF 25V	40
470UF 63V	60
1000UF 16V	40
1000UF 25V	50
1000UF 35V	74
2500UF 16V	87
2500UF 25V	98
2500UF 35V	1 60
2500UF 50V	1 80
4700UF 35V	2 40

ELECTRO METAL CAN

2500UF 80V	3 50
4000UF 75V	5 40
5600UF 40V	3 40
8000UF 75V	8 40

ELECTRO BIPOLAR

2 2UF 50V	35
4 7UF 50V	38
6 8UF 50V	39
10UF 50V	40
22UF 50V	46

GREENCAPS

001UF 100V	09
0015UF 100V	09
0022UF 100V	09
0033UF 100V	09
0039UF 100V	09
0047UF 100V	09
0056UF 100V	09
0068UF 100V	09
0082UF 100V	09
01UF 100V	09
015UF 100V	09
022UF 100V	09
033UF 100V	09
039UF 100V	09
047UF 100V	14
056UF 100V	14
068UF 100V	18
082UF 100V	18
1UF 100V	18
15UF 100V	18
22UF 100V	18
27UF 100V	22
33UF 100V	30
47UF 100V	34
1UF 250V	85
2 2UF 250V	1 25
3 3UF 250V	2 30
4 7UF 250V	2 80
6 8UF 250V	4 40
10UF 250V	5 90

GREENCAPS HIGH VOLTAGE

01UF 630V	22
022UF 630V	24
033UF 630V	26
047UF 630V	30
1UF 630V	38
22UF 630V	45
33UF 630V	46
47UF 630V	50

CERAMIC

1PF	08
1 5PF	08
2 2PF	08
2 7PF	08
3 3PF	08
3 9PF	08
4 7PF	08
5 6PF	08
6 8PF	08
8 2PF	08
10PF	08
12PF	08

STYROSEAL

56PF 630V	25
68PF 630V	25
82PF 630V	25
100PF 630V	25
120PF 630V	25
150PF 630V	25
180PF 630V	25
220PF 630V	25

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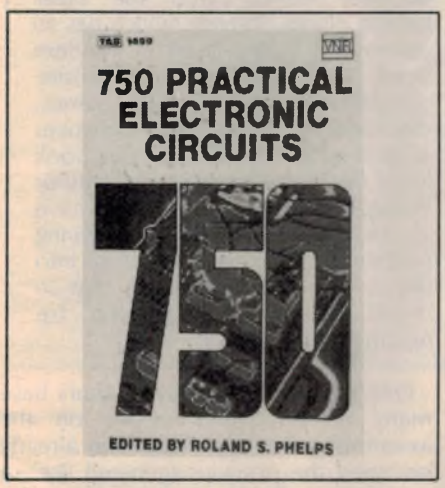


Practical circuits

750 PRACTICAL ELECTRONIC CIRCUITS, edited by Rolan S. Phelps. Published by TAB Books Inc, USA, 1983. Soft covers, 130 × 207mm, 568 pages, illustrated with line drawings. ISBN 0-8306-1499-0. Price $27.50.

The title of this book – 750 Practical Electronic Circuits – is probably one of the most accurate and revealing titles this reviewer has encountered in a long time, because that is exactly what the book contains – and nothing else!

There is no text, or even captions, for any one of the 750 circuits. The circuits are just as they have been lifted from a variety of (acknowledged) sources, and they suffer from various shortcomings as a result. Some are over reduced, to the point where values are hard to read and, in some cases, broken up and illegible. In other cases the identification, or pin connections, of vital components are missing, presumably having been covered in the original text. Unfortunately, nobody bothered to notice this during the book's preparation.

According to the acknowledgments, most of the circuits have been taken from component manufacturers' data books. These include AEG-Telefunken, Analog Devices, Exar Integrated Systems, LSI Computer Systems, Motorola, National Semiconductor, Optical Electronics, Precision Monolithics, Raytheon, SGS, Signetics, Silicon Systems, Sprague, Supertex, and Workman Electronic Products.

Against this background, all the circuits are probably based on sound engineering practice. But without the advantage of a text to explain the circuit philosophy, printed circuit boards or other diagrams to take care of critical layouts, or the identification of, or specifications for, ancilliary devices, such as sensors, lamps etc, their value would seem to be extremely limited.

In most cases, having found an interesting circuit, the reader would have to locate and consult the original manufacturer's databook for the vital additional information. In this role, therefore, this book would serve simply as a glorified index. In some cases this may justify the book's existence, but it would seem to be a rather expensive index.

In short, the book would seem to have a limited use only, and prospective buyers should make sure it will suit their requirements before they commit themselves.

Our copy came from Thomas Nelson Australia, 480 La Trobe St, Melbourne, Victoria, 3000. (PGW).

Acoustic techniques

ACOUSTIC TECHNIQUES FOR HOME AND STUDIO. F. Alton Everest. Soft covers, 216 x 137mm, 224 pages, photos and line illustrations. Published by TAB books, Blue Ridge Summit, Pennsylvania. $12.50 from McGills.

This covers a wide range of typical listening and recording venues and the suitable acoustic treatment for their most effective use. The fourteen chapters cover sound and hearing theory, speech, music and noise, resonances in rooms, standing waves, diffusion, control of interfering noise, sound absorbers, reverberation and its computation, acoustic design of a studio, adjustable acoustics, tuning the listening room, evaluating studio acoustics, plus appendices on absorption coefficients and formula for dead rooms.

The book was originally printed in 1973 and the copy to hand was a 1980 reprint with no obvious revisions.

In his preface the author stresses the point that his approach is for an "understand it yourself" book rather than a "do it yourself" effort and I would tend to agree as a lot of the treatment recommended for listening rooms would involve major surgery on the average home apart from the cost. Sixteen pages of photos serve to illustrate the text in a practical fashion and although there is a somewhat dated appearance to most of them, the principles are still valid if you are contemplating the construction of a studio.

A lot of the constructional information would be of use to an architecture student or somebody faced with the task of reducing the noise level in an industrial situation as a lot of quietening methods are better built in rather than added at a later date. (NJM)

Basic programming

YOUR FIRST BASIC PROGRAM by Rodnay Zaks. Published 1983 by Sybex Inc, Berkeley, USA. Soft covers, 178 x 276mm, 184 pages, profusely illustrated with drawings. ISBN 0 89588 092 X. Price $14.95

This is a curious book, since it is illustrated with cute diagrams and funny pictures seemingly meant to explain computer concepts to young children, yet the text is written on an adult level.

After dealing with general concepts the author introduces flow-charts and simple Basic statements. As it turns out, the program designated "Your First" is a simple ounces to grams conversion routine. Perhaps with the guidance of a teacher this book would be suitable for use as a textbook in an elementary computer awareness course, but it has little to offer the hobbyist.

Our review copy came direct from the publishers, ANZ Book Co. Pty Ltd, PO Box 459, Brookvale, NSW, 2100. (P.V.)

Z80 applications

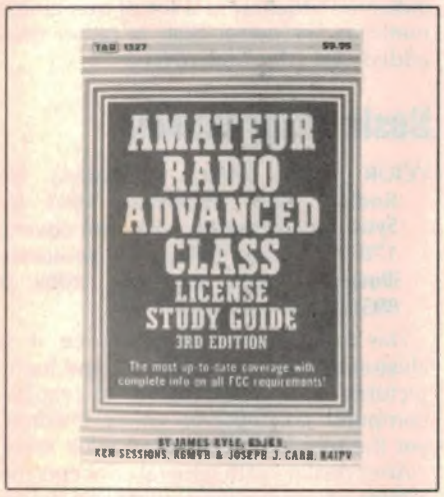
Z80 APPLICATIONS by James W. Coffron. Published 1983 by Sybex Inc, Berkeley, USA. Soft covers, 175 x 225mm, 295 pages, illustrated with diagrams and charts. ISBN 0 89588 094 6. Price $25.95.

This book provides practical, understandable instruction on using the Z80 microprocessor with popular memory and peripheral controller chips. Numerous diagrams and example circuits give detailed information on the use of ROM and RAM chips (both static and dynamic), the Z80 interrupt structure and peripheral devices including the Z80 serial I/O, parallel I/O counter/timer and the Intel 8255 parallel I/O chips. Trouble-shooting of Z80 designs is also covered in a separate chapter using simple hardware and a technique called "static stimulus testing", which substitutes an array of switches for

Books & Literature

the microprocessor and allows new circuits to be checked out.

Each of the 12 chapters concludes with a summary of the material covered, and the detailed information and practical circuit designs have much to offer the engineer or hobbyist working with the Z80 family. Our review copy came direct from the ANZ Book Co Pty Ltd, PO Box 459, Brookvale, NSW, 2100. (P.V.)



Amateur radio

AMATEUR RADIO ADVANCED CLASS LICENCE STUDY GUIDE by James Kyle (K5JKX), Ken Sessions (K6MVH), and Joseph J. Carr (K4IPV). Published by TAB Books, USA, 1982. Soft covers, 130 × 207mm, 348 pages, illustrated with line drawings. ISBN 0-8306-1327-7. Price $16.95.

As the name suggests, this book is aimed at prospective candidates for the Advanced Class Licence as prescribed by the US Federal Communications Commission for US amateurs. The Advanced Licence is the second highest of five grades of licence allocated for US amateurs: novice, technician, general, advanced and extra.

The authors set out with the declared and laudable intention of presenting a text which will enable the prospective student to answer questions because he understands the subject, and can work out the answer from basic principles, rather than encourage him to memorise a swag of answers to a set of (probably mythical) standard questions.

Just how well they have succeeded is a little difficult to assess against the Australian background. They have certainly covered most of the subjects likely to be encountered by a prospective amateur, but how useful the depth of treatment will be for the Australian reader is another matter.

One problem is that the authors base many of their explanations on the assumption that the reader has already obtained the previous (general) licence and, as a result, has a good grounding in basic principles. The student starting from scratch may therefore find himself out of his depth in places.

Another criticism is that many of the explanatory circuits used are still based on valves, whereas the modern student is expected to think almost exclusively in terms of solid state.

These criticisms aside, and provided they are appreciated, the book may still prove a valuable addition to an amateur study group, provided it is only in addition to more fundamental texts more suited to the Australian scene.

Our copy from Australian & New Zealand Book Co, Pty Ltd, 10 Aquatic Drive, Frenchs Forest, NSW, 2086. (PGW).

Digital logic design

DIGITAL LOGIC DESIGN By B. Holdsworth. Soft covers, 214 x 137mm, 338 pages, numerous line drawings and tables. Published by Butterworths, 271 Lane Cove Road, North Ryde. ISBN 0 408 00566 1. Price $27.

This book is aimed at undergraduate students and those whose engineering studies have not included digital techniques. There are twelve chapters, eleven with test questions and answers, so that the reader may pace his studies. The subjects covered include Boolean algebra, Karnaugh maps, Nand & Nor logic, Combinational Logic design, Single bit memory elements, Counters, Shift register counters and generators, Clock-driven sequential circuits, Event driven circuits, Digital design with MSI, Hazards, Introduction to Microprocessors.

All the chapters have plenty of illustrations, block diagrams, truth tables and Karnaugh maps for all the applications given.

For anyone faced with the need to become familiar with the ideas behind digital circuitry, which has so penetrated every facet of modern living, with computers, calculators, compact disc players, video games, electronically controlled appliances as well as car electronics, this book looks like a useful guide. The author presupposes that any reader will have a good grounding in engineering mathematics before launching into this course of study. With that in mind, it is a book to be recommended. (NJM)

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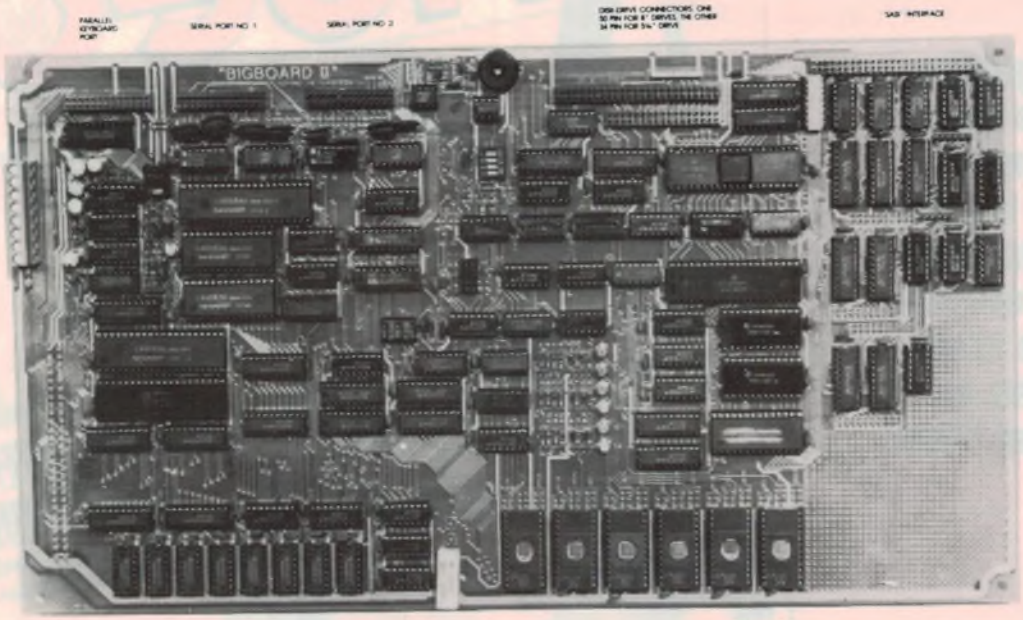
"BIG BOARD II"



EPROMs shown only for clarity.

STD Bus Connector

Prototyping Area

4 MHz Z80 — CPU AND PERIPHERAL CHIPS

The Ferguson computer runs at 4 MHz. Its monitor code is lean, uses Mode 2 interrupts, and makes good use of the Z80-A DMA chip.

64K DYNAMIC RAM + 4K STATIC CRT RAM + 24K E(E)PROM OR STATIC RAM

"Big Board II" has the three memory banks. The first memory bank has eight 4164 RAMs that provide 60K of user space and 4K of monitor space. The second memory bank has two 2Kx8 SRAMs for the memory-mapped CRT display and space for six 2732 As, 2Kx8 staticRAMS, or pin-compatible E(E)PROMs. The third memory bank is for RAM or ROM added to the board via the STD bus. Whether bought as a bare board, a full kit, Or assembled and tested, it comes with a 450nS2732 EPROM containing the monitor.

MULIPLE-DENSITY CONTROLLER FOR SS/DS FLOPPY DISKS

The new Ferguson single-board computer has a multiple-density disk controller. It can use 1793, 1797, or 8877 controller chips since it generated the signal with TTL parts. The board has two connectors for disk signal with 34 pins for 5.25" drivers, the other with 50 pins 8" drives.

VASTLY IMPROVED CRT DISPLAY

The new Ferguson SBC uses a 6845 CRT controller and 8002 Video Attributed controller to produce a display that will rival the display of quality terminals. Characters are formed by a 5x7 dot matrix on 15 75 KHz monitors and 7x9 dot matrix on 18 60 KHz monitors. The display is user programmable with the default display 24 lines of 80 characters. 8002a chip supplied for 18 to 60 kHz monitors.

STD BUS CONNECTOR

The Ferguson computer brings its bus signals to a convenient place on the PC board where users can solder an DSTD, bus cards can be plugged directly into it, and it can as well be connected by bus cable to industry-standard card cages.

DMA

The new Ferguson computer has a Z80-A DMA chip that will allow byte-wise data transfers at 500K bytes per second and bit serial transfers via the Z80-A S10 at 880K bytes per second with serial processor overhead, though the monitor for the new computer uses the DMA chip mainly for transferring data to and from disk, the chip can readily be used for other things since its "wait/ready" pin can be connected under software control to some half a dozen signal lines. When a hard-disk subsystem is connected to the "Big Board II" via its "SASI" interface, the DMA chip makes breathtaking disk performance possible.

"SASI" INTERFACE FOR WINCHESTER DISKS

The "Big Board II" implements the Host portion of the "Shugart Associates Systems Interface". Adding a Winchester disk drive is no harder than attaching a floppy-disk drive. A user simply 1: Runs a 50-conductor ribbon cable from a header on the board to any of several inexpensive controller cards for Winchester drives that implement the controller portion of the SASI interface. 2: Cables the controller to an appropriate drive, and 3: Provides power for the controller card and drive. Since our CBIOS contains code for communication with hard-disk, that's all a user has to do to add a Winchester to a system!

A Z80-A S10/0 = TWO ASYNCHRONOUS/SYNCHRONOUS SERIAL PORTS
A PARALLEL KEYBOARD PORT = FOUR OTHER PARALLEL PORTS USER 1/0

The new Ferguson single-board computer has one parallel port for an ASCII keyboard and four others for user-defined 1/0. When the computer is powered-up or reset, the monitor looks for a carriage-return at the keyuboard and serial ports. If the first carriage-return the monitor gets comes from the parallel keyboard, the monitor uses the board's video display circuitry to communicate with the user via a CRT. If the first carriage-return is typed at an ASCII terminal attached to a serial port, the monitor autabauds and makes the terminal the system console.

TWO Z80-A CTCs = EIGHT PROGRAMMABLE COUNTERS/TIMERS

The new Ferguson computer has two Z80-A CTCs. One is used to clock data into and out of the Z80-A S10/0, while the other is for systems and application use.

PROM PROGRAMMING CIRCUITRY AND SOFTWARE

The new Ferguson SBC has circuitry and drivers for programming 2716s, 2732(A)s, or pin-compatible (E)EPROMs. Software $25 extra.

CP/M

CP/M with Russell Smith s CBIOS for the new Ferguson computer is available for $220.
The CBIOS is available separately for $65.
Actual board size 39.6cm x 22.2cm. 5 inch BIOS being developed. Approx price $95.

Pricing and Availability:

Available ex-stock

In single quantities, full kits cost $695 inc. tax . and A&T'd computers cost $895. There are attractive discounts that range to 35% for OEM's and dealers. For details about them please call Rod Irving on (03) 489 7099. ie: 3 Ferguson II "Big Board" are less 20% off the one-off price. hard disks disk controllers, boxes and power supply to suit both 8" & 5¼" systems will be available.

Bare board with main chips now available (includes PCB, Manual, PALS, Monitor ROM, SMC chips). You have to add rest of components at $395 + tax

Errors and omissions excepted

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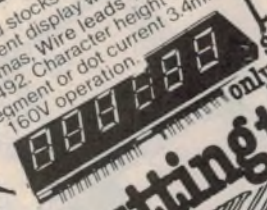

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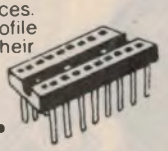

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SCR	S2010L	200V 10A	NON SENSITIVE GATE T0220AB	$1.00	$0.80
SCR	S6020L	600V 20A	NON SENSITIVE GATE T0220AB	$1.50	$1.25
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SCR	T0-106B1	200V 4A	SENSITIVE GATE T0220AB	$1.00	$0.80
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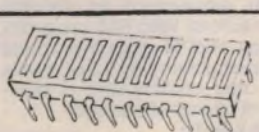

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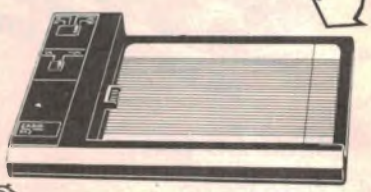

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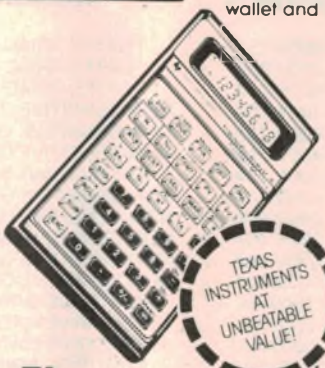

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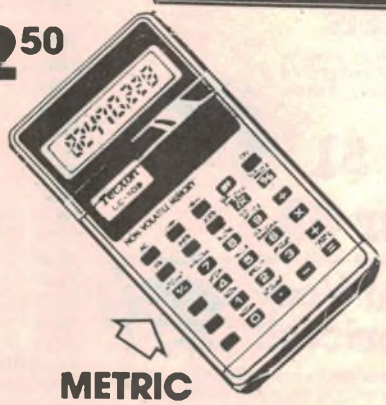

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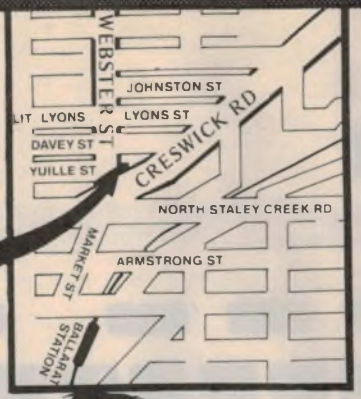

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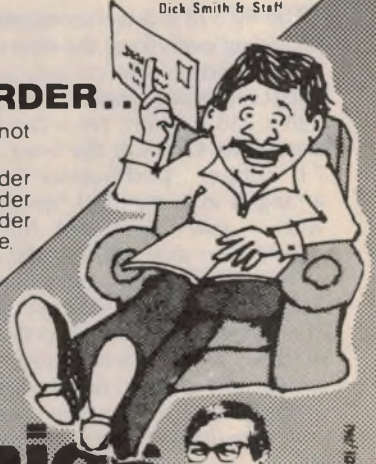

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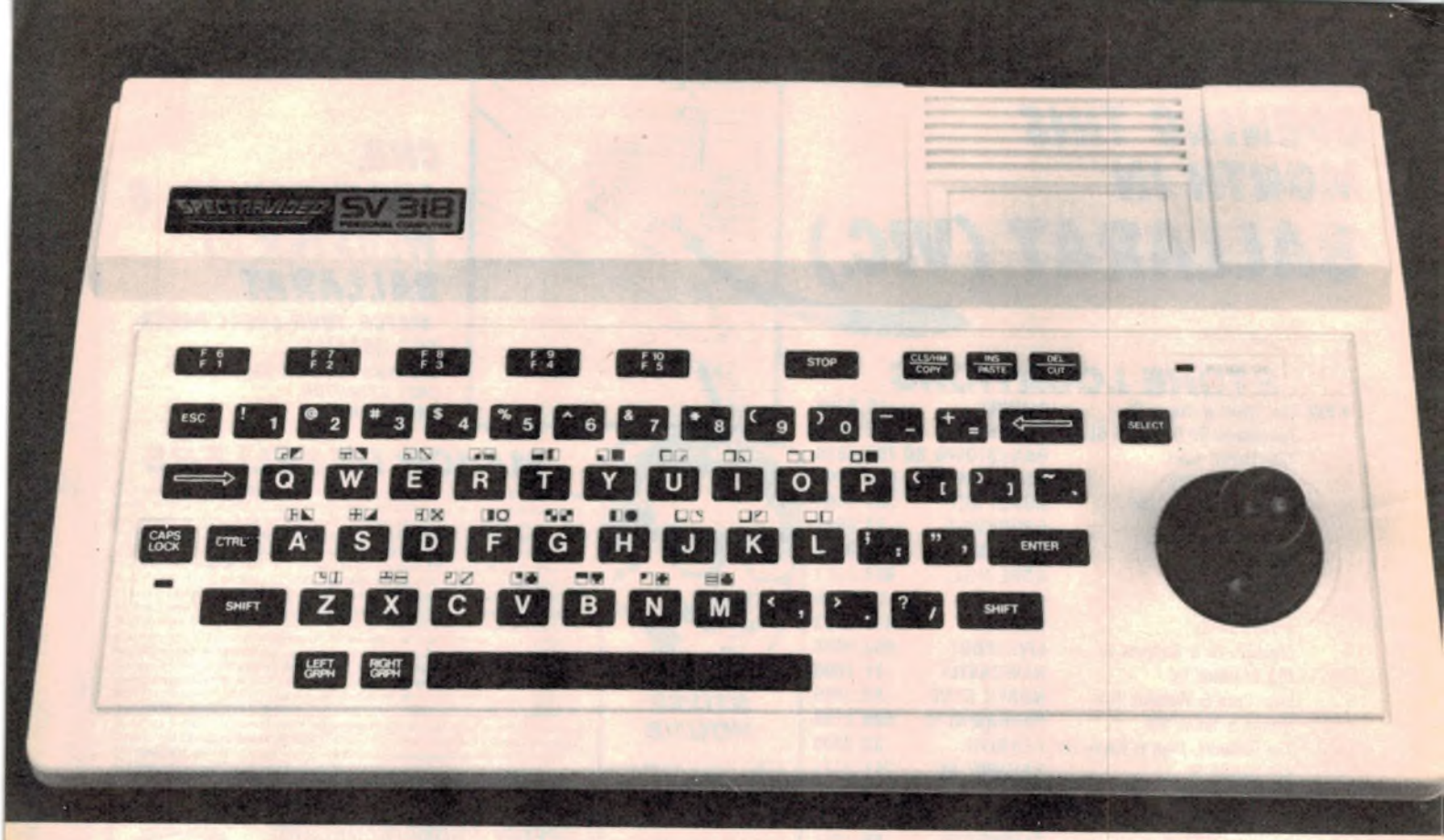

Graphics, sound and software

by PETER VERNON

Spectravideo SV-318

The first widely available machine to be based on the proposed MSX hardware standard, the Spectravideo SV-318 is an attractive home computer system with some exceptional features. High resolution colour graphics, extensive sound effects and a powerful Basic interpreter combine to offer excellent value for money.

The SV-318 is a well-presented system, providing everything the new user needs to get started. The console is in white, impact-resistant plastic and measures 398 x 218 x 75mm (W x D x H at rear), sloping to 45mm at the front. There are 71 rubber pushbutton style keys arranged in a standard "qwerty" layout, with a row of special function and editing keys at the top of the keyboard.

Power is supplied by a separate metal-boxed unit with adequately long leads. The power connector is on the right side of the keyboard console, just behind the rocker-type power switch, and a small rectangular LED on the console top indicates that the computer is switched on.

Also on the top of the console is a slot for software cartridges, normally covered by a hinged lid to protect the circuitry from prying fingers.

On the right side of the console are two connectors for external joysticks or games controllers. The pin-outs of these ports conform to the Atari arrangement so that many different types of joysticks can be used, apart from the three different controllers available from Spectravideo.

At the rear of the console is a cassette interface port, direct audio and video output (a 5-pin DIN socket) and a bus expansion connector. A VHF modulator is supplied so that SV-318 can be used with a standard television receiver on either channel 0 or channel 1. When the modulator is used sound signals are also sent to the television and heard over the receiver's speaker. Using the direct video output to drive a monitor would require separate provision for sound.

Text is normally displayed in white on a light blue background and is stable and easily legible, using a direct video connection. The RF modulator is provided with a TV antenna switch box with rather long cables which seem to render it prone to interference.

A feature of the SV-318 is the built-in joystick. At the right of the keyboard is a circular "cursor control pad" pivotted in the centre. Four pushbuttons are arranged around the periphery, indicated by small depressions in the surface of the pad, while a hole in the centre takes a small plastic handle to create a non-proportional joystick.

We were also supplied with a Spectravideo SV-903 cassette drive, as standard cassette recorders cannot be used with the SV-318. The cassette drive derives power from the computer and comes equipped with a tape counter, "in use" LED indicator and an internal

◀ *The SV-318 provides pushbutton keys and a built-in cursor control pad and joystick. Sprites and high resolution graphics in 16 colours allow excellent animated effects.* ▼

home computer

microphone with a cut-out switch.

The microphone allows verbal comments to be added to taped programs as the SV-903 is a stereo recorder, with one channel reserved for programs and the other for voice. However the manual provides no details of how to use this feature.

Keyboard and video display

Extensive facilities are provided by the SV-318 keyboard, including upper and lower case letters, graphics, 10 programmable functions and editing keys.

Shift keys appear in the usual places, and the Caps Lock key is equipped with a rectangular LED indicator, a convenient feature, as the key itself does not lock down. Two sets of 26 graphics patterns are shown above the alphabetic keys and are accessed with the "Left Grph" and "Right Grph" keys which are both mounted to the left of the space-bar.

Five keys provide 10 programmable functions (with the use of the Shift key). Initially these default to frequently used Basic keywords, such as CLOAD, COLOR and LIST, but are easily changed from Basic. The definition of each key is shown on the bottom line of the display screen, changing when the Shift key is pressed.

Although it is not mentioned in the manual, these prompts can be disabled with the statement:

SCREEN,0

and re-displayed with;

SCREEN,1

(Courtesy of the Spectravideo Computer Users Group of Tasmania).

Only two editing keys are provided, but the cursor control pad and provision for full screen editing allow very flexible manipulation of program lines on the display. Once a program is listed the cursor can be moved to any line and new characters typed over the old. The two editing keys, INS and DEL, operate to open up space within a line for new characters or to delete characters and close up those remaining.

One other key clears the screen and/or moves the cursor to the top left corner. It also carried the label "COPY", which on some other computers is used to dump the contents of the screen to an attached graphics printer, but no information is available on this function. Information is also lacking on the use of the "Select" key, placed prominently on the extreme right of the keyboard.

The keyboard of the SV-318 is not recommended for typists. The flat keys are slightly larger than usual and well spaced, with limited travel. They also wobble uncomfortably, and must be struck at the exact centre to operate correctly. Hitting the edge of a key does not register as a key press, forcing the user to adopt a very careful typing style. Most users of the SV-318, however, will find the keyboard satisfactory. One-finger typing seems to be the norm, and the optional audible click as each key press is registered largely overcomes the peculiarities of the key movement. As such, the keyboard compares favourably with those of other computers in the same price range.

The Spectravideo provides three display modes – text in a 40 column by 24 line format, 64 x 48 resolution block graphics and 256 x 192 high resolution graphics. All modes allow a choice of 16 colours (including black and white) and both graphics modes allow the use of up to 32 "sprites".

"Sprites" are blocks of definable characters which are displayed independently of the remainder of the screen. Once defined a sprite is moved by simply updating its X and Y coordinates with the PUT SPRITE statement. The display controller then automatically places the sprite on the screen in a plane which takes priority over the text and background characters, so that a sprite, for example, can move over an existing display, leaving it undisturbed.

Sprites also have their own priority, so that sprite 0, for example, will be displayed on top of sprite 1, which is in turn displayed on top of sprite number 2.

Either 8 x 8 or 16 x 16 pixel sprites can be used and the ease of definition and movement, combined with the automatic priority feature make them ideal for fast moving games displays and other animated graphics.

Spectravideo Basic

The SV-318 comes with Microsoft Extended Basic in ROM, a language which fully supports the graphics, sound and programmable key functions and has other extensive capabilities which make it one of the most powerful versions of Basic available for home use.

A complete listing of the language is shown in Table 2, but some statements are especially noteworthy. AUTO enables the automatic generation of line

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numbers, while RENUM will renumber an existing program from a designated starting point, using a designated line number increment.

Once a program is written, the trace functions TRON AND TROFF are available to assist debugging. TRON, or "TRace ON" will enable tracing, printing each line number as the corresponding statement is executed and continuing until disabled with TROFF.

Graphics are supported with the PSET, PRESET, LINE, CIRCLE, PAINT and DRAW statements. The first two turn individual pixels on and off on the screen while LINE draws a line between two specified points. It takes parameters which specify the colour of the line and also enables a rectangle to be drawn with diagonal corners at the points specified. Simply adding an "F" to the statement will fill in the box to create a solid shape.

The CIRCLE statement draws a circle centred on a specified point, but it too takes parameters which specify the radius of the circle, the colour, the ratio of width to height (allowing ellipses to be drawn) and the starting and end points of the curve (allowing arcs and partial shapes to be created).

Once a line drawing has been created the PAINT statement can be used to fill an area with colour. The fill begins at a specified point and continues until a border of the designated colour is encountered.

The DRAW statement actually leads into a subset of Basic called a "Graphics Macro Language". DRAW takes a string of parameters which specify points to move to, the direction and length of lines drawn, and the scaling factor of a drawing. Additionally a separate string of drawing instructions can be included and called from the original string in the nature of a subroutine, allowing complex repetitive designs to be created quickly and easily.

GET and PUT are also interesting. GET allows a specified area of the screen to be stored in an array in memory, while PUT takes the information from the array and displays the shape on the screen. Together the two statements allow the use of "shape tables" for complex graphics and patterns, although they execute too slowly for use in animated displays. With sprites however, GET and PUT are not required for this use.

The sound effects and music capabilities of the SV-318 are extensive, and are well supported by the Basic interpreter. Sound is produced by a General Instruments AY-3-8910 chip, which provides three voices, each with a seven octave range, plus a noise source. The volume and wave shape of each sound source can be separately controlled and the outputs combined in a programmable mixer by use of the SOUND statement.

In addition to SOUND for direct manipulation of the sound generator, the SV-318 Spectravideo Basic provides CLICK (for enabling and disabling audible feedback from the keyboard), BEEP and PLAY, a statement which introduce the "Music Macro Language".

PLAY takes a string expression which specified the notes to be played, octaves, flats and sharps, duration, tempo and volume, as in:

PLAY "CDEFGAB 02 CEF V15 GAB"

The wave shape and volume of the noise source can be specified, and as with the graphics macro language, substrings can be executed from within the main string.

Graphics and sound support are not the only exceptional features of Spectravideo Basic. Extensive string handling capabilities are provided, including hexadecimal, octal and binary string functions and an array of I/O and disk data formatting statements.

Four types of variables are supported, double precision, single precision, integer and string. Unless otherwise specified all variables will be treated as double precision types, which automatically performs calculations with 16 digit accuracy (better than many calculators).

The programmable function keys are supported by KEY( ), which allows a string of up to 16 characters to be associated with each key, and KEY LIST, to display all current key definitions. Interrupts generated by a key press can re-direct the flow of program control using with the statement ON KEY ( ) GOSUB. The internal timer, joystick buttons and sprites also generate interrupts and are supported with their own statements.

In short, Spectravideo Basic is a comprehensive language with some intriguing new features, in keeping with the advanced hardware design of the Spectravideo computer.

The hardware

Spectravideo is so far the only company to market a computer based on the proposed MSX standard for 8-bit home computers. This standard arose from an agreement between Microsoft and 14 computer companies, including Spectravideo, NEC, Matsushita, Sony and Toshiba and other major Japanese companies.

The specifications of the standard so far cover only I/O port and major hardware functions and are intended to ensure that all MSX machines will run a common set of software. MSX machines are based on the Z80A microprocessor, the Texas Instruments 9918 video display processor (the PAL version is the 9929) and the General Instruments AY-3-8910 sound generator chip.

Input/output ports are provided by an Intel 8255 parallel I/O chip and an Atari type joystick interface and at least 32K of ROM for Microsoft's extended Basic are also specified.

In keeping with this standard the Spectravideo uses a Z80A processor running at 3.6MHz. The 40 x 24 text display, low and high resolution graphics modes and 32 sprites are provided by the 9929 VDP (the same chip is used in the TI-99/4A home computer), while the 8910 is responsible for the Spectravideo's extensive sound effects capabilities.

The standard SV-318 comes with 32K

Table 1: Spectravideo SV-318 specifications

Processor:	Z80A at 3.6MHz clock speed.
RAM:	32K (12.8K usable from Basic) expandable externally to 256K.
ROM:	32K expandable to 96K with cartridges.
Interfaces:	Cassette port, two games controller port, expansion connector.
Display:	40 x 24 line upper and lowercase text; 52 graphics characters; 64 x 48 and 256 x 192 pixel graphics in 16 colours; 32 sprites.
Sound:	Three voices, seven octave range, programmable noise source.
Software:	Microsoft Extended Basic in ROM, cassette and cartridge CP/M and Coleco adapter available.
Documentation:	Lacking detail for advanced users.

Spectravideo SV-318 home computer

of programmable memory, but of this, 16K is dedicated to the video display and another 3569 bytes is used for "house keeping" overhead, leaving just 12.8K available to the user. External cartridges are available in 16K and 64K sizes to expand this memory, and of course software ROM cartridges expand the Read Only Memory capability of the machine, although they have yet to appear in quantity.

For some reason the Spectravideo is not fully compatible with the MSX standard. The Spectravideo will need a special cartridge slot adapter to allow it to use MSX software cartridges when they appear but as there is no indication of when this will be the point is a minor one.

The other expansion possibilities of the SV-318 are also intriguing. Promised in brochures accompanying the computer is a games adapter which will allow the Spectravideo to use cartridges designed for the Coleco video games machines. Other possibilities include memory expansion to 256K, using an external expansion unit. This memory would be accessed by a bank switching scheme, currently supported by the Basic SWITCH statement.

A graphics tablet, disk drives and a printer are also on the way. To use these units, however, separate interfaces are required, and without an expansion unit only one can be used at a time. So far a disk drive controller, Centronics printer interface, 16K and 64K RAM modules and an RS232 interface are advertised.

The disk drive comes with a CP/M system disk, which (allowing for format incompatibilities) opens up another huge source of software for the SV-318. So far no details have been announced, and it is unclear exactly how CP/M disk programs can be transferred to the SV-318.

Software and documentation

For this review we were supplied with four programs on cassette tape. As expected, the games are very strong on graphics and sound effects and well up to the usual standard in the price range.

The "Basic Tutorial" was disappointing, consisting of a cassette of example programs and a booklet explaining what each does. No attempt was made to use the graphics, sound and audio from the cassette interface to assist instruction, so this series of programs does not do justice to the machine.

The home management system consists of two programs, one for keeping track of bonus coupons which are apparently offered with many products in the United States.

The second program is a recipe filing system, a good example of the use of the cassette recorder for data storage.

Also announced is a spreadsheet package, home accounting programs, a word processing package, programmer's utilities and of course, more games. Coupled with the support for Coleco games cartridges (via an adapter) and a CP/M disk system, the SV-318 appears to be well supplied with software. The powerful Basic interpreter, sound and graphics support is also likely to encourage third party suppliers to provide software.

The most disappointing aspect of the SV-318 is the documentation. Two manuals are provided with the system, one a tutorial introduction to Basic and the other a reference guide. These are good as far as they go, but they don't go very far. The serious user is likely to quickly pose questions which the documentation does not answer, such as how to call machine language routines, use sprites directly (rather than through Basic) and details of programming the sound generator. In this respect, the data manuals on the 9918 VDP and the 8910 sound generator would be invaluable.

Certain Basic statements are either not mentioned or are dealt with incompletely by the manuals. There is a TIME function, for instance, that returns the value of a timer in the SV-318, but you must read newsletters from Spectravideo users groups to find out about it. The SWITCH function, which allows banks of RAM to be swapped in and out of the system memory is also unexplained, although it is mentioned.

This lack of information is most likely to affect the user who wishes to expand the system or write machine language software.

Table 2: Spectravideo Basic statements

ABS, AND, ASC, ATN, AUTO, BEEP, BLOAD, BSAVE, CDBL, CHR$, CINT, CIRCLE, CLEAR CLICK(ON, OFF), CLOAD, CLOSE, CLS, COLOR, COS, CONT, CSAVE, CSNG, CVD, CVI, CVS, DATA, DEF FN, DEF USR, DELETE, DIM, DRAW, EQV, ERASE, ERL, ERR, ERROR, EXP, FIX, FOR . . . STEP, FRE, GET, GOSUB, GOTO, HEX$, IF . . . THEN . . . ELSE, IF . . . GOTO . . . ELSE, IMP, INKEY$, INPUT$, INSTR, INT, INTERVAL (ON/OFF/STOP), KEY(), KEY LIST, KEY ON/OFF/STOP, LEFT$, LEN, LET, LINE, LIST, LLIST, LOAD, LOCATE, LOG, LPOS, MAXFILES, MDK$, MERGE, MID$, MKI$, MKS$, MOD, MOTOR ON/OFF, NEW, NOT, OCT$, OPEN, ON ERROR GOSUB, ON . . . GOSUB, ON . . . GOTO, ON INTERVAL . . . GOSUB, ON KEY() GOSUB, ON STOP GOSUB, ON SPRITE GOSUB, ON STRIG GOSUB, OUT, PAINT, PEEK, PLAY, POINT, POKE, POS, PSET, PRESET, PUT, PUT SPRITE, REM, RENUM, RESTORE, RETURN, RIGHT$, RND, RUN, SAVE, SGN, SIN, SCREEN, SOUND ON/OFF, SOUND (reg, exp), SQR, SPACE$, SPC, SPRITE$, SPRITE ON/OFF/STOP, STOP, STOP ON/OFF/STOP, STRING$, STR$, STRIG ON/OFF/STOP, SWAP, SWITCH, SWITCH STOP, TAB, TAN, TIME, TROFF, TRON, USR, VAL, VARPTR, VPEEK, VPOKE, WAIT, WIDTH, XOR.

Pricing

As with all home computers, the Spectravideo SV-318 starts off inexpensively and ends up becoming an open invitation to spend money. The basic keyboard with 32K of RAM costs $399, while the special purpose cassette recorder adds $99 to this price.

From this point, pricing depends on how many peripherals are added. A Centronics interface, cable and dot matrix graphics printer are available as a package for $699. A disk drive and controller together add $798, but if you want to use both together you'll need either a "mini-expander" (two slots, for $39) or the seven slot "super-expander" unit ($249).

Given its initial low price, the SV-318 is good value for money. The wisdom of expanding the system is questionable however, as a system with a disk drive and printer costs will over $1000 while the pushbutton keyboard remains unsuited for serious use. Users intending to create a fully expanded system might be better advised to look at the Spectravideo SV-328.

The SV-328 is the big brother of the machine reviewed here. It is software and hardware compatible with the SV-318 but comes with a full-stroke 87-key keyboard including a numeric pad and cursor control keys (there is no built-in joystick). Standard memory is 48K of ROM and 64K of RAM (with 29.2K usable). Like the SV-318, memory is expandable to 256K.

Our review machine was supplied by Computer Wave Pty Ltd, Lower Ground Floor, Grace Brothers Market Street store, or 325 George St, Sydney (02) 29 1631. The postal address is PO Box 268, GPO Sydney, NSW, 2001.

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Electronics Australia reviews the
Multitech MPF-III Personal Computer

The MPF-III from Multitech is the latest development of the Microprofessor series, expanded to a full disk-based computer system with video output. Two microprocessors are provided, the Z80 and 6502, to allow the MPF-III to run software intended for the CP/M system and the Apple II.

Multitech has gone to a great deal of trouble to ensure that the standard operating system of the MPF-III is compatible with that of the Apple II without breaching Apple's copyright. Most of the system calls are preserved and all software we tested ran without problems.

At the time of this review Apple's appeal against Computer Edge Pty Ltd is pending and we do not in fact know whether Apple's claim that their operating system is copyright will be successful. While the point is important to manufacturers offering other Apple "work-alikes", it will make no difference to the MPF-III, as Multitech had Apple's permission to produce a compatible operating system without actually copying the code in dispute.

While the MPF-III may use a 6502 it physically in no way resembles the Apple II. The actual computer is in two parts, a detachable low-profile keyboard and a "system unit" which contains the dual processors, control logic and 64K of programmable memory. Two half-height 14cm minifloppy drives in a matching case rest on top of the system unit, and a 30cm green phosphor video monitor on a tilt and swivel stand complete the set up.

A coiled, extensible cable connects the keyboard to the system unit via a 15-pin D-type connector plugged into the right side of the system unit while the disk drives are connected by a flat cable at the rear.

The MPF-III keyboard is in the latest "ergonomic" style, measuring just 18mm high at the front by 400 × 178mm (W × D). Height at the rear is 34mm or 45mm when two small legs are used to tilt the keyboard. The key layout is dished, or slightly concave from back to front and 90 keys are provided, in buff and grey with black legends.

In addition to 48 alphanumeric keys the MPF-III provides 12 programmable function keys, a 14-key keypad with cursor control keys and its own Return key and 16 miscellaneous system control keys, including Caps and Number lock, Reset, Break and Halt.

On the review machine the space bar seemed a little stiff in action, and in spite of its ergonomic design approach the keyboard places the left Shift key one key further to the left than normally expected, leading to some initial confusion. The same placement is used on the IBM PC keyboard, causing considerable controversy, but has been abandoned in favour of the more usual layout on the PC Junior.

Single key entry of Basic commands is supported, using the ALT key in conjunction with alphanumeric keys.

The front of the system unit is bare except for a ventilation grille and a small rectangular LED power-on indicator. At the rear is a socket for 240VAC power and a rocker-type power switch, an RF modulated TV signal output and separate composite video and external speaker outputs, a printer port, disk drive connectors and EAR and MIC sockets for a cassette recorder. A bus expansion port and a connector for a proportional joystick or paddle is available at the right side.

Also at the rear is a four-way DIP configuration switch which sets the MPF-III for an 80-column text display, Epson or C-Itoh printer operation, RF television channel output, and operation with 64K or 48K RAM (to emulate the functioning of the language card).

Only the composite video output can be used, as the modulated RF output is in NTSC format, unsuitable for connection to Australian television receivers. There is also no PAL colour display adapter available, so colour is not an option on the MPF-III.

On the other hand the MPF-III provides some compensation. First of all the screen display is 24 lines of 40 characters each, in upper and lowercase. An 80-column mode is also available with its own 2k screen memory, either selected by a configuration switch or from software, duplicating the function of boards such as the Vision-80 for the Apple II.

MPF-III Basic statements and functions

ABS, AND, APPEND, ASC, ATN, BASS, BLOAD, BRUN, BSAVE, CALL, CATALOG, CHR$, CLEAR, CLOSE, COLOUR, CONT, COS, DATA, DEF FN, DEL, DELETE, DIM, DRAW, EFFECT, END, EXEC, EXP, FLASH, FOR . . . NEXT, FP, FRE, GET, GOSUB, GOTO, GR, HCOLOR, HGR, HGR2, HIMEM, HLIN, HOME, HPLOT, HTAB, IF . . . THEN, INIT, INPUT, INSTR, INT, INVERSE, IN# LEFT, LEN, LET, LIST, LOAD, LOCK, LOG, LOMEM, MAXFILES, MID$, MON, NEW, NOMON, NORMAL, NOT, NOTRACE, ON . . . GOSUB, ON . . . GOTO, ON ERR GOTO, OPEN, OR, PDL, PEEK, PLAY, PLOT, POKE, POP, POS, POSITION, PRINT, PR#, READ, RECALL, REM, RENAME, RESTORE, RESUME, RETURN, RIGHT$, RND, ROT, RUN, SAVE, SCALE, SCRN, SGN, SHLOAD, SIN, SPC, SPEED, SQR, STEP, STOP, STORE, STR$, TAB, TAN, TEMPO, TEXT, TRACE, UNLOCK, USR, VAL, VERIFY, VLIN, VTAB, WAIT, WRITE, XDRAW.

MPF-III comes in two parts: a low profile keyboard and a "system unit" which contains the dual processors, control logic and 66K of RAM.

Thus the MPF-III provides both an Apple-compatible display and a standard 80 x 24 line format for CP/M programs.

In both display modes a screen editor is available, allowing the user to move the cursor on the screen, re-type program lines and insert and delete characters.

High and low resolution graphics are also available. Low resolution is 40 × 48 blocks and high resolution is 280 × 192 points. In both modes, four lines at the bottom of the screen can be reserved for text, although otherwise text and graphics cannot be mixed on the screen.

Colour can be specified for graphics, but on monochrome monitor the result is to change the pattern of the character as individual bits are shifted left or right. The original Apple II produces colour according to the phase difference between the colour burst signal and the luminance signal so that the colour of any particular point depends on its exact position on the screen.

Sound is provided by an AY-3-8910 generator chip. Six Basic commands are available to produce various special effects, including waveforms to simulate a piano, xylophone, organ and bell sounds and a percussion accompaniment which can be set for various rhythm patterns. Sound is produced through an internal speaker, although there is a connector at the rear for an external loudspeaker.

Statements controlling the sound generator are SONG, BASS, TEMPO, INSTR, PLAY and EFFECT. SONG takes parameters specifying the pitch and duration of notes over a three octave range while BASS selects one of eight percussion accompaniments. TEMPO is specified in beats per minute from 16 different settings available and INSTR selects the "instrument" or sound waveform.

The MPF-III comes with a floating-point Basic interpreter in 11K of ROM, a machine language monitor and a comprehensive driver for the Epson MX-80 and C-Itoh printers. Sound effects and the 80 × 24 display screen are also supported.

When a disk drive is connected the MPF-III will automatically load a disk operating system on start-up, allowing immediate access to disk-based application programs. If a CP/M master disk is used to boot up the system, the Z80 processor will be switched in automatically and the screen will display the CP/M prompt.

MPF-III specifications

Processors	6502 and Z80
RAM	66K including 2K buffer for 80-column display
ROM	24K
Interfaces	Serial printer, cassette interface, joystick interface, external expansion slot
Disks	A maximum of two, single-sided single density, 140K each unformatted
Keyboard	90-key full-stroke IBM-style
Display	24 lines, 40 or 80 columns text, upper and lower case 40 × 48 resolution and 280 × 192 resolution graphics, no colour adapter available.
Sound	Three octave range, special effects and rhythm accompaniment
Software	Compatible with CP/M 2.2 (assuming availability in a compatible disk format). Compatible with Apple II operating system
Documentation	161 page operation manual

In conclusion

At $699 for the system unit and keyboard, the MPF-III offers the ability to run software for two of the most widely used microcomputer operating systems, Apple DOS and CP/M. It is not really a beginner's system however, as the user is very much alone when it comes to obtaining software in the correct disk formats.

The MPF-III operating manual lists the facilities available, and provides details of the hardware and memory arrangement, but must be supplemented by other material if the user is not already familiar with a similar computer.

Against these disadvantages is the relatively low price and potentially vast software base. For an experienced computer user looking for a "compatible", the MPF-III has much to offer.

Further information on the MPF-III and a range of other computer systems is available from Emona Computers Pty Ltd, PO Box K720 Haymarket, NSW, 2000.

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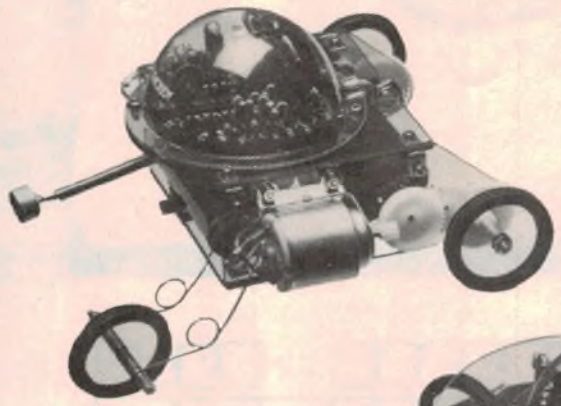

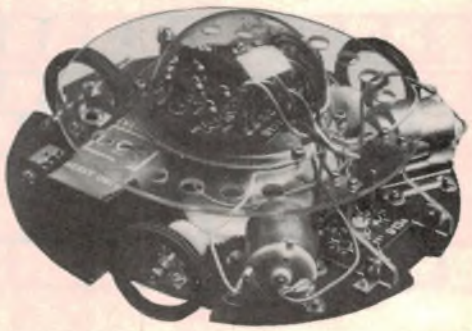

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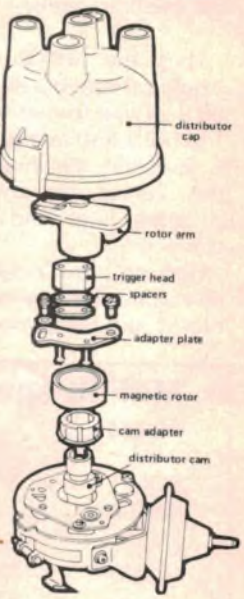

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Cat. XE-6297 ..... $22.50

FORTH
A new language for the MicroBee. Comes complete with interpreter on one side of the tape and supporting programs on the other side. As well as this it includes a very well written, bound manual.
Cat. XE-6865 ..... $47.50

PSYCHOTEC By Dreamcards
Psychotec provides a striking example of artificial intelligence, allowing a dialogue in English between computer and operator, the computer playing the role of psychiatrist and the operator being a "patient" on the couch. Leaves other "similar" types for dead.
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MERLIN By Dreamcards
Merlin is a 32K adventure set in England during the dark ages. Your task is to search through the dark forest inhabited by robbers, outlaws and creatures with awesome magic powers to find a legendary sword. An excellent adventure.
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LOG - GENERAL PURPOSE INDEX
This program is designed to suit a wide range of records where indexing (and later searching) can be on one or two words, or on a string of up to 15 characters. Each record consists of its index heading, plus up to 12 lines of text. Each line can contain up to 41 characters.
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MINE DROP
You are a tank running around a maze gathering all the supplies you can. It sounds easy, but you have a guided missile hot on your trail. Your only defence is a remote controlled mine which you drop and explode at will. A very fast joystick or key controlled game.
Cat. XE-6960 ..... $15.95

PENETRATOR
A low resolution graphic version of the popular game "Scrambler". You must defeat the rockets and bomb the radars in an effort to get to the next stage which is even harder. This game can be either controlled by a Joystick or by keys. Being in Lo-res graphics it is a very fast game. If you are bored with the same land pattern you can devise your own.
Cat. XE-6855 ..... $19.95

METEOR RESCUE - Mytek
Your mission is to rescue stranded astronauts. You are the commander of the Landing Module docked in space with the mother ship. It is your responsibility to guide the landing module through the meteor field, down to the surface of the planet, to land safely on a landing pad. An astronaut will then run to your landing module and you will blast off. You must use your lasers if necessary and dock with the mother ship again. A total of 6 astronauts must be shuttled to the mother ship.
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KING KONG - Mytek
Just like the arcade game of a similar name. The game consists of several frames which you must complete to rescue your sweetheart from Kong. Excellent graphics and sound. Joystick compatible.
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CHOPPER - Mytek
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SKETCH PAD
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Cat. XE-7056 ..... $19.95

PRINTERS MATE
This program is two screen dump programs to suit CP80, MX80, DT80, 80DP and FAX80 printers. One program is a screen dump utility while the other prints out memory contents in both hexadecimal and ASCII characters. A must for use with printers.
Cat. XE-7051 ..... $17.50

DUO - ONE
Another two programs for the price of one from Dreamcards. One side has poker, and the other is Casino which is a three reel poker machine. Both use Hires graphics. Excellent value.
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EXTENDED TURTLE
A "Turtle" program which has been written by a teacher and has been several months in the writing. This is one of the best Turtle programs written and comes complete with a 40 page clearly written manual with many helpful drawings.
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DEFENDER - Mytek
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COULOMBS LAW
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This game conforms exactly to that set down in the official rules of the International Backgammon Association, including the rules of doubling and scoring.
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This is the first in a series to assist students in grasping the fundamentals of geometric and technical drawing. It uses good graphics with excellent explanations.
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DISASSEMBLER By Dreamcards
Some may say "Not another Disassembler". But this one has a difference. It allows you to set out where the data fields are so the computer is saving time, not trying to disassemble data. A program you shouldn't be without.
Cat. XE-6915 ..... $15.95

CHEAPIE By Dreamcards
Two top quality programs for the price of one. The best Hangman we've seen yet on side A and a superb version of Battleship on side B. Both have excellent graphics.
Cat. XE-6920 ..... $15.95

COMPOSER BEE
This is a very well written program for music. This program allows you to compose, play, edit, transpose as well as being able to load and save your music. A program that has been a long time in the writing and well worth buying.
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TRSBEE - Mytek
TRSBEE is a package of 3 programs that loads TRS-80 Model 1 and 3 program tapes into the MicroBee without any additional hardware. Although some program editing will still be required prior to their running, the majority of program typing time is saved by TRSBEE. The first program loads TRS-80 BASIC programs into MicroWorld BASIC. Most programs may then be edited and run. The second program in the package loads any TRS-80 machine code file into the MicroBee memory. The third program loads TRS-80 assembler files into the MicroBee EDITOR/ASSEMBLER. Any TRS-80 Model 1 or 3 tape may be loaded. TRSBEE opens up a whole new world of possible software on your MicroBee!
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This program will simplify the task of determining the value of your homes contents for insurance purposes, as well as providing descriptions of all listed items in the event of their loss or destruction. Effects are catalogued by their name, description and value. Nine separate rooms are provided, and up to 28 items may be listed in each.
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BASIC TUTORIAL
Is a super teaching aid for any classroom. Basic Tutorial is a set of 9 interactive exercises designed for teaching Basic to the computer novice. No previous knowledge is assumed. Basic Tutorial uses a unique double screen technique to display both the normal computer output and the tutorial exercises at the one time. This allows the student to use the MicroBee in the normal way, while the tutorial instructions appear in the lower half of the screen.
Cat. XE-6880 ..... $22.00

MACHINE CODE TUTORIAL - Mytek
Consists of 8 interactive exercises designed for teaching machine code programming and related topics as they apply to the MicroBee computer. Only a general knowledge of the BASIC language is assumed. Machine Code Tutorial is designed to bridge the gap between BASIC programming and being able to understand and use typical Z80 manuals.
Cat. XE-6855 ..... $27.80

DATABEE
This program is a well written data base management system that utilises the MicroBee to its fullest to provide a Data Management System similar to those found on larger and more expensive systems. This comes complete with large bound manual.
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Ref: ETI January 1984
Great kit enables you to convert the serial (almost RS-232) port on your MicroBee to a parallel port suitable for the cheap parallel printers now around.
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NEW! ETI 656 BUG DEBUGGER
Ref: ETI January 1984
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Cat. KE-4655

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MICROSOFT BASIC-80 MANUAL
This book explains in detail the MicroSoft BASIC that comes with Disc Drive Systems. It includes information about Disc file loading and instructions on the use of assembly language routines.
Cat. XE-8018 ..... $29.95


NEW SOFTWARE FOR FEBRUARY 1984

COMPOSER BEE II
This program allows you to write music straight onto the screen. You can then either edit, transpose, playback or save the notes onto cassette. This is a program which is educational and entertaining.
Cat. XE-7081 ..... $21.95

DATA MANAGER
Data Manager can hold up to 200 records (32K) or 60 records (16K). Each record consists of 4 lines, a search can then be done on any word in any record and those records displayed.
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WILDCARDS II
This book is the sequel to Wildcards Vol.1. It contains much, much more information and a memory map of 7 pages. If you liked the first volume you're going to love the second even more.
Cat. XE-8016 ..... $16.00

EMU JAUST
Another excellent hi-res graphic game from Mytek. This is a game with added realism, excellent graphics and fantastic sound. Mytek have far surpassed themselves with this one.
Cat. XE-7058 ..... $22.50

TAPE DOCTOR
A great utility program from Mytek. As well as being able to make backup tapes, it can load bad tapes and in doing so points out the errors in the tape. A very useful program.
Cat. XE-7059 ..... $18.50

DEBUG
Another utility program from Mytek. It operates at assembler level and allows the entering of breakpoints into machine language programs. A very useful utility to use.
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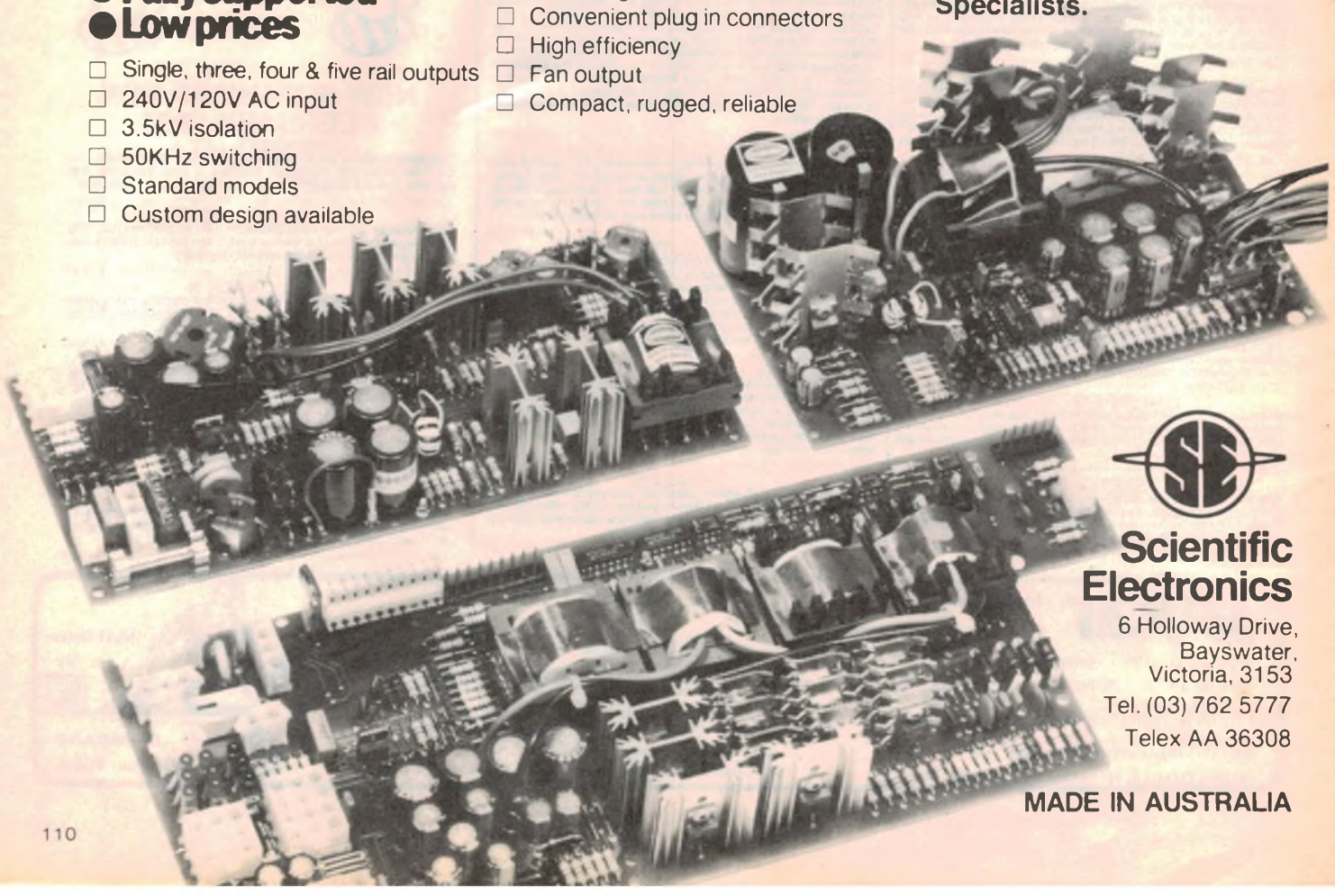

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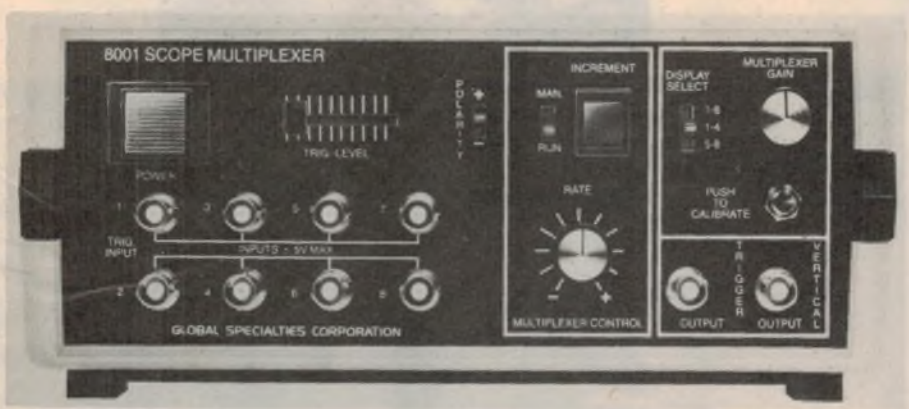
New Products...

Product reviews, releases & services



Multiplexer converts CRO to eight channels

A multiplexing device which converts a general-purpose single or dual-channel oscilloscope into an eight-channel instrument has been developed by Global Specialties. The new Model 8001 multiplexer functions in the same way as a simple logic analyser minus its memory and allows simultaneous events on different channels to be compared and displayed in direct relationship to one another.

The instrument allows oscilloscope users to view events occurring synchronously or asynchronously, and the user can observe all eight channels at once or one of two 4-channel combinations. Once the overall signal relationships have been observed the operator can "zero in" on a single channel by placing the multiplexer in the manual mode and incrementing the display to the desired channel.

Input to the multiplexer is via eight BNC connectors and the instrument will accept signals of ±5V (10V peak-to-peak) with frequency response which is flat to 12MHz and 3dB down at 20MHz. Input impedance is 1MΩ.

Comprehensive trigger facilities are provided – the signal which is to serve as the trigger is connected to channel 1, and the trigger level can be continuously varied over the ±5V range with polarity switchable to positive or negative. Trigger output is a TTL level signal which is internally switch-selectable to 0.1μs or 1μs duration, and connected to the oscilloscope's external trigger input.

The 8001 is said to be ideally suited to applications such as field service, development and monitoring work.

Global Specialties is represented by Vicom International Pty Ltd, 57 City Road, South Melbourne, Victoria 3205 or 6th Floor, Eagle House, 118 Alfred Street, Milsons Point, NSW, 2061.

Linear magnetic field sensor

A new magneto-resistive sensor from Philips measures both linear and angular displacement and is said to offer several advantages over conventional Hall effect sensors. Designated the KMZ10, the sensor detects small variations of magnetic field at frequencies from DC to several megahertz and provides a proportional linear output signal over a temperature range of −40°C to +120°C.

When used in conjunction with permanent magnets, the KMZ10 can translate magnetic field variations into measurements of linear or angular displacement ranging from a few millimetres to tens of centimetres with a resolution down to one micrometre.

The device is a Wheatstone bridge arrangement using thin film permalloy resistors on a silicon substrate. Four sensitivities are available and applications are seen in remote position sensing, instrumentation and control equipment, electronic ignition systems, gas and oil level monitoring and other automative applications.

For further information contact Philips Electronic Components and Materials, 67 Mars Rd, Lane Cove, NSW, 2066. Phone (02) 427 0888.

New hearing aid from Sennheiser

R. H. Cunningham has introduced a unique new device for people who require an occasional hearing amplifier. Called the Conferette 2 and manufactured by Sennheiser, the device incorporates two miniature microphones and twin amplifiers to give binaural sound, allowing users to perceive the direction of the sound source.

The stereo balance of the unit can be adjusted to compensate for a different degree of hearing loss in each ear and the C2 can also be used in conjunction with an infrared transmitter connected to a television set, as a wireless headphone set.

In this application the microphones remain in circuit so that other people can talk to the user at the same time. In order to prevent ambient noise from impairing the wireless sound transmission however the microphones are only enabled when a defined sound level is reached, equivalent to a normal speaking voice from a distance of one metre.

The Conferette C2 is distributed by Shaw Sound, 160A New South Head Rd, Edgecliff, NSW 2027, phone (02) 32 5222, and is available through hearing aid specialists.

New Products...

Arlec introduce the Weldmate

Arlec Pty Ltd has introduced a new arc welder, claimed to combine economy and ease of use. The Weldmate 140 arc welder is compact and completely portable, and is said to be designed to allow the inexperienced operator to achieve professional results with just a little practice.

Features of the welder include operation via a 15A outlet from the standard 240VAC domestic supply and a graduated scale on the outer casing which indicates the most suitable current for a particular size of welding electrode. A large handwheel on the front of the unit adjusts the current.

The Weldmate is supplied with a two-year guarantee and comes complete with a face mask, electrode holder, earth clamp, cables, a wire brush, chipping hammer and a selection of welding electrodes. Also supplied are operating instructions and a 32-page illustrated manual entitled "A Guide to Welding".

A carbon arc torch is also available with the Weldmate to allow brazing and spot welding. The carbon arc brazing kit includes a torch, carbon rods, wrap-around headshield, flux impregnated brazing rods and an attachment enabling the torch to be converted for spot welding.

Further information is available from Arlec Pty Ltd, 30 Lexton Rd, Box Hill, Vic 3128.

New 100MHz CRO from Parameters

Parameters Pty Ltd has released the new Trio CS-2110 100MHz oscilloscope, an upgraded replacement for the older CS-2100A model. The new CRO offers four channels, a sensitivity of 1mV/div to 100MHz and a −6dB bandwidth point of 140MHz.

Using an alternate delayed sweep technique, the user can view four channels and their corresponding delayed signals simultaneously, giving a total of eight traces. Sweep time is continuously variable from 0.5 seconds to 20ns per division, and an internal delay line enables accurate observation of the leading edge of high frequency signals.

Other functions include dual sweep, LED illuminated pushbuttons for all major function selections, A and B intensity control, a channel one output for use with a frequency counter and a single sweep mode for viewing isolated events.

With a rectangular 150mm display, the CS-2110 measures 284 × 400 × 138mm (W × D × H) and weighs 7.4kg.

Further information is available from Parameters Pty Ltd, PO Box 573, Artarmon, NSW 2064. Phone (02) 439 3288.

LCD Bar Graphs

Bowmar/Ali Inc. manufactures a large range of LED and LCD direct reading analog panel meters, available in 75mm, 125mm and 250mm bar lengths (using LEDs) and 80 and 125mm LCD versions. The LED units are available with inputs from 50mV to 100V DC and 10μA to 10A, or AC voltages up to 250V RMS in addition to 7 bit binary TTL and CMOS inputs.

LCD bar graphs are available with digital and DC inputs only, although both types can also be supplied with single or dual adjustable set points with flashing alarms and can also include a digital LED readout in addition to the analog bar graph display.

For further information on any of the products mentioned here contact Paton Electronics, 90 Victoria St, Ashfield, NSW 2131.

New Products...

Auto-ranging capacitance meter

Global Specialties Corporation has developed a handheld auto-ranging capacitance meter, model 3002, which features a degree of precision, range, and flexibility normally associated with benchtop instruments.

The new meter, which incorporates a 3½-digit liquid-crystal display and measures only 193 x 95 x 44mm, provides direct readings of capacitance from 1pF to 19,999μF. Eight automatically selected ranges remove the need for manual switching, and a dual-threshold measuring technique ensures an accuracy within 0.2% (± one count) from 1pF to 199μF and 1.0% (± one count) between 200μF and 19,999μF.

The dual threshold measurement technique used in the Model 3002 eliminates reading errors caused by dieletric absorption, and the use of DC charging characteristics to determine true capacitance means that the instrument can be used for measurements on cables, switches and other components as well as on capacitors. For capacitor measurements, input connectors are provided for round or flat-leaded devices.

The Model 3002 operates from six AA nickel-cadmium or alkaline batteries, and the maximum current consumption of 75mA ensures a long battery life. An optional AC adapter/charger is available.

Further details from Vicom International Pty Ltd, PO Box 366, South Melbourne, Victoria, 3205.

Motorola wins police radio contract

The Victorian Public Works Department has awarded Motorola Australia a $3.2 million contract to supply their new UHF MCX100 Series Two-Way Radios to the Victorian Police Force. The contract is for almost 2000 mobile radios, including equipment specifically designed for motorcycles, boats and for the police airwing and is believed to be the single largest order for mobile radios awarded in Australia.

The fully synthesized 140 channel, MCX100 mobile radio will allow communication on all police radio channels and also provide direct "car-to-car" communication when vehicles are away from the Motorola repeater base stations being currently installed around the state. The radio uses three separate Motorola Semiconductor microprocessors, each controlling separate stages in the equipment – frequency synthesis, tone signalling and receiver scanning.

In addition to clear voice communications, the equipment will provide for encrypted (scrambled) voice transmissions to prevent eavesdropping by scanning equipment and other unauthorised listeners. The scrambling method, known as Digital Voice Protection (DVP), is currently employed by police and government agencies throughout the world in order to halt the flow of restricted information accessible directly from the radio waves.

DVP provides the user with up to 2.36×10^{26} possible unique codes on which to operate and thus provides a high degree of security.

The new equipment is expected to be fully operational later in the year. For further information contact: Motorola Electronics Australia Pty Ltd, 666 Wellington Road, Mulgrave 3170. (03) 561 3555.

Precision Circuits upgrades PCB production plant

Precision Circuits, manufacturers of printed circuit boards, have installed a Computer Numerical Control Drilling and Routing machine at their Nunawading premises.

This is the first CNC machine, acquired by a Victorian circuit board manufacturer, that is able to carry out both tasks of drilling and routing. The machine is fully programmable and has the capacity to drill over 300 holes per minute.

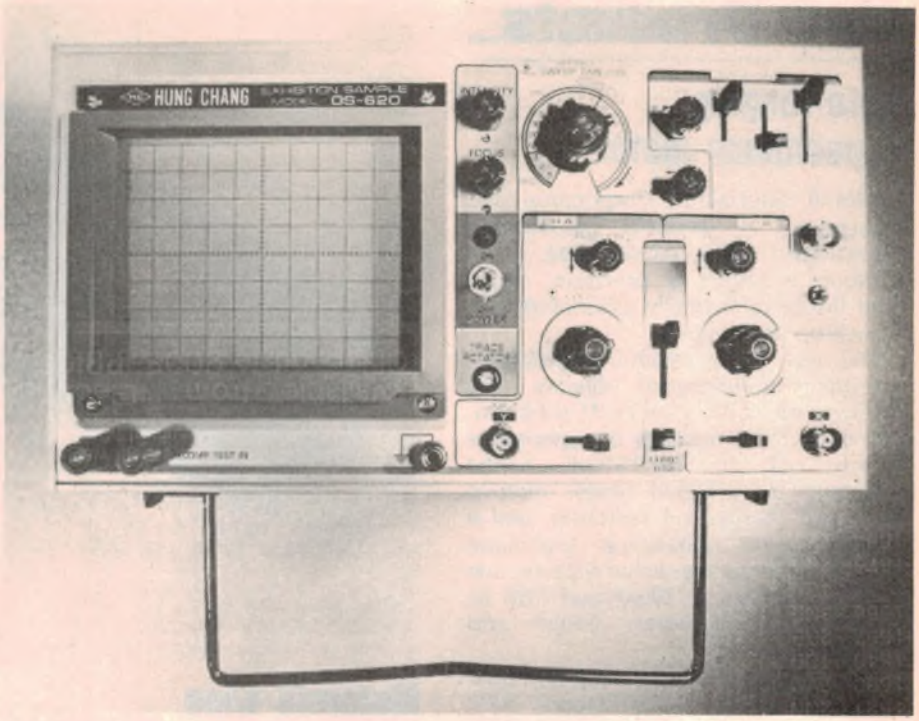
Mr Chris Marks, Manager of, Precision Circuits, sees the installation of the new CNC machine as a prime example of the company's policy to produce the finest quality circuit boards for the electronics industry.

Precision Circuits is Victoria's longest established manufacturer of circuit boards, with 20 years of service to the industry.

Further information is available from Vincent Rovere, Precision Circuits, 1 Glendale St, Nunawading, Vic, 3131. (03) 877 3222.

New Products...

Oscilloscopes from Paton Electronics

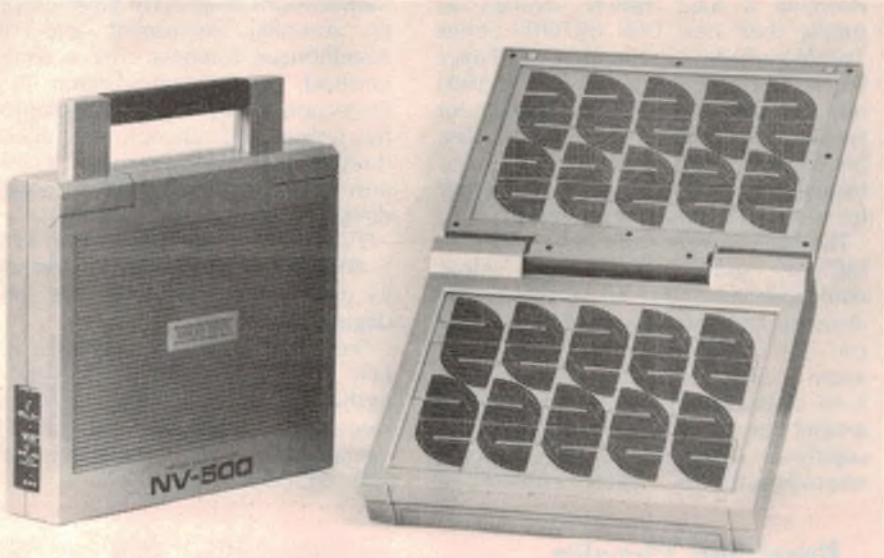


Paton Electronics, a division of Paton Electrical Pty Ltd, has recently introduced a number of new products from overseas manufacturers, including oscilloscopes from Hung Chang, the PK300 clip-on digital ammeter and a range of solid-state analog panel meters from the US Bowmar company.

The two new oscilloscopes are the OS-620 20MHz dual trace unit and the 45MHz OS-645, which features a 15kV CRT display, delayed triggering, TV-sync, and either X, Y or X, Y, Z operation. The CRT is a 150mm rectangular type displaying eight 10mm divisions and bandwidth is quoted as 10Hz to 45MHz (the −3dB point).

The PK300 digital clip-on ammeter operates in two ranges covering 0-1000A, 0-650VAC and 0-2000 ohms over a frequency range of 20Hz to 50kHz. Rectangular probes allow use of the ammeter with busbars as well as circular cables, and readings are displayed on a 13mm high 3½ digit LCD panel.

Further information from Paton Electronics, 90 Victoria St, Ashfield, 2131.



Portable solar power generator

Amtex Electronics has just released a portable solar power generator in a lightweight carrying case. Called the NV-500M, it can supply up to 5W of DC power for a variety of appliances. It is especially useful for recharging batteries for portable video cameras which a person may take to the beach, a sports event or anywhere away from mains electricity.

The unit produces 12V at 0.5A and has a built in overload protector. It also has outlets for 3V at 0.5A, and 6V or 9V at 1A. The hinged, moulded plastic, attache-style case measures 330 x 350 x 65mm and snaps shut to protect the cells during transport. It simply needs to be opened flat to expose its solar cells, which immediately begin converting sunlight into electricity.

Price of the NV-500M is $389, from Amtex Electronics, 11 Spring Street, Chatswood, 2067. Telephone (02) 411 1323.

New devices from Fairchild

Recently released by Fairchild is the uA727, a fixed gain differential input/output preamplifier chip constructed with the company's planar epitaxial process. Intended for applications where stability is critical, the uA727 is designed for use as a self-contained input stage in very low drift DC amplifiers, replacing complex chopper-stabilised amplifiers in applications such as thermocouple bridges, strain-gauge transducers and A/D converters.

With the release of the uA727 Fairchild also announced the first JAN (Joint Army Navy) approvals of their FAST logic family. FAST is a Fairchild trademark standing for "Fairchild Advanced Schottky TTL" — a range of products which provide much faster switching speeds than Schottky devices, at one third the power consumption.

Five devices have been given JAN approval — the 54F00 quad two input NAND gate, 54F04 hex inverter, 54F10 triple three input NAND gate, 54F20 dual four input NAND gate and the 54F32 quad two input OR gate. Another 25 devices are ready for production and are expected to be available shortly.

For further information contact Fairchild Australia Pty Ltd, PO Box 19, Nunawading, Vic, 3131. Phone (03) 877 5444.

DICK DOES IT AGAIN!

The new, improved DATAPHONE II plug-in Data Modem + Phone still only $199!

Now with added phone!

Australia's fastest-selling direct data modem is now even better value than ever! Not only have we improved its performance and reliability, but we've added a high quality pushbutton type electronic phone as well – for added convenience. It even has last-number-redial. And all this is at no extra charge!

No delays – install it yourself!

Besides the added convenience, the built-in phone brings a further dramatic bonus: installing the Dataphone II is now simply a matter of plugging into a standard Telecom phone socket. It's legal and there's no delay or fee to pay!

Australia's first direct modem to meet new Telecom regulations!

Dick Smith's Dataphone was the first to meet the 1982 Telecom regulations permitting privately owned direct-coupled data modems. It was also the first to break through the $200 price barrier, opening the way for owners of virtually any personal computer to communicate with other computers over the switched telephone network.

Here's your chance to join the many thousands of happy Dataphone users, with this improved and upgraded model!

Telecom Authorisation No. C83/37/1080

Dataphone II's features:

- ★ Simple plug-in connection – no delay or fee.
- ★ Built-in pushbutton phone with last number re-dial.
- ★ Full duplex, Answer/Originate operation for convenience.
- ★ Operates at the standard data rate of 300 baud.
- ★ Designed in Australia and fully authorised by Telecom.
- ★ Uses standard RS-232C computer interface.
- ★ Outstanding value for money at only $199!

Cat X-3272

DICK SMITH Electronics

See page 98 for full address details

DSE A686 PAI

New Products...

Monitor amplifier from Audiosound

Audiosound Laboratories has released a new Mosfet monitoring amplifier which provides balanced line bridging inputs to two separate 50W channels for stereo use or two channel monophonic use. When both channels are bridged together the amplifier can also be used as a single channel 100W unit if required.

For domestic use the matching ASC-1 control unit provides a wide selection of inputs.

Further information is available from Audiosound Laboratories, 148 Pitt Rd, North Curl Curl, NSW, 2099. Phone (02) 938 2068.

Monolithic power FET arrays

Soanar Electronics has announced the release of a series of monolithic power FET arrays by Supertex Inc, USA. Supertex has produced the industry's first monolithic power FET arrays designed to drive high voltage non-impact printers or flat panel (plasma, LCD or electro-luminescent) displays. The 8-channel, ANO1 (N-channel) and APO1 (P-channel) devices use lateral DMOS technology.

The devices, which are available in 18-pin DIPs, reduce the cost per channel by up to 40% compared to similar circuits designed with discrete TO-92 parts. They have a common-source construction with undedicated gates and drains, allowing each FET to be independently driven. Designers using these arrays can directly interface CMOS logic with high voltages.

The ANO1 and APO1 can sustain continuous drain current of 30mA and 15mA per channel respectively and are rated from 200 to 400V drain to source voltage.

Further information from Soanar Pty Ltd, 30 Lexton Rd, Box Hill, Victoria, 3128. Phone (03) 890 0661.

Leader AM/FM signal generator

Recently released by AWA, the Leader LSG-215A AM/FM Signal Generator covers the frequency range from 100kHz to 120MHz. It provides stable outputs locked to a crystal oscillator, with level variable from −10dBu to 120dBu (0dB = 1uV) in 1dB steps. The output impedance is 50Ω and the VSWR less than 1.2.

A battery supported memory can store up to 100 selections combining frequency, modulation and output level. Frequency indication is by a 6-digit LED readout with 100Hz resolution up to 30MHz and 1kHz resolution from 30MHz to 120MHz.

Modulation facilities include internal oscillator at 400Hz or 1kHz and an external modulation input. Frequency modulation can be up to 100kHz deviation and amplitude modulation can be up to 50%. Typical applications include servicing MF/HF/VHF receivers, VHF communications equipment, TV IF stages and cordless telephones.

For further information, contact Amalgamated Wireless (Australasia) Ltd, Cnr Talavera and Lane Cove Roads, North Ryde 2113. Telephone (02) 887 7111.

REVIEWS OF RECENT
Records & Tapes
CLASSICAL • POPULAR • SPECIAL INTEREST

TCHAIKOVSKY

Symphony No. 6 (Pathetique). Cleveland Orchestra conducted by Lorin Maazel. CBS Masterwork Series Digital Disc D37834.

It seems to be a late date to review still another Tchaikovsky Pathetique after the multitude of recordings that have proceeded the one. But Maazel and the Cleveland have their own style of presenting the work, one which still carries on to a degree the tradition of precision of the orchestra under the direction of the late George Szell.

It is typical Cleveland reading – straight as a rule and without any of the emotional drooling the music so encourages in other conductors of the Stokowsky type.

That it was its creator's favourite work may account for some of its popularity. But many of those who enjoy its mood of sadness and despair may not know the Tchaikovsky admitted that it had a program. What this was he never divulged and so far as I know nobody has ever successfully guessed it. You might like to try.

He left one clue. He admitted that it was "deeply subjective" and we all should know how deeply his homosexuality troubled him and his brother Modeste.

This latest recording has a sombre opening – nothing unusual about that. But Maazel does emphasise its gloom. Throughout the work he lets the music speak for itself without self-indulgence or hysteria. Another detail. We do know that Tchaikovsky often wept when composing it. But Maazel doesn't set out to wring your withers. He takes the next, faster portion steadily, preparing a climax in exactly the right place but never over-reaching himself in delivering it. Everything is beautifully balanced, articulated and recorded. The Cleveland has lost none of Szell's precision.

The strings in the second subject are lovely. Yet despite Maazel's unexaggerated version it is never deadpan. True he can be ferocious but this occasion is always meticulously planned. Neither does he ever pull the tempo about with needless rubatos.

He starts the second (5/4) movement smoothly but then tends to hurry the rest, slightly trivialising it.

Whether you like it or not will depend entirely on your taste. As might be expected the third march movement is sprightly and buoyantly rhythmic and never too loud or assertive. More in the style of a scherzo. The Finale, so tempting to overdo in tear-producing reaching, has just the right dignified sorrow. No hysterical self-pity. A version eminently worthy of acquisition whether you have another or not. By the way – have you guessed the program. (J.R.)

KIRI TE KANAWA

Aria recital with items from Don Carlos, Il Trovatore, La Traviata, Le Villi, Tosca, La Rondine, La Boheme, Manon Lescaut, Gianni Schicchi and Madame Butterfly. With the London Philharmonic Orchestra conducted by John Pritchard. CBS Masterworks Digital Disc DBR 003.

For those who still indulge in Verdi and Puccini operatic recitals Kiri te Kanawa has recorded a most enjoyable disc. It has an added bonus that between old war horses like Ah, Fors e lui, One Fine Day, and Vissi d'Arte she has added a few quite unhackneyed items.

For instance there are areas from such works as the early Le Villi, La Rondine and Manon Lescaut. Ms Kanawa has a beautiful voice of lovely even quality throughout its wide range, her high notes effortlessly produced, the low ones rich and vibrant. Her taste in phrasing is always faultless, her attack always dead in the middle of the note and passion is added when necessary.

Should she rarely be a little forceful on a top note she compensates generously elsewhere by the amount of pleasure she gives in most of this pleasing disc. The accompaniments are admirably provided by John Pritchard and the London Symphony Orchestra. (J.R.)

MOZART

MOZART – Piano Concertos Nos 23 in A major K488 and 27 in B flat major K 595. Vladimir Ashkenazy with the Philharmonia Orchestra conducted from the piano by Ashkenazy. Decca compact disc 400 087-2.

Recorded in March 1980, in the Kingsway Hall, London, these two popular Mozart piano concertos feature Vladimir Ashkenazy as both soloist and conductor – a dual role which subtracts nothing from the performance, as heard. Whether the concertos are old friends, or a new sound, you should find the recording a sheer delight.

When Julian Russell reviewed the LP version in September '83, he described both performances as "exquisite" and continued:

"Ashkenazy has been accused in some quarters of neglecting to decorate the last notes of the slow movement (of the A-major). I think otherwise. They do not sound the slightest bit bare. Indeed, under Ashkenazy's fingers, the single notes fall so beautifully that I stopped breathing for fear I should miss a single sound – a rare experience at my age.

"Everywhere the nuancing is perfectly handled. The first movement of both works is beautifully fluent, the A-major sunny but serene.

"The finale of the A major is gay, that of the B flat joyous, almost jaunty. Everywhere in both works solo and accompaniment blend superbly. The slow movement of the B flat is extra sumptuous in tone. The decorations by the soloist are modest throughout. Ashkenazy never intrudes."

On the technical side, Julian commended the quality of the LP version but warns of the necessity to set the volume control with care, if the range of the music is to be encompassed comfortably.

After having listened recently to a number of Telarc CDs, which seem to make a fetish of dynamic range, my own reaction to this Decca release is to see its dynamic range as modest – and I do not say this in any spirit of criticism. It fits neatly into the dynamics of a domestic listening room and still leaves some latitude for a choice in the overall listening level.

As far as sound quality is concerned, it is superb, with notes from the piano cascading clear and sparkling against a background of orchestral sound – or of silence.

Julian's verdict: "Don't on any account miss this lovely disc." I need only to add the further dimension: if you're starting out with a CD system, I couldn't suggest a better record with which to start your collection, for your own delight and that of your friends." (W.N.W.)

SYDNEY STRING QUARTET

Janacek – Quartet No. 1. Banks – Four pieces for String Quartet. Sculthorpe – Quartet No. 9. Cherry Pie/Festival Digital Audiophile Disc LA 07724.

This is another example from Cherry Pie/Festival advertising the high degree of efficiency achieved by modern Australian processing. But despite its high tonal quality I can't see it attracting the popular appeal of the same company's products previously reviewed in this column.

This is not due to the standard of playing of the fine Sydney String Quartet which again shows its usual perfection, but to the choice of program. The first item, the Janacek, is the easiest taken at first hearing. Despite the extremes in pitch of the scoring for the various instruments and Janacek's highly individual style its ultimate result is almost tonal.

All four movements are curiously marked con moto yet manage to keep their own quite separate personalities. The same style of repetitive two-bar phrases persists through most of the work. Some are quietly lyrical in a polyphonic way, others are passionately assertive. The fourth movement is the most lyrical, the other three stormier. Altogether acceptable to the general musical public.

Don Banks' atonal Four Pieces for String Quartet are made up of his usual trendy tuneless stuff. Works like this explain the shortage of audiences for such fare and why the halls in which they are played are always so sparsely populated.

The stuff may look good on paper but is meant to impress the eye and not the ear – two very different propositions.

It might have been good had it been limited to one meritorious phrase repeated at various pitches singly or in combination throughout. I cannot imagine any but the trendiest listeners bothering to make anything of it. I could detect no hint of melody anywhere.

By contrast the Sculthorpe Quartet No 9 is at any rate logical and very expertly put together. Bits may even help you on your avant garde journey should you feel inclined to undertake one. There are plently of lyrical interludes mostly in bridge passages and it actually finishes on the tonic – if it can be so described. (J.R.)

DEBUSSY

Three Nocturnes. The Sea. Ambrosian Singers Philharmonia Orchestra conducted by Michael Tilson Thomas. CBS Masterworks Digital Disc D37832.

This is the same coupling as that by Davis and the Boston for Philips reviewed here a few issues ago. Of the two I vastly prefer the Philips. I cannot recall ever having heard the Philharmonia play so coarsely as in this disc. The idea of Debussy style seems to elude them and yet I know they can play him like angels when in the mood. One can only blame either the conductor or the recording for their failure here.

Although in the First Nocturne, clouds, the huge cumulus seem to drift lazily across the sky there is something wrong about the balance in the first bar. The extreme top register seems to disappear whatever the gain used. Later this improves but I prefer Davis' reading. It conveys more the spirit of indolence.

The second, Fetes, starts sprightly enough but takes a moment for the rhythm of the accompaniment to settle down. After that things improve except that it is all a little heavy-handed and the side drum that leads into the final climax is inaudible.

The great failure of the suite in my mind is Sirenes. Instead of mysterious distant voices the Ambrosian girls sing as if they were rehearsing for a disco performance. I know from countless hearings of this body that they can sing excellently if made to. The fault here must surely be the conductor's. They are either too close to the mike or the recordings engineer is way out – perhaps under instruction. In any case it is quite contra Debussy.

La Mer, on the reverse side starts a bit better, though this too is recorded a little heavy-handedly. In compensation there is plenty of audible detail. Much of it is like a microscopic picture of the score. The result, there is no real bloom on the sound. It is all starkly clean. But the restlessness is there all right. It would be an excellent reading for someone learning the score.

I liked the second movement, Wave Play, best of all. The water runs sparkling from rock-pool to rock-pool. Debussy's atmosphere is well preserved and the orchestra, as usual, plays with impeccable unanimity. The finale, Conversation Between the Wind and the Sea, starts menacingly and goes on satisfactorily. The range however, is digital wide, so watch your setting of loud gain. (J.R.)

RIMSKY-KORSAKOFF

Scheherazade. Symphonic Suite in Four Movements. Vienna Philharmonic Orchestra with Rainer Kuchl (solo violinist) conducted by Andre Previn. Philips digital disc 6514 231.

I cannot guess how many recordings of this work I have reviewed over the years or how many times I have heard the music accompanying the great Fokine ballet. In the last mentioned, of course, the third movement is always omitted. But I soon realised after listening to this performance for a few minutes that it was going to be the best I had ever heard.

For instance, in the first movement not even the supreme clarity of the digital recording could remove the bloom from

the strings of the Vienna Philharmonic. By the way for the benefit of those who know the work only as a ballet the first movement is taken here so as to convey the rocking motion of the sea – as originally intended by the composer when he wrote this symphonic suite – rather than as the prelude to the Arabian nights ballet.

Rimsky-Korsakoff was one of the greatest orchestrators of his time, even if we include Berlioz who, great as he was, lacked Rimsky's glitter. Under Previn the Vienna Symphony sound is never less than sumptuous when it is not scintillating! The solo violinist who has an important role in all four movments and is featured on the cover in type as big as the orchestra (Rainer Kuchl) is splendid in even the most difficult passages, his double and treble stopping always perfectly intoned.

To those who listen to this recording in terms of the ballet the opening of the second movement – the bassoon solo will sound a little slow but it is beautifully balanced against the rest of the interpretation. The balance of the music – the march-like section – couldn't be more exciting. It carries one along with it irresistably. And I have never heard the slow movement played so voluptuously. The low strings have a slumbrous quality all their own.

The spiccato, too, in this movement is uniquely unanimous. All this leads to a final movement of shifting colours that has been compared to a child playing with coloured bricks. The climax is worthy of all that has gone before. To lovers of this exotic work this performance will be a must. (J.R.)

READER'S DIGEST SET

EASY LISTENING CLASSICS. Boxed set of eight stereo LP recordings from Reader's Digest Services Pty Ltd. Box 4353, GPO Sydney 2001.

When I first received this new boxed set from Reader's Digest, I was expecting to find inside a larger-than-normal collection of the usual 5-minute excerpts from the classics. Instead, I found an eight-record set of symphonies, concertos, suites and other major items from 14 composers – from Beethoven to Vivaldi.

Then why the description "Easy Listening"? The answer, it would appear, is that those who have compiled the program have selected items which, if not already well known and popular, will

make for pleasant listening, even at first encounter.

They are presented by orchestras such as the Royal Philharmonic, National Philharmonic, Philadelphia, Boston Symphony and two or three others less well known in this country. Conductors include Anatole Fistoulari, Erich Leinsdorf, Charles Munch, Josef Krips and Morton Gould.

As a guide to those who already have a reasonable collection of classical records, it may be helpful to indicate the contents, even if in a very abbreviated form:

BEETHOVEN Piano Concerto No. 4 with Artur Rubenstein, soloist.
BIZET: Symphony No. 1 in C, conducted by Charles Munch.
BRAHMS: Variations on a Theme by Haydn conducted by Eugene Ormandy.
DELIBES: Ballet Suite from "Coppelia". Ballet Suite from "Sylvia".
GERSHWIN: An American in Paris.
GOULD: American Salute.
GRIEG: Holberg Suite (Morton Gould).
HAYDN: Symphony No. 104 "London", conducted by Josef Krips.
MENDELSSOHN: Symphony No. 4 "Italian" conducted by Massimo Freccia.
MOZART: Piano Concerto No. 21 (Earl Wild, soloist). Symphony No. 40.
RACHMANINOFF: Rhapsody on a Theme by Paganini, 18th Variation.
SCHUBERT: Symphony No. 2, conducted by Charles Munch.
TCHAIKOVSKY: Serenade in C for Strings, conducted by Charles Munch.
VIVALDI: The Four Seasons, with James Galway, soloist, flute.

Accompanying the set is a 36-page booklet containing notes on the composers, mention of the various artists and conductors and explaining the background to each of the works. Used in conjunction with the listing on the box itself, the booklet makes it a simple

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Jaycar Electronic Agencies is proud to announce the 1984 range of microbee computers – at new low prices!! The microbee Series 2 machines are ALL supplied with built-in communications capability, dual font 80 character by 24 line & 65 character by 16 line displays. Remember, your microbee is obsolete-proof with g'teed upward expandability.

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By popular request, the low cost microbee Series 2 Experimenter has been designed for those who are starting out in the fascinating world of computers or those who want to share the fascination of exploring the exciting developments in the fast moving MICRO WORLD.

Demand for projects using the microbee is so great that 'Electronics Today' are now planning to run a microbee project every month during 1984. So far ETI has described the light pen, EPROM programmer, a radio TTY printer, the world's first home facsimile receiver and ROM expander board for the microbee. Virtually every local computer magazine has run reviews and/or columns devoted entirely to the microbee. If you want to be part of the MICROCOMPUTER GENERATION in 1984 then microbee Series 2 Experimenter is the ideal starting point. Of course you can expand your microbee Series 2 Experimenter as your need grows.

$399 Cat. XE-4000

Note: the software that is supplied with each machine – at no extra charge!!

microbee Series 2 EDUCATOR

The microbee Series 2 was specifically designed to serve the needs of the EDUCATION MARKET. Let's face it, the primary non-business use for most personal microcomputers is to increase our learning capabilities either about computers (computer awareness) or about life itself. microbee Series 2 has now been officially approved by Education Departments in NSW, WA and Queensland and is being carefully considered in virtually all other states and by the National Schools Commission at the time this ad was going to press.

The microbee Educator uses BATTERY BACKED NON VOLATILE CMOS RAM so your programs are saved in the microbee Series 2 after the power is switched off. Students can bring the microbee Series 2 Educator home from school to complete assignments ready for class the next day. With the optional BEEMODEM you can use your microbee Series 2 Educator to talk to other computers or information networks.

$449 Cat. XE-4050

microbee Series 2 PERSONAL COMMUNICATOR

With the BUILT-IN WORDBEE in ROM as well as MICROWORLD BASIC and NETWORKING, the Personal Communicator is a powerful home computer ideal for virtually any home use from wordprocessing, spreadsheet analysis, eduction and even experimentation with the computer concepts as they evolve during the year. With the optional BEEMODEM you can send WORDBEE files across any telephone line to another computer. Bee the first on your block to have home telex!

$499 Cat. XE-4100

microbee Series 2 ADVANCED PERSONAL COMPUTER

Now for the first time in Australia: the microbee Series 2 Advanced Personal Computer with 400K disk drive. Then add bundled world class software such as CP/M, MICROSOFT BASIC, MULTIPLAN, WORDSTAR and a powerful library of support programs and you will have some idea as to why the microbee Series 2 Advanced Personal Computer is the most powerful and best price/performance computer in its class. What's more any existing microbee owner can convert his microbee to the Series 2 APC at any time.

The microbee Series 2 APC uses the popular Z80 microprocessor and runs standard CP/M so that users have access to the vast library of CP/M software available world wide. MICROSOFT BASIC is now supplied on disk. WORDSTAR, according to independent surveys now accounts for 50% of ALL word processing software now in use so the designers of the Series 2 APC decided to purchase the OEM rights for your benefit. MULTIPLAN is considered by many to be one of the most powerful spreadsheets yet produced for the microcomputer.

$1495 Cat. XE-4200 SINGLE 400K DISK DRIVE

$1795 DUAL 400K DISK DRIVE Cat. XE-4300

NEW GAMES FOR MICROBEE

KING KONG – from MYTEK
Just like the arcade game of a similar name. The game consists of several frames which you must complete to rescue your sweetheart from Kong. Excellent graphics and sound. Joystick compatible.
Cat. XE-7054 $22.00

CHOPPER – from MYTEK
A fast action packed game which must rate as one of Mytek's best. You have full control of a helicopter and you must fly over enemy lines to rescue your allies. Fast realistic graphics and excellent sound.
Cat. XE-7055 $22.00

SKETCH PAD
A program to help you design your own P.C.G. characters. Simple commands allow easy drawing of circles, polygons and boxes etc. These then can be dumped to tape to be used in a future program. Comes complete with manual.
Cat. XE-7056 $19.95

PRINTERS MATE
This program is two screen dump programs to suit CP80, MX80, DTB0 80DP and FAX80 printers. One program is a screen dump utility while the other prints out memory contents in both hexidecimal and ASCII characters. A must for use with printers.
Cat. XE-7051 $17.50

DUO – ONE
Another two programs for the price of one from Dreamcards. One side has poker, and the other is Casino which is a three reel poker machine. Both use Hi-res graphics. Excellent value.
Cat. XE-7052 $15.95

EXTENDED TURTLE
A Turtle program which has been written by a teacher and has been several months in the writing. This is one of the best Turtle programs written and comes complete with a 40 page clearly written manual with many helpful drawings.
Cat. XE-7053 $29.50

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matter to correlate the information with what you are listening to.

Although the material comes from a variety of sources, it would appear from code marks on the pressings that they have all been especially re-mastered for this set. Certainly, one is not aware of any significant variation in the general sound quality. It is well up to normal LP standards and the only minor complaint I had was a slight eccentricity or "swing" in record 6 – fortunately not enough to produce any audible result.

The playing time of certain sides is not as generous as it might be, with record 8, side 2 the worst offender, with "American in Paris" and "American Salute" adding up to only 12 minutes 50 seconds. Other sides are longer, however and, if my arithmetic is right, the overall average is about 21 minutes per side, or a total playing of just over 5½ hours. For that, the set will cost you $52.95, plus $2.50 for postage and handling.

If you are reasonably familiar with classical music, you will probably have a good idea whether it would be money well spent in your case. If you are a stranger to the classics, this set could well provide a pleasurable introduction. Have a listen to Vivaldi's "Four Seasons", featuring James Galway on flute; then Delibes' "Coppelia" and "Sylvia" ballet Suites; and the slow movement of Mozart's Piano Concert No. 21, which was "borrowed" for the popular Swedish film "Elvira Madigan". (W.N.W.)

HAPPY SOUND

THE WHISTLING JAN LINDBLAD. Stereo LP album, Starcall STAR-303. Distributed through RCA.

I recall having reviewed a Jan Lindblad album some time ago but, whether it was this one, or one like it I'm not sure. Either way, if you haven't met up with Jan Lindblad, you may be interested to know about the album.

By inference, I would take him to be Swedish by birth and professionally involved in the production of TV wildlife documentaries, which have taken him across the world "from the dense rain forests of South America to the teeming jungles of Asia".

It also happens that he has developed outstanding abilities as a whistler, both in the musical sense and as a mimic of many of the birds he has encountered in his travels. According to the jacket notes, he is often able to attract such birds to himself and his camera.

On this album, aided by an orchestra and recorded sound effects, where appropriate, of surf and storm, he whistles his way through 10 familiar tunes, breaking off here and there to intersperse some of his bird calls. The track titles:

Sailing – Pa Sangens Vingar – A Nightingale Sang in Berkeley Square – Raindrops Keep Falling on my Head – Shenandoah – Swedish Spring at Dawn – El Condor Pasa – Danzante Del Destino – Ave Maria (Schubert) – Listen to the Ocean.

It's a simple, happy sound, involving an unusual skill and very well recorded. If you respond when someone "whistles a happy tune", or have a budgie in the house who does so, you'll both enjoy Jan Lindblad! (W.N.W.)

NOSTALGIA

GREAT ORIGINAL HITS OF THE '50s and '60s, Volume 2. Reader's Digest 8-record boxed set. Mono, simulated and normal stereo. (Available by writing to: Reader's Digest, Box 65 GPO, Sydney 2001.)

What kind of a time frame would you put on nostalgia? Twenty years, or 30 years, maybe?

If those figures sound about right, then you should be a good prospect for this new release by Reader's Digest, on eight LP records or six compact cassettes. Mind you, it does span the years from 1950 to 1969 and, in consequence, covers quite a bit of ground in the history of popular music.

Perhaps I should add that the listing is not based on the date when the various titles first appeared, but the year when they made it to the top, for one reason or another.

Containing a neat 100 tracks, the new set provides a lot of listening – too much, I might add, for this reviewer to cope with in the available time. But I did check through every side, sampling tracks as I went, and listening through those that held a special interest.

While I am far from being a devotee of popular music, I recognised track after track as a one-time standard – an impression confirmed by a 100-word (or more) jacket note on each item, with appropriate references to source,

THE WORLD AROUND US

IT'S ABOUT TIME – John Denver. Digitally mastered stereo, RCA Victor APL1-4740.

In a bracket of 10 songs, for the most part his own lyrics and his own music, John Denver is in a predominantly introspective mood in this album: memories of his father Lt Col (Ret) H. J. ("Dutch") Deutschendorf, laments for a lost love and, more especially, concern for a world that seems more preoccupied with force than with finding a peaceful solution to its problems.

The track titles: Hold on Tightly – Thought of You – Somethin' About – On the Wings of a Dream – Flight (the Higher We Fly) – Falling Out of Love – I Remember Romance – Wild Montana Skies – World Game – It's About Time.

Perhaps the final stanza of the title track says it all: "It's about time we begin to turn the world around; it's about time we start to make it the dream we've always known; it's about time we start to live it the family of man; it's about time . . ."

The lyrics are provided in full, in the double-fold jacket.

John Denver's diction is very good, as also is the vocal and instrumental backing. With the benefit of digital recording and mix-down, providing clean and well balanced sound, "It's About Time" is an album with a lot of potential appeal, whether or not you are a John Denver fan. (W.N.W.)

composer and the artist(s) or group involved.

With 100 tracks to be accounted for, there is no way that the details can be listed here. Just for starters, however, the jackets carry a standard montage of some of the performers, identified as: Mama Cass, The Platters, Perry Como, Doris Day, Neil Sedaka, Louis Armstrong, Tennessee Ernie Ford, The Everly Brothers, Johnnie Ray, Cilla Black, Dean Martin, Nat King Cole, Patti Page and Engelbert Humperdinck.

But that doesn't include other artists and groups which turn up in the '60s tracks: Gerry and The Pacemakers, who can claim to have pioneered the Liverpool sound; Helen Shapiro; The Tremelos; The Shadows; The Delltones; The Seekers; The Beachboys; 5th Dimension, and so on.

The very listing of the names tends to highlight the element of history. Record 1 (1951/53 includes "Harry Lime Theme", "Sweet Violets", "Old Smokey", "Moulin Rouge", "Tennessee Waltz" and "Cry". Record 2 (1954/56) starts off with "A Many Splendoured Thing" and concludes with "Mack the Knife". Records 3 and 4 (1957/60) include "Singing the Blues", "Pub With No Beer", and "Just a Closer Walk".

But record 6 (1963/65) ushers in the era of the Groups – those mentioned earlier, and others. And so to record 8 (1968/69) where the items/artists have scarcely had time to establish a tradition, or nostalgia time enough to mature!

Cost of the 8-record or 6-cassette set is quoted by Reader's Digest as $54.95, to which should be added postage and handling charges: $2.50 for records and $1.75 for cassettes. Be sure to specify Volume 2, since the catalog lists an earlier "Collector's Edition" containing nine records and a different track selection but using the same title. (W.N.W.)

Solution for January

B	A	N	D	W	I	D	T	H		A	R	G	O	N
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C	A	R	D	I	A	C		A	E	R	I	A	L	S
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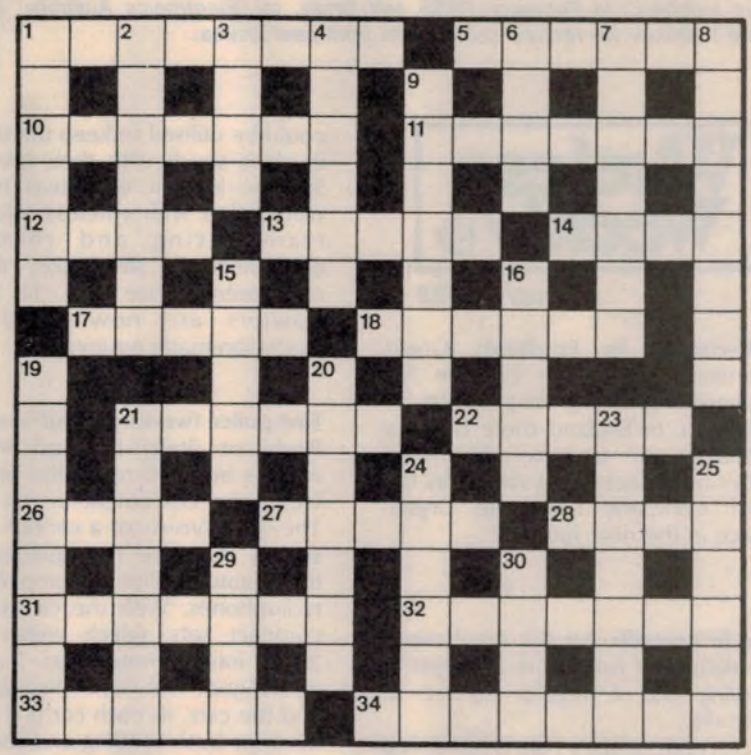
Electronics Australia

FEBRUARY CROSSWORD



ACROSS

1. Energy absorber. (8)
5. Null point device. (6)
10. Reception item. (7)
11. Type of component which does not produce gain. (7)
12. Kind of washer. (4)
13. Useful rare gas. (5)
14. Gold plated. (4)
17. Response time. (5)
18. Bloodsucking intimate electronic eavesdropper? (6)
21. Light control. (6)
22. A computer can play this game. (5)
26. Metric prefix. (4)
27. Type of energy source. (5)
28. Extreme high-frequency radiation. (1-3)
31. What calculators do. (7)
32. Biased. (7)
33. Connective part. (6)
34. Ring fittings. (8)

DOWN

1. What an overworked speaker may become. (6)
2. Cause an operation to commence. (7)
3. Natural waveform. (4)
4. Said of an arrangement more cleverly done. (6)
6. The time for pulse incidence. (4)
7. Powering an oscillation. (7)
8. Charged polar device. (8)
9. Wound on tape. (7)
15. Nuclear radiation. (5)
16. CGS unit of resistance. (5)
19. Joins components. (8)
20. Valves with six electrodes. (7)
21. Having changing electrical parameters. (7)
23. Routine maintenance. (7)
24. Device to prevent overshoot. (6)
25. Periodic variations. (6)
29. Protective device. (4)
30. magnetic component in some computers. (4)

50 & 25 YEARS AGO

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

February, 1933

Television, in England: Great improvements in the cathode ray tube are brightening the pospects for television. In England there is every possibility of a new short-wave television service being started by the Baird Company from the Crystal Palace in the near future.

☆ ☆ ☆

And in Australia: Mr Fisk emphasised the danger of premature attempts at carrying out a regular service in Australia.

Television, said Mr Fisk, is certainly a matter for short-waves. Technicians in America and the Continent were laying plans for work on such a scale that the ordinary broadcast band could not handle. At least 1000kcs band width would be needed for anything likely to satisfy them, which included pictures having up to 360 lines.

In America technicians were talking about using wavelengths as low as 3 metres for television channels. The problems of generating and amplifying radio energy at this high frequency were many, and likely to comprise some of the major problems that lie ahead.

☆ ☆ ☆

Wireless at sea: If you see a trawler streaking along the coast in the direction of Sydney at about twice her ordinary speed, you can be sure that her skipper has been having a telephone chat by wireless with her owners, who have given him the tip that the condition of the market calls for a prompt load of fish. In 1925 an enterprising firm approached Amalgamated Wireless and asked how best the new science of radio could be utilised to keep the trawlers in close touch with their owners in Sydney. In that year two trawlers were fitted with wireless telephone transmitting and receiving equipment. So satisfactory did the experiment prove that 11 Sydney trawlers are now fitted with Australian-made equipment.

☆ ☆ ☆

First police two-way radio? The city of Piedmont (Italy) has just installed what is believed to be the first two-way radio equipment in the world. The unit consists of a central control station in police headquarters, and four automobiles equipped with radiophones. With the cars carrying compact sets, which weigh about 25lb each, messages can be exchanged between headquarters and the cars, as each car unit can be used for both sending and receiving. The central control operates on 15 watts of power, and the car sets on two watts and the latter are operated by ordinary automobile batteries.

☆ ☆ ☆

Promises, promises! The British Electricity Board is considering legislation to prohibit the supply of electric current to any premises where plant is installed that causes electrical interference to wireless reception.

February 1958

A look into the future: Only about 15 months ago the first earth satellite was elevated by the Russians. It marked the starting point for a program of practical research unequalled in modern times.

Last year we watched satellites moving across the sky. Now we have two of them whcih have gone so far beyond the earth as to encircle the sun itself.

Set down for an early date is a vehicle which will send human beings into orbit, so confident are engineers of their increasing skill.

Still more important is a proposal that an aircraft – if we can call it that – containing a pilot will be sent into space, re-enter the atmosphere, and return to base.

(From an Editorial by John Moyle.)

☆ ☆ ☆

Satellite mail box: Brig.-General David Sarnoff, Chairman of the Board of Radio Corporation of America, recently announced that RCA is studying possible uses for special-purpose satellites, including an orbital post office, to speed mail delivery anywhere in the world.

General Sarnoff said that RCA scientists and engineers, who developed a large part of the communications relay system for the Atlas satellite, are now investigating satellite relay stations for international television as well as orbital weather stations.

☆ ☆ ☆

Compatible stereo: BBC engineers are now studying new single-channel stereophonic systems, which aim at developing a new compatible system using a single transmitter for sound, whereby the listener with a single conventional receiver and the listener who had had a second sound reproducing unit fitted to his receiver could both hear the same production at the same time – one in the normal way, the other stereophonically.

☆ ☆ ☆

70mm movies: The Todd-Ao system of film presentation, installed by Philips in a Sydney theatre, is winning high praise.

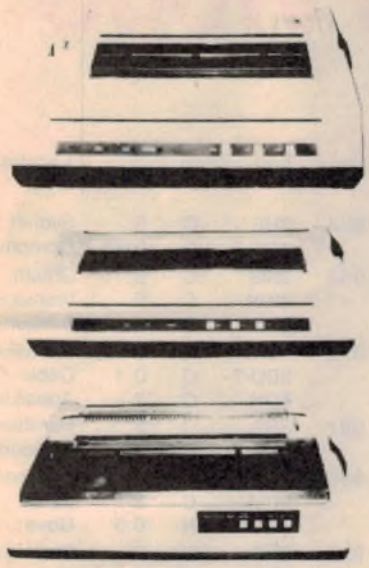
While the size of the projected picture is normally smaller than available from Cinerama, also being shown in Sydney, it does not suffer the basic limitations of Cinerama of presenting a picture made up of three distinct pieces.

The Todd-AO picture comes from a single specially-designed projector.

Pioneered by the late Mike Todd and the American Optical Company, the Todd-AO system uses a new and larger film, 70mm wide, and with a picture area three and a half times that available on the more usual 35mm film.

C. Itoh PRINTERS

FROM ROD IRVING ELECTRONICS



Pro/Writer Printer 8510

Print Features: Number of columns—136 col. max. Print Speed—120 CPS. Print Direction—Single-directional and Bidirectional. Switch Selectable. Throughput Speed—From 44 to 152 lpm. Character spacing (max. number of columns per line)—Pica (10 CPI) (80). Double Width 5 CPI (40). Compressed Font 17 CPI (136). Double Width 8.5 CPI (68). Elite 12 CPI (96). Double Width 6 CPI (48). Proportional Double Width Proportional. Line Spacing—Variable to 1/144". Print Width—203 mm (8") max.
Forms Type: Fan Fold Roll or Cut Sheet: Width—113 mm to 254 mm (4.5" to 10.0"). Total Thickness—0.05 to 0.28 mm (0.002" to 0.011"). Number of Copies—Original + 3 copies nominal.
Form Feed: Method—Tractor or Friction. Form Loading—Either rear or top.
Interface—Serial: Method—EIA RS232 C and 20mA (40 & 60mA switchable option) Current Loop Serial Interface. Baud Rate (BPS)—110, 300, 600, 1200, 2400, 4800, 9600. Transmitting Method—Half Duplex. Synchronization—Asynchronous.
Interface—Parallel: Method—TTL compatible 7 bit, parallel interface. Control Signals—ACK, BUSY, SELECT, DATA STB, INPUT PRIME FAULT, INPUT BUSY, PAPER EMPTY. Instruction Codes—(ASCII) CR, LF, VT, FF, CAN, SO, SI, DEL, DC1, DC2, DC3, DC4, GS, RS, US, FS, EM; GRAPHIC SYMBOLS, BIT GRAPHICS.
Error Detection: (1) Parity (VRC)—Odd, Even, No-parity. Switch selectable. (2) Framing Error—Stop bit check. (3) Overrun Error—Error is detected when data are received before the previous data have been processed.
Physical dimensions: 356 mm W x 120 mm H x 285 mm D (15.7" W x 4.7" H x 11.2" D).
Weight: 8.5 kg (18 lbs., 12 oz.)

Model 1550

The Model 1550 is a compact desk-top dot matrix serial impact printer used for data communication terminals, hardcopy of CRT displays, peripheral terminals for minicomputers and microcomputers, and small-sized business systems.
The character format is a dot matrix of 7(H) x 9(V), or 8(H) x 8(V).
Print speed is 120 characters/second. Up to 136 characters can be printed per line at 10 CPI.
Its main features are: ● Compact desk-top dot matrix printer ● 136 column print ● Light-weight ● Low power consumption ● High quality print ● Bit image graphics ● Graphic Symbols ● Prints in six different languages ● High reliability ● Low cost.

F-10 Printmaster Daisy Wheel Printer

Print Speed: 40 CPS. **Print Method:** Static Print Impact. **Number of Printable Columns:** 136, 163. Variable. **Character Spacing:** 1/120 Inch (minimum). **Line Spacing:** 1/48. **Return Time:** 900 msec. **Line Feed Time** 40 msec. **Paper Width:** 406 mm (maximum). **Print Characters:** 96. **Printwheel:** Industry Standard 96 Character Wheel. **Interface:** Industry Standard 8-bit Parallel, RS232-C Compatible, X-ON, X-OFF, 12-bit Qume and Diablo Compatible. **Dimensions:** 574 mm W x 405 mm d x 153.5 mm H (22.5" W x 15.9" D x 6" H). **Weight:** 14 kg (30.8 lbs.) with cover and power supply. **Noise:** Less than 65 Db (1M from Platen, A Scale).

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Functional Specifications

Printing method — Serial impact dot matrix.
Printing format — Alpha-numeric — 7 x 8 in 8 x 9 dot matrix field. Semi-graphic character graphics — 2 x 3 dot matrix. Bit image graphic — Vertical 8 dots format, horizontal 640 dots serial line.
Character size — 2.1mm (0.083"W x 2.4mm (0.09"H — 8 dot matrix.
Character set — 128 ASCII characters. Normal and true alpha-numeric fonts, symbols and semi-graphics.
Printing speed — 80 CPS, 640 dots per second.
Line feed time — Approximately 200 msec at 4.23mm (1/6") line feed.
Printing direction — Normal — Bidirectional logic seeking. Superscript and bit image graphics — Unidirectional, left to right.
Dot graphics intensity — Normal — 640 dots, 190mm (7.5") line horizontal. Compressed characters — 1280 dots, 190mm (7.5") line horizontal.
Line spacing — Normal — 4.23mm (1/6").
Programmable in increments of 0.35mm (1/72") (or) 0.118mm (1/216").
Columns/line — Normal size — 80 columns. Double-width — 40 columns. Compressed print — 142 columns. Compressed/double width — 71 columns. The above can be mixed in a line.
Paper feed — Adjustable sprocket feed and friction feed.
Paper type — Fanfold, Single sheet. Thickness — 0.05mm (0.002") to 0.25mm (0.01"). Paper width — 101.6mm (4") to 254mm (10").
Number of copies — Original plus 3 copies by normal thickness paper.

Mechanical Specifications

Ribbon — Cartridge ribbon, exclusive use, black.
MTBF — 5 million lines (excluding print head life).
Print head life — Approximately 30 million characters (replaceable).
Dimensions — 377mm (14.8") W x 295mm (11.6") D x 125mm (4.9") H (excl. spindle knob).

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	4KZ	C	5	Innisfail
	5UV	P	0.5	Adelaide
	6DL	N	10	Dalwallinu
540	4QL	N	10	Longreach
	7SD	C	5	Scottsdale
549	2CR	N	50	Cumnock
558	4AM	C	5	Atherton
	4GY	C	5	Gympie
	6WA	N	50	Wagin
	7BU	C	2	Burnie
567	2BH	C	0.5	Broken Hill
	4JK	N	10	Julia Creek
	6MN	N	0.1	Mt Newman
	6PN	N	0.1	Pannawonica
	6PU	N	0.1	Paraburdoo
	6TP	N	0.1	Mt Tom Price
576	2FC	N	50	Sydney
	2WEB	P	2	Bourke
594	3WV	N	50	Horsham
603	6PH	N	2	Port Hedland
	7ZL	N	10	Hobart
612	4QR	N	50	Brisbane
	6NM	N	0.2	Northam
621	3AR	N	50	Melbourne
630	4QN	N	50	Townsville
	6AL	N	0.4	Albany
	7QN	N	0.4	Queenstown
639	4MS	N	1	Mossman
	5CK	N	10	Crystal Brook
648	2NU	N	10	Tamworth
	6GF	N	2	Kalgoorlie
657	2BY	N	10	Byrock
	8DR	N	3	Darwin
666	6LN	C	1	Carnarvon
675	2CO	N	10	Corowa
	6BE	N	0.05	Broome
	8KN	N	0.05	Katherine
684	2KP	N	10	Kempsey
	6BS	N	4	Busselton
	8TC	N	1	Tennant Creek
693	4KQ	C	5	Brisbane
	5SY	N	2	Streaky Bay
702	2BL	N	50	Sydney
711	4QW	N	10	St George
	7NT	N	10	Launceston
720	2AN	N	0.05	Armidale
	2ML	N	0.4	Murwillumbah
	3MT	N	2	Omeo
	4AT	N	4	Atherton
	6WF	N	50	Perth
729	5CL	N	50	Adelaide
738	2NR	N	50	Grafton
	6MJ	N	5	Manjimup
747	4QS	N	10	Toowoomba
	6LN-T	C	1	Exmouth
	6SE	C	5	Esperance
	8JB	N	0.1	Jabiru
756	2TR	N	2	Taree
	4QA	N	2	Mackay
	6KW	N	0.1	Kununurra
765	2BE	C	3.5	Bega
	2BE-T	C	0.5	Moruya
	6KA-T	C	0.1	Paraburdoo
	6KA-T	C	0.1	Mt Tom Price
	8DN-T	C	0.25	Katherine
774	3LO	N	50	Melbourne
	4TO	C	5	Townsville
783	2KA	C	2	Katoomba
	6VA	C	2	Albany
	8AL	N	2	Alice Springs
792	4QG	N	10	Brisbane
801	4QY	N	2	Cairns
	5RM	C	2	Renmark
810	2BA	N	10	Bega
	6WN	N	10	Perth
819	2GL	N	10	Glen Innes
828	3GI	N	10	Sale
	4NA	C	5	Nambour
	6GN	N	2	Geraldton
837	3CR	C	0.25	Melbourne
	4RK	N	10	Rockhampton
	6ED	N	1	Esperance
	7QT	C	0.5	Queenstown
846	2CY	N	10	Canberra
	4CA	C	5	Cairns
	6CA	N	0.2	Carnarvon
855	4QB	N	10	Pialba
	4QO	N	10	Eidsvold
864	4GR	C	2	Toowoomba
	6AM	C	2	Northam
	7HO	C	2	Hobart
873	2GB	C	5	Sydney
	6DB	N	2	Derby
882	3YB	C	2	Warrnambool
	4BH	C	5	Brisbane
	6PR	C	2	Perth
891	5AN	N	50	Adelaide
900	2LM	C	2	Lismore
	6BY	G	2	Bridgetown
	7AD	C	2	Devonport
	8HA	C	2	Alice Springs
918	2XL	C	2	Cooma
	4VL	C	2	Charleville
	6NA	C	2	Narrogin
927	3UZ	C	5	Melbourne
	4CD	C	5	Gladstone
	4CD-T	C	0.1	Biloela
	6NR	P	2	Perth
936	4AY	C	5	Ayr
	7ZR	N	10	Hobart
945	3BO	C	2	Bendigo
	4HI-T	C	1	Dysart
954	2UE	C	5	Sydney
	4CA-T	C	0.35	Gordonvale
963	2RG	C	5	Griffith
	4WK	C	5	Warwick
	6TZ	C	2	Bunbury
972	2MW	C	5	Murwillumbah
	2DU-T	C	0.1	Cobar
	5DN	C	2	Adelaide
981	3HA	C	2	Hamilton
	6KG	C	2	Kalgoorlie
990	4RO	C	5	Rockhampton
	6PM	C	2	Perth
	8GO	N	0.5	Gove
999	2NB	N	2	Broken Hill
	2ST	C	5	Nowra
1008	2XX	P	0.3	Canberra
	410	C	5	Brisbane
	6GE	C	2	Geraldton
	7EX	C	5	Launceston
1017	2KY	C	5	Sydney
	6WH	N	0.1	Wyndham
1026	3DB	C	5	Melbourne
	4MK	C	5	Mackay
	6NW	C	2	Port Hedland
1044	2UH	N	1	Muswellbrook
	4WP	N	0.5	Weipa
	5PI	C	2	Crystal Brook
	6BR	N	1	Bridgetown
1053	2CA	C	5	Canberra
1062	4TI	N	2	Thursday Is
1071	3CV	C	5	Maryborough
	4SB	C	2	Kingaroy
	6WB	C	2	Katanning
1080	2MO	C	2	Gunnedah
	4MI	N	0.2	Mount Isa
	6IX	C	2	Perth
	7HT	C	5	Hobart
1089	3WM	C	5	Horsham
	2GZ	C	5	Orange
1098	4LG	C	2	Longreach
	6MD	C	2	Merredin
	7LA	C	2	Launceston
1107	2UW	C	5	Sydney
1116	4BC	C	5	Brisbane
1134	2AD	C	2	Armidale
	3CS	C	5	Colac
	6CI	C	2	Collie
1143	2HD	C	2	Newcastle
	4HI	C	5	Emerald
1152	2WG	C	2	Wagga Wagga
1161	4MB	C	2	Maryborough
	5PA	N	10	Naracoorte
	7FG	N	1	Fingal
1170	2CH	C	5	Sydney
	4GC	C	0.1	Charters Towers
1179	3KZ	C	5	Melbourne
1188	2NZ	C	2	Inverell

kHz	Call	Class	Power (kW)	Location
	6XM	N	2	Exmouth
1197	4GG	C	5	Gold Coast
	5KA	C	2	Adelaide
1206	2CC	C	5	Canberra
	2GF	C	5	Grafton
	6KY	C	2	Perth
1215	2ST-T	C	0.35	Bowral
	4HI-T	C	0.1	Moranbah
1224	2WS	C	5	Sydney
	3EA	S	5	Melbourne
1233	2NC	N	10	Newcastle
1242	3TR	C	5	Sale
	4AK	C	2	Oakey
	5AU	C	2	Port Augusta
	8DN	C	2	Darwin
1251	2DU	C	2	Dubbo
1260	3SR	C	2	Shepparton
	6KA	C	1	Karratha
1269	2SM	C	5	Sydney
1278	3AW	C	5	Melbourne
1287	2TM	C	2	Tamworth
1296	6BK	C	5	Brisbane
	5SE	C	2	Mt Gambier
1314	2WL	C	5	Wollongong
	3BA	C	5	Ballarat
1323	2GO	C	5	Gosford
	5AD	C	2	Adelaide
1332	2SH	C	2	Swan Hill
	4BU	C	5	Bundaberg
1341	2NX	C	5	Wallsend
	3GL	C	5	Geelong
1350	2LF	C	5	Young
1368	2GN	C	2	Goulburn
	4LM	C	2	Mt Isa
1377	3MP	C	5	Mornington
1386	2EA	S	5	Sydney
	5AA	C	5	Adelaide
1395	2LT	C	5	Lithgow
1404	2PK	C	2	Parkes
1413	2KO	C	5	Newcastle
1422	3XY	C	5	Melbourne
1431	2WN	N	2	Wollongong
1440	2CN	N	2	Canberra
1449	2MG	C	5	Mudgee
1458	2NM	C	2	Muswellbrook
	5MU	C	2	Murray Bridge
1467	3MA	C	2	Mildura
1476	2KA-T	C	0.5	Penrith
	4ZR	C	2	Roma
1485	2LG	N	0.2	Lithgow
	4EB	P	0.1	Brisbane
	4HU	N	0.05	Hughenden
	5LN	N	0.2	Port Lincoln
	2EA-T	S	0.1	Wollongong
1494	2AY	C	2	Albury
1503	2BS	C	5	Bathurst
	3AK	C	5	Melbourne
1512	2NA	N	10	Newcastle
1521	2QN	C	2	Deniliquin
1530	2VM	C	2	Moree
1548	4QD	N	50	Emerald
1557	2RE	C	2	Taree
1566	3NE	C	5	Wangaratta
	4GM	N	0.2	Gympie
1575	200	C	5	Wollongong
1584	2WA	N	0.1	Wilcannia
	5MG	N	0.2	Mt Gambier
	5WM	N	0.05	Woomera
	7SH	N	0.1	St Helens
	2EA-T	S	0.1	Newcastle
1593	4SO	N	0.2	Southport
	5MV	N	2	Renmark
1602	2CP	N	0.05	Cooma
	3WL	N	0.2	Warrnambool
	5LC	N	0.1	Leigh Creek

FM broadcasting stations

MHz	Call Sign	Power (kW)		Location
89.7	2VTR	0.02	M	Windsor Colo
	5PBA	0.25	M	Elizabeth
90.1	2NBC	0.1	V	Narwee
91.5	2NSB	0.08	V	Chatswood
92.1	5ABC	10	H	Adelaide
	6UVS	5	M	Perth
	7THE	3	H	Hobart
92.3	2ARM	0.1	H	Armidale
	2MCE	1	V	Bathurst
	3EON	10	M	Melbourne
92.5	2NCR	3	M	Lismore
92.9	2ABC	50	H	Sydney
	2ABC	10	V	Orange
	5EBI	4	M	Adelaide
	6NEW	0.25	H	Newman
93.3	6ABC	60	H	Bunbury
	7ABC	120	H	Launceston
93.7	3MBS	4	H	Melbourne
	4ABC	50	H	Rockhampton
	5MMM	4	M	Adelaide
93.9	7ABC	27	M	Hobart
96.1	6NOW	10	M	Perth
97.5	6ABC	50	H	Perth
101.5	4ABC	65	H	Townsville
101.9	2ABC	50	V	Canberra
	3FOX	10	M	Melbourne
102.1	4ZZZ	6	M	Brisbane
	8CCC	0.125	V	Alice Springs
102.3	3ABC	100	H	Mildura
102.5	2MBS	10	M	Sydney
102.7	3RRR	10	M	Melbourne
	4DDB	2	H	Toowoomba
103.2	2CBA	10	M	Sydney
103.3	4MBS	2	M	Brisbane
	7HFC	1.5	M	Hobart
103.5	3GCR	0.05	M	Churchill
	3MBR	0.5	V	Murrayville

MHz	Call Sign	Power (kW)		Location
103.7	2NUR	3	M	Newcastle
103.9	3CCC	2	V	Castlemaine
	4TTT	0.05	M	Townsville
104.1	2CHY	0.04	V	Coffs Harbour
	2DAY	35	M	Sydney
	4MMM	6	M	Brisbane
	5ABC	150	H	Mt Gambier
	8TOP	10	M	Darwin
104.3	3ABC	50	M	Albury/ Wodonga
104.9	2MMM	35	M	Sydney
105.1	5ABC	95	V	Loxton
105.3	3ABC	50	H	Ballarat
105.7	2ABC	50	M	Wagga Wagga
	2JJJ	10	H	Sydney
	3ABC	50	H	Melbourne
106.1	2ABC	25	H	Newcastle
	4ABC	50	H	Brisbane
106.3	3ABC	100	M	Bendigo
	3RPC	0.035	M	Portland
107.1	2AAA	0.2	M	Wagga Wagga
	3ABC	100	H	Traralgon
107.5	2ABC	50	M	Griffith
	2SER	4	M	Sydney
	5SSA	5	M	Adelaide
107.7	3PBS	0.1	M	Melbourne
107.9	2ABC	25	M	Wollongong
	2REM	0.3	M	Albury
	4ABC-FM	50	M	Toowoomba

Notes

T	Translator	H	Horizontal
N	National	V	Vertical
C	Commercial	M	Mixed
P	Public		

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See November EA 1983
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DIN
2 PIN LINE PLUG P-1520 **60¢** (10 up 50¢)

5 PIN LINE PLUG P-1550 **85¢** (10 up 80¢)

5 PIN PANEL SOCKET suit P-1550 P-1552 **85¢** (10 up 80¢)

5 PIN LINE SOCKET suit P-1554 **90¢** (10 up80¢)

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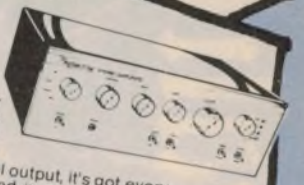

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See Page 98 for full address details

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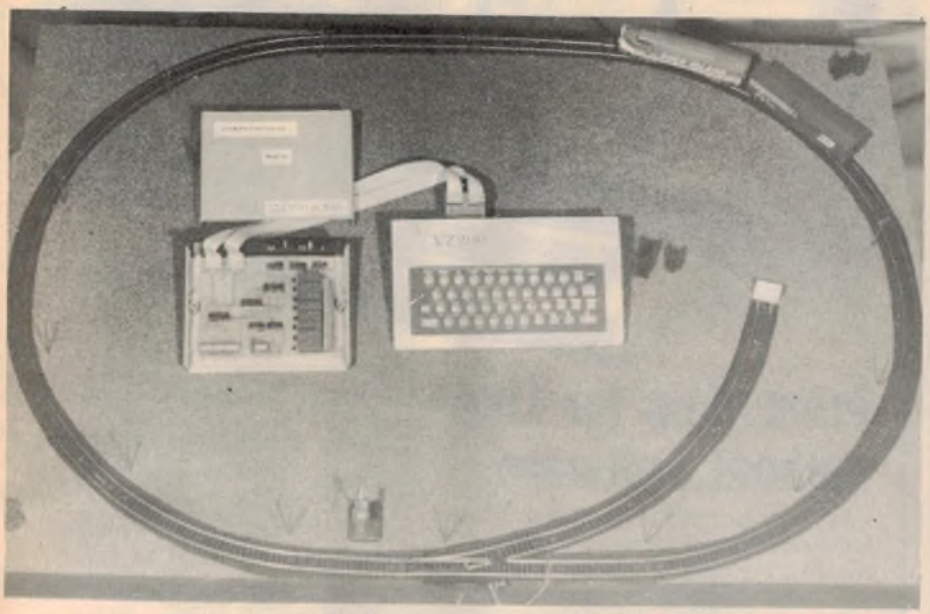

Real-world interface suits any computer

Sydney firm Meyertronix now has available a computer input/output unit suitable for use with any Z80-based computer system. The unit, available either as a kit or fully assembled, provides eight digital inputs, eight outputs to relays and a single programmable analog voltage output.

The unit we have seen came complete with cables and connectors for the VZ-200 computer, but interfacing requires only the connection of four address lines, the data bus and the Z80 control signals IORQ, RD and WR, making it suitable for the ZX81, MicroBee and Super 80 computers, among others. A version is also available for the Commodore 64 and VIC 20 computers.

If more than eight inputs and outputs are required, up to five boards can be connected in parallel, using a special cable arrangement.

The unit is supplied in an ABS plastic case measuring 196 x 158 x 64mm. The main circuit board measures 170 x 133mm and is double-sided with plated-through holes. Eight ICs are used, with data and address line connections to and from the board made by DIP header sockets. The VZ-200 version also comes with a smaller PCB terminated in a 30-way edge connector suited to the peripheral interface of the computer. Power for the circuitry is provided from the computer itself.

Address decoding is performed on-board, with three locations allocated – one each for the eight bit input and output ports and a separate port for the analog voltage output. The decoding is hard-wired, so that the port addressing cannot easily be changed. In the Z80 version the input port is at location 80 hex (128 decimal), the relay output port at 81 (hex) and the analog output port at 82 hex.

The method of producing the analog voltage is interesting. One eight bit output port is dedicated to this function and drives a set of eight analog switches. These switches in turn connect one or more resistors in series with the ADJ input of an LM317 adjustable voltage regulator.

Sending a binary code to the output port thus produces a voltage which is adjustable between 1.2V (the minimum output of the LM317) and the maximum input voltage to the regulator (which can be up to 30V if required). Provided that the resistors in the controlling network are selected for precise values, the output is programmable in 256 equal steps.

Programming the controller is simple as the Basic statements OUT and INP do all the work (PEEK and POKE for the Commodore machines). Some trial and error would be required to develop a program capable of close control of the analog voltage output as the relationship between data values and output voltages depends naturally enough on the maximum value of the voltage input to the LM317.

The eight input lines are unlatched and are normally held high by pull-up resistors. Pushbuttons, reed switches or more complex sensors are easily connected and must be arranged so that they pull the appropriate input line to ground when operated. Reading the status of the switches is simply a matter of performing an INP or PEEK statement.

The second output port controls relays which are claimed to be suitable for switching 240VAC at up to 2A. Unfortunately the provision for connecting to the relays is rudimentary, consisting of a terminal block mounted on the PCB inside the case of the unit. The user must supply and run cables to the terminal block, which would require cutting access holes in the case.

The relays are operated by binary codes which of course are represented by decimal values in Basic, but the scheme is easy to use.

Documentation for the unit consists of seven pages of description, construction and application notes, some example software, circuit diagram and PCB overlay. Cost of the unit in kit form is $98, and fully assembled and tested versions are available for $158.

Meyertronix also has available an industrial version of the controller, again designed to interface with any computer system. This version is supplied in modular form in a 19" rack mount

Emona MIC-504 business computer

Emona Computers Pty Ltd has introduced the MIC-504 business computer, a Z80A-based system business system which comes with a range of software.

The MIC-504 is manufactured by Multitech, a Taiwan company which has made a name for itself with the world's most advanced Chinese-language computer and the MicroProfessor range of educational and hobbyist systems.

Specifications of the MIC-504 include CP/M 2.2 operating system, two built-in 14cm double-sided, double density disk drives providing 2 megabytes of storage, and 64K of RAM. Two RS-232C serial ports and a Centronics type parallel printer port are also provided.

Further information on the MIC-504 and a range of other computer systems and peripherals is available from Emona Computers Pty Ltd, PO Box K720, Haymarket, NSW, 2000.

Micronews

Continued from page 131

cabinet with separate boards each providing eight optically-isolated digital inputs or outputs. A real-time clock, parallel printer interface and parallel printer interface boards are also available.

To use this system a separate address decoder board is required which supplies 128 individual I/O select signals. A power supply board is also required, bringing the cost of a minimum system to around the $1000 mark (depending on the number of input and output boards making up the system).

For further information on either version of the I/O controller contact Meyertronix, PO Box 65, Riverstone, NSW, 2765. Phone (02) 627 2510.

Magazine on a floppy disc

Ashton Scholastic, suppliers of educational computer programs and classroom materials, has released a new hybrid product called "Microzine", a magazine on a floppy disk.

Edited for eight to 14-year olds, Microzine is designed to reach microcomputer users in the home and the school, says Ken Jolly, managing director of Ashton Scholastic. The programs on the disk have a magazine-like format, with regular departments and stories that will continue from one issue to the other. The emphasis is on interaction and education.

The "Microzine" is just one of some 20 new titles released recently by Ashton Scholastic. Instructional software and books are available covering the Apple II, Atari 400 and 800, TI 99/4A and VIC 20 computers. A complete catalogue of the range is available on request.

For further information contact Ashton Scholastic, PO Box 579, Gosford, NSW, 2250.

Price drop for Lisa without software

Apple Computer Australia has announced a new pricing strategy for the Lisa personal computer system. By unbundling Lisa's applications software packages from the hardware, the company will be offering the basic system hardware for $8,595.

Floyd Kvamme, Executive Vice President, Marketing and Sales, said, "Our roll-out strategy centred on three key objectives: introduce a revolutionary product that would be attractive to both end users and third-party software developers, establish a solid, initial dealer base and gear up for volume manufacturing.

"We've now reached the point where enough third-party software is being written to allow us to fulfil our commitment to unbundle our own software from the hardware and where we can produce enough aggressively priced product to supply an expanded dealer base. Interest in the product at the retail level clearly merits a larger number of Lisa dealers who can serve a broad market of small businesses and large offices," he said.

Following the price reduction, the Lisa system hardware which is a one megabyte, 68000 system with a five megabyte winchester disk drive, two 860kb floppy disk drives, a high resolution monitor, keyboard and a mouse will be priced at $8,595.

The Lisa personal office system with six application programs will be sold for $9,990.

Applications can also be purchased separately. Lisawrite, Lisacalc and Lisagraph are each priced at $375, Lisaproject and Lisadraw are each priced at $495 and Lisalist is priced at $260. In addition, Apple is also offering as a special promotion the six applications, an Apple Dot Matrix printer and parallel card on the Lisa system for $10,395. Lisa had previously been priced at $12,300 for the system with six applications packages but without the Dot Matrix Printer.

"The value end users will receive is tremendous", said David Roman, National Marketing Manager of Apple Australia, "They're able to purchase a system of far greater performance than other similarly configured high priced competitor systems. We also anticipate increasing the number of dealers".

MicroBee controls air conditioning

Thos. Clark & Son, air conditioning engineers, has released a range of process control systems based on the MicroBee computer.

The company's TC-1000 system is designed for owners and managers of small buildings whose energy management requirements cannot be met by time switches and relays. The system provides computerised control and monitoring functions and can perform complex interlocking sequences and closed loop control functions such as those required for chiller and damper control of air conditioning systems.

The MicroBee computer provides a keyboard and video display unit as well as the processing power needed for the task. Specially written software allows instructions to be entered by selecting entries from an English language menu. Alarms and status displays appear on the video monitor and are signalled by an audible alert.

Each load controlled by the system can be switched either automatically or manually from the keyboard with a maximum of 32 digitally controlled 240VAC switching outputs, 64 digital inputs and relay isolated 12-bit analog inputs for feedback sensors.

Thos. Clark is one of Australia's largest contractors in the energy management field and their selection of the MicroBee must be a feather in the cap for Applied Technology.

WAVETEK®

NEW APPOINTMENT

Commencing on the 25th day of December, 1983, Scientific Devices Australia Pty Ltd was appointed as the new Australian representative of Wavetek Corporation USA.

Wavetek made this appointment after many months of assessing and negotiation with both Scientific Devices and other leading instrumentation representatives. This now allows Scientific Devices to offer one of the largest and most comprehensive electronics instrumentation product lines in Australia.

Wavetek, with the addition of two new divisions to their structure, namely Nicolet Scientific Corporation and Pacific Measurements, are one of the largest instrumentation suppliers in the USA.

There products include FFT analyzers, synthesizers, programmable filters, RF signal generators, RF components, communication service monitors, radio and CATV test equipment, RF sweep generators, microwave generators, instrumentation controllers, pulse/function generators, arbitrary programmable generators, instrument controllers, network analyzers and power meters.

From the December 25, 1983, Scientific Devices offers marketing and support for Wavetek products with full service facilities.

Please contact Scientific Devices Australia Pty Ltd for further information on this appointment at any one of the offices in Melbourne, Sydney or Adelaide.

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Aust. subsidiary for Epson Corporation

Epson Corporation of Japan has set up an Australian subsidiary, Epson Australia Pty Ltd, to handle the distribution of all computer and peripheral products from the parent company.

Epson, a member of the Seiko group, first made its name in the printer market, with its MX-80 establishing a standard for low-cost dot matrix printers. The company also manufactures miniature printer mechanisms, LCD displays and the HX-20 portable and QX-10 desktop computers.

Epson is one of the largest manufacturers of liquid crystal displays in Japan, concentrating on alphanumeric panels for use in portable computers. At the conference announcing the formation of the Australian subsidiary, executives from the parent company spoke of the development of 80 character by 16 line and 25 line LCD screens, said to be on their way later this year.

Epson Australia Pty Ltd is at Unit 3, 17 Rodborough Rd, Frenchs Forest, NSW, 2086.

Free information on computer books

The Technical Book and Magazine Company is offering a free information service for micro-computer and electronics enthusiasts. A regular mailing will keep hobbyists up to date with the latest books from all over the world and the company also offers mail order service and magazine subscriptions to customers who cannot visit their Melbourne store.

To be placed on the mailing list write to Technical Book & Magazine Company Pty Ltd, 295 Swanson St, Melbourne 3000, or phone (03) 663 3951.

'how I wun a pryze in a short storey competish- un fer gud Inglish.'

While it's highly unlikely our **WordPlus** system ever would have to clean up a sentence such as the one above, it could without any trouble whatsoever.

Essentially, **WordPlus** is a computer programme that catches errors in spelling and other dictionary based tasks.

However, you are the one in control, you can over-ride its advice at your discretion.

Software Source also has another programme called **Punctuation and Style.** This system catches errors in punctuation and grammar and picks up phrases that are being misused and suggests alternatives. As you can imagine, both these systems can help your writing style considerably.

Correct grammar can cut down greatly the costly misunderstandings in business communication, so these programmes from Software Source may well be the best means a business has nowadays of cutting down the competition.

See Software Source for Basic/z, C-86, Directory Sort, Modem 86, Spellbinder, Super Calc, VSpool & VEdit.

Software Source Pty Ltd

P.O. Box 364, Edgecliff, N.S.W. 2027. Phone: 389 6388

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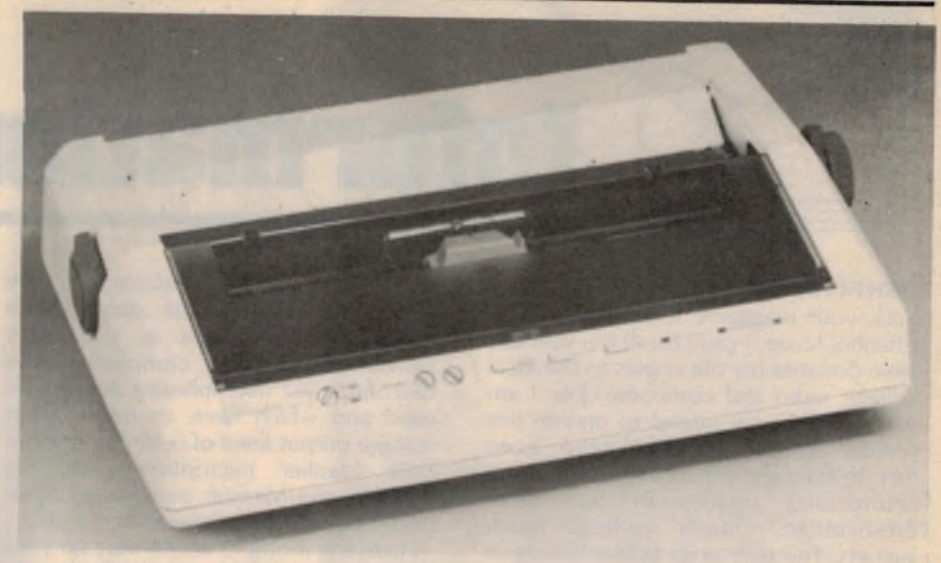
Micronews

Datascope releases new NEC Spinwriter



Datascape, a major Australian distributor for NEC's range of Spinwriter printers, has released the new Model 2000 Spinwriter, said to offer the advantage of larger NEC units at a lower price.

The Model 2000 is rated at a 20cps printing speed and can use the complete range of 90 "print thimbles" made by NEC. The thimbles look like daisywheel print elements with the spokes bent upwards and provide fully formed characters and special symbols in a range of type fonts.

Interfaces to the printer are available as separate plug-in modules, covering RS-232C serial, Centronics parallel, Diablo serial and IBM parallel formats so the Spinwriter can be used with any computer system. Also available is a range of paper-handling options, including single and dual bin sheet feeders, an envelope feeder, tractor feed options and a single sheet guide.

The price of the basic Model 2000 is $1,135 excluding sales tax, with interface modules ranging from $275 to $360.

For further information contact Datascope International Pty Ltd, PO Box 579, Neutral Bay Junction, NSW, 2089. Phone (02) 909 1233.

Club News

● The Spectravideo Users Group of Tasmania has grown rapidly in the past few months, requiring some changes in administration to give the best service to members. The new telephone number for enquiries is (003) 31 2648 and the new postal address is SVUGT, PO Box 191, South Launceston, Tasmania, 7250.

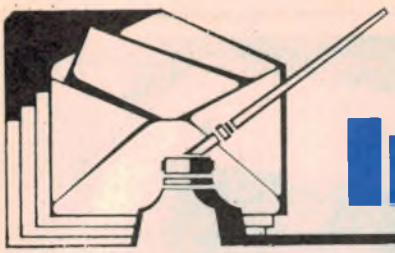
The group publishes a newsletter with advice and program listings, running to 15 to 20 pages each month. Membership is $15 per year, and new members receive back issues of all newsletters when they join.

● The Melbourne Super 80 users group will hold an open day on Saturday, March 17, from 9am to 4pm at the Uniting Church Hall, 83 Canterbury Rd, Heathmont, Victoria. The 150 members of the group, guests and visitors will offer a display of Super 80 computers and associated hardware, with information on all aspects of the club.

Further information is available from the group at 17 Stephen Crescent, Croydon, Vic. 3136 (03) 723 2713.

● A COMX 35 users group newsletter is available from Frank Rees, 27 King St, Boort, Vic. 3537. Subscription to the group costs $18 per year, entitling the members to at least six copies of the newsletter, containing programs and items of interest to users of the COMX 35 and other computers based on the RCA 1802 microprocessor.

● We have received a very well presented newsletter from the ACT VIC-20 User's Association. The 36-page magazine is published six times a year with programs, advice and other news of interest to VIC 20 users. An annual subscription costs $12, and the issue we saw contained 15 programs and a wealth of other information. The address to contact is "VIC", 25 Kerferd St, Watson, ACT, 2602, or phone (062) 41 2316.



Information centre

EIGHT-CHANNEL MIXER: Some years back your magazine featured an Eight-Channel Mixer. I can't recall the year as I have donated my old copies to the local college radio and computer club. I am wondering if you intend to update this project as at present I have been investigating the introduction of a sound reinforcing system in our local Presbyterian Church without much success. The only units available here in New Zealand are limited in the number of inputs and the suppliers charge like the cavalry.

I had endeavoured to procure the Shure M268E which I consider to be the ideal unit for the Church but the powers that be would not let the local agent import it. This unit features 30V DC for condenser microphones, automatic muting, regulated power supply, and four transformer balanced microphone inputs plus switched inputs for Lo or Hi-Z mids.

I was also contemplating building your 50W Mosfet amplifier to run with the mixer but as things stand it appears to me to be the opportune time to look into a system that includes all the features housed in the one cabinet which would include a LED peak indicator, and would complement the two Shure 562 microphones that will be used and which have an open circuit voltage output level of 0.06mV. A Shure 545L Lavalier microphone will be worn by the Minister and has an open circuit voltage output level of 0.11mV.

I trust the thoughts above may stir your imagination and help others like myself. (R.D., Te Awamutu, NZ.)

● The mixer in question was described in February, March and April 1975. We do not intend updating it as it is well and truly superseded by the eight-channel mixer from Jaycar which was described in April and May 1983. This would serve your purpose although it does not have inbuilt power for condenser microphones. Electret microphones are a simpler and more effective proposition.

CAR COMPUTER: I am a late starter in building the Car Computer described during 1982. However, this is now operating after encountering a few difficulties. Other readers may have experienced similar problems, hence my remedies could be of interest.

The kit was purchased from Altronics and after three open circuits were repaired in the PCB plated-through holes it worked well on the bench – almost. The clock readout was fast, one minute being clocked in 36 seconds, real time. The symptoms pointed to the divider IC (MM5369). National Semiconductor advise they make three versions of the MM5369: 3.58MHz deriving 100Hz, 60Hz and 50Hz, differentiated by suffixes EST/N, AA/N and EYRN respectively. I had the 100Hz chip. Altronics remedied this oversight promptly, enclosing a courteous note explaining the difficulties encountered with manufacturer's numbering and also mentioning the functionally equivalent 2716 EPROM and the Texas Instruments 2516, as supplied in my kit. These days a touch of personal service is much appreciated. The new 60Hz IC fixed the clock problem, but I found quite a difference between a project working well on the bench and

Heart rate monitor disappointment:

HEART RATE MONITOR: I am disappointed with the Heart Rate Monitor.

It is not that it just does not work – it is unreliable in every phase. For instance, I will set the calibration to the correct figure one day and the next it may be 20 points out either way.

At one stage I thought I was getting a reliable pulse on the annunciator by putting my thumb over the LED and the light receiver but next time I try it is unreliable. I got it to read 50 when my pulse is 50 and I go for a run and it reads 193 and I know my pulse can not go over 120 in those circumstances.

I pressed the box into my wrist to get a larger pulse signal and thought the annunciator was at last following the pulse. All this was after I had put a .01μF condenser across the input as I thought to eliminate noise but then I lengthened the leads also as to strap the infrared diode and the light receiver to my wrist and hold the box in the same hand but again I could not reproduce the same results.

There is intermittent action of the annunciator as if the input to the first IC was indeterminate in height perhaps sometimes too close to the top rail or too close to the bottom rail. At other times the second and third ICs etc can be seen reliably flipping up and down but not for long.

First, it needs more reliable calibration. Second, it needs more reliable input. Third, the whole concept is wrong. It should count 15 seconds and multiply by four or count for seven and a half seconds and multiply by eight.

Fourth, it appears to need either zener control of voltage or a temperature control or both. Without those I can only abandon it to the junk help and it is not as though I did not have enough instruments to measure it with. All voltages appear correct and a check of the major IC does prove it measures 200mV correctly. It does read something but any accuracy is totally non existent. It cannot perform the function I wanted of it which was to record my maximum pulse while running uphill. (F.F., Dundas, NSW.)

● Since you cannot get the heart rate monitor to stay at the correct calibration number the logical place to start fault-finding is at the calibration circuit. This circuit outputs a series of 0.2 second pulses which should not vary in length. Likewise the output voltage of the pulses should not vary in magnitude. If they do, which is suggested by the drift in the display calibration, then the timing components and S1 should be checked thoroughly. If you have used sockets for the integrated circuits then these should probably be discarded and the ICs soldered directly to the PCB since bad contacts in the sockets housing IC2 could cause a drift problem.

when installed in a 1971 Valiant.

Erratic behaviour occurred mostly when starting the engine, resulting in a loss of stored data and quite often no readout at all from the display. Pressing the function switches, when this happened, had no effect. Turning the engine off and restarting usually produced a display, although not always meaningful. However, repeating this procedure once or twice would give a rational readout. I hasten to mention that I had incorporated all modifications published under "errata" in subsequent EA editions. Noise in the supply line seemed the most likely cause of this problem and possibly a battery not fully charged, being a contributor. I should add that the Valiant sits idle for lengthy periods as it is used mainly for towing our caravan.

To overcome noise in the supply, the positive and negative 12 volt lines were run direct to the computer from binding posts close to the battery and on the opposite side of the engine to the TAI system. Prior to entering the computer, Vs is filtered through an LF choke, bypassed to Vo with a 1000μF capacitor before the choke and a 0.1μF ceramic after the choke. The choke was salvaged from a defunct National car radio. After the filter, Vs enters the computer via normally closed (N/C) contacts of a relay, energised from the car starter circuit.

This relay interrupts the 12V supply to the computer when the ignition key is turned to the start position, thus preventing a low battery voltage at the 7805 voltage regulator. During the starting period the computer derives its standby supply from a 9V battery as per your article published in EA March 1983. The ignition input to the computer is derived from the Vs supply, after the first relay, and via the normally open (N/O) contacts of a second relay, energised from the ignition switch. This is to ensure the ignition input is as noise-free as possible. The filter and both relays are easily contained in a small jiffy box.

When starting the engine the blank display still persisted on occasions so it appeared I would have to live with the shortcoming. To avoid turning the engine off and restarting I provided a N/C mini pushbutton switch on the side of the computer case which, when pressed momentarily, interrupts the ignition input. One or two presses produces a rational display – not all that scientific but it works. A further idea considered desirable was to mount the 7805 externally on a heavy heatsink, along with the 10μF tantalum and 10μF electrolytic capacitors. The capacitors are connected as close as physically practicable to the pins of the 7805.

To complete the installation a "head-up" display consisting of four FND507s held together by a thin "u" shaped metal strap are pinned by two PK screws to the underside of the instrument cowl, directly above the speedometer. The 12-year-old Valiant's speedometer is calibrated in MPH, hence this additional display provides an excellent metric update. The one set of function button switches in the computer appears adequate.

On occasion data is still lost but, by and large, the foregoing modifications have provided, in my opinion, a viable installation in my vehicle. (A.S., Mount Eliza, Vic.)

● We are a little surprised that you found it necessary to go to such lengths in order to make the Car Computer work properly. A number of people have experienced problems when the motor is starting which leads us to believe that perhaps the starter motor commutator is injecting large noise pulses into the 12V battery line. As such, more filtering is the answer, with perhaps diode isolation during starting rather than the relay system you have used.

We draw your attention to the Errata published in the June 1983 issue which said: A 10kΩ resistor should be connected from pin 9 of IC6c to ground, to keep CB2 low after the Reset and before it is driven high. This ensures that the NMI does not occur before all initial conditions have been set and will prevent data loss at switch-on.

MUSICOLOUR MK IV: Please help me if you can. I have assembled a Musicolour Mk IV kit which works well but I would like to add two extra features.
(1) Inductive load capacity (for 240-6V transformer lights) without blowing up output Triacs as I did.
(2) Individual manual control for each channel, ie, four flasher buttons and four pots to dim from full bright to off. (I know I can mount buttons and slider pots on the top of the case of the kit – but where do I wire them to and how?) The manual control is for amateur theatre lighting. (C.M., Lyneham, ACT)

● Unfortunately, we are unable to nominate the necessary series RC network which should be fitted across each triac and strictly speaking, across each optocoupler. To do this one must know the parameters of the inductive load.

Individual dimmer controls could be added for each of the four channels but it would not be a simple matter of just wiring in four potentiometers. You need to feed a variable DC voltage to the non-inverting input of each of the IC5 op amps. While we have not tried it, the way to do this would be to connect a 10kΩ potentiometers across the +12V supply and connect the pot wiper to the non-inverting input of the relevant op amp via a diode with anode to wiper.

To do all four channels you would need four pots and four diodes. Such a scheme could be used simultaneously with the Musicolour function.

ORGAN KEYING: In "Wireless World" for January 1981 there was a very interesting "TDM-System" for electronic organs introduced and explained. I know little about this type of electronics but the system for pedals and keys uses a matrix.

The key contacts are turned into a series of pulses by sequential scanning of the matrix. Data is passed over a single wire through various delay systems to demultiplexers to switch off and on the appropriate notes. The delay consists of shift registers and performs the task of

Electronics Australia Reader Service

"Electronics Australia" provides the following services:

PHOTOSTAT COPIES: $3 per project, or $6 where a project spreads over multiple issues (price includes postage). Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries. We reserve the right to supply complete back issues instead of photostats, where these are available.

CHASSIS DIAGRAMS: For the few projects which require a custom metal chassis (as distinct from standard cases) dyeline plans showing dimensions are normally available. $3 including postage.

PC BOARD PATTERNS: High contrast, actual size transparencies: $3, including postage. Please specify positive or negative.

PROJECT QUERIES: Members of our technical staff are not normally available to discuss individual projects, either in person at our office, or by telephone.

REPLIES BY POST: Limited to advice concerning projects published within the last three years. Charge $3. We cannot provide lengthy answers, undertake special research, or discuss design changes. Nor can we provide any information on commercial equipment.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" or submitted without fee may be answered in the "Information Centre" pages, at the discretion of the Editor.

COMPONENTS: We do not sell electronic components. Prices and specifications should be sought from advertisers or agents.

BACK ISSUES: Available only until our stocks are exhausted. Within six months of publication, face value plus 30c for post and packing for each issue. Seven months and older, $3 (includes post and packing and storage fee).

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Chippendale, 2008.

pitch selection and coupling. Interesting in that for a 4-manual organ only 39 wires are necessary.

Until now, the wiring of multipitch organs was very time consuming. If you could come up with some practical circuits to put this idea to good use I believe you should find many interested music buffus, including me. This keying system could take the hardship and unpleasantness out of organ building. (J.D., Villawood, 2163.)

● We have referred to the "Wireless World" article and agree that it is interesting as far as it goes. The key scanning principle is used quite a lot on the latest mass-produced organs but normally requires the use of a microprocessor to control all the keying functions.

As far as a kit project for the magazine is concerned, it is not really feasible due to the large amount of development required.

300 WATT INVERTER: I require help with some of your electronic projects. I hope you can assist. Whilst in England a year or so ago I acquired a circuit for a 300 Watt Inverter which I built on my return to Australia, having a transformer wound for the purpose. This project was a dismal failure as all it did was burn up components. No matter how many times I went over it I could not find the fault.

Seeing your project of June '82 I tried to incorporate my transformer, the power transistors which were the same, and the other bits and pieces to make it work. My major problem is that I don't have the secondary winding S1 to give the sample voltage. I have tried to construct the inverter without the current overload, relying on the thermal overload only. With this I have achieved an output of 240 volts but only for a short time after which it stops.

If turned on it will re-start only to stop again. I appreciate my enquiry is an unusual one but if there is some way you can help me it will be much appreciated.

I have also built your electric fence project, this one to plan, and found it works well, but find the 6V supply a little difficult as I run my home from 12V batteries. Should I run two in series, or is there another economical solution?

Finally I have a problem running my 12V radio when I have my fluoro lights on. I believe this high frequency distortion in the radio to be coming through the supply as the aerial is on the roof and there is a layer of insulation and corrugated iron between it and the light. Is there any filter I can put in the supply line to eliminate this distortion. Also is your bright/dim switch as in October '80 issue legal as far as supply authority is concerned? (J.S., Tyalgum, NSW.)

● It should be possible to make the inverter circuit work without IC7 and associated components although note that pin 12 of IC1d and pin 9 of IC1c should be tied high. Alternatively, it should be possible to use IC7 with a voltage sensing circuit from the S2 winding. To do this, you would need to upgrade the four 1N4002 diodes to 1N4006 and increase the 390Ω resistor to 47kΩ.

Regarding the electric fence, you should be able to get this to run from 12V by connecting the circuit in series with a suitable resistor.

As for the high frequency hash from the fluoro lights it should be possible to bypass this with a large electro electrolytic capacitor across the supply at the radio and a series inductor which could be an old transformer.

The bright/dim switch described in October 1980 is not favoured by the supply authorities but there are still relatively large numbers of appliances on the market which also put DC on the mains and these are in fact, still approved.

DIGITAL CAPACITANCE METER: I wish to inform you of my experiences with the digital capacitance meter described by Ron De Jong in the March 1980 issue.

Rather than go through the problems of collecting parts and constructing a board, I decided to purchase a kit and thus speed up the process to have a very useful piece of lab equipment with which I could then check and sort the growing box of capacitors that were around the workshop.

Unfortunately for me the project was to prove not quite as simple as I first thought. The initial kit had a small change in the line up of components: the trimpot VR1 was changed from a 2MΩ to a 1.5MΩ and the series resistor from 680kΩ to a 1.5MΩ. This was indicted on the parts list and as such did not present any problems in the amount of resistive range control available to the calibration process.

The problem that I had came to light on the pF range when I wanted to calibrate the instrument. All went well on the micro and nanofarad ranges but I could not get the pF range to zero as indicated in the article. No matter what I did I would have a minimum of 14 or 15 pF displayed on the screen when nothing was connected to the input terminals and this could not be nulled as described in the text.

After much thought, tracing of board tracks and eventual changing of the chips IC2 and IC3 and noting the various reader enquiries that were published in later editions I still found that I could not get the device to calibrate.

Recently, I decided to "fix or throw" the device and tried altering the value of the nulling cap (.0022) but found that at certain values the device would not even read capacitance value let alone allow a null of internal capacitance. I then removed the nulling trimpot VR4 after finding that the device only approached the null with maximum resistance in circuit. On replacing this with a 1MΩ trimpot I found that the device would now allow adjustment through to a null and also small capacitors with known values would now calibrate on the instrument. (C.C., Box Hill South, Vic.)

● Thanks for this feedback. We have published it in the hope that it may help some other readers.

UNKNOWN MICRO: Recently whilst shopping for a personal computer I came across a "new" one that I have not heard about before. The computer is a "Base 64A". If possible I, and I suspect your readers, would be interested to know more. The salesman quoted me "complete compatibility with all Apple software, extended Micro-soft Basic language, colour graphics, optional plug-in board for Tandy compatability at $1100". This sounds like a good buy. (V.A., North Sunshine, Vic.)

● We are sorry to say that we haven't heard of a computer called the Base 64A. We would indeed be interested in finding out about such a machine and perhaps you could send us more details if they become available to you.

Computers with some of the specifications you mention include the COMX 35, the Apple-compatible Franklin Ace 1200 and the TRS-80 compatible Komtek system.

NOTES & ERRATA

PARALLEL TO SERIAL CONVERTER (July 1983, 2/CC/83): There is an error in the circuit diagram on page 97. Pin 5 of IC3 should be connected to +V instead of GND to give the correct division ratio of 15.

L. E. CHAPMAN

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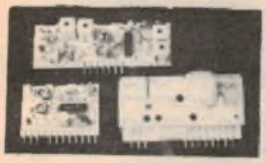

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S041P	50c	74LS00N	50c
MC1306P	50c	747SO8N	50c
S7648	50c	NE5667	50c
2112B	50c	SA5050	50c
SC87024P	50c	MM5718GN	1.50
SN29848N	50c	747S08N	50c
747S92N	50c	747S90N	50c
MG14011UB	50c	4011BP	50c
S7646	50c	MM53114N	50c
74LS157N	50c	NE560N	50c
74LS10N	50c	74LS76N	50c
NE566N	50c	MM53114N	50c
SN29760N	50c	2612N	50c
MM57186N	50c	S041P	50c
HEF4011BP	50c	2112N	50c
211N	50c	MC1306P	50c
2N29862N	50c	21128	50c
74LS10N	50c	NE566N	50c
MM57186N	50c	HEF4024BP	50c
SAA5050	$2.50	MC1306P	50c
SC87024	50c	7647-2112B	50c
74LS93N	50c	21128	50c
SAA6060	50c	MC1401UB	50c
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7000 to 3 5 **$3.50**

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$1 each
Aerial OS coils
75c each

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CAR RADIO Suppressors
5 for $1

455 MINI IFs
for transistor radios 50c pair

SPECIAL
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Usual price 60c to 80c each

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28 pin	40c
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½ Meg	30c
1 Meg	30c
100K	30c
100K Switch	50c
50K Double Pole Switch	50c
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10K Switch	50c
250K	30c
50K	30c
20K	30c
10K Min Pots	25c
50-ohm	50c
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½ 1 meg dual Concentric tapped at 100K	$1
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2 meg ganged log	$1
1 meg dual ganged	$1
½ meg dual ganged LIN	75c
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20K wire wound	75c
dual log 10K	75c
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10K sub min log pots	50c
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25K lin ganged pots	75c

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EC97	3.00	6C5	3.00
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3V4	3.00	6AM5	3.00
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6J6	3.00	6AU5	3.00
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6X9	3.00	UCL82	3.00
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6CZ5	3.00	VR118	5.00
6B8	5.00	EF37	5.00
6X5	3.00	35A5	5.00
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6BA8	3.00	D77	2.00
6SH7	3.00	6DS8	4.00
25Z5	4.00	12X4	2.00
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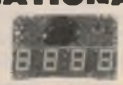
19Y3	3.00	6BW7	3.00
EBF89	3.00	6CK5	3.00
50EH5	3.00	E80033	3.00
6ES6	3.00	EZ40	3.00
30AE8	3.00	16A6	3.00
6201	3.00	UF41	3.00
6AB8	3.00	50C5	3.00
30AE3	3.00	EY51	3.00
6DB5	3.00	PCL81	3.00
6JN8	3.00	6DA6	3.00
15CW5	3.00	6AT6	2.00
UBC8	3.00	6ET6	2.00
17Z3	3.00	6BF6	2.00
6CJ6	3.00	PCL82	3.00
6FC7	3.00	PCL84	3.00
6BN8	3.00	UCC85	3.00
6DA4	4.00	PCL81	3.00
6N7	4.00	6AQ8	3.00
6SC7	4.00	9JW8	3.00
17BF11	5.00	6BJ5	3.00
6BK7	3.00	PY83	3.00
PCC84	3.00	EAF42	4.00
12SQ7	4.00	EY51	4.00
6BJ8	3.00	6A08	3.00
6DB5	3.00	6BX7	5.00
12K5	3.00	16A5	3.00
EF97	2.00	ZEZ6	12.00

CLOCK MODULES NATIONAL

CIRCUIT DIAGRAM SUPPLIED



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Micro switches to suit. **$3**

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½ meg dual	50 cents
1 meg dual	50 cents
2 meg dual	50 cents
25K dual	50 cents
250K dual	50 cents
1K dual	50 cents
50K single	30 cents
250K single	30 cents
10K single	30 cents
250K dual slide	50 cents

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Less motor & heads **$5**

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EA marketplace EA marketplace

FOR SALE

EA KITS: Ignition. Two types of this popular system are now available. The Feb 83 version prolongs ignition tune and provides a more consistent spark thus reducing servicing and improving economy. Complete kit $34. The Dec 83 system replaces the contact set with a Hall Effect trigger to eliminate ignition timing variations caused by contact wear. Complete Hall device ignition system $64. Also available Sept 83 in-circuit transistor tester complete with C&K click action switch and smart box like EA used. $15. Add $2 pack and post to Kitronics PO Box 126, Epping, Vic 3076, or for evening shopping by bankcard phone (03) 435 0865 between 6 and 9pm.

TEST GEAR: All VG cond, Marconi gen, 10-470MHz, $275. Tek 549 Storage CRO, with some spares, $850. Solatron ptble. DB CRO 7MHz, $175. Two inch Ampex VTR deck only, with vac pump, $250. Six chl thermal chart recorder $175. S. Dekker, Box 437 Gawler, SA 5118.

CIRCUIT BOARD MATERIALS: Including copper clad epoxy glass board, 1oz single and double sided. Teflon double sided board. Riston coated negative acting board cut to size. Riston developer, 3M Scotchcal film and developer. Marking pens etc. Australian Printed Circuits P/L, 73B Osborne Ave, Springvale. Phone (03) 547 6860.

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APPLE: No its a BANNANA and they are compatible. Yes a 48K BANNANA computer from overseas can cost about $400 and it's APPLE compatible. A Green Screen Monitor for around $290. For price list and information send $5 to C and K, PO Box 205 Oakey, Qld 4401. A good $5 investment.

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Fundamentals of Solid state has been reprinted, revised and updated showing how popular it has been. It provides a wealth of information on semiconductor theory and operation, delving much deeper than very elementary works but without the maths and abstract theory which make many of the more specialised texts very heavy going. It begins with atomic theory, diode types, unijunction, field effect and bipolar transistors, thryistor devices, device fabrication and microcircuits. A glossary of terms and an index complete the book. Fundamentals of Solid State has also been widely adopted in colleges as recommended reading — but it's not just for the student, it's for anyone who wants to know just a little bit more about the operation of semiconductor devices.

Available from:
"Electronics Australia", 57 Regent St, Chippendale. **PRICE** $3.50 OR by mail order from "Electronics Australia", PO Box 163, Chippendale, 2008. **PRICE** $4.40.

Motorcycle Intercom . . . cont from p43

Velcro material can be used to secure the microphone and earpiece to the inside of the helmet. The loop half of the Velcro is glued in place inside the helmet with contact adhesive and the hook half glued to the back of the microphone and earpiece.

Leads for the microphone should be shielded cable while those for the earpiece can be unshielded. Run the leads down to the side rim of the helmet and connect the stereo socket to these leaving several centimetres length below the base of the helmet. The wires can be secured by stitching with cotton thread to the lining of the helmet.

Do not be tempted to omit the helmet socket connections and just use a cable from helmet to intercom. This could make an accident even more hazardous if the cable connections do not break. And make sure that the intercom leads are bundled out of the way when the intercom is not in use.

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The binders and magazine holders are available over the counter from Electronics Australia, 57 Regent Street, Sydney, NSW — Price $5.10 binders, $4.50 holders.

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Prices including postage are:

Holders: $5.50 NSW; $5.60 other states; or six for $29.00 NSW; $31.50 other states, $A33.00 NZ.

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Some readers have problems obtaining PC boards and front panels for projects. Many of our advertisers sell these items and their advertisements should be checked in the first instance. Failing that, below is a list of firms which produce or sell PC boards and front panels.

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117 York Street,
Sydney 2000.
Telephone 264 6688,
267 1614

Cnr. Carlingford & Pennant Hills Road,
Carlingford 2118.
Telephone 872 4444

115-117 Parramatta Road,
Concord, 2137.
Telephone 745 3077.

121 Forest Road,
Hurstville 2220.
Telephone 570 7000

Radio Despatch Service,
869 George Street,
Sydney 2000.
Telephone 211 0816.

RCS Radio Pty Ltd,
651 Forest Road,
Bexley, NSW 2207
Telephone: 587 3491

VIC.

Rod Irving Electronics,
425 High Street,
Northcote, 3070.
Telephone 489 8131.

48 A'Beckett Street,
Melbourne 3001.
Telephone 347 7917
347 9251.

Kalextronics,
101 Burgundy Street,
Heidelberg 3084
Telephone 743 1011.

Shop 11,
Regional Shopping Centre,
Melton 3338.
Telephone 743 1011.

Sunbury Printed Circuits,
Lot 14, Factory 3,
MacDougal Road,
Sunbury 3429.
Telephone 744 2714

WA

Altronics,
105 Stirling Street,
Perth 6000.
Telephone 328 1599.

Jemal Products,
5 Forge Street,
Kewdale, 6105
Telephone (09) 451 8726

N.Z.

Marday Services,
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Avondale, Auckland.

Mini Tech Manufacturing Co Ltd,
PO Box 9194,
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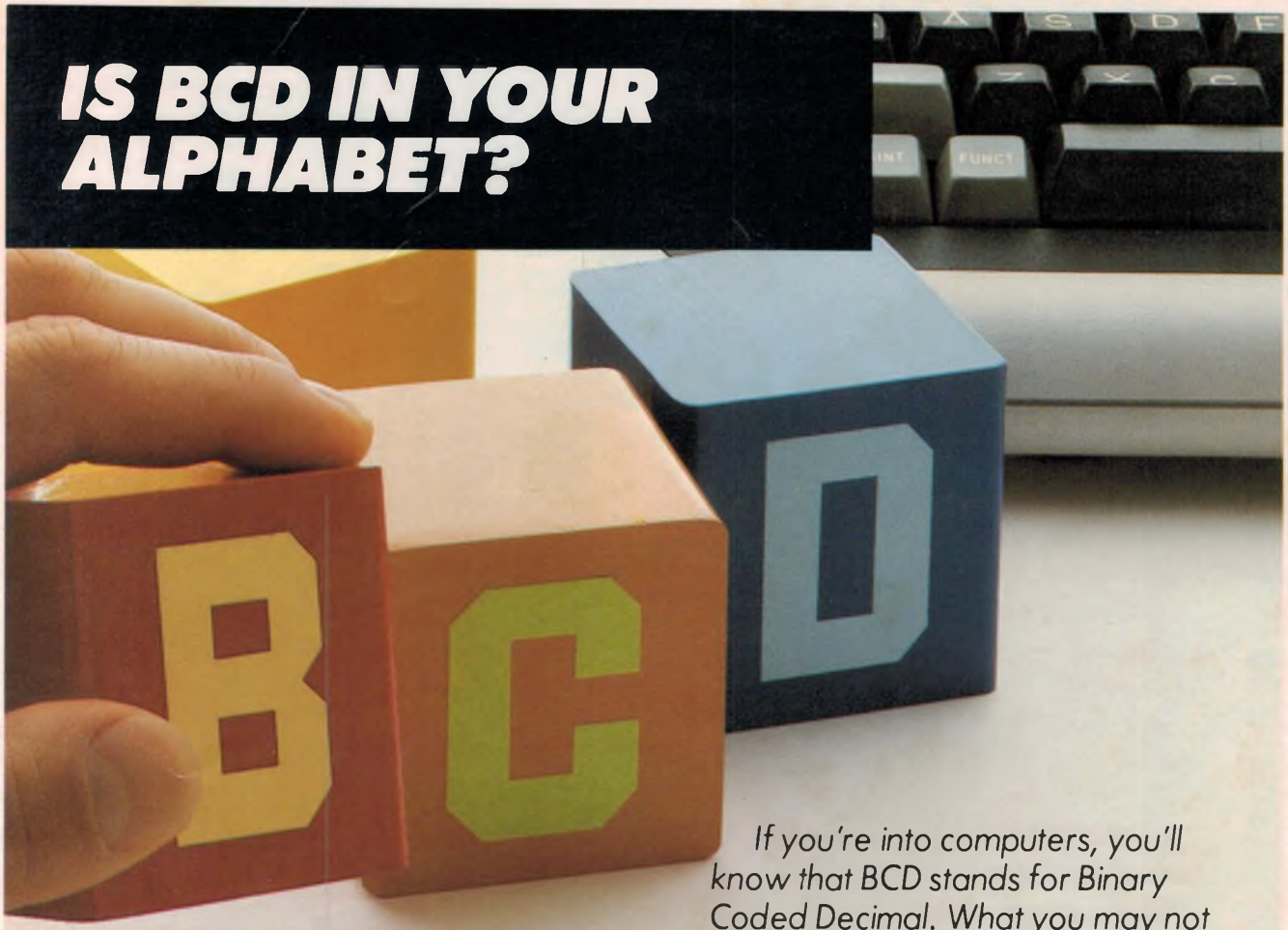

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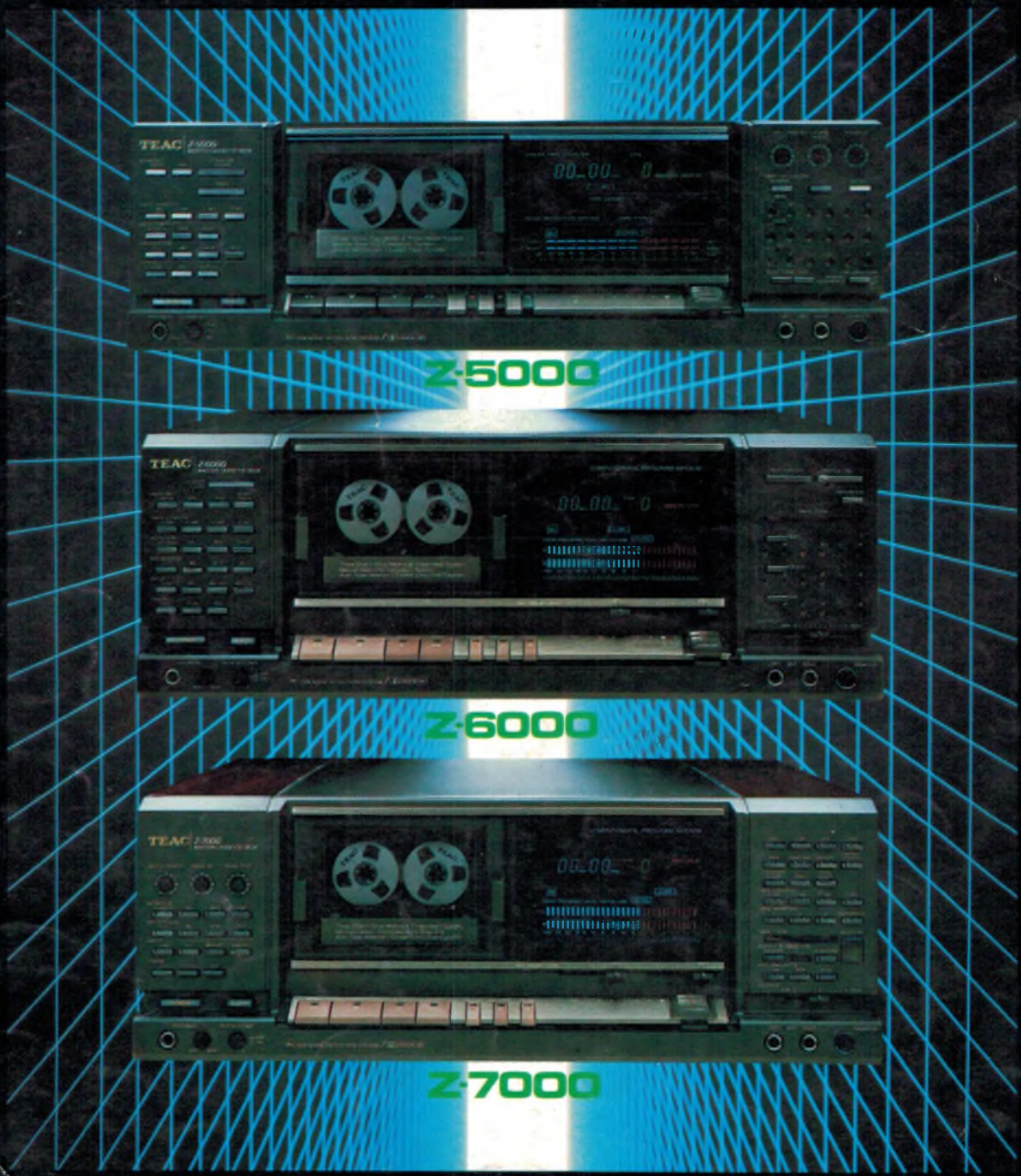

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- Manual recording bias, level and EQ calibration system
- Heavy duty diecast chassis
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- Direct-coupled playback EQ amplifier
- Real-time tape counter
- Memory repeat/play/stop
- CPS (Computomatic Program Search)
- Rec mute with auto spacer
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- 3 direct-drive DC motors
- Direct-coupled playback EQ amplifier
- 3-head system
- dbx and Dolby B–C noise reduction
- dbx disc position
- Manual recording bias, level and EQ calibration system

- Dual-capstan closed-loop transport system
- Real time tape counter
- Automatic tape select
- 30-segment FL peak level meters
- Memory repeat/play/stop
- CPS (Computomatic Program Search)

- 3 direct-drive DC motors
- 3-head system
- dbx and Dolby B–C noise reduction
- dbx disc position
- Automatic recording bias, level and EQ calibration system
- Tape calibration memory
- Block Repeat

- Dual-capstan closed-loop transport system
- Real-time tape counter
- Automatic tape select
- Search To Cue, Search To Zero, Search To Record
- Spot Erase System
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